INTERNATIONAL JOURNAL FOR INNOVATION EDUCATION AND RESEARCH

ONLINE ISSN: 2411-2933 PRINT - ISSN: 2411-3123

INTERNATIONAL EDUCATIVE RESEARCH FOUNDATION AND PUBLISHER (IERFP)

Volume- 7 Number- 10

October Edition

About the Journal

Name: International Journal for Innovation Education and Research

Publisher: Shubash Biswas

International Journal for Innovation Education and Research
44/1 Kallyanpur Main road
Mirpur, Dhaka 1207
Bangladesh.
Tel: +8801827488077

Edition: October 2019

Publication fee: $100 and overseas.

Editorial

Dear authors, reviewers, and readers

It has been a month since I was given the privilege to serve as the Chief Editor of the International Journal for Innovation Education and Research (IJIER). It is a great pleasure for me to shoulder this duty and to welcome you to ***THE VOL-7, ISSUE-10 of IJIER*** which is scheduled to be published on **31st October 2019.**

International Journal for Innovation Education and Research (IJIER) is an open access, peer-reviewed and refereed multidisciplinary journal which is published by the International Educative Research Foundation and Publisher (IERFP). IJIER aims to promote academic interchange and attempts to sustain a closer cooperation among academics, researchers, policy makers and practitioners from a wide range of disciplines, which contribute to state of the art in science, education, and humanities. It provides a forum for the exchange of information in the fields mentioned above by welcoming original research papers, survey papers, and work-in-progress reports on promising developments, case studies, and best practice papers. The journal will continue to publish high-quality papers and will also ensure that the published papers achieve broad international credibility.

The Chief Editor, appointed by the Associate Editors and the Editorial Board, is in charge for every task for publication and other editorial issues related to the Journal. All submitted manuscripts are first screensed by the editorial board. Those papers judged by the editors to be of insufficient general interest or otherwise inappropriate are rejected promptly without external review. Those papers that seem most likely to meet our editorial criteria are sent to experts for formal review, typically to one reviewer, but sometimes more if special advice is needed. The chief editor and the editors then make a decision based on the reviewers' advice.

We wish to encourage more contributions from the scientific community to ensure a continued success of the journal. We also welcome comments and suggestions that could improve the quality of the journal.

I would like to express my gratitude to all members of the editorial board for their courageous attempt, to authors and readers who have supported the journal and to those who are going to be with us on our journey to the journal to the higher level.

Thanks,

Dr Eleni Griva
Ass. Professor of Applied Linguistics
Department of Primary Education
University of Western Macedonia- Greece
Email: chiefeditor@ijier.net

Table of content

Relationship Between School Feeding Programmes And the Pupils' School Attentance In Public Primary Schools in Kitui County, Kenya

Evelyne Malinda Mwendwa
school of education Maasai Mara University P.o Box 861-20500, Narok;
Email-mwendwaevelyne60@gmail.com

Dr. Justus Mochama Gori
School of Education,Arts and Social Sciences,Garissa University P.o Box 1801-700 Garissa,
Email-mochamagori@gmail.com

Abstract

Education can be achieved successfully if hunger is controlled. This can be done if SFPs are introduced and implemented in schools. School Feeding Programme was initiated in Kenya in 1979 with provision of milk packets to the pupils and it was fully implemented in 1980 by the government of Kenya with collaboration with World Food Programme (WFP). The objective of this study was to assess the relationship between SFPs and the pupils' effectiveness in learning in public primary schools in Kitui County. The study intended to assess attendance as an indicators of effectiveness in learning. The study used Classical Liberal Theory of Equal Opportunity and Maslow's Theory of Human motivation. The researcher used Survey Research Design. The target population was 374 primary schools under feeding Programme in Kitui County. The sample size was 112 schools which are 30% of the target population. These schools were sampled randomly. The researcher also randomly sampled five percent (19) class seven teachers to get a total of 131 respondents. The research instruments used by the researcher were the questionnaires for head teachers and the interviews for class seven teachers' representatives. To test validity of the research instruments, the researcher did piloting in two schools (10%) of the sample target, 19 class seven teachers. The researcher also discussed the instruments with her supervisors and was advised accordingly. Reliability of the research instruments was calculated using test-retest method. Quantitatively collected data was analyzed using descriptive statistics and Pearson r with the help of SPSS software while qualitatively collected data was analyzed using Focus by Question Analyses Strategy. Analyzed results were presented using tables, graphs and pie-charts. The findings of the study may help the administrators and policy makers in laying their strategies successfully. Results show that there was a significant relationship between school feeding program and the pupils' school attendance. Findings from the interviews further confirmed that there was unwavering agreement among class seven teachers' representatives that school feeding program was positively associated with pupils' school attendance. The study concludes that SFP has significant influence on effectiveness in learning in relation to attendance among primary school pupils, hence the hypothesis that there is no significant relationship between school feeding Programme and the pupils' attendance was therefore, rejected. The study recommends that the county government should liaise with parents and guardians of primary school pupils so as to expand SFPs

to retain pupils at school. These findings will be beneficial to the Ministry of Education and the school administrators while laying their strategies.

1. Introduction

School Feeding Programme (SFP) can be used to curb temporary hunger to make a significant contribution in the improvement of effectiveness in learning. Kenya is a signatory to many international agreements that have among other things recommended the attainment of Universal Primary Education (UPE). School feeding Programme is aimed at achieving this course in Kenya. When pupils feed in schools, their attendance will be enhanced and they will be confined in schools.

2. Background of the Study

The availability of school meals is considered to have a positive effect on cognitive development and learning. Investing in education is a key component which leads to the development of a country. Education is a fundamental right for a person for effective contribution to the development of a country since it enhances equity, diversity and lasting peace as stipulated by World Education Forum Education for all in 2000.Successful school attendance which is an indicator of effectiveness in learning can be sustained through provision of food which can be done through implementation of feeding programmes in schools. The programmes have been established to positively impact educational outcomes for learners. School feeding programmes have been implemented in both developed and developing countries across the world. In developing Nations, school feeding programs have a major goal of ensuring that there is increased learners' concentration span by reducing short-term hunger. In Kenya, school feeding programmes have been implemented since 1980s with varying degrees of success. They were originally focused in promoting enrollment and retention of pupils in schools especially in rural areas. The Kenyan Home Grown School Meals Program (HGSM) is designed as a safety net strategy to increase food supply, improve incomes and reduce hunger and malnutrition.

3. Statement of the Problem

Food has been acknowledged as one of the tools that help in the effectiveness in learning of primary school pupils. Education is one of the economic developmental factors in the world; therefore effective strategies for providing education to pupils should be well formulated especially in primary schools since they lay the learning foundation worldwide. Effectiveness in learning in Kitui County was not achieved positively as evidenced by the 2016 Kenya Certificate of Primary Education (KCPE) results; Kitui County was ranked position 37 out of the 47 counties in the Nation. The enrolment rate was very high but the completion rate was very low (EMIS 2005).The county has low retention rates and attendance rates.

4. Purpose of the Study

This study was set to assess the relationship between school feeding programmes (SFP) and the pupils' effectiveness in learning in relation to attendance in public primary schools in Kitui County, Kenya.

Objective of the study

This study was guided by the following objective. "To establish the value of school Feeding Programmes on pupils attendance in Public Primary schools in kitui County.

Research Hypothesis

This study was guided by the following hypothesis:

There is no significant relationship between school feeding programmes and the pupils' attendance rates in public primary schools in Kitui County.

Significance of the Study

The findings of this study may help the educational policy makers to make relevant policies pertaining SFPs. The findings of this study could also be used by the WFP to improve on their effectiveness and efficiency when laying their strategies. The findings may also assist the school administrators in their administration especially when planning about issues concerning feeding. The findings of this study could be used by the policy makers in the education sector when formulating policies on the pupils' effectiveness in learning in the nation. The findings of this study could become a base for further researches related to this subject matter. The findings of this study may also benefit the key educational stakeholders for instance, parents, primary school managers, teachers, as well as other researchers by equipping them with enough information on matters pertaining school feeding. Teachers and pupils will also greatly benefit from this study. The study will enhance their perception and understanding of factors promoting effective learning. It may also help to determine strategies teachers use in teaching.

5. Justification of the Study

Empirical studies reveal that SFPs have significant positive impact on learning effectiveness (See He, 2009).According to WFP 2008; SFP is an incentive for vulnerable families to retain children at school. Therefore, this study intended to assess the relationship between school feeding programmes and the pupils' effectiveness in learning in relation to attendance. Effectiveness in learning in Kitui County is decelerating, completion of the primary school course is negatively affected therefore the researcher chose to carry out the study in Kitui County to assess the relationship between the SFP and effectiveness in learning in relation to attendance. Quality education is considered the key to economic development of any country.

6. Limitation of the Study

The results of the sample taken in this study may not be generalized to cover other counties in the republic since the study did not include all the schools such as the private schools and the schools not under Feeding Programme. The researcher recommended another study to be done covering all the primary schools. The study involved different categories of respondents who were required to give the required information through answering the set questions, availing the required documents and answering the set questions for the interviews. The researcher encouraged the respondents through creating rapport and simplifying the research instruments. Research tools and the research instruments were developed in English language to enable the respondents to respond appropriately but some respondents did not respond appropriately due to biasness. Some head teachers did not have some of the documents needed by the researcher. The researcher encouraged the respondents to provide appropriate responses.

7. Literature review

It is about the literature related to school feeding programmes and its effects on effectiveness in learning in relation to attendance in various parts of the world. The other areas that were discussed and reviewed included conceptual and theoretical framework of the study.

8. Theoretical Framework

The study under investigation was guided by Classical Liberal Theory of Equal Opportunity and Maslow's Hierarchy of Needs Theory which is also known as Human Motivation.

Classical Liberal Theory of Equal Opportunity

This Theory was advanced by John Dewey in 1946.The theory expresses that there should be equal opportunities of similar treatment of people in every area including education. The basic assumption of this theory is that every child is born with innate talents and capabilities therefore; education systems should be planned with a view of a pupil taking advantage of the inborn talents that could accelerate social promotion (Sherman & Wood 1982). This would enable the pupils to be more effective in learning and it will enhance pupils' attendance. This Theory suits this study because the independent variable (School Feeding Programme) will have effect on dependent variable (Pupils' Attendance). When food is provided to schools it will enable pupils from different family backgrounds to access education equally and at ease.

Abraham Maslow's Theory of Human Motivation

The other theory that has been used in this study is Abraham Maslow's Theory of Human Motivation which was developed in 1943. This theory explains that, human beings target to meet their basic needs, they equally aim to meet successfully higher needs in the form of a pyramid as established by Maslow. Maslow's Hierarchy of needs has often been presented in a hierarchical pyramid witch have five levels with the largest and most fundamental at the bottom and the need for self-actualization at the top. At the base of the

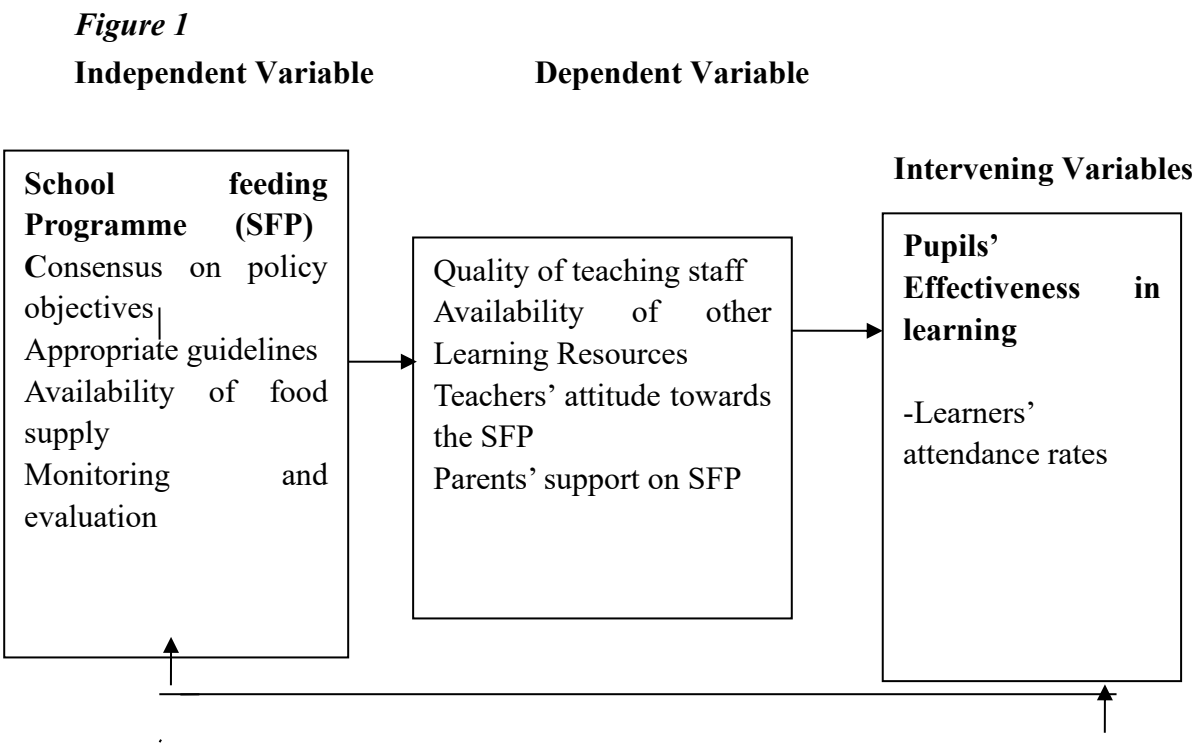
hierarchy are the physiological needs, followed by safety needs, love/belonging, esteem, and self-actualization, which is the topmost need at the top of the pyramid (Jerome, 2013).

In this study, Maslow`s theory of Human Motivation was used due to its analysis of physiological needs. In this case, physiological needs which include food have an impact on various aspects of children's learning such as attendance. Parents have inadequate finances to buy food; hence children have to help them work to get food instead of being in school. Therefore, as explained by Maslow, provision of food leads to satisfaction of hunger, which is a physiological need that ought to be satisfied before others are done.

9. Conceptual Framework

A conceptual framework shows the relationship between independent and dependent variables. The interaction of the variables is indicated by the arrows. In this study, the conceptual framework was based on the relationship between school feeding programme and the pupils' effectiveness in learning. The feeding programme is the independent variable, while the factor affecting effectiveness in learning, attendance is the dependent variable as shown in figure 1.The study conceptualized on the relationship between SFP and pupils' effectiveness in learning of the children attending primary schools. With food provided at school theoretically, pupils would be expected to be receptive to learning. This would enhance positive effectiveness in learning. Pupils would desire to stay at school learning. There could be a few drop-outs or any unplanned transfers, retention level will be optimal at all times. As observed in the figure above, a number of factors ensure effective learning of school children through school feeding programs.

Figure 1



The study conceptualized on the relationship between SFP and pupils' effectiveness in learning of the primary schools pupils. With food provided at school theoretically, pupils would be expected to be

receptive to learning. This would enhance positive effectiveness in learning. Pupils would desire to stay at school learning. There could be a few drop-outs or any unplanned transfer, retention level will be optimal at all times. As observed in the figure above, a number of factors ensure effective learning of school children. When school feeding programmes are implemented in their areas, effectiveness in learning will be enhanced.

10. Research Design

The study adopted survey research design. The use of surveys refers to an approach of collecting information through asking questions. It also uses approaches such as focus group discussions, interviews, and questionnaires to ensure that questions are answered. Further, since it is difficult to ask questions to every individual in the population under study, a survey research design allows selection of a representative sample of participants that will be involved in the study, and the findings of the study applied to the larger population. Therefore, in a study such as this covering all primary schools in Kitui County, a survey research design is the most appropriate. To conduct a survey research design, the first step involves identification of the study population. This is followed by sampling the study population to identify a representative sample that will take part in the study. After identification of the study sample, a data collection tool is identified and designed to suit the identified respondent characteristics. Data collection is then scheduled and performed, while data is analyzed through appropriate techniques. The researcher personally administered the questionnaires to the head teachers and left them to work at their own phase however the researcher was there for any clarification. The researcher also interviewed the class seven teachers' representatives and recorded down the responses given by the teachers. These responses were later used by the researcher for analyzing the qualitative data. This created high response rates as well as good return rate. The researcher compared responses from the head teachers and the ones from the class seven teachers; he then got similarities and differences that helped the researcher to get the relationship between school feeding programme and the pupils' effectiveness in learning in relation to attendance. The Survey research design was a very valuable tool for assessing opinions and trends and also judging opinions, in this case it was effective in assessing the relationship between SFPs and the pupil' effectiveness in learning. The survey research design was convenient for respondents and it yielded good response rates. It was relatively easy to administer, numerous questions were asked about a subject allowing extensive flexibility in data analysis. It was capable of collecting data from a large number of respondents. Collected data can be generalized to a population. This prompted the researcher to choose this research design. Survey research design is less time consuming and it is not expensive as compared to other designs.

11. Target Population

The target population for this study was 374 schools, the only schools under feeding Programme in Kitui County. The study targeted the head teachers and the class seven teachers from these schools.

12. Sampling Techniques and Sample Size

The researcher used simple random sampling to sample the schools. According to the rule of thumb as stated by John Curry professor for Educational research, 30% is convenient for sampling a big population like the 374 schools to be studied. This translated to 112 schools out of which the researcher used the112 head teachers of these schools. The researcher wrote the names of the 374 schools in separate pieces of papers, put them in a container and mixed them thoroughly. The researcher randomly picked 112 pieces which is 30% of the target population. The head teachers of these schools were the sample size who answered questionnaires for the quantitative data. The researcher sampled 5% of the class seven teachers that translated to 19 class teachers. The researcher gave numbers to all schools among the 374 schools which had class seven and randomly picked 19 schools. The class seven teachers from these schools formed the other part of the sample to be interviewed for the qualitative data. This totaled to 131 respondents. According to Gall, Gall & Borg (2003), a smaller percentage for the qualitative study is allowed provided the respondents are the key informants. As in this study, the head teachers and the teachers are the key informants.

Table 1

Sample for the study

	Target Population	Sampling%	Sample
Head teachers	374	30	112
Class seven teachers	374	5	19
Total	748	35	131

13. Research Instruments

The researcher used questionnaires because they can yield quantitative data and the interview guide because they can yield qualitative data. To collect the quantitative data, the researcher personally distributed the questionnaires to the 112 head teachers. From their responses, the researcher collected quantitative data. The researcher conducted face-face interviews to the 19 class seven teachers and also listened to their verbatims.From their responses the researcher got the qualitative data that was required for the study.

14. Findings and Presentations

First, the survey findings pertaining responses from the head teachers' concerning the head teachers' opinions assessing the relationship between school feeding programme and the learners' effectiveness in learning was presented using tables. The information in these tables showed the head teachers' views pertaining the relationship between school feeding programme and the learners' effectiveness in learning. The quantitative data was presented in a more manageable form. Qualitative data was also presented by analyzing the answers given by various teachers pertaining various interview questions comparison was made and a certain conclusion was arrived at.

15. Data Analysis

This study used Pearson r to test quantitatively data collected from the head teachers. Correlation method of hypothesis testing is applied in testing whether there is a linear association between two variables. In this study, the main objective was to investigate whether there was a relationship between school feeding program and the effectiveness of learning in public primary schools in Kitui County. Therefore, the two main variables involved are the school feeding programs and the effectiveness of learning among primary school pupils. The correlation method was therefore used to identify existence of a linear correlation between the two variables. To analyze the collected data, the researcher used statistical Package for Social Sciences (SPSS) software; the software performed data entry and analyze it. This software helps to analyze data based on Pearson. The coded data was calculated to determine the relationship between school feeding Programme and effectiveness in learning. This data was also analyzed using descriptive statistics from the responses given by the head teachers. Qualitative data was also obtained from interviews and was analyzed thematically. Qualitative analysis involves classification of data into patterns in order to produce results. It is essential for the analysis of attitudes, behaviors, or feelings. In this study, the use of qualitative analysis was necessary because it fully lead to understand different aspects of the study objective. For instance, qualitative analysis was used in evaluating the attitude of teachers towards school feeding program. Qualitative data was recorded after interviewing the class seven teachers and it was analyzed using Focus by Question Analysis strategy. With this method, the researcher had all the answers given by each respondent for each question then comparison was done to get out similarities and differences. Percentages based on the19 respondents were sought to help in the analysis.

16. Data presentations

The researcher presents the findings of the study in line with the research objective. Based on the findings, the researcher further presents the discussion of the results detailing both quantitative and qualitative analysis. To establish existence of relationship, Pearson *r* was employed at 95% confidence interval. The p-values obtained from the Pearson *r* formed the basis for rejecting or failing to reject the null hypothesis of this study. Results have been presented using tables and graphs. The head teachers' responses have been compared with the interview results using verbatim.

17. Relationship Between School Feeding Programme and School Learners' Attendance in Public Primary Schools

A Pearson correlation coefficient (*r*) was calculated at 95% confidence interval, and its significance used to determine whether there existed a significant relationship between the two variables. Findings from the correlation were also supported by other findings from the interviews, where class seven teachers' representatives were requested to give their opinions regarding the relationship between provision of school meals and learners' attendance. Head teachers were subjected to a series of likert scale statements. In the scale, 1 was strongly agree while 4 was strongly disagree. It was deemed important that issues of attendance

be assessed since they are part of effective learning in primary schools. Failure to attend classes and other academic activities adequately disadvantages the learners, hence making learning process ineffective.

Table 2

Respondents' opinions on School Feeding and learners' attendance in school

Variable	F %	strongly agree	agree	disagree	strongly disagree	Total
Absenteeism rate has increased since the introduction of the School Feeding Programme	F	6	0	44	58	108
	%	5.6	0	40.7	53.7	100.0
Despite the introduction of the School Feeding Programme in your school, attendance level has decreased.	F	2	2	34	70	108
	%	1.9	1.9	31.5	64.8	100
Pupils do not miss classes after the introduction of School Feeding Programme in your school	F	42	58	4	4	108
	%	38.9	53.7	3.7	3.7	100
Cases of sneaking have increased after introducing the School Feeding Programme in your school	F	26	36	30	16	108
	%	24.1	33.3	27.8	14.8	100

The above results show that School Feeding Programme have a positive relationship with pupils learning effectiveness as pertains their attendance. For instance majority of the head teachers 70(64.8%) of them strongly disagreed that attendance level had decreased after the introduction of the School Feeding Programme. The results also show that pupils were no longer missing classes after the introduction of School Feeding Programme since 58(53.7%) strongly agreed on this statement. In support of the positive relationship between school feeding programme and the pupils' effectiveness in learning, only 6(5.6%) of the head teachers opined that absenteeism had increased after the introduction of the school feeding programme .Meanwhile,42(38.9%) agreed that pupils were not missing classes since school feeding Programme was introduced in kitui County.

Table 3

Relationship between School Feeding Program and pupils' attendance

		School feeding program	Attendance
School feeding program	Pearson Correlation	1	.46
	Sig. (2-tailed)		.047
	N	108	108
Transition	Pearson Correlation	.46	1
	Sig. (2-tailed)	.047	
	N	108	108

P< 0.05 df = 106

p=0.047<0.05), hence the hypothesis that 'there is no significant relationship between school feeding program and pupils' attendance is rejected. The results from the interviews with class seven teachers' representatives were similar to those of head teachers. Most of the teachers opined that class attendance rates had increased after introduction of School Feeding Program.

18. Summary of the Findings

Relationship Between School Feeding Programmes and the Pupils' School Attendance Rates

The study found that school attendance improved tremendously after introduction of school feeding program. Both head teachers and class seven teachers' representatives were of the opinion that attendance rates increased after introduction of school feeding programme.The results from the interviews show that there was a significant difference in absenteeism rates before and after school feeding program was introduced.

19. Conclusion

On whether school feeding program has a significant relationship with pupils' school attendance rates, this study concludes that there was tremendous improvement in class attendance and participation in other learning activities after introduction of school feeding programme. The findings have shown that data on absenteeism and pupils' rates of sneaking changed significantly after introduction of school feeding programme in public primary schools in Kitui County. The finds show a positive significant relationship hence, the hypothesis that 'there is no significant relationship between school feedings program and pupils' school attendance and in class is hereby rejected.

20. Recommendations

i. The study recommends that the county government to liaise with parents and guardians of primary school pupils in order to expand the school feeding programme and include breakfast and supper so that more learners can attend and be retained in school.

ii. The researcher further recommends that the head teachers and teachers to take advantage of school feeding program to ensure that more learners complete their studies within their respective cohorts.

iii. The study further recommends that the National government improvise more strategies that will ensure more learners are enrolled and attend school regularly.

iv. The researcher recommends that the County government ensure that all the schools in Kitui County have school feeding programmes and support them fully.

21. Suggestions for Further Study

i. The researcher suggests that further studies should be conducted on methods used to implement the school feeding program, in order to ensure that the intended purpose if fulfilled.

ii. The study further recommends further studies to be conducted on school feeding program disparities existing between boarding and day primary schools. Various studies pertaining effectiveness in learning should be conducted to improve effective learning in Kitui County.

References

Adam, J.Kamuzora, F. (20080). Research methods for business and social studies, Morogoro; Mzumbe book project.

Adekunle, T., & Ogibogu, C. (2016). The Effects of School Feeding Programme on Enrolment and Performance of Public Elementary School Pupils in Osun State, Nigeria. *World Journal of Education*

Ademokun, O., Osungbade, K., & Obembe, T. (2014). A Qualitative Study on Status of Implementation of School Health Programme in South Western Nigeria: Implications for Healthy Living of School Age Children in Developing Countries. *American Journal of Educational Research*

Ahmed, A. (2004). *Impact of Feeding Children in School: Evidence from Bangladesh*

Ahmed, A. U. (2004). *Assessing the performance of conditional cash transfer programmes for girls and boys in primary and secondary schools in Bangladesh.* Project report prepared for the World Bank. Washington, D.C.: International Food Policy Research Institute.

Ahmed, A. U., & Del C.N. (2002). *The food for education programme in Bangladesh: An evaluation of its impact on educational attainment and food security*. Discussion Paper 138. Food Consumption and Nutrition Division. Washington, D.C: International Food Policy Research Institute

Ahmed, A.U. (2004). *Impact of feeding children in school; Evidence from Bangladesh,* Washington, DC: International food policy research Institute (IFPR).

Aila, B. (2012). *The Impact And Challenges Of School Feeding Programme In Enhancing Access To Primary Education In The Unplanned Settlements Of Kibera In Nairobi*

Ajani, O. (2012). The Effect of School Feeding Programme on Primary School Attendance in Rural Areas of Lagos State, Nigeria. *African Journal for the Psychological Study of Social Issues*, *12*(1).

Best, J. W&Kahnj. (2000). *Research in education;* New Delta: Prentice Hall India.

Chaula, E. (2015). *An Assessment Of Influence Of School Feeding Program On Pupils' Enrollment, Attendance And Academic Performance In Primary Schools In Njombe District, Tanzania* Chepkwony, B., Kariuki, B., & Kosgei, L. (2013). School Feeding Program and Its Impact on Academic Achievement in ECDE in Roret Division, Bureti District in Kenya. *Journal of Emerging Trends in Educational Research and Policy Studies*.

Cheserem, K, G. (2013). Influence of School Feeding Programme on Pupils' Participation in Public Primary Schools in Baringo North, Baringo County – Kenya, University of Nairobi.

Clay, E., & O. Stokke. (2000). Food aid and human security book, Frank Cass, EADI, ODI. Functions of school children of differing nutritional status.*American Journal of Clinical*

Darko, B. (2014). *The School Leadership Views on the Impact of the National School Feeding Programme in Ghana The Case Study of Adumanu M/A and Ayaasi D/A Primary Schools*.

Dayuor, F. (2015). Effect of the National School Feeding Programme on Pupils' Enrolment, Attendance and Retention: A Case Study of Nyoglo of the Savelugu-Nantong Municipality, Ghana. *Canadian Journal of Behavioral Science*.

Doets, E. (2007). Quality evaluation and update of the Mali food composition table (TACAM 2004) .Wageningen University.

Drake, L., Woolnough, A., Burbano, C., & Bundy, D. (2016). *Global School Feeding Source Book: Lessons from 14 countries* [Ebook]. Imperial College Press.

Finan, T. (2010). Impact Evaluation of WFP School Feeding Programmes in Kenya (1999- 2008): A Mixed-Methods Approach. Rome: World Food Programme.

Galloway, R. (2009). School Feeding: Outcomes and Costs. Food and Nutrition Bulletin.

Gay, L.R. (1992). Education Research: Competence for Analysis and Application. 4th Edition. New York. Macmillan Publishers.

Gete, T. (2017). Over 1.3m Students to Benefit from School Feeding Program. Ghana School Feeding Programme (GSFP): Ministry of Gender, Child and Social Protection (2017). Githuku, J. (2012). *Effects Of School Feeding Programme On Pupils' Enrolment In Early Childhood Education In Karaba Zone, Mbeere South District, Embu County* .

Githuku, J. (2012). *Effects Of School Feeding Programme On Pupils Enrolment In Early Childhood Education In Karaba Zone, Mbeere South District, Embu County*

Hamupembe, E. (2016). *Investigating the Administration of the School Feeding Programme: A Case Study of Two Primary Schools in Windhoek, Namibia*

Hamupembe, E. (2016). *Investigating the Administration of the School Feeding Programme: A Case Study of Two Primary Schools in Windhoek, Namibia*

Jerome, N. (2013). Application of the Maslow's hierarchy of need theory; impacts and implications on organizational culture, human resource and employee's performance. *International Journal of Business and Man*

Kamaludeen, H. (2014). The Impact of the Ghana School Feeding Programme on Enrollment, Attendance and Retention in Ga South Municipal SchoolsKarisa, K. S. & Orodho, J. A. Assessment of Home Grown School Feeding Programme (HGSFP) Theory in Kinango Sub-County, Kwale County, Kenya. *Journal of Humanities and Social Science*

Khatete, I., Pendo, W., & Oyabi, J. (2013). School Feeding Program and Pupils' Participation in Primary Schools in Kenya. A Study of Taita Taveta and Nairobi Districts. *Journal of Emerging Trends in Educational Research and Policy Studies*.

King, N., Dewey, C., & Borish, D. (2018). Determinants of Primary School Non-Enrollment and Absenteeism: Results from a Retrospective, Convergent Mixed Methods, Cohort Study in Rural Western Kenya

Kokwee, Z. (2014). *Impact of school feeding programme on participation of learners in primary school education in Mogotio district, Baringo County*

Langinger, N. (2011). School Feeding Programs in Kenya: Transitioning to a Homegrown Approach. *Stanford Journal of International Relations*, 13(1): 30-38

Langinger, N. (2011). *School Feeding Programs in Kenya: Transitioning to a Homegrown Approach* [Ebook]. Langinger, N. (2011). *School Feeding Programs in Kenya: Transitioning to a Homegrown Approach*

Lawson, M. (2012). School Feeding programmes in Developing countries. *Impacts on Children's Health and Education Outcomes. Nutrition Review,* 69. 83-98

Lawson, T. (2012). Impact of School Feeding Programs on Educational, Nutritional, and Agricultural Development Goals: A Systematic Review of Literature. Mburu, P. (2012). *Effectiveness of management strategies in the enhancement of Pupils' access and participation in free primary school Education in Githunguri Kiambu County*

Mhurchu, C., Gorton, D., Turley, M., Jiang, Y., Michie, J., Maddison, R., & Hattie, J. (2012). Effects of a free school breakfast programme on children's attendance, academic achievement and short-term hunger: results from a stepped-wedge, cluster randomised controlled trial. *Journal of Epidemiology and Community Health*, *67*(3), 257-264. doi: 10.1136/jech-2012-201540

Migosi, J., Nanok, D., Ombuk, C., Ombuk, K., Evusa, Z., & Metet, J. (2012). Determinants of primary school access and participation rates in the pastoralist Turkana County, Kenya. *Universal Journal of Education and General Studies*

Mohamed, A. (2015). Influence of feeding programs on the participation of learners at early childhood development education institutions: A case of Bungoma South district. International Academic Journal of Social Sciences and Education

Moore, E., & L. Kunze. (1994). *Evaluation of the Burkina Faso school feeding programme.* Catholic Relief Services, Consultant Report (Unpublished).

Muema, T., & Mutegi, R. (2011). *The impact of school feeding programmes on pupil retention in primary schools in Kenya*

Mugenda, J. (2003).*Research methods*, African Centre for technology studies. Nairobi, Kenya.

Mugenda, O., &Mugenda A. (1999). *Research methods quantitative and qualitative approaches.* Nairobi: Act Press, KenyaUNESCO, (1990).World Food Programme Handbook Rome UNESCO, Printing Press.

Mukanyiriga, V. (2010). *WFP Rwanda School Feeding Programme: "Food Assistance For Education"*

Murungi, K. (2013). *An Evaluation of the School Feeding Programme: A Case of Wamba Division, Samburu County, Kenya*

Mushonga, Kujinga, Changwena, Chituhu, & Nyabanga. (2014). A Retrospective Study of

Musyoka. (2013).*Provision of basic needs and its impacts on educational outcomes*. Kenyatta University. Unpublished theses

Mutia, j. (2015). *Strategic planning in public secondary schools in kitui west sub- County.*

Mwavula, A. (2014). *Influence Of School Feeding Programme On Pupils Participation In Public Primary Schools In Flood Prone Areas Of Garsen Division, Tana Delta District, Kenya*

Nafula, W. (2015). Impact of School Feeding Programme on Pupils' Retention Rates in Public Primary Schools in Fafi Sub-County Garissa County Kenya. Unpublished Thesis University of Nairobi.

Zeneb, M.Gebremedhin, Henry,C.& Regassa,N. (2018).School feeding Programme has bring about in improved dietary diversity, nutritional status and class attendance of school children .Italian Journal of Pediatrics.

World Food Programme: Two minutes to learn about School Meal 92012).

WFP. (2006).reviewing the evidence: Food for education experts' seminar. Rome

WFP. (2001) Operational contract between the government of Kenya and the world food programme, Kenya country programme press, Nairobi.

WFP, (2016) Home Grown School Meals Benefit Children, Farmers and Communities.

Saeni, J. (2015).An Evaluation of the Impact of School Feeding Programme on Retention in learning of ECDE Children in Kilgoris Constiency.Narok County, Kenya.

Propagation of *Piper carniconnectivum* through leaf cuttings

Mauricio Reginaldo Alves Dos Santos, Eric Jonisson Rios Bisi, Leormando Fortunato Dornelas Júnior

Universidade Federal de Rondônia, Brazil

ABSTRACT

The regeneration of roots and shoots through leaf cuttings is a feasible technique for plant clonal propagation, using a quite available organ, which can be collected without great damage to the plant. A protocol of propagation through leaf cuttings was defined to Piper carniconnectivum, a plant whose compounds have great potential use in medicine and agriculture. Leaves were cut in halves (apical and petiolar) by transverse cutting in the middle of the leaf blade. The petiolar parts were immersed into a solution of indole 3-butyric acid (IBA) at 1000 ppm for 30 seconds, or not submitted to the hormone. Then the cuttings were planted in soil, using two positions of the petiolar halves: petiole down and petiole up. A factorial design was used – 2 times of immersion in IBA x 2 leaf half position x 3 blocs x 6 replications. After 145 days the number of shoots, shoot length, leaf area, dry matter of aerial part, root volume and root dry matter were evaluated. The highest number of shoots was observed in the petiole down position without IBA. In relation to the other aerial characteristics – shoot length, leaf area and dry matter of the aerial part, the highest values were observed both in the petiole down position without IBA and in the petiole up position with immersion in IBA. The characteristics related to the root – root volume and root dry matter were both highest in the petiole up position with immersion in IBA. Leaf cuttings can be a practical method to propagate P. carniconnectivum vegetatively. Both petiole up cutting with immersion in IBA and petiole down cutting without immersion in hormone can be used as propagules.

Keywords: Leaf cuttings. Leaf rooting. Adventitious shooting. Clonal propagation.

1. Introduction

The botanical family Piperaceae has tropical and subtropical distribution, with nearly 2,500 species and five genera, from which 500 species and four genera are found in Brazil (Magevski et al., 2011). The genus *Piper* is composed by more than 700 species, distributed in tropical regions around the world, with 170 species native to Brazil. These species are notable producers of secondary compounds with proven biological effects on insects, fungi, bacteria, trypanosomes (Navickiene et al., 2003; Dyer et al., 2004; Danelutte et al., 2006; Balbuena et al., 2009) and can also affect human health, such as analgesics, antidepressants, cytoprotectors, antiulceratives, anticonvulsants, anti-inflammatories and antioxidants (Ahmad et al., 2010). Throughout the tropics, various *Piper* species are used for many purposes such as foods, spices, perfumes, oils, fish poisons, insecticides, hallucinogens and medicines (Michel et al., 2010). *Piper carniconnectivum* C. DC., known in Brasil as pimenta-longa (long-pepper), is endemic to the Amazon region of Northern Brazil (Freitas et al., 2014), occurring in Amazonas, Amapá and Pará states;

in transition forest with occasional rock outcrops, low forest seasonally flooded, and occasionally on disturbed area, between altitudes of 150 and 200 m (Monteiro, 2018).

Traditional propagation of *Piper* species is not efficient, due to poor seed viability, seed recalcitrance, low rates of germination, and scanty or delayed rooting of cuttings, evidencing the need of alternative methods of propagation (Abbasi et al., 2010; Ahmad et al., 2014; Padham, 2015).

In vitro techniques have been also used to propagate *Piper* species. However, serious fungal and bacterial contamination of the explants is peculiar to this genus, and to overcome this problem surface sterilization has been made by using mercury chloride (Bhat et al., 1992; Bhat et al., 1995; Kelkar et al., 1996; Zhang et al., 2008; Ahmad et al., 2011; Rani & Dantu, 2012; Ahmad et al., 2010; Maju & Soniya, 2012; Ahmad et al., 2014; Padham, 2015; Umadevi et al., 2015), a compound whose toxic effects on environment, human and animal systems are well known (Micaroni et al., 2000; Rao & Sharma, 2001; Issa et al., 2003; Pandey et al., 2005).

The objective of the present research was the regeneration of plants of *P. carniconnectivum*, by promoting rooting in leaf cuttings and the subsequent shoot formation, aiming at the establishment of a simple method for propagation of this species.

2. Material and Methods

The experiments were carried out at Embrapa (Brazilian Agricultural Research Corporation) in Porto Velho, Rondônia state, Brazil. The leaves were collected from two years old stock plants of *P. carniconnectivum* grown in a greenhouse with 50% shading and sprinkler irrigation three times a day for 30 minutes. Leaves were cut in halves (apical and petiolar) by transverse cutting in the middle of the leaf blade. The petiolar parts of the halves were immersed into a solution of the hormone indole 3-butyric acid (IBA) at 1000 ppm for 30 seconds, or not submitted to the hormone. After that, the cuttings were planted in vertical position, individually, in plastic cups (400 mL) containing soil, according to the method described by Basak et al. (2014). Two positions of the petiolar leaf halves were used: petiole down (i.e. with the cross section up), and petiole up (i.e. with the cross section down). A total of 72 petiolar leaf halves were used, in a factorial design – 2 times of immersion in IBA x 2 leaf half positions x 3 blocs x 6 replications. After 145 days the number of shoots, shoot length, leaf area, dry matter of aerial part, root volume and root dry matter were evaluated. Variance analyses and Tukey test ($P<0.05$) were performed by using the Assistat 7.5 program.

3. Results and Discussion

The highest number of shoots was observed in the petiole down position without IBA (Table 1). In relation to the other aerial characteristics – shoot length, leaf area and dry matter of the aerial part, the highest values were observed both in the petiole down position without IBA and in the petiole up position with immersion in IBA. The characteristics related to the root – root volume and root dry matter were both highest in the petiole up position with immersion in IBA. It seems like the absence of buds in the cut surface was compensated by the presence of exogenous auxin. As stated by Mercier (2008), the rooting of leaves or stem cuttings occurs due to the accumulation of auxin in the portion immediately above the cut, since

the polar transport of auxin is interrupted in this region. Furthermore, the treatment of the surface of the cut with an auxin solution can be used in order to enhance this effect.

Table 1. Averages of shoot number (SN), shoot length (SL), leaf area (LA), dry matter of aerial part (DMAP), root volume (RV), and root dry matter (RDM) of *P. carniconnectivum* in relation to the positions of petiolar leaf halves – petiole down and petiole up, and immersion or not in IBA, at 145 days of cultivation.

Treatments	SN	SL (cm)	LA (cm^2)	DMAP (g)	RV (mL)	RDM (g)
Petiole down, without IBA	5.55 a	37.2 a	2,024 a	0.873 a	120.9 b	15.33 b
Petiole down, with IBA	4.50 b	29.5 b	1,734 b	0.754 b	108.0 b	14.19 b
Petiole up, without IBA	3.72 c	27.7 b	1,725 b	0.694 b	129.2 b	17.3 ab
Petiole up, with IBA	4.70 b	34.0 a	2,172 a	0.956 a	147.1 a	20.46 a

*Letters indicate significance among treatments, within each factor (Tukey test 5%).

One pattern observed in the current research is that, in the petiole up position, the immersion in IBA was positive in relation to every aspect evaluated. The hormone probably induced rooting first, and then the abundant roots promoted the growth of the aerial part. The opposite was observed by Dornelas Júnior et al. (2018), studying the propagation of *P. hispidum* through leaf cuttings. The authors tested three positions of the leaf halves – basal (petiole down), inverted basal (petiole up), and apical, and the immersion in IBA (1000 ppm) for 5 and 20 minutes. They observed the inverse production of roots or shoots in relation to the exposure to auxin. The number of roots was higher when the cuttings were immersed into a solution of IBA, but this hormonal treatment had a negative effect in relation to the length of the shoots. After all, they recommend the use of basal and inverted basal leaf halves, without IBA.

On the other hand, the immersion in IBA was not positive in the petiole down position, both in relation to rooting and growing of the aerial parts. In relation to the aerial parts, the petiole down cuttings not subjected to the hormone had a better performance. In relation to the rooting, the subjection of these leaf portions to the hormone had no effect. In an entire plant, the apex and leaves of the plants produce auxins, which are transported to all growing tissues (Mercier, 2008), what can explain the presence of roots in cuttings not treated with hormone in the present study.

Basak et al. (2014) also used leaf cuttings (apical and basal portions) in order to propagate *P. longum*, without or with immersion for 30 seconds in IBA (1000 ppm), NAA (1000 ppm) or both hormones together IBA (1000 ppm) + NAA (1000 ppm). The authors observed that basal cuttings, treated with IBA (1000 ppm) + NAA (1000 ppm) resulted in the highest number of roots and shoots, percentages of rooting and shooting, root length and survival of the cuttings. These authors mention that this method can be adopted

with minimum capital to produce quality planting material. Besides, leaves can be obtained with very little damage to the plant.

In the present study it was clear that leaves of *P. carniconnectivum* can function as a cutting, alike a stem cutting. This is possible because the leaf has all the structures present in the stem, including those meristematic ones, like procambium and cambium (leaves of some species), which give origin to primary and secondary xylem and phloem in the stem, respectively. According to Raven et al. (2007), the pattern formed by the vascular bundles reflects the close structural and developmental relationship between the stem and the leaves. As the leaf primordium grows in length, the procambial bundles also differentiate toward it. From the beginning, the procambial system of the leaf is continuous with that of the stem. At each node, one or more vascular bundles diverge from the cylinder of stem strands, cross the cortex and enter the sheet. Thus, the mesophyll of the leaf is completely covered by a system of veins or vascular bundles, which is continuous with the vascular system of the stem. The median rib and sometimes the larger caliber veins show secondary growth in some leaves of dicotyledons.

It is interesting to observe that is still unclear the tissue which gives origin to the adventitious roots in cuttings, even in stem cuttings, widely used in horticulture. As stated by Haissig (1986), most information concerning metabolism during rooting describes the rooting zone but not events in the precise location of primordium initiation. At present, histochemical tests offer the only hope of describing biochemical differentiation within root primordium initials and their progenitor cells. According to Verstraeten et al. (2013), adventitious roots are defined as roots that develop on non-root tissue, such as leaves, hypocotyls, stems, and shoots. This process is distinct from other organogenesis processes as it involves the *de novo* initiation of a meristem. These authors carried out an experiment using adventitious root induction in *Arabidopsis thaliana* as a model for root organogenesis and observed that the adventitious roots emerged from cells that are located at the center of the stem structure, and histological sections pointed to cambial/phloem cells that start dividing upon auxin application.

4. Conclusion

5. Acknowledgments

The authors thank CAPES / FAPERO (Coordination for the Improvement of Higher Education Personnel / Research Support Foundation of the State of Rondônia, Brazil) for providing scholarship of Bisi, E.J.R. and CAPES for providing scholarship of Dornelas Júnior, L.F.

6. References

Abbasi BH, Ahmad N, Fazal H and Mahmood T, 2010. Conventional and modern propagation techniques in *Piper nigrum*. Journal of Medicinal Plants Research 4(1): 7-12.

Ahmad N, Abbasi BH, Fazal H, Khan MA and Afridi MS, 2014. Effect of reverse photoperiod on *in vitro* regeneration and piperine production in *Piper nigrum* L. Comptes Rendus Biologies, 337: 19-28.

Ahmad N, Fazal H, Abbasi BH, Rashid M, Mahmood T and Fatima N, 2010. Efficient regeneration and antioxidant potential in regenerated tissues of *Piper nigrum* L. Plant Cell, Tissue and Organ Culture, 102: 129-134.

Ahmad N, Guo B, Fazal H, Abbasi BH, Liu CZ, Mahmood T and Shinwari ZK, 2011. Feasible plant regeneration in black pepper from petiole explants. Journal of Medicinal Plants Research 5(18): 4590-4595.

Balbuena TS, Santa-Catarina C, Silveira V, Kato MJ and Floh EIS, 2009. *In vitro* morphogenesis and cell suspension culture establishment in *Piper solmsianum* C. DC. (Piperaceae). Acta Botanica Brasilica, 23(1): 274-281.

Basak UC, Dash D, Jena GJP and Mahapatra AK, 2014. New technique for adventitious rooting and clonal propagation of *Piper longum* L. (pippali) through leaf cuttings. African Journal of Plant Science, 8(2): 108-112.

Bhat SR, Chandel KPS, and Malik SK, 1995. Plant regeneration from various explants of cultivated *Piper* species. Plant Cell Reports, 14:398-402.

Bhat SR, Kackar A and Chandel KPS, 1992. Plant regeneration from callus cultures of *Piper Iongum* L. by organogenesis. Plant Cell Reports, 11:525-528.

Danelutte AP, Constantin MB, Delgado GE, Braz-Filho R and Kato MJ, 2006. Divergence of secondary metabolism in cell suspension cultures and differentiated plants of *Piper cernuum* and *P. crassinervium*. Journal of the Brazilian Chemical Society, 16(6b): 1425-1430.

Dyer LA, Richards J and Dodson C., 2004. Isolation, synthesis, and evolutionary ecology of *Piper* amides. In: Dyer LA and Palmer ADN (Eds.) *Piper*: a model genus for studies of phytochemistry, ecology, and evolution. New York: Kluwer Academic.

Dornelas Jr LF, Bisi EJR and Santos MRA, 2018. Propagation of *Piper hispidum* through leaf cuttings. International Journal of Development Research, 8(8): 22414-22418.

Freitas GC, Batista Jr JM, Franchi Jr GC, Nowill AE, Yamaguchi LF, Vilcachagua JD, Favaro DC, Furlan M, Guimarães EF, Jeffrey CS and Kato MJ, 2014. Cytotoxic non-aromatic B-ring flavanones from *Piper carniconnectivum* C. DC. Phytochemistry, 97: 81–87.

Haissig BE, 1986. Metabolic processes in adventitious rooting of cuttings. In: Jackson MB. New root formation in plants and cuttings. Dordrecht: Martinus Nijhoff Publishers.

Issa Y, Watts DC, Duxbury AJ, Brunton PA, Watson MB and Waters CM, 2003. Mercuric chloride: toxicity and apoptosis in a human oligodendroglial cell line MO3.13. Biomaterials, 24: 981-987.

Kelkar SM, Deboo GB and Krishnamurthy KV, 1996. *In vitro* plant regeneration from leaf callus in *Piper colubrinum* Link. Plant Cell Reports, 16: 215-218.

Magevski GC, Czepak MP, Schmildt ER, Alexandre RS and Fernandes AA, 2011. Propagação vegetativa de espécies silvestres do gênero *Piper*, com potencial para uso como porta enxertos em pimenta-do-reino (*Piper nigrum*). Revista Brasileira de Plantas Medicinais, 13: 559-563.

Maju TT and Soniya EV, 2012. *In vitro* regeneration system for multiplication and transformation in *Piper nigrum* L. International Journal of Medicinal and Aromatic Plants, 2(1): 178-184.

Mercier H, 2008. Auxinas. In: Kerbauy GB. Fisiologia Vegetal. 2.ed. Rio de Janeiro: Guanabara Koogan.

Micaroni RCCM, Bueno MIMS, Jardim WF, 2000. Mercury compounds: review on determination, treatment and disposal methods. Química Nova, 23(4): 487-495.

Michel JL, Chenb Y, Zhang H, Huang Y, Krunic A, Orjala J, Veliz M, Soni KK, Soejarto DD, Caceres A, Perez A and Mahady GB, 2010. Estrogenic and serotonergic butenolides from the leaves of *Piper hispidum* Swingle (Piperaceae). Journal of Ethnopharmacology, 129: 220–226.

Monteiro D, 2018. Flora of the canga of the Serra dos Carajás, Pará, Brazil: Piperaceae. Rodriguésia 69(3): 1285-1309.

Navickiene HMD, Bolzani VS, Kato MJ, Pereira MS, Bertoni BW, França SC and Furlan M, 2003. Quantitative determination of anti-fungal and insecticide amides in adult plants, plantlets and callus from *Piper tuberculatum* by reverse-phase high-performance liquid chromatography. Phytochemical Analysis, 14(5): 281-284.

Padham B, 2015. Regeneration of plantlets of *Piper longum* L. through *in vitro* culture from nodal segments. Journal of Applied Biology and Biotechnology, 3(05): 035-039.

Pandey S, Kumar R, Sharma S, Nagpure NS, Srivastava SK and Verma MS, 2005. Acute toxicity bioassays of mercuric chloride and malathion on air-breathing fish *Channa punctatus* (Bloch). Ecotoxicology and Environmental Safety, 61: 114-120.

Rani D and Dantu PK, 2012. Direct shoot regeneration from nodal, internodal and petiolar segments of *Piper longum* L. and *in vitro* conservation of indexed plantlets. Plant Cell, Tissue and Organ Culture, 109: 9-17.

Rao MV and Sharma PSN, 2001. Protective effect of vitamin E against mercuric chloride reproductive toxicity in male mice. Reproductive Toxicology, 15: 705-712.

Raven PH, Evert RF and Eichhorn SE, 2007. O sistema caulinar: estrutura primária e desenvolvimento. In: ___. Biologia Vegetal. 5.ed. Rio de Janeiro: Guanabara Koogan.

Umadevi P, Saji KV and Suraby EJ, 2015. Meristem culture for rapid regeneration in Black pepper (*Piper nigrum* Linn.). Annals of Plant Sciences, 4(03): 1029-1032.

Verstraeten I, Beeckman T and Geelen D, 2013. Adventitious Root Induction in *Arabidopsis thaliana* as a model for *in vitro* root organogenesis. In: Smet, I.D. Plant Organogenesis: methods and protocols. New York: Springer.

Zhang Z, Zhao L, Chen X and Zheng X, 2008. Successful micropropagation protocol of *Piper methysticum*. Biologia Plantarum, 52(1): 110-112.

Accessibility analysis for the visually impaired using *LazarilloApp*

Luiz Fernando Delboni Lomba, Josivaldo Godoy da Silva, Andréia Insabralde de Queiroz Cardoso, Aislan Vieira de Melo, Alline Lam Orué, Débora Salvaterra de Araújo, Marcelo de Oliveira, Marcos Antonio Ferreira Júnior, Maria Lúcia Ivo, Maria Lígia Rodrigues Macedo, Camila Medeiros da Silva Mazzeti, Paulo Roberto Haidamus de Oliveira Bastos, Iandara Schettert Silva
Federal University of Mato Grosso do Sul, Brazil

Abstract

Visual impairment causes limitations, including mobility. Studies show that there are about 1.3 billion people in the world with some type of visual impairment. Another important factor refers to the need to include these visually impaired people in schools and universities, for autonomy, learning and personal development. Public policies seek to implement measures that ensure the inclusion of people with disabilities, in order to ensure the use of environments in an equal manner. However, these measures are not implemented due to several factors, such as the lack of knowledge of professionals and the lack of financial and technological resources. This research project aimed to evaluate the use of LazarilloApp, a georeferencing application that helps the mobility of people with visual impairment. The tests were conducted at a university in Brazil. Although it has many features and potential, the application was partially effective and efficient, since in only one of the four routes drawn by it the user arrived at the destination. The accessibility problems identified reinforce the need to enable access through structural changes in physical spaces. The results indicate the need to foster the improvement of the functionalities of LazarilloApp and other mobile applications of free access, for the disabled.

Keywords: Accessibility, School Environment, Visual Impairment, Lazarillo app, Assistive Technology.

1. Introduction

The autonomy of movement is a fundamental right of the human being, and therefore requirement essential to enjoy citizenship. However, in the age of human rights, many people fail to enjoy it, because the lifestyle, historically consolidated, enshrined a type of social organization of architectural structures based on full physical capabilities, established as "normal", regardless the congenital or acquired physical impairment [1].

The convention about the rights of persons with disabilities adopted by the United Nations Organization indicates that the government must create measures that ensure accessibility for persons with disabilities with the utmost independence [2]. According to the 7 Principles of Universal Design, developed by the Center for Universal Design, the environments should allow people with diverse physical abilities to use them equally [3].

Among those with congenital or acquired bodily impairment, the most notable are the visually impaired, blind or low-vision persons, who account for about 18.6% of the world population (1.3 billion people), which represents the most commonly incident disability [4].

The visually impaired face difficulties related to their social inclusion due to their physical limitation, which starts with locomotion in different environments because of structural problems. These problems can be solved or minimized with the use of assistive technology (AT) appropriate to the needs of the disabled. The AT refers to the development of products, systems, services, and technologies that improve the living conditions of persons with disabilities, with the gain of autonomy and their social inclusion [5]. The information and communication technologies (ICTs) enhance the application of ATs, expand the forms of communication, interaction and integration of people with the environment which they live in. The technological resources generated by the ATs modify the lifestyle, interactions and social behaviors by innovating habits and daily attitudes, and facilitating the independence, security and improving the quality of life [6] [7].

Several technological resources have sought to assist people on their journey, usually through apps and / or specific devices that map the user´s routes.

An app was designed to map the areas that are not covered by the Global Positioning System (GPS) devices, such as a mall area. The app was named iExplore and it adds to the map generated by the Google Maps, an additional layer of information of places of interest, with ease for the identification of the indoor shopping spaces by the visually impaired, however it was developed only for the iphone [8].

The Easy Return is another app aimed at guiding the visually impaired person to move around indoors. The difference is that it automatically maps the routes traveled by the user and creates a graphical representation that can be used later. It provides guidance on the direction and the amount of remaining steps to reach the destination through voice messages. It is available only for Apple devices [9].

Another app, made up of radio communication devices distributed in the environment and a hardware that provides guidance about the environment to the user, through the voice, was developed to assist the displacement of visually impaired people in a university library [10].

As a solution for outdoor environments, the Crosswatch app was developed, it provides real-time feedback to the visually impaired about their location in relation to the crosswalk, with the use of computer vision [11]. Later the researchers added new resources to the app, such as the geographical coordinates of the crosswalks and the presence of traffic lights, from the location obtained out of the smartphone (SM) [12]. These works point out the difficulties encountered in identifying the different types of crosswalks, technology used in photographic cameras and the accuracy of GPS in SMs.

The Virtual Mobility Trainer is another type of app, consisting of two parts: the Route Creator, which allows the creation of routes by an authorized person; and the Virtual Mobility Training, which the disabled uses to navigate the created routes. While defining the routes in the Virtual Mobility Trainer the user can indicate places with obstacles or points of interest with the SM GPS. The app was developed only for the Android operating system [13].

In order to create a collaborative solution, the SoNavNet social network was structured, it uses the user's location to obtain pertinent information and share with other users. An evolution of SoNavNet was developed in order to allow the users to provide supplementary information regarding the accessibility of places in use, classifying them as accessible or inaccessible [14, 15].

The surveys mentioned highlight the use of apps to allow people with visual disabilities to move around, while other works [16] [17] evaluated the infrastructure of cities to verify the accessibility and mobility.

The results show the needs and expectations that the visually impaired have about the public facilities in the city [16]. There are cities that encourage social initiatives to help citizens with disabilities to have greater autonomy and quality in their travel [17].

The Lazarillo App is a georeferencing app that produces intelligent and automatic spatial orientation by generating voice messages that guide the handicapped with information about their location and the services available nearby.

Given the importance of ATs in improving the quality of life of visually impaired people, this article aimed to test and evaluate the use of Lazarillo App in the context of a university campus.

2. Materials and methods

This is an experimental and technological research, carried out through the observation and collection of field data. With qualitative approach and objective to analyze the practical use of the mobile application LazarilloApp. The research was conducted on a university campus in the state of Mato Grosso do Sul, Brazil, in June 2019.

2.1 Materials used

Two SMs were used, an iPhone with the iOS operating system and another Xiaomi with the Android system, with LazarilloApp installed in both.

The annotations of interactions, conditions and problems observed in the field were recorded in manuscripts, photographs and screenshots of the SMs.

2.2 LazarilloApp

It is a free app from a project that started in 2014 in the city of Santiago (Chile) and its mission is to improve the quality of life and autonomy of visually impaired people.

The app works based on SM GPS data, it requires internet connection and it is available for iOS and Android operating systems, with support for Spanish, English, Indonesian and Portuguese languages.

It provides guidance through voice-message based on the user's real-time location, with information about the nearby services such as banks, restaurants, streets, intersections, bus stops.

2.3 Data collection

An interdisciplinary team of researchers was made up of professionals from the areas of health and computer science, in order to generate standard of conduct and observation of the reality and to maintain the coherence of the information generated by the app. There is little evidence of direct involvement of the interdisciplinary staff to conduct researches that develops improvements in the apps used as TA [18].

Initially the SMs were used simultaneously for the setting in the app and comparison of operation on Android and iOS system, later only the SM with Android system was used.

The data collection was performed through the researchers' interaction with the app and the university campus environment. One researcher took photographs of the university environment, another operated the app to get directions and screen captures, while a third wrote down the team's perceptions during the routes

they made.

2.4 The setting in the LazarilloApp

The first experiment was to create directions for the setting of the researchers in the app and to compare with maps presented by LazarilloApp and Google Maps.

The LazarilloApp not only has a database but also uses the main international databases to feed its maps, as shown in Figure 1A. The advantages offered by LazarilloApp compared to Google Maps are the higher audio interaction, both in its configuration and route usage, and the presence of a gallery with desired locations such as transportation, banks and ATMs, health, food, among others, as shown in Figure 1B.

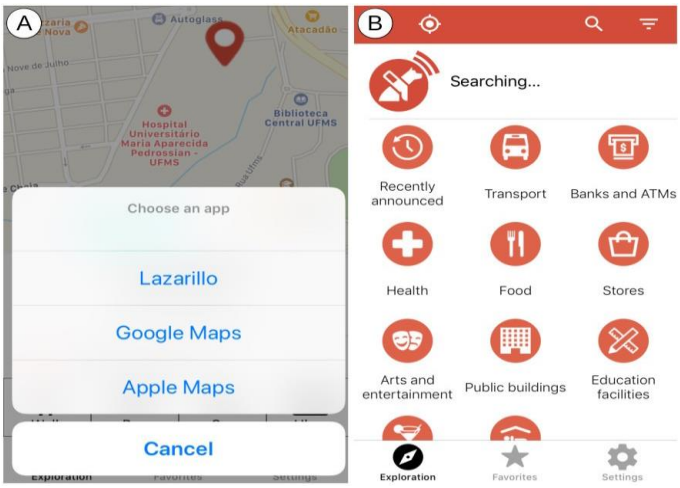


Figure 1. A) Screen for choosing the maps database to trace the routes. B) Screen with location categories available in LazarilloApp, 2019.

To evaluate the features of the app in the university campus, routes were defined to four places of interest to be walked: a bus stop (located at coordinates -20.499089 and -54.612672), core of bank branches (coordinates -20.500359 and -54.612687), a university restaurant (coordinates -20.503291 and -54.614394) and Faculty of Medicine (coordinates -20.497774 and -54.614366).

2.5 Data Analysis

The data were analyzed qualitatively through observations whose characteristics were noted in the field research, which, in turn, was organized into two distinct parts: app setting, use of the app with the campus accessibility.

Therefore, aspects related to efficiency were considered by defining the shortest and / or fastest route, and the most appropriate and signaled for the visually impaired people. And regarding effectiveness, resulting from the identification and arrival at the destination, proposed through the route traced by the app.

An analysis of the accessibility condition existing in the university campus was also performed.

3. Results and discussion

During the evaluation of the app were found interesting points to be highlighted regarding the effectiveness presented.

Initially for the definition of routes there was a problem regarding the starting point for navigation, the physical space was not tracked: the location was identified by the app, but no route could be defined from it.

The version of the app for the Android operating system showed only an error message on the screen, as shown in Figure 2A, while on the iOS system, in addition to the message on the screen, a beep repeatedly indicated a search for a route. At other times the error screen was shown, as shown in Figure 2B, however the app continued to function and pass along sound instructions.

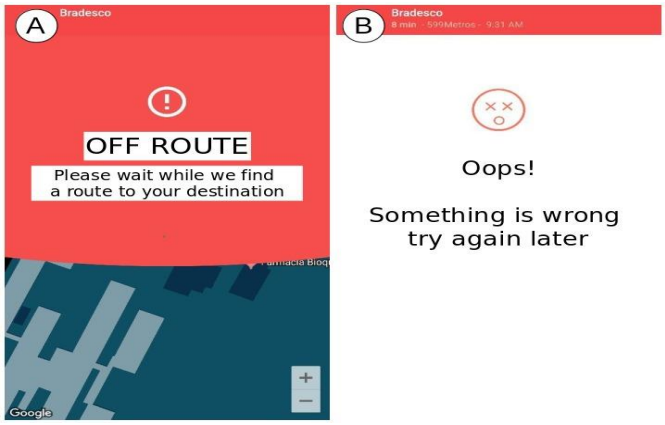


Figure 2. A) Screen with problem to detect the route start point in Android version. B) Screen with error message displayed while using the LazarilloApp app, 2019.

One of the highlights of LazarilloApp is the voice message notification, which indicates locations near the user. This fact was evidenced when the route was close to the university library and the app sent the message with the information. But this is an uncomfortable factor when there are several prominent locations along the route, such as near the campus bank branch area, as there were constant beeps and this disturbed the interpretation of the other messages. Despite the inconvenience, there is the option to disable or customize the messages you want to hear.

Another notification option refers to the user's location, which was sometimes based on cardinal points, such as north, south, east, west, and other times in relative directions, such as front, back, right, left. There is the option to choose the type of beep format for user´s location, as shown in Figure 3A, but even with the relative directions option enabled, notices based on cardinal points were heard.

Still regarding the sound notifications, in the Android version, the messages were sometimes issued in local language (Portuguese) and other times in English, including some messages in both languages, which represents a problem.

Regarding the language, it is not possible to change it in the Android version, using Google's text-to-audio engine, as shown in Figure 3B. In iOS version it is possible to configure for several languages, as shown in Figure 3C.

Another feature observed in LazarilloApp was that after a period of time without interacting with the screen, it darkens, but the app's sound information continues to transmit without change.

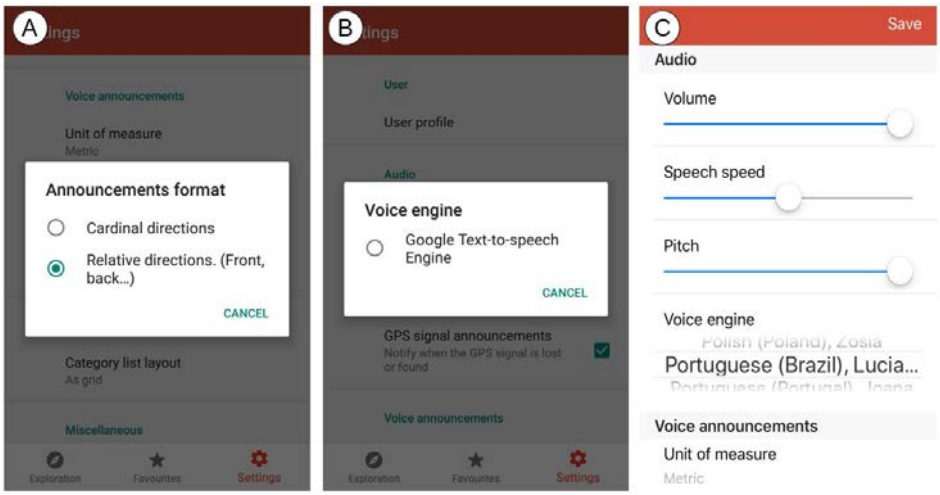


Figure 3. A) Configuration of the sound notices format in the Android version of LazarilloApp. B) Language and voice engine configuration in the Android version of LazarilloApp. C) Configuration of language and voice engine in iOS version of LazarilloApp, 2019.

3.1 Analysis of the traced routes

As already reported, we could not start the route from the desired location. The researchers went to another point, where the app pointed as the beginning of the route, for then the first destination be traveled, with destiny to a bus stop. The selection of the destination to be traveled was made in the app gallery, with the option “transport”: the bus stop was automatically selected by choosing the “bus stop” option. On the way to the destination, two other bus stops were identified, however there was no notification of the app. It was observed that one of these bus stops was closer than the one indicated on the route.

The route required the crossing of a street, but at the end of the crosswalk there was no sound notification about the direction to continue, the only notification was about the distance to reach the destination. Purposely the team converged in the opposite direction to the destination, the app only continued the notification of the distance increase to the destination, that is, the opposite way.

Another route was from the bus stop to the bank branch region, on which the route suggested by the app was used, as shown in Figure 4. However, it was not possible to reach the destination, once that only part of the path has tactile floor. The researchers started a different route and the app automatically updated the path.

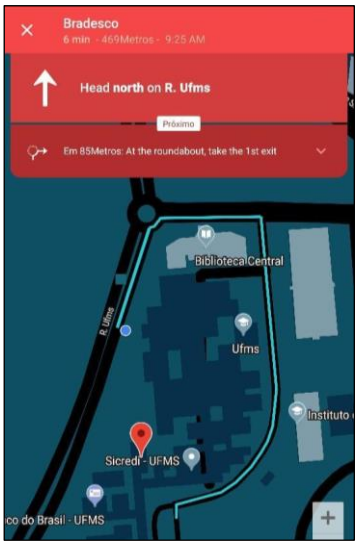


Figure 4. Screen with the route mapped to the bank branch region in the LazarilloApp app, 2019.

One more route was set up from the bank branches toward the university restaurant. Unfortunately, there were problems regarding the location validated by the app, lack of tactile floor, and problems with pavement on the streets. An alternative route was performed by the researchers, not identified by the app. The area of the university restaurant was the one which presented the highest accessibility problems for the visually impaired, such as paving in poor conditions for use and the absence of tactile floor.

The return to the initial destination was also problematic due to the need to cross the street and incomplete information, due to inaccuracy in SM GPS location.

It is worth to mention the importance of combining the use of the app with the accessibility of environments. An example was the difficulty in converging and go down the sidewalk to cross the street due to the absence of tactile floor, as shown in Figure 5.

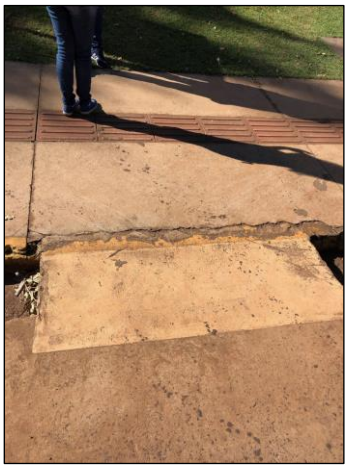


Figura. 9. Intersecção da calçada com a rua sem a devida marcação de piso tátil, 2019.

3.2 Acessibility within the university

When considering the problems encountered, unfortunately in some places there is a lack of tactile flooring and this makes it impossible to use the app correctly. Along the way he observed that there are many uneven

paving areas, extremely steep ramps and areas of total tactile floor wear due to lack of maintenance. In some regions due to lack of attention there were obstacles such as garbage bags and cars under the tactile floor line to be followed by the visually impaired.

One part of the campus had irregular pavement and no tactile floor, which made it impossible for the disabled to have autonomous access to classrooms, auditoriums and health clinics.

These problems must be analyzed and worked on by the university management in favor of adequate physical mobility and maximum independence of its teachers and students with disabilities. Since these aspects are discussed and listed by WHO and other social actors in favor of improving the quality of life and access of people with disabilities [2, 3, 17].

4. Conclusion

One advantage of LazarilloApp is that it is freely accessible and available for Android and iOS operating systems.

Another important feature is the sound interface of good quality that allows the communication of the app with the user. However, this sound information suffers interference in the way it is presented, making its understanding difficult.

Considering the proposal to evaluate the functionality of the app in the university campus, concluded that can be applied in the several situations encountered provided that the structural and mobility conditions are adapted and preserved to the needs of the disabled.

From the technological point of view the inclusion of visually impaired people in several spaces and also in the university depends on public policies to improve infrastructure conditions and the existence of apps with adequate resources for the environment.

The importance of apps for SM was verified, and in the case of LazarilloApp its functionalities should be improved to avoid confusion during the use.

As a proposal for future researches, new apps can be developed and evaluated, as well as a complete mapping of the university campus.

Finally, it is concluded that the inclusion depends not only on the existence of laws, but also on an effort to develop technologies and financial resource that enable their use.

5. References

[1] N. Bobbio, A era dos direitos. Rio de Janeiro: Elsevier, 2004.

[2] United Nations, "Convention on the Rights of Personswith Disabilities and Optional Protocol", New York, 2006.

[3] NC State University, "The Principles Of Universal Design", The Center for Universal Design, 1997.

[4] World Health Organization, "Vision impairment and blindness", Who.int, 2018. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/blindness-and-visual-impairment. [Accessed 15 July 2019].

[5] World Health Organization, "Assistive technology", Who.int, 2018. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/assistive-technology. [Accessed 15 July 2019].

[6] J. Braga, A. Campi Junior, R. Damaceno, N. Albernaz, "Estudo e Relato sobre a Utilização da Tecnologia pelos Deficientes Visuais.", in IHC Anais do 11º Simpósio Brasileiro sobre Fatores Humanos em Sistemas Computacionais, 2012.

[7] L. Hakobyan, J. Lumsden, D. O'Sullivan, H. Bartlett, "Mobile assistive technologies for the visually impaired", Survey of Ophthalmology, vol. 58, no. 6, pp. 513-528, 2013.

[8] A. Paladugu, P. Chandakkar, P. Zhang and B. Li, "Supporting Navigation of Outdoor Shopping Complexes for Visually-impaired Users through Multi-modal Data Fusion", in 2013 IEEE International Conference on Multimedia and Expo (ICME), San Jose, 2013.

[9] G. Flores, R. Manduchi, "Easy Return: An App for Indoor Backtracking Assistance", in Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Montreal, 2018.

[10] I. Abu Doush, S. Alshatnawi, A. Al-Tamimi, B. Alhasan, S. Hamasha, "ISAB: Integrated Indoor Navigation System for the Blind", Interacting with Computers, 2016. Available: http://dx.doi.org/10.1093/iwc/iww016. [Accessed 15 July 2019].

[11] V. Ivanchenko, J. Coughlan, H. Shen, "Crosswatch: a Camera Phone System for Orienting Visually Impaired Pedestrians at Traffic Intersections", in ICCHP 2008: Computers Helping People with Special Needs, 2019, pp. 1122-1128.

[12] J. Coughlan and H. Shen, "Crosswatch: a system for providing guidance to visually impaired travelers at traffic intersection", Journal of Assistive Technologies, vol. 7, no. 2, pp. 131-142, 2013.

[13] R. Koutny, K. Miesenberger, "Virtual mobility trainer for visually impaired people", Technology and Disability, vol. 26, no. 4, pp. 211-219, 2015.

[14] H. Karimi, B. Zimmerman, A. Ozcelik, D. Roongpiboonsopit, "SoNavNet: A Framework for Social Navigation Networks", in Proceedings of the 2009 International Workshop on Location Based Social Networks, Washington, 2009.

[15] H. A. Karimi, M. Dias, J. Pearlman, G. J. Zimmerman, "Wayfinding and Navigation for People with Disabilities Using Social Navigation Networks", EAI Endorsed Transactions on Collaborative Computing, vol. 1, no. 2, 2014.

[16] R. Nuzzi, E. Bottacchi, F. Monteu, "Low vision, visual impairments and metropolitan urban planning: example of a topographic enhancement, need and monitoring in an Italian city", Clinical Ophthalmology, vol. 12, pp. 2107-2119, 2018.

[17] J. Barahona, Ó. Estupiñán, "La construcción de nuevos territorios y narrativas para las personas con discapacidad visual en las ciudades accesibles e igualitarias El caso de la aplicación “Lazarillo”, Santiago de Chile", in ACTAS ICONO14 – VII Congreso Internacional Ciudades Creativas, 2019.

[18] L. Hakobyan, J. Lumsden, D. O’Sullivan, H. Bartlett, "Mobile assistive technologies for the visually impaired", Survey of Ophthalmology, vol. 58, no. 6, pp. 513-528, 2013.

IoT-based Smart Mini Greenhouse

Deisiane Santos da Cruz, Caio Castro Rodrigues,
Otavio A Chase, Dênmora Gomes de Araújo, José Felipe Souza de Almeida
Federal Rural University of Amazonia (UFRA), Brazil

Abstract

The purpose of this article is to present an architecture of a reduced-size greenhouse, monitored and controled via Internet of Things (IoT). As an experiment, seeds of Apuleia leiocarpa (Vog.) Macbr were used and at 25°C, 75% germination was obtained. In order to apply the automation on seed germination process, sensors are required and a prototype has been built with support of a computational system installed in its interior by including the control in conserving temperature, humidity and the degree of brightness inside the structure. In this sense, sensors are used for monitoring and control of the variables that most influence in the development of a vegetal species. The proposed system has a cloud-based storage and the effective contributions of the computer system are started from the web platform, transfer the set-points to the controllers, and upload data read from sensors to the same web page.

Keywords: The Greenhouse Technology; IoT Communication; Temperature Control; Seed Germination

1. Introduction

The technology of the Industrial Revolution 4.0, which emerges in today's world is known as the Internet of Things or IoT [1]. Among its benefits are mainly the optimization, control and automation of processes, previously done manually [2].

Light in seed germination plays a predominant role in the photochromatic pigment system, which is responsible for the perception of the luminosity in the plants. These pigments are found in all higher plants and become active when they absorb certain wavelengths of a specific range, acting as if they were an enzyme [3]. Consequently, the effect of light on the embryo allows the radicle, embryonic root, to penetrate the endosperm for seed germination and eventual plant growth [4].

Another important factor in germination is temperature, responsible for the speed and uniformity of emergence of seedlings [5]. The effect of temperature is mainly present in the absorption of water and in the biochemical processes that will act on its energy reserves [6]. As a result, it is essential to control these two variables, i.e., temperature and brightness, so that more uniform germination occurs in optimized time.

Recently, several attentions have been focused on the provision of improvement on the IoT and how to utilize it with the various applications principally on the sector of agriculture [7]. This work deals with the development of a computational system, targeting applications on agricultural context [8]. For this purpose, a prototype of a mini greenhouse was built, and the embedded system implementation is made using sensors capable of *in vitro* verification of the conditions suitable for the germination and growth phase of plant species [9]. From this monitored environment, a database is generated with cloud storage of

computers and the records of the obtained data are made available in real time with computer access through Internet or network for mobile devices.

Therefore, the objective of this study is to present the development of a system model embedded in IoT communication, with a function of access to information records on irrigation, temperature, humidity and with indoor lighting. For the measurement, *Apuleia leiocarpa* seeds have been used in the monitoring and control related to its germination processes.

2. Materials and Methods

The current project considers an embedded computer system that has been developed capable of collecting environmental data by sensors and storing them in the cloud (digital cloud). This process is facilitated through the IoT communication, which was built primarily to monitor and control all events involved in a greenhouse and the data are obtained in short time intervals without the need for manual recording.

The data processing and acquisition was performed by the microcontroller board NodeMCU ESP8266 which in its circuit has the Wi-Fi module enabling the communication of the proposed system with the digital cloud, the acquisition system is connected to a router with Internet access, thus, the data flow occurs through port 8433 (SSL) of the router. The digital cloud Blynk™ has an app for online data visualization, is an IoT platform with reliability and data security, allows data analysis and upload and integration to applications with external Http API. The protocol used in the communication between the microcontroller and the digital cloud is the MQTT (Message Queue Telemetry Transport), this protocol is widely used in IoT applications for providing speed and reliability in data traffic and works asynchronously between devices, making it one of the most recommended protocols in IoT applications. Figure 1 shows the topology of the system.

Figure 1. Topology of the IoT-based Smart Mini Greenhouse.

The developed system can collect data through sensors related to temperature and relative humidity (DHT22), luminosity (TLS2561) and soil moisture (Hygrometer). The DHT22 module is a digital measuring device, consisting of a capacitive sensor for the measurement of air temperature and relative humidity, with an accuracy of ±0.3 °C and ±2% RH respectively, and a thermistor for temperature measurement, with an accuracy of ±0,5°C - both measurements with resolution of 0.1 and response time of 2s. This information together with incident light data is very important for the biochemical development of plants. The BH1750 light sensor uses I2C communication interface and 16-bit AD converter, making possible to measure from 1 to 65,535 lx, with a resolution of 0.5 lx when set to operate at intervals over 120ms. These devices function as a feedback signal for the controller to process and send the control signal, which is responsible for the activation of an incandescent lamp – 60W of power was used as the source of light and heat. Also, for a specific purpose in experiments it is necessary to maintain luminosity without significant change in temperature, LED tapes can be used – 15W was used as light source. A cooler was also used to soften the effects of temperature and humidity, with the renewal of the air inside the prototype at the mini greenhouse. Figure 2 shows the system architecture.

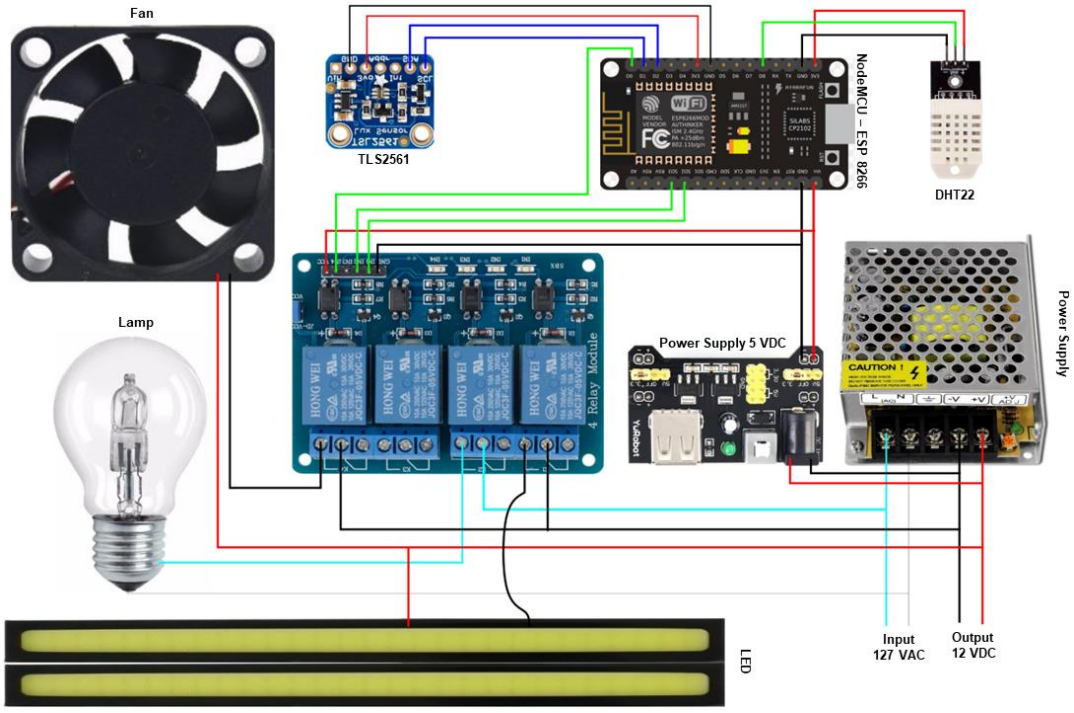


Figure 2. Topology of the IoT-based Smart Mini Greenhouse.

A total of 120 *Apuleia leiocarpa* seeds were collected and distributed on 6 replications. Aiming at improving the process of preparing seeds for germination, the seeds have been sterilized with sodium hypochlorite (NaClO) solution for 15 minutes, then washed under running water for 3 minutes, and superficially dried with paper towels. As the seeds of this species have a hard and impermeable integument, to break seed dormancy the seeds were scarified with sulfuric acid (H_2SO_4) for 5 minutes. Subsequently, they were sown on commercial type of substrate, at a depth of 1cm. Figure 3 shows the seeds on this process of preparing for germination.

Figure 3. Image of a sterilization and scarification process for seeds.

Finally, the mini greenhouse has been built with a wooden structure, whose dimensions are 40x50x40cm and glass on its side faces. Figure 4 shows the prototype model for remote IoT handling system.

Figure 4. The prototype of a mini greenhouse.

The light bulb is responsible for heating the room and the cooler for decreasing the temperature. The LED lamps kept the environment constantly illuminated from 6 a.m. to 6 p.m. every day.

3. Results

In this project, the proposed system has been based on the architecture of a smart mini greenhouse and with the same characteristics of a chamber of type B.O.D. (Biochemical Oxygen Demand). Linked to this prototype, a computer system was shipped with communication via IoT, using the Blynk™ platform. After installation of the sensors and actuators, these devices were calibrated according to information suggested by the manufacturers. Figure 4 shows the prototype of the mini greenhouse and includes sensors for monitoring and actuators related to the control of conditions that may favor the study of seed germination.

Germination is a process by which the seeds re-perform their metabolic activities from the embryonic axis, thereby emitting their root system [10]. This biophysical process is regulated by an interaction between its physiological state and environmental conditions, such as temperature and light [11]. In this way, the system was activated, and the tests were performed, to obtain control about these data. Firstly, the data acquisition was tested by the microcontroller along with IoT communication on the Blynk™ platform. Figure 5 shows the measurements accompanied by real-time on the cell phone screen.

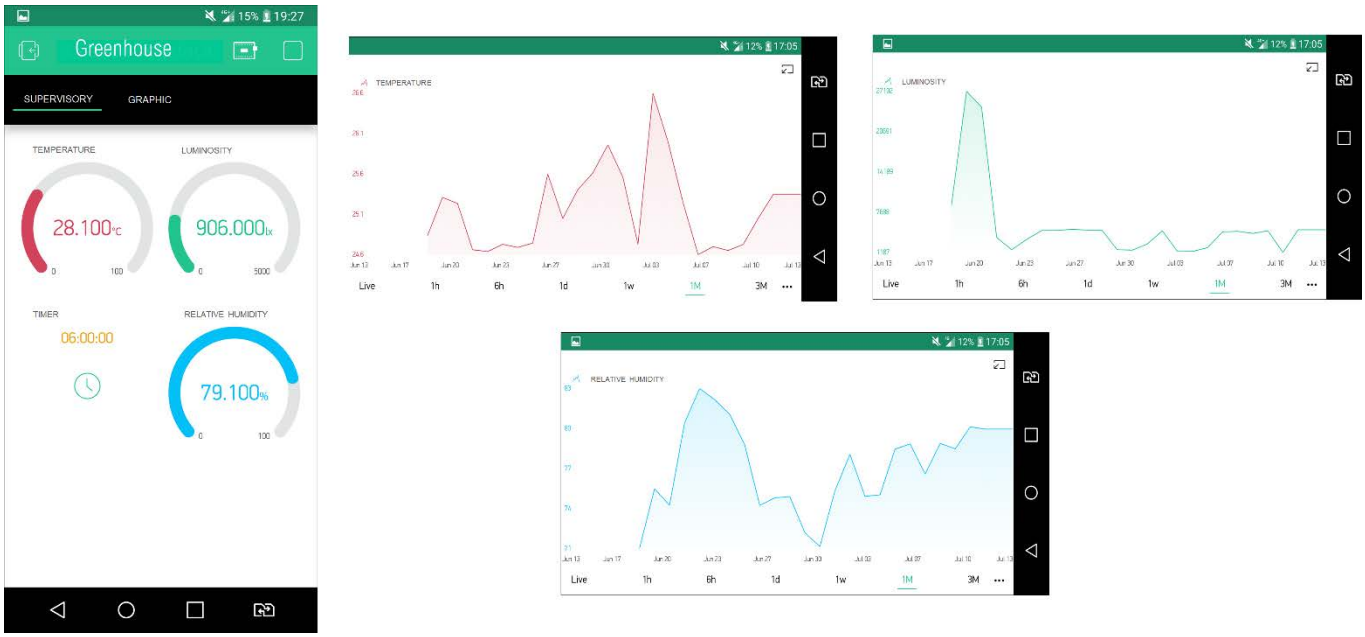


Figure 5. Temperature, Luminosity and Relative Humidity, inside at mini greenhouse via Blynk™.

For the experiment, data acquisition and variable control by the microcontroller were tested, together with IoT communication on the Blynk™ platform, in which the system was programmed to obtain constant luminosity during the day. In case the temperature increases or decreases during the process, the cooler is activated by the microcontroller such that the average remains adequate for the experiment. The temperature used inside the mini greenhouse was 25 ºC, according to [12], seeds germinate better under these conditions. The experiment was entirely randomized and conducted over a period of 15 days. From a total of 120, the seeds began to emerge after seven days of sowing, being a total of 90 germinated seeds, and presenting germination percentage of 75%, according to the graph in Figure 6.

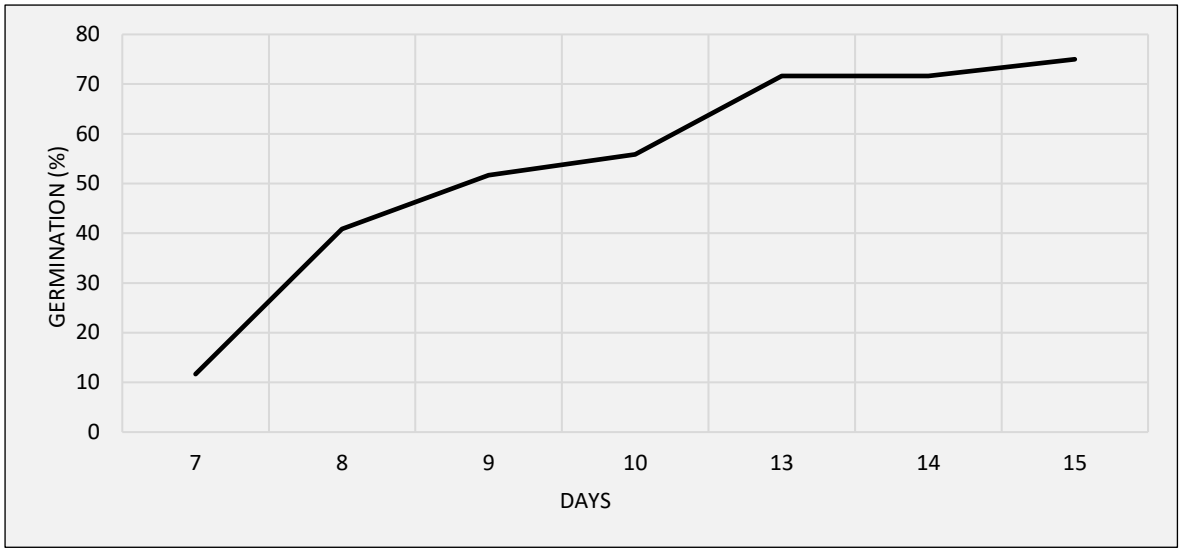


Figure 6. Percent accumulated germination graph.

4. Conclusion

This work dealt with a mini-greenhouse architecture, using sensors and access via IoT. Regarding the applicability of this architecture, the control and monitoring of the variables corresponding to the morphometry of structures can be present for analysis. As a result, embedded system devices and real-time graphical obtained by using IoT platform in cloud computing were shown. It is worth mentioning that the computational module has several advantages over conventional B.O.D., which are well known in these procedures related to seed germination, as an example: low cost; the control of irrigation, luminosity and temperature; and access the information in real time. In the experimental test, the optimum temperature for *Apuleia leiocarpa* was 25°C in the incubation period of 7 to 15 days, considering the appropriate type of substrate and maintaining adequate levels of humidity and light conditions. Considering the limitations of the sensors in response time, NodeMCU processing time and cloud communication, the system sampling time was 30s – with stable internet connection and speed of average connection established at 12MB/s. In this system, the seed germination phase can be kept in control, thus obtaining information on its main growth characteristics. The major advantage of this tool is that uses open source software and generic hardware in which the system allows insertion of new sensors, as is the case of CO_2 measurements, ultraviolet radiation, among others.

5. References

[1] O.A. CHASE, A.N. CARVALHO, E.S.S. ANDRADE, C.T. COSTA JUNIOR and J.F. ALMEIDA, “Environmental Measurement Technology: an approach to the Amazonian environment,” IEEE Latin America Transactions, 2018, pp. 1036-1041.

[2] Greengard, S., The Internet of Things, The MIT Press, Cambridge, 2015.

[3] N.L. MENEZES, S.M. FRANZIN, T. ROVERSI and E.P. NUNES, Germination of Seeds of *Salvia splendens* Sellow in Different Temperatures and Qualities of Light, Brazilian Seed Journal, 2004, pp. 32-37.

[4] Taiz, L., Zeiger E., Møller I. M., Murphy A., Physiology and Plant Development, Artmed, Porto Alegre, 2017.

[5] R.S. GUEDES, E.U. ALVES, E.P. GONÇALVES, J.M.J. BRAGA, J.S. VIANA and P.N.Q. COLARES, "Substrates and Temperatures for Germination and Seed Vigor Tests of *Amburana cearensis* (Allemão) A.C. Smith Seed," Revista Árvore, 2010, pp. 57-64.

[6] V.G. DEMUNER, C. ADAMI and J. MAURI, "The Influence of Light and Temperature on Seed Germination of *Erythrina verna* (Leguminosae, Papilionoideae)," Bulletin of the Biology Museum Prof. Mello Leitão, 2008, pp. 101-110.

[7] Z.F. SHENAN, A.F. MARHOON, A.A. JASIM, "IoT Based Intelligent Greenhouse Monitoring and Control System," Basrah Journal for Engineering Sciences, 2017, pp. 61-69.

[8] M. MATULOVIC, F.M.J.O. MORAIS, A.V. SOUZA, C.A. AMORIM and L.F.S. COLETTA, "Aflatoxin Detection on Direction of the 4.0 Age at 3.0 Costs," International Journal for Innovation Education and Research, 2019, pp. 338-346.

[9] N. MAKISHIMA and O.A. CARRIJO, "Protected Tomato Cultivation," Embrapa Technical Circular Greens, 1998.

[10] A.K.M. OLIVEIRA, J.W.F. RIBEIRO, K.C.L. PERREIRA and C.A.A. SILVA, "Seed Germination of *Aspidosperma tomentosum* Mart. (Apocynaceae) at Different Temperatures," Brazilian Journal of Biosciences, 2011, pp. 392-397.

[11] V.H.V. MANDO, S.J.P. CARVALHO, A.C.R. DIAS and J. MARCOS FILHO, (2010). Effects of Light and Temperature on Seed Germination of Four Species of Weed Plants of the *Digitaria Genus*. Brazilian Journal of Seeds, 2010, pp. 131-137.

[12] M.S. PADILHA, L.S. SOBRAL, C.R.D. BARETTA and L. ABREU, "Substrates and moisture content for the seed germination test of *Apuleia leiocarpa* (Vog.) Macbr," Revista Verde, 2018, pp.437-444.

Optimization of the Production Process of Sealing Bricks in a Ceramic Factory in Urucurituba City in Amazonas – Brazil

Denilson Fernandes Vital
denilsonvital71998@gmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO - Brasil

Mauro Cezar Aparício De Souza
mcas1691@gmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Francisco Carlos Tavares Amorim
amorim.mao17@gmail.com
Laureat International Universities – UNINORTE – Amazonas - Brasil

Ana Jaqueline Travessa Amorim
anajaque.arq@gmail.com
Laureat International Universities – UNINORTE – Amazonas - Brasil

Carlos Eduardo de Oliveira
ceoedu2450@gmail.com
Universidade Federal do Pará – UFPA - Brasil

Abstract

In recent years there has been a high growth in Brazil, in the construction industry this event reflects a great economic development in the regions of the country, in the Amazon, the ceramic brick industry has been gradually increasing to meet this demand, especially in the interior of the state. In them there are failures and waste during its manufacturing process that greatly affects the final product. This article aims to employ the quality tools in the production process of a ceramic pottery that is located in the city of Urucurituba - AM, through them to discover the flaws and propose improvements in the production process of sealing bricks so that there is no problems in the final product. Through site visits data were

collected through interviews with employees and the plant manager, the visit also allowed the mapping of the process of manufacturing eight-hole bricks, from this verification it was possible to apply the flowchart that allowed describing Throughout the process flow, the Ishikawa Diagram was also applied, which made it possible to detect faults (cracks and cracks) and their root causes. These occur during the brick production process and used the 5W2H, which helped to organize the ideas. and make a proposal to solve the problems, and bring quality to the final product

Keywords: Brick; Quality tools and process; Ceramic;

1. INTRODUCTION

Ceramics companies, also known as potteries, being small, medium or large have great contributions to the national and regional economy. Some of these contributions are in increasing employability, providing salary and income, especially for people who have not had access to a professional qualification. These companies participate in about 1% of the Brazilian GDP (Gross Domestic Product), which corresponds to about 12 million reais [1].

In the presented pottery there are many failures during its production process that cause defects in the final product. Employing quality tools makes it possible to detect the problems that occur during the brick making process, to correct them and thus improve their quality.

According to [2] "Quality is the necessary condition to guarantee the success of a production operation".

It is of the utmost importance to produce quality to remain competitive in the market and to ensure the success of the enterprise, correcting the errors that occur during the brick production process, will eliminate or reduce the rework, waste and productivity costs of the company. By taking these steps the organization will gain control over its process and offer a better quality product, so it will be prepared to compete with competitors and stay alive in the marketplace.

This article aims to employ the quality engineering tools as a strategy for improving the production process of a ceramic industry, located in the city of Urucurituba-AM. As for its specific purpose, analyze the process of producing the sealing bricks, identify and apply the appropriate quality tools to find out the problems or errors that occur during the company's product manufacturing procedure that lead to noticeable flaws in the final product. , and present an action plan to address these issues and increase the quality of the bricks.

2. THEORETICAL REFERENTIAL

2.1. Quality tools

Quality tools are methods used in industries that seek process improvement or solve problems that occur during them to make decisions, and obtain greater productivity, reduce losses, rework and consequent cost of production.

According [3] states that quality tools assist us in finding problems so that they can be solved in different situations and systems.

According to [4], the seven classic quality tools aim to assist and support management in decision making for problem solving or just to improve situations.

According to [5] identifies as a quality tool all processes employed to obtain improvements and positive results, thus allowing a better exploration of its products in the competitive market.

2.1.1. Flow chart

The flowchart is the representation of the processes of a company through graphic symbols in order to describe the step-by-step process flow.

The flowchart is an excellent tool for analyzing the process as it allows a quick understanding of the activities that are performed by all parties involved. It is a fundamental tool, both for process planning or elaboration, as well as for process improvement or analysis, criticism and changes [6].

According to [7] The flowchart is an essential tool in any product and service quality program. It is a very useful tool for recording a product's production flow or a service delivery flow by adopting a "common language or universal language" for learning, communication or dialogue purposes and for opportunities for improvement.

2.1.2. Ishikawa Diagram

Also known as Cause and Effect Diagram or Fishbone Diagram, it is a tool used in many areas such as quality control, people management and decision making.

Usually this diagram is used to jointly visualize the main and secondary causes of a problem, broaden the possible causes of the problem, enrich its analysis and identify solutions, as well as analyze the process for improvement [8].

For [9], the diagram can be adjusted to the needs of the organization, primarily in establishing responsibilities by designating the authority of each element or action. We also realize that the analysis is represented by the 6 Ms, which are:

1 M (materials): refers to the analysis of the characteristics of materials for uniformity, pattern, etc .;

2 M (machine): refers to the operation of the equipment and its proper operation;

3 M (method): consider how the actions will be developed:

4 M (environment): assesses which situation may be the cause of a particular effect (execution situations and / or fixed infrastructure);

5 M (labor): characterizes the pattern of labor used, if it is properly trained, if it has the necessary skills, finally, if it is qualified to perform the task;

6 M (measurement): translated by how values are represented (by distance, time, temperature etc.) and by the measuring instruments used.

2.1.3. 5W2H

According to [10, the 5W2H tool is understood as an action plan, that is, the result of planning as a way of guiding actions that should be executed and implemented, being a way of monitoring the development of what is established in the planning stage.

Tool 5W and 2H addresses the use of questions that begin with the letters W and H, which also contains

the meaning of each one. The questions aim to generate answers that clarify the problem to be solved or that organize ideas in problem solving [9].

2.2. Ceramics Industry

In Brazil, before the colonization of the Portuguese, different peoples already lived on the banks of the Amazon River, more than 1,000 years AD, and these peoples used the clay for housewares, for house building, for religious purposes and even for decorative purposes. Archaeological studies show that the oldest and best known here in Brazil are the Marajoara ceramics of the people who inhabited the island of Marajós, a very advanced indigenous culture. There are also studies that indicate Brazilian ceramics over 5000 years ago [11].

According to [12], states that the Portuguese only concentrated and qualified the labor that existed here, setting up potteries to speed up and enrich the process.

The Amazon is a state in great economic development. Over the past 7 years, Suframa has invested in the Interiorization program, the equivalent of one hundred and twenty-nine million reais, in projects aimed at generating infrastructure in the 52 (fifty-two) state-owned municipalities. The red ceramics industry is an essential sector for the national economy, as it supplies the civil construction production chain throughout the national territory and is also fundamental for the habilitation sector [13].

The municipality of Urucurituba is located in the interior of the state of Amazonas, according to data from [14] estimated that its population is 22,537 (twenty two thousand, five hundred and thirty seven) inhabitants. The city contains only one pottery industry in its entire territory, it produces about 320 million bricks per month, which are distributed and marketed in the municipality and surrounding cities.

According to [15], materials can be classified into two groups: traditional ceramics and technical ceramics, whereas traditional ceramics use clay, silica and feldspar as raw materials and technical ceramics are composed of materials. pure or almost pure.

According to [16], ceramic materials have as main characteristics among the materials used for construction, durability and ease of manufacture, as well as abundance of raw material, low cost. One of these ceramics that has become a basic component of any masonry construction is brick and can be classified as: solid, drilled and perforated.

The activities of an industry operating in the traditional red ceramics sector begin in the mining of the raw material. Often two or three types of clay materials are plowed to achieve the desired characteristics in the final product. Most of the raw materials used are natural, being in deposits scattered in the earth's crust [17].

2.2.1. Production Process: Sealing brick.

According to [18], he mentions in his research the red ceramic production process is divided according to the steps:

Raw Material: Most of the red ceramic extrusion masses are mainly made up of two clays, one very plastic and one not very plastic, which are transported from the deposits to the storage sheds, where they are dosed according to the desired ceramic characteristics for the product.

Destroyer: It has the function of crushing the larger clumps of clay (clods), in order to facilitate the

subsequent operations.

Mixer: Performs circular motions, allowing the homogenization of the dough and the addition of water, until the ceramic dough formed has adequate moisture and plasticity for extrusion.

Laminator: Performs circular movements, allowing the homogenization of the dough and the addition of water, until the ceramic dough formed has adequate moisture and plasticity for extrusion.

Extruder: Also known as maromba, the homogenized clay is driven, thrown into a vacuum chamber and pressed against a steel die (mouthpiece), where the dough is shaped to the desired shape.

Cutting: At the exit of the extruder, the continuous molded dough is cut manually or automatically, with the desired dimensions, having then the ceramic block.

Drying: Molded elements are arranged in covered sheds, placed on shelves (fixed or movable) or even stacked on the floor to reduce their moisture content.

Synthesizing or Burning: The firing temperature ranges from 750 to 900ºC for the blocks, and may reach 1200ºC in the case of ceramic tubes. The firing step is conducted in thermal equipment called furnaces, which can use various types of fuels as a source of energy.

Cooling: After burning, the product remains inside the oven so that it can cool, as it cannot suffer a sudden drop in temperature, otherwise deformation and cracking may occur.

Storage: Storage of the final products is done in a covered area, remaining there until commercialization.

Also according to [18], for a better visualization and understanding of the steps of the brick production process can be illustrated according to Figure 1:

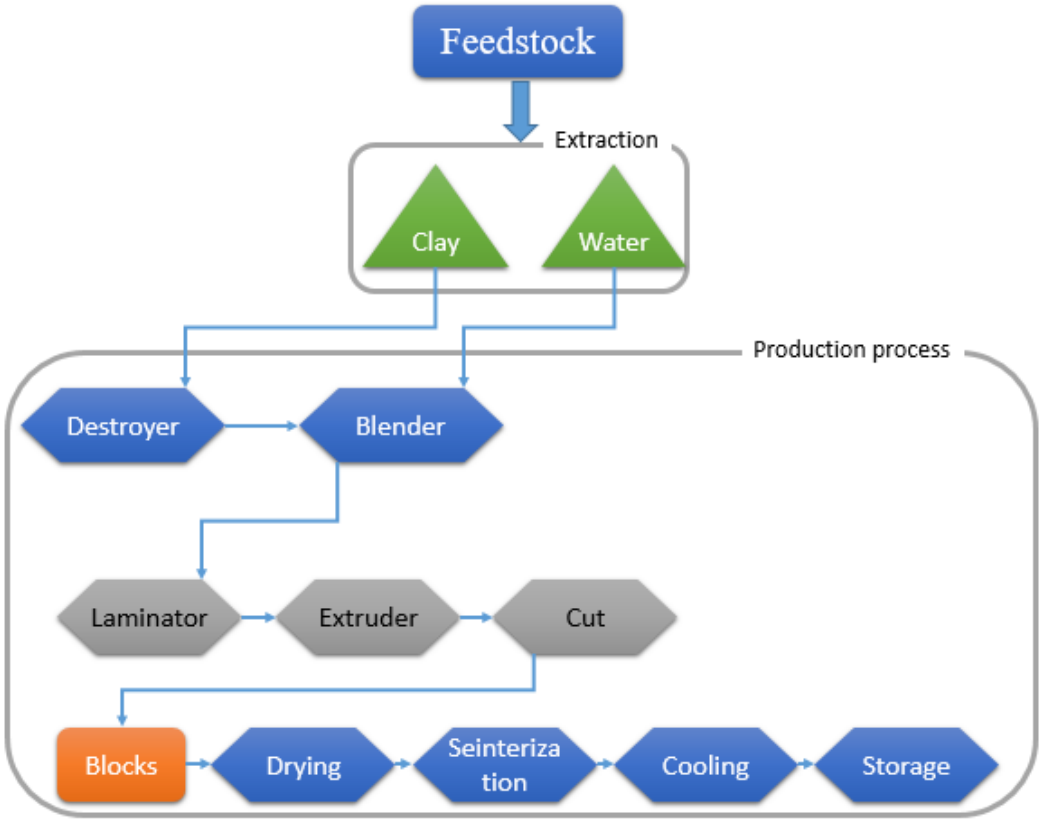


Figure 1 - Flowchart of the production process of ceramic blocks.

Source: Adapted from [18].

For each purpose there will be specific process needs to be performed by people or a group of people [19].

In this sense, according to [20] states that “the act of producing implies transforming” and can be considered the practical result, material or immaterial, intentionally generated through a set of organized factors.

Quality will be mainly ensured by minimizing the variety of important features [21].

3. TOOLS AND METHODS

This work is a case study conducted in a ceramic industry (pottery), located in the city of Urucurituba-AM, from May to August 2019.

Through on-site visits to the company, interviews and application of questionnaires to employees and their manager, it was possible to obtain updated information and data from the pottery production process. The data allowed the application of quality tools: Flowchart, Ishikawa Diagram and 5W2H, whose objective was to map the process, discover the problems and propose a solution to optimize the brick production process.

From the objectives were used the methods for the elaboration of the work. Flowchart allowed to map all the steps of the brick manufacturing process and to find out where the production errors occur in them. The Ishikawa Diagram made it possible to uncover the problems that occur in the company's production process and its root causes, and the 5W2H helped to provide a proposal for the continuous improvement of the brick manufacturing process, the ideas that will be presented allowed reducing waste and improving the company's production efficiencies.

Essentially for the theoretical basis of the research were extracted contents of books and academic articles in which it deals with the areas of quality and the ceramic industry.

4. CASE STUDY

4.1. Company characterization

The company in which the case study was prepared has been in operation for 6 years and is located in a rural area of Urucurituba-AM. It is a small pottery that has: 1 complete brick making machinery, 5 drying sheds, 2 synthesizing ovens, and an outdoor storage area, as shown in Figure 2.

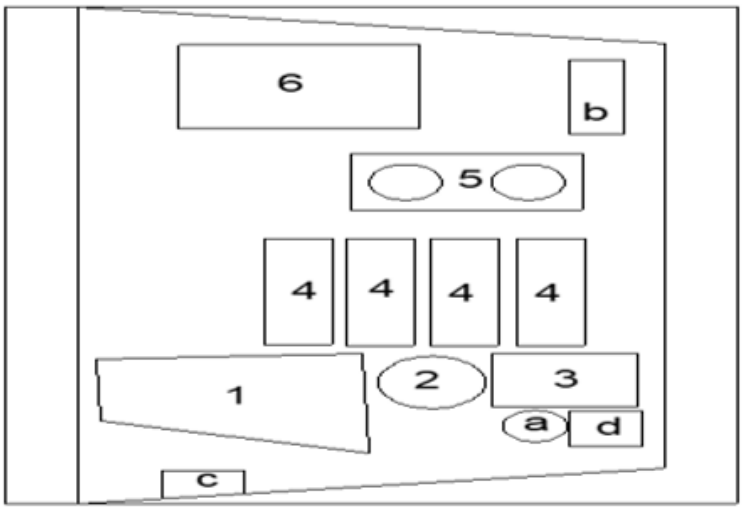


Figure 2: Sketch of brick factory.
Source: Own authorship.

Subtitle:

1- Raw Material Stock. 2- Coffin feeder. 3- Machinery.
4- Drying sheds. 5- Ovens. 6- Storage of the final product.

a- Artesian well and water boxes. b- dining hall.
c- office. d- deposit of materials.

The company has 21 employees which is divided as follows: 1 owner, 1 manager, 1 bucket driver and 1 backhoe driver, 1 coffin digger, 7 production / machinery staff, 3 drying loaders, 5 loaders oven and storage and 1 supply.

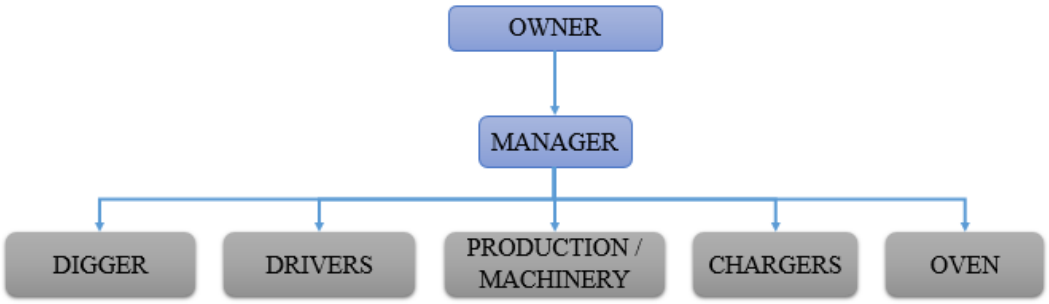


Figure 3: Organization chart of the company.
Source: Own author.

The company only produces eight-hole sealing bricks, in this study it was defined the flow chart tools, Ishikawa diagram and the 5W2H. The flowchart was employed to identify the process flow of brick production. The Ishikawa diagram was used to identify production problems and their root causes. 5W2H was applied in order to make the necessary decisions to control the potential causes and to solve the problems of the brick production process, thus improving the pottery product quality.

4.2. Process Flowchart

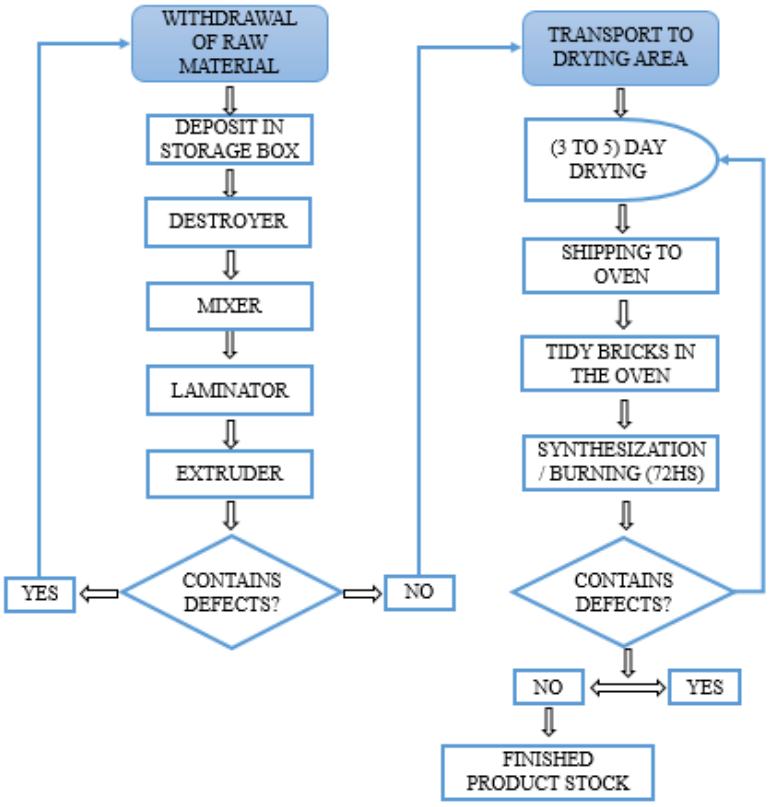


Figure 4: Flowchart of the production process of the pottery studied.
Source: Own author.

First step: The raw material, the clay, is removed by the pottery employees from land owned by the owner of the company, which is approximately 2km away from the factory. Clay is transported by company vehicles and placed in towers in the pottery clay storage area.

Second step: the raw material is deposited by a tractor inside the storage coffin (figure 5) where excavation by a worker occurs (figure 6), the clay is moved through conveyor belt and proceeds to the next process.

Figure 5: Tractor placing clay in the coffin

Figure 6: Worker digging the clay

Third step: the hard clay moves to the destroyer where the large pieces of clay are crushed into smaller pieces by the machines (figure 7), then moves to the mixer where it is mixed with water to soften the clay, it is sawdust. will help the dough to heat and burn better when baking (figure 8).

Figure 7: Destroyer.

Figure 8: Mixing with water and sawdust.

Fourth step: the clay is still being conveyed by the conveyor belt to the rolling mill, where the raw material will be rolled and its disintegration process will be complete (figure 9).

Figure 9: Laminator.

Fifth step: the clay is moved to the extruder or maromba where it goes through the extrusion process in this step is added more water to the clay does not harden is to damage the machine, it is also used a vacuum pump that serves to generate air in the clay and compacting it, so the product takes on the desired shape (figure 10).

Figure 10: Extrusion Process.

Sixth step: The products are transported by rollers and go to a table where the bricks are cut by a line that is positioned horizontally that moves every 15 seconds to cut the bricks to optimal size. The leftovers and the defective bricks are placed in a separate area where they will be reused back to the coffin (Figures 11 and 12).

Figures 11 and 12: Cutting process.

Seventh step: Bricks are transported by wheelbarrow to the drying sector and stay there for 3 to 5 days, drying, depending on the weather (Figures 13 and 14).

Figure 13: Internal drying area

Figure 14: External drying area

Eighth step: After the drying process the bricks are again transported by wheelbarrows to the ovens where they will be arranged to go through the synthesizing or burning process (Figure 15). In this process the oven doors are sealed with soft clay so that the outside air does not enter and the internal temperature of the oven does not come out (figure 16). In this process an exhaust fan is also used to trap the fire in the oven. burning for 72 hours.

Figure 15: Synthesizing process

Figure 16: Oven door seal

Eighth step: After this procedure the oven doors are broken and the bricks removed, fans are used so that employees are not exposed to high temperatures in the process of removing bricks from inside the oven. Then the product is transported by the employees to the finished product inventory area (figure 17), where they go through a survey and separate the products, the good ones are arranged on pallets organized by thousands of trucks and then delivered to their trucks. resellers or customers. The raw bricks are taken to the drying area and will go through the burning process again. Cracked bricks are discarded. And the burned bricks will be separated and reused in works in the pottery or sold at a lower price in the market because it is used to make houses and pots.

Figure 17: Finished product stock area.

4.3. Definition and analysis of problems.

The company produces about 320,000 bricks per month, it has 2 ovens each supports burning 27,000 bricks, but only 23,500 bricks are good for trading, ie the company operates with only 87% of its production. , another 13% are losses that occur in it.

The quality problems in brick production are shown in figure 18. Presented in the following chart:

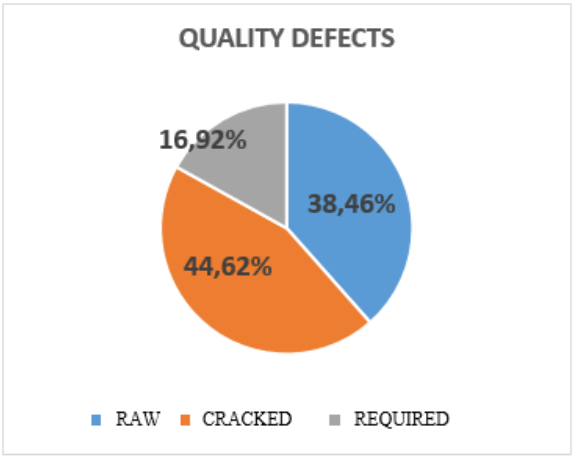


Figure 18: Graph with percentages of problem bricks.

As observed in the graph in Figure 18, of the problems found, 16.92% refers to burnt bricks, 38.46% of raw bricks and 44.62% of cracked bricks.

This paper seeks to solve the two major problems that occur in the company that are cracked and raw bricks. Using the Ishikawa diagram it was possible to find the root causes of these problems.

Root causes of cracked bricks.

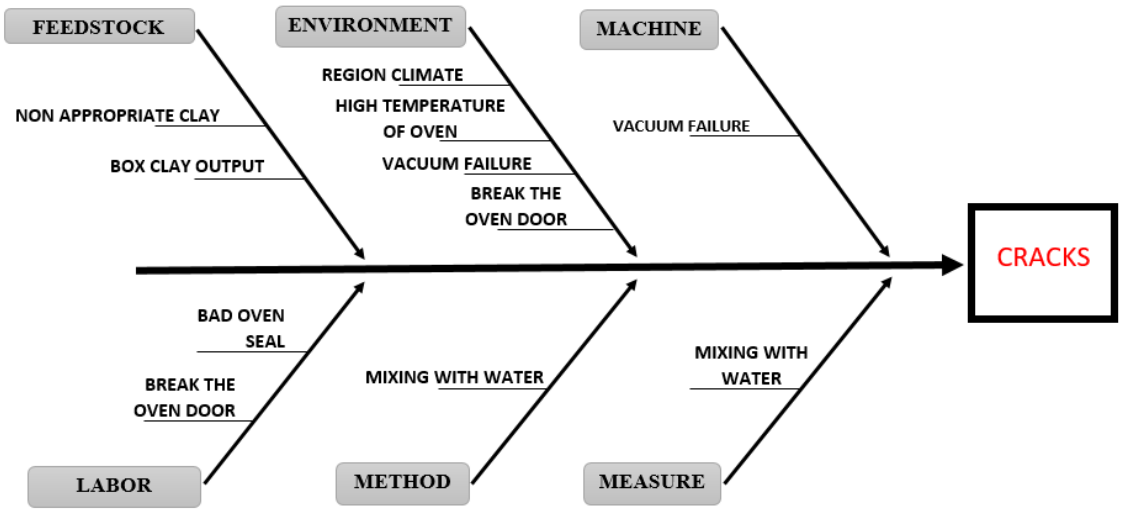


Figure 19: Ishikawa Diagram – Cracks

UNPROPRIATE CLAY: The clay that is placed in the coffin is not 100% suitable for brick making as it has a portion of the upper soil layer, the perfect brick making clay is about 80 cm deep underground. . The top layer of soil is very hard and contains tree roots, stones and other solid aggregates, which obstructs the passage of good clay on the mat and cause cracks in the bricks in the burning process. (FEEDSTOCK).

CLAY CLAY OUTPUT: The raw material when it arrives in the pottery is placed in high towers on site the material hardens, when it is placed in the coffin the clay is already in the shape of stones they fall on the mat and obstructs the passage of the ideal clay for The mixing thus causes cracks in the final process

of the bricks. (FEEDSTOCK).

REGION CLIMATE: Because the photo of the Amazon has a tropic climate (hot and humid) and the pottery is located in the rural area of the city in an area surrounded by woods, the bricks that are in the drying area are exposed to winds and serene, Because the sheds are covered but do not have a side shield, this suit does not allow the bricks to dry well, and when being transported to the ovens cracks occur. (ENVIRONMENT).

HIGH OVEN TEMPERATURE: Because the furnace does not know the exact temperature inside the oven when placing too much firewood causes the oven to come out of its ideal temperature when the bricks are exposed to high temperatures comes from cracking the bricks. (ENVIRONMENT).

VACUUM FAILURE: The vacuum pump is placed in the extrusion process to generate air in the clay so that it does not come out softly through the mouth of the machine. When the amount of clay in the maromba is lower than the vacuum pump does not work perfectly that causes cracks in the bricks (MACHINE).

MIXING WITH WATER: When little water is mixed in the clay, the clay does not reach its ideal point and cracks in the products. (METHODS AND MEASUREMENT).

POOR OVEN SEALING: When the oven door seals are poorly sealed, the cold winds from the outside environment enter the oven and there is a sudden variation in temperature and the result is cracking of the bricks inside the oven. (LABOR AND ENVIRONMENT).

INADEQUATE BREAKING OF OVEN DOORS: When the bricks are already baked you must break the oven doors to remove them, if by breaking the door quickly hot air will come out quickly and the temperature will drop is where the bricks crack. (LABOR AND ENVIRONMENT).

Root causes of raw bricks.

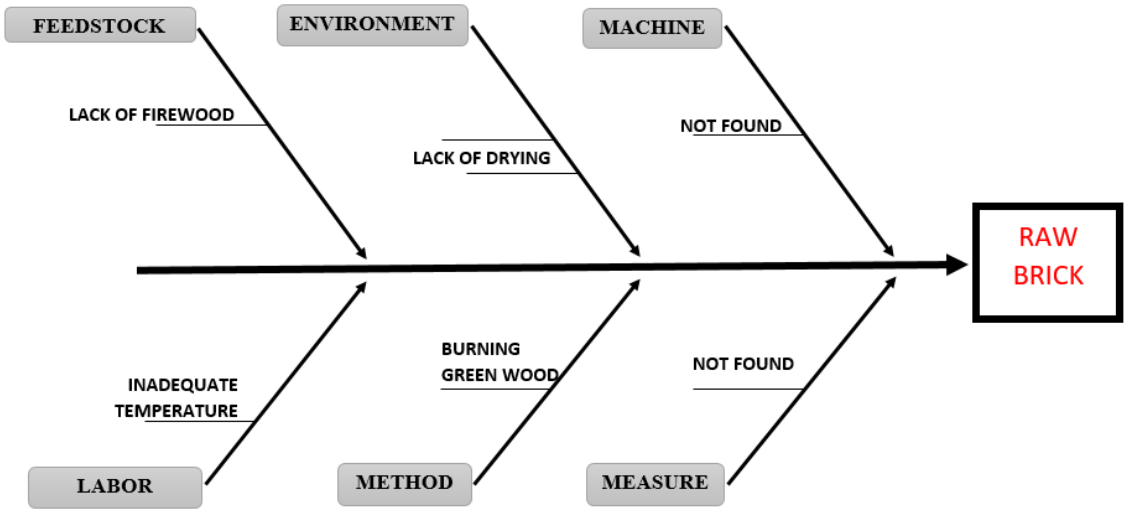


Figure 20: Ishikawa - Raw diagram

BAD DRYING: Due to the fact that the drying sheds do not have a lateral seal, the bricks are exposed to wind and serene and in the rainy season the bricks do not dry well and are placed moist in the oven and do not burn well. (ENVIRONMENT).

GREEN WOOD BURNING: Green firewood is often burned in the oven because dry firewood is not available in stock, this affects the burning of bricks as green firewood takes longer hours to heat the oven and burn them, this delay makes that the bricks don't bake perfectly. (MEASURE).

BAD TEMPERATURE CONTROL: The furnace does not know the temperature of the furnace, and varying it allows many bricks not to reach the exact point and become raw. (LABOR)

LACK OF WOOD: At many times in the synthesis there is a lack of firewood in the final period of the process, this fact makes the oven does not reach its ideal temperature causing many bricks to be undercooked.

4.4. Proposal for improvement.

Defined the major causes of problems affecting brick quality, and applied the 5W2H tool to manage ideas that solve those problems.

5W2H action plan to solve crack and raw brick problems.

What?	Who?	Where?	Whwn?	Why?	How?	How much?
What should be done?	Who is responsible?	Where should it be done?	When should it be done?	Why does it need to be done?	How will it be done?	How much will it cost?
Withdrawal and storage of raw material	Backhoe driver and the digger	Extraction Area	Every Friday from 7:00 to 9:00 hours	Get quality raw material and avoid cracking the bricks	Using the backhoe to remove the clay	$ 0.00. (For only the work will be perfected.)
Control the amount of materials in the production process	Production staff / machinery	Productive sector	Every full weekday	Avoid cracking the bricks	Monitoring the amount of material in the process	$ 0.00. (For only the work will be perfected.)
Purchase clear plastic tarps for drying area	Owner	Trade	September 5, 2019	Avoid exposure to winds and serene, and do not get raw and cracked	Company resource	$ 1.200,00
Buy thermometers for the ovens	Owner	Trade	August 30, 2019	Monitor oven temperature	Company resource.	$ 800,00
Train the synthesizing / burning process staff	Manager	Productive sector	August 25, 2019.	Empower workers and reduce quality problems	Through hands-on training	$ 0.00. (For only the work will be perfected.)
Control over the stock of firewood	Manager	Productive sector	Every full weekday	Do not miss proper wood for burning	Spreadsheets or inventory control software	$ 0.00. (For only the work will be perfected.)

Figure 21: 5W2H Action Plan Table.
Source: Own Authorship

5. RESULT AND DISCUSSIONS

This work was elaborated with data collection, through interviews with the employees and the company manager. It was possible to map the whole process of brick production with their help, with mapping the flow chart was applied to have a better view of the flow. In the production process of the pottery, at this stage the points were identified where the most frequent problems in brick production (raw material collection, drying and synthesis) occur during the production process and are only noticed in the final product.

After mapping, the Ishikawa diagram was also used, which identified the most frequent problems in bricks (raw and cracked) and pointed out its root causes which are: Clay not suitable for production, the output of the coffin clay, the climate of the region. high oven temperature, vacuum failure, mixing with water, poor oven sealing and improper oven door breakage. Defects occur during the synthesizing / burning process and are visible only in the final product.

The proposal to solve these problems that occur during the brick production process of the company was elaborated with the aid of the 5W2H tool, which proposes: To remove the appropriate raw material to put in the storage coffin, to control the correct amount of the materials during the process. production

process, buy clear plastic tarpaulins to fence the sides of the drying sector, buy a digital oven thermometer, train employees on the synthesizing process and have control over the stock of firewood.

This measure will allow the correction of failures and bring continuous improvement in the brick making process. This proposal will eliminate 10.8% of the waste that the company has with defective bricks, and will make it work with 97.8% of productive efficiency.

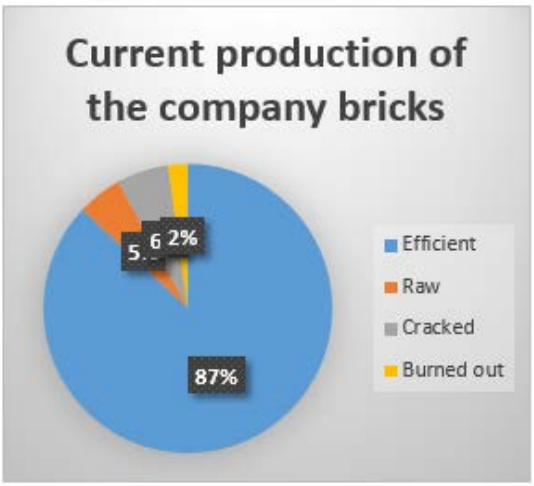


Figure 22: Graph of the current production of the company.

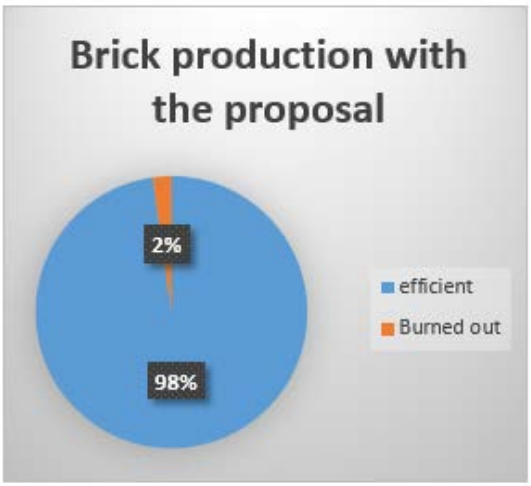


Figure 23: Graph of the company's production with the proposal.

6. FINAL CONSIDERATIONS

Quality tools provide ways of defining, measuring, analyzing and proposing solutions to problems that interfere with company performance, quality, and bottom line, as well as establishing better data-based resolution methods, which increases the prospects for success. company.

The purpose of this work is to employ solutions to correct the errors that occur during the production process of bricks that cause damage to that company and improve the quality of its products. The study made it possible to employ solutions to correct these problems, all process steps were examined in detail, in which occurrences of failures in the pottery production procedure were identified. The proposed improvement suggested to the owner and manager of the company was elaborated through a thorough investigation with the help of bibliographic studies and dialogues with experienced and knowledgeable people, the factors are in agreement with the data collected with the employees and the manager. of the company, the solutions presented was taking into account the economic situation of the company.

7. ACKNOWLEDGMENT

To Production Engineering Coordination of FAMETRO University Center - Brazil;
To the Galileo Institute of Technology and Education of the Amazon - ITEGAM - Brazil;
To Laureat International Universities - UNINORTE - Amazonas - Brazil;
To Federal University of Pará - UFPA - Brazil.

8. REFERENCES

[1] SEBRAE; ESPM. **Cerâmica vermelha: estudos de mercado**. São Paulo: SEBRAE Nacional, 2008. Relatório Completo.

[2] BESTERFIELD, Dale H. **Quality control**. Pearson Education India, 2004.

[3] Szabó Júnior, Alberto Mohai – **Qalidade total**./Alberto Mohai Szabó Júnior./Cutitiba: Juruá 2013.

[4] Corrêa, H. L.; Corrêa, C.A. **Administração de produção e operações: Manufatura e serviços, uma abordagem estratégica.** 3 ed. São Paulo: Atlas, 2012

[5] Godoy, Adelice Leite de. **Ferramentas da Qualidade.** 2009.

[6] Lucinda, Marcos Antônio. **Qualidade: fundamentos e práticas para cursos de graduação.** 3 ed. Rio de Janeiro: Brasport, 2010.

[7] Berssaneti, Fernando Tobal. **Qualidade: conceitos e aplicações – Em produtos, projetos e processos** / Fernando Tobal Berssaneti, Gregório Bouer. – São Paulo: Blucher, 2013.

[8] Giocondo, Francisco I. César. **Ferramentas Básicas da Qualidade. Instrumentos para gerenciamento de processo e melhoria contínua**. São Paulo: Biblioteca 24hora, 2011.

[9] Seleme, Robson. **Controle da qualidade: as ferramentas essências** / Robson Seleme, Humberto Stadler. – Curitiba: InterSaberes, 2012.

[10] FRANKLIN, Yuri; NUSS, Luiz Fernando. **Ferramenta de Gerenciamento**. Resende: AEDB, Faculdade de Engenharia de Resende, 2006.

[11] Santos, Irandir Cristina Policeno dos. **Cerâmica no Brasil Sobre a Origem e a Cultura** – Centro Universitário Leonardo da Vinci – Uniasselvi. Artes Visuais (ART 0155) – Pratica Módulo V. 16/10/2015.

[12] ROSSA, Aline. **O olhar da criação: arte como tendência**. Dissertação (Graduada em Artes Visuais) Universidade do Extremo Sul Catarinense, UNESC. Criciúma, 2009.

[13] Magalhães, Cilene Farias Batista, 1969 – **Análise do Processo do processo produtivo dos tijolos cerâmicos na fábrica Nova São José de Itacoatiara/AM**: um estudo de caso / Cilene Farias Batista Magalhães. – 2016

[14] **Instituto Brasileiro de Geografia e Estatística**. 1 de julho de 2018. Consultado em 20 de agosto de 2019

[15] XAVIER, G. C. (2006). **Resistência, alterabilidade e durabilidade de peças cerâmicas vermelhas incorporadas com resíduo de granito.** Tese (Doutorado) Engenharia Civil. Universidade Estadual do Norte Fluminense, UENF– Ciências de Engenharia – Campos dos Goytacazes, RJ. 202 p.

[16] **INSTITUTO NACIONAL DE METROLOGIA, QUALIDADE E TECNOLOGIA. Informação ao Consumidor: Bloco Cerâmico (Tijolo**). INMETRO, 2012. Disponível em: Acessado em: 06 de Março de 2016

[17] Azeredo, Neila Gondim de. **Avaliação das propriedades físicas e mecânicas em blocos cerâmicos estruturais através do método de ultrassom na região de Campos dos Goytacazes - RJ**/ Neila Gondim de Azeredo. – Campos dos Goytacazes, 2015.

[18] MEDEIROS, E. N. M. (2006). **Sistema de Gestão da Qualidade na Indústria Cerâmica Vermelha. Estudo de caso de uma indústria que abastece o mercado de Brasília.**. Dissertação de Mestrado em Estruturas e Construção Civil, Publicação E.DM-004A/06, Departamento de Engenharia Civil e Ambiental,

Universidade de Brasília, Brasília, DF, 190p.
[19] PARANHOS PARANHOS FILHO, Moacyr. Gestão da Produção Industrial. Curitiba: Inter Saberes, 2012, 338 p.
[20] ERDMANN, R. H. **Organizações de sistemas de produção**. 1 ed. Florianópolis: Insular, 1998. 216p.
[21] SAMOHYL, R. W. **Controle Estatistico de Qualidade.** São Paulo: Campus. 2009.

Expert System Development for the Prevention of Hoof Pathologies Applied to the Intensive Swine Production

Mario Mollo Neto[1]

[1]São Paulo State University (UNESP), Faculty of Science and Engineering, Tupã/SP Brazil

Domingos da Costa Lopes Street, 780 - Jd. Itaipu - Tupã / SP - ZIP Code 17602-496

Phone: (55 14) 3404-4200

Corresponding author: Mario Mollo Neto[1], mario.mollo@unesp.br

Abstract

Claw lameness can be associated with biomechanical factors caused by imbalances of the pressure distribution under the hooves when swine are confined in modern facilities with hard concrete flooring. Comparing hoof pressure distribution data of swine boars walking over two different types of floors (standard concrete vs. 3mm rubber mattress) in previous research, it was found a great advantage favoring the rubber mat flooring showing that it was capable of reducing pressures under the claws as the pressure became more evenly distributed under this treatment resulting in balanced weight-bearing surfaces. The objective of this study was to develop an expert system based on Fuzzy logic algorithm for the prevention of hoof pathologies applied to the intensive swine production by estimating occurrence of claw lesions based on the association of knowledge gathered on pressure distribution from previous research as well as the influences of nutrition, friction coefficients found on different types of available flooring, hoof sizes and animal weight on the welfare of the swine's locomotory system. The data were correlated initially using Matlab® platform associating expert's knowledge and literature through a knowledge system that weights the variables according to their impact on claw health. The final user interface was coded using Microsoft Visual Studio Rapid Application Development tool and the resulting system was validated in several different laboratory scenarios and its performance was considered to be satisfactory according to findings in the literature. The expert system was coded and the authors concluded that the system could be a great contribution and advance in the swine's industry, nonetheless, its performance still requires field testing for fine adjustments which should be encouraged to be carried out in further researches.

Keywords: Expert system; Fuzzy logic; Mamdani; Swine production; Claw health; Flooring;

1. INTRODUCTION

The Fuzzy logic theory was introduced, in 1962 and 1965, by Lotfali Askar-Zadeh, professor of the Department of Electrical engineering of the University of California - Berkley-USA, with the intuit of giving mathematical treatment to certain subjective linguistic terms such as, "approximately", "around of" among others ([28]; [29]; [30] and [31]).

According to ref. [1], to overcome the fuzziness and uncertainty problem, expert systems based on fuzzy

logic can be considered.

A natural question is the effectiveness of the use of Fuzzy Logic for health-status certification in Preventive Diagnostics, and to develop an Expert's System aiming the reduction of losses in order to maintain economically feasible the processes involved. The answer has two aspects: first, the aspect that Fuzzy Logic is well suited for controlling/predicting a process or system that is nonlinear or poorly understood to use conventional control designs, and second is that it enables control engineers to systematically implement control and monitoring strategies used by human operators with experience and expertise.

According to [29] and [30] in contrast to crisp set, a Fuzzy Set is a set without a crisp boundary. This means the transition from "belong to" set and "not belong to" set is gradual. This smooth transition is characterized by membership functions that give flexibility in modeling linguistic expressions.

Fuzzy Inference is the process of mapping from a given input to an output using Fuzzy Logic. The mapping then provides a basis from which decisions can be made or patterns discerned.

The process of Fuzzy Inference involves all of the concept's membership functions if-then rules and Fuzzy operators. The essential components of a Fuzzy System are the Fuzzy Inference engine, Fuzzy rule base, and defuzzifier. The following definitions explain the blocks used in the Fuzzy System.

Since the inputs in most applications are real numbers, the fuzzifier serves as the proper interface between the Fuzzy Inference engine and the physical world. The criteria, according to [29] and [30] in designing a fuzzifier are:

1. The Fuzzy set A should have a large membership value at x.
2. The fuzzifier should simplify the computations involved in the Fuzzy Inference engine.

Fuzzy Inference, as presented in the research of the ref. [17], is a method that interprets the values in the input vector and, based on user-defined rules, assigns values to the output vector. The Fuzzy Logic Toolbox provides a set of editors that let you build a Fuzzy Inference System (FIS).

In a Fuzzy Inference Engine, Fuzzy Logic principles are used to combine the Fuzzy IF-THEN rules in the Fuzzy rule base into a mapping from a Fuzzy set in an n-dimensional universe of discourse to a Fuzzy set in a one-dimensional universe of discourse [29] and [30].

The inference method introduced by MAMDANI [15], as also presented by the ref. [17], proposed an inference model that was used in this research to design the Fuzzy Controller. The Mamdani Fuzzy Inference System employs the individual rule-based inference scheme and derives the output y when subjected to a crisp input x.

The Fuzzy Set Theory (FST) introduces a tool that can be efficient for monitoring and preventing a variety of pathologies in the medical and veterinary fields since these areas are often surrounded by vagueness and subjectivity due to the nature of the medical field to be dependent on several sources of uncertainty [29].

As suggested in the ref. [26], as some of the sources that represent fuzziness to be, for instance, lack of information, non-specificity, probabilistic nature of data and outcome, vagueness in the formulation of recommendations, conflicts among various sets of alternatives, and fuzziness in the determination of clinical signs. In his work, he discusses the application of FST theory in dealing with sources of fuzziness of textual clinical guidelines in formulating automated alerts and advice for a CPOL (Care Plan On-Line), an intranet-based chronic care planning system intended for general practitioners (GP). The client-side of

the CPOL is a relatively generic shell that receives guidelines and EMR (Emergency Room) specifics from a central server.

Other examples of the use of Fuzzy Logic are in the detection of signs either for optimization of the reproductive protocol of farms and in the effects of heat stress-related production losses, which are areas that have been proven to be benefited economically by correct monitoring of behavior patterns. Some of the work done for monitoring animal heat stress related to production losses was described by the references [2] and [9] for mastitis and oestrus detection in dairy cattle.

This research aimed to estimate the occurrence of lameness in-housed male pigs in concrete pens using Fuzzy Logic. This paper describes the algorithm and the resulting system was tested in several different laboratory scenarios.

2. MATERIAL AND METHODS

The preliminary knowledge base was created gathering information that related pig claw pressure distribution over two types of flooring system (standard concrete vs. 3mm rubber mattress) [4].

The rule base was initially elaborated using a Microsoft Excel Spreadsheet to correlate all the variables composing the system and to apply the weights to each variable according to its importance in predisposing claw lameness, discussed later in this chapter.

The variables were selected according to its influence on hoof pathologies previously described through literature and experimentation.

The variables biotin (representing nutrition) The B vitamin, biotin (Vitamin H), is an essential coenzyme that takes part in biological carboxylation reactions. It is involved in the tricarboxylic acid cycle, gluconeogenesis, and fat synthesis. Biotin is a factor in controlling the rate of production and deposition of proteins such as keratin, which is a component of skin, hair, and horn.

Biotin is an essential coenzyme in carbohydrate, fat and protein metabolism [16]. Dietary supplementation of biotin has been shown to increase the claw pig strength and reduce digital lesions in pigs) and floor roughness has been studied and is well documented as far as provoking claw lesions in modern swine farming [7]; [18]; [3]; [27] and [13]. On the other hand, the association among animal weight, claw area and the use of alternative flooring such as rubber mattress were obtained through experiments performed as part of this research project. The results obtained for these variables were correlated to biotin and floor roughness to build the algorithm presented here.

The combination of nutritional factors, such as biotin, floor roughness, weight influence, interacting or not with plantar surface pressure (given by the claw natural physiological growth) was used for implementing the rule governing the Fuzzy logic controller.

The Fuzzy logic controller was created using the software Matlab® Fuzzy toolbox based on 540 rules organized initially using Microsoft excel spreadsheet and implemented in the Matlab® interface associating 5 input variables: Mat thickness in millimeters (mm), according to ref. [4], Animal weight (kg), claw area (mm2), Friction coefficient (unitless), according to ref. [7] and biotin supplementation (µg/kg) as stated by ref. [19]; [3]; [27] and [13].

The system outputs a value corresponding to the risk of developing claw lesions (APL). It is composed of

7 linguistics terms: very low, low, medium, high, very high, extremely high.

The input variables were composed of either Gaussian or Trapezoid pertinence functions applied to the Mamdani inference method [15].

Mamdani's method is the most commonly used in applications, due to its simple structure of 'min-max' operations. To exemplify the construction of membership functions, the friction coefficient pertinence function was chosen and is presented in Figure 1.

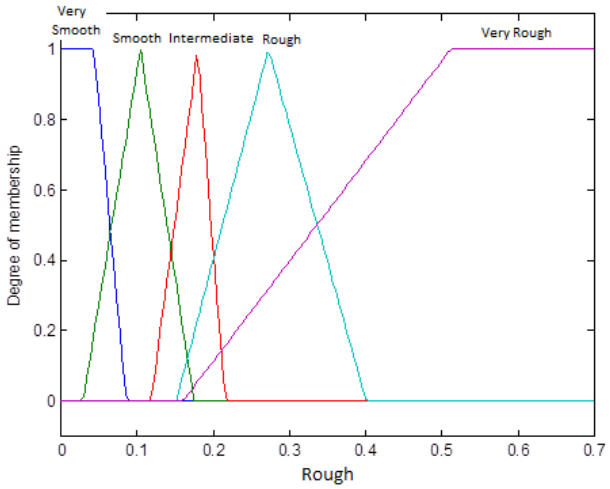


Figure 1. Pertinence function for the friction coefficient variable.

The graphic representation of the Fuzzy system is initially designed using the Matlab® toolbox for the simulation of the preventive diagnostic system and further develop the final version of the expert system.

The objective of the rules is to either filter or add information into the possible scenarios using the input variables associated to each other to output a value indicating the risk associated with the possible onset of claw condition according to the information provided by a user.

For the linguistic variable “Friction coefficient”, it was considered an interval of [0, 0.7] unitless, where 0 is a low friction coefficient and therefore slippery in contrast to 0.7, a high friction coefficient and therefore very abrasive. Both extremes are not desirable and therefore have been given high values for weight in the system.

Both trapezoid and triangular pertinence functions were used to represent this variable as they were found to best describe the flooring coefficient intervals according to literature cited previously.

The coefficients were classified as Very Smooth (ML), Smooth (L), Intermediate (I), Rough (A) and Very rough (MA) with the following intervals respectively: ML [-0.0504 -0.0056 0.0441 0.0861], L [0.02968 0.105 0.175], I [0.119 0.18 0.216], A [0.152 0.273 0.401] e MA [0.161 0.512 0.715 0.831].

For the linguistic variable “mat thickness -Ep”, was considered an interval of [0, 3], representing the length in millimeters (mm). With an interval of [-1.0 0 0.75] and Gaussian pertinence function representing the limits of a floor thickness of 0mm or simply concrete, [0.25 1 1.75] triangular pertinence function representing the limits of an alternative floor thickness of 1mm or thin mattress with low protection, [1.25 2 2.75] triangular pertinence function representing the limits of an alternative floor thickness of 2mm or slightly thick mattress with medium protection and [2.25 3 5] triangular pertinence function representing the limits of an alternative floor thickness of 3mm or thick mattress providing the best protection tested.

Considering nutritional factors as biotin levels added to ration, where lack of suitable levels is proved to affect claw integrity and health by making the claw soft and fragile to stresses and predisposing to increasing incidence of lesions ([27] and [13]), other factors as: animal weight, sole area and friction coefficient of flooring used in pens are sufficient to provoke abrasive scars and further lesions of the soft tissue of claws by exposing vital fragile structures to inadequate pressures [7].

Therefore, there is a great benefit by providing pavement with certain amount of cushioning that will influence the pressure distribution and therefore improving balance to these pressures under the claws as well as reducing friction coefficient to healthy levels which consists of enough abrasion only to stimulate horn growth and avoid slips and not damaging it or causing fractures by slipping and falling.

For these reason and severity of scenarios created through association among the five input variables, the results of the association of mechanical factors and nutritional factors can elevate the possibility of developing lesions on heavy boar claws with proved genetic performance as well as reducing them if the conditions of the input variable are changed by the user by providing better management conditions.

For the linguistic variable "Biotin -Bio", was considered an interval of [0, 1560], in ug/kg, with an interval of [0 0 185 401.1] and trapezoid pertinence function representing minimal levels of biotin supplementation, [218 399 700 859.5] light and [671 955.5 1560 1570] ideal supplementation.

The variables: Animal weight – (Pan) and Claw area – (Aan), follow the same method with intervals obtained from results of experiments using the Matscan – DB - Tekscan® pressure distribution system – Boston, MA - USA [6].

The addition of weights to the variables interacts by either increasing or reducing the severity of scenarios and was designed using a pattern obtained from knowledge gathered from literature ([19]; [3]; [27] [13] and [7]) and experimentation in this project.

Each item of a variable counts with a value given according to its importance and impact on health in relation to the others which will contribute to aggravate or attenuate the final ALP in a given situation. When associated with the algorithm will sum and produce a numerical result that is translated in the linguistic output (ALP) variable with a range that represents several prognosis conditions for the farm management.

The form the weights were applied to the variables was by adding values to each factor of a variable (i.e., 5, 10, 15). When the factors of a variable are associated, the sum of the weights of the factors being associated yield the final output risk which ranges from 0 to 100.

In a hypothetical situation, i.e., concrete would have a high weight value of 15 (for concrete flooring represent a high-risk level it will be given a high value).

A high level of biotin in a diet (i.e., 800 ug/kg), represents a low-risk level having a positive effect on claw health as opposed to concrete and therefore will be given a low weight value of 2 and so on. Adding mattress to the floor will reduce the variable's factor weight value proportionally to its thickness. The thicker the lower the factor's value and therefore the system's output value that will represent the risk associated.

The method of summing numerical values for the independent factor within a variable was adapted from a known system consensually used worldwide in the medical field for the subjective emergency evaluation of the neurological state of a person following a polytrauma. Glasgow Coma Score evaluates levels of consciousness and neurological reflexes of a patient attributing values to the presence or absence of vital

signs leading or not to the need for a specific emergency intervention [10].

3. RESULTS AND DISCUSSION

The results of the Fuzzy inference system can be tested by changing the values of the input variables on the Matlab® rules interface and checking the resulting changes on the corresponding surface chart generated by the Matlab® software. The lesion development possibility (ALP) displayed in Figure 2 is as a nonlinear function representing the level of biotin supplement given as a function of the thickness of the mattress.

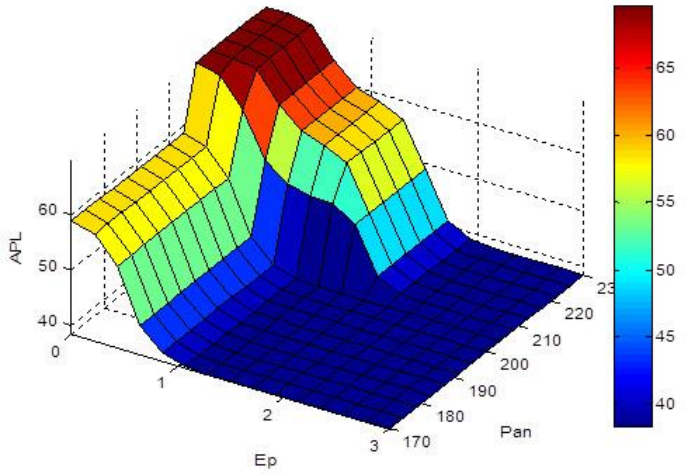


Figure 2: Surface chart of possible scenarios using mat thickness and biotin as input variables.

The chart in question provides a general representation of the system and also permits adjustments for eventual errors in the set of rules assembled previously by correlating the expert information gathered into the system's database. The surface chart allows the visualization of the points represented by associating the variables that fall out of the performance.

The decision support system is achieved by controlling levels of nutritional components, mostly by increasing levels of biotin, altering floor properties with better-cushioning properties and dissipating better stresses and adequate roughness to increasing lifespan of claw soft tissue structures, also preventing fractures by falling due to slippery floors.

The software can give a range of alternatives to accommodate the farm's profile according to its managements and will analyze the risks of several choices by farmers and farm managers.

The system's algorithm was tested in Matlab® Fuzzy logic ToolBox using various distinct scenarios associating adequate, inappropriate and deficient levels of biotin as nutritional variables to the 3 different thicknesses available for mattresses tested in the field, as well as combinations of flooring roughness, animal weight and claw area obtained during field experiments.

There were performed 40 simulated situations at random for suitable range of outcomes from minimal probabilities such as ALP of 8,85% using high amount of biotin (1000 ug/kg), 3mm rubber mat, 0,25 for coefficient of friction for the mat, and an animal of approximately 200 kg in weight to severely probable (ALP of 91,8%) using low amount of biotin (200 ug/kg), 0mm or concrete flooring , 0,40 coefficient of friction for concrete, and an animal of approximately 220 kg in weight (Tables 1).

Table 1. Extreme situations obtained by the scenario's combinations.

scenario	ET (mm)	Pan (kg)	Aan (cm2)	Roug (unitless)	bio (ug/kg)	ALP (%)
better	3	200	45	0.25	1000	8,85
worse	0	220	20	0.40	200	91,8
intermediate	0	190	35	0.45	400	58,9

A correlation between Claw area (Aan), Biotin (bio) and Mattress thickness can be seen in Figure 3.

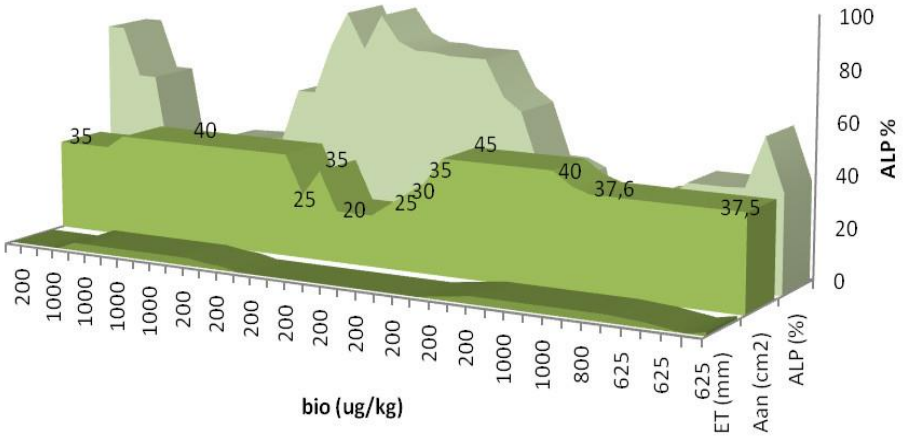


Figure 3. Correlation between Claw area (Aan), Biotin (bio) and Mattress thickness

The prognosis software was developed using a Microsoft® tool called RAD (Rapid Application Development). The application is called Microsoft Visual Studio. System developed for building 32/64 Bits application for Windows® operational environment.

In this application was coded the algorithm tested with Matlab® tools and designed all the input and output interfaces of the expert system. It was developed a set of input/output data interfaces as well as assembling and edition of the support tool for the decision system.

These interfaces were designed in a way to allow a suitable dialog between the end-user and the system including veterinarians, framers, Farmworkers and technicians, livestock facility designers, feeding industry personnel, among others.

The use of the Matlab® mathematical tool with its Fuzzy logic toolbox provided a set of editing possibilities to build the Fuzzy inference system (FIS) and allowed the validation through laboratory testing of the mathematical core algorithm helping to estimate hoof pathologies based on the independent input variables enlaced to the projected dependent variable.

Figures 4, 5 and 6 correspond to some of the functional steps of the designed software running using a microcomputer working under Windows® operational system.

After the installation of the system, a splash screen is loaded, following its operational interface and independent variables data input (Figure 4 and 5).

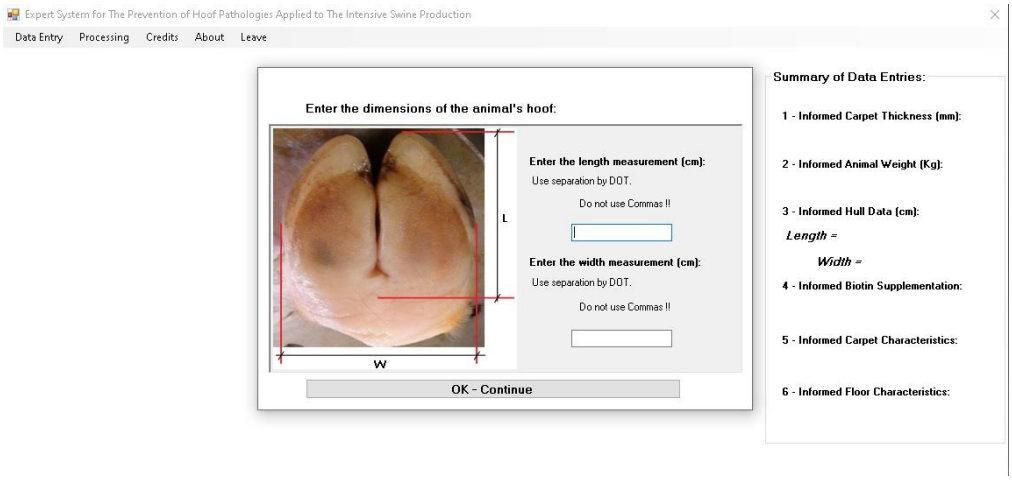


Figure 4. Data input for calculation of the approximated claw area

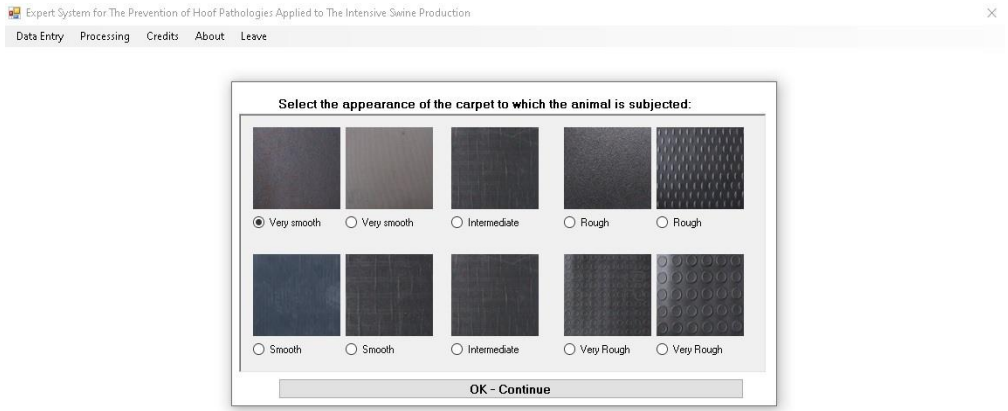


Figure 5. Data input for alternative stall flooring.

The information input by the user are regarding the facilities through the type of flooring, biotin levels, claw area which is estimated by the herd's mean claw length and width and the area is calculated by the software.

After the data input, the system will calculate the possibility of developing claw lesions based on the entries provided by the user and calculating as an outcome the ALP value which gives a perspective of the pig's welfare and can be evaluated by the user (Figure 6).

The alteration of the data input can be done in real-time within the interface at any time allowing the user to test several scenarios within the farmer's realistic economical possibilities.

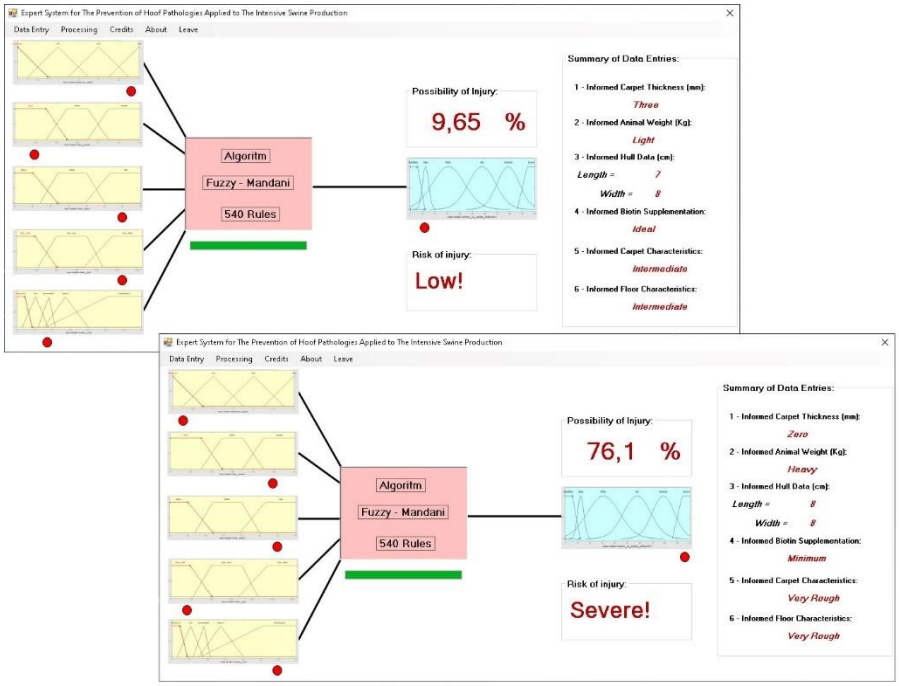


Figure 6. Risk of developing lesion resulting from the processing using two extreme scenarios

Similar systems have been reported for the prevention of some diseases such as a knowledge-base system for diagnosis of mastitis problems at the herd level was proposed by the ref. [12], the application of an expert system that provides a means of consultation imitating the reasoning process of an expert in solving complex problems concerning the health of cows reproduction proposed by the ref. [23] and the development of an "Expert System" based on a Fuzzy Logic model, designed to analyze the outcome a number of variables have on the performance of livestock production (milk and meat) in the Huasteca region of Veracruz in order to support the decision-making of a Sustainable Livestock Production Dynamic System (SLPDS) by the ref. [25].

Pneumonia and jaundice Expert's Systems were proposed by the ref. [21] through the modeling of the knowledge and thinking process of a doctor. A Fuzzy Logic Controller is used to model the process and a genetic algorithm helps in the selection of a number of good rules from manually constructed large rule base, which is based on the opinion of ten doctors. According to the authors, once the rule base is optimized by the genetic algorithm (off-line), the system can diagnose the diseases on-line. The interface takes the symptoms as input variables and the output, grade of the disease, is determined.

Zovex, a zootechnical veterinary expert system to advise swine farms on animal health management was proposed by the ref. [11]. It is composed of two applicable functions: a vertical problem solver and a horizontal preventive screener. In the vertical function, a structured analysis of health, welfare or performance problems is executed, followed by advice for the solution of the problem. In the horizontal function screening of the pig fattening farm on a specific zootechnical domain for the presence of risk factors that sooner or later may cause problems is performed.

In the present system, claw health is the main concern as it affects the general performance of the animals and is not greatly explored as far as forces and pressure are concerned and how it interacts with other management conditions.

According to the ref. [20], flooring is of particular importance on claw health, because of pressure distribution and redistribution on claws. Uneven weight-bearing of hoof walls managed on hard floors (i.e. concrete) lead to pressure redistribution on claws and thus causes greater pressure concentration and stress on claws.

As stated in the ref. [4], the authors used 3 different thickness of rubber mat 1mm, 2mm, and 3mm to assess pressure redistribution and balance of boars' claws. The results showed a difference of 0,46 kg/cm2 Net pressure (3,24 vs. 2,78 kg/cm2 for the 1mm against 3mm rubber mattresses, $p < 0.0001$, by increasing the area under the foot from 30,7 cm2 41,9 cm2, $p < 0.059$), strengthening the knowledge that the use of flooring systems that cushion and provides balance to pressures under the claw can prevent pressure concentrations and therefore the development of sole ulcers and other lesions favoring the onset of lameness.

The present expert system considers pressure balance as one of the most important factors affecting claw health and hence, the outcome is greatly affected by choosing an appropriate thickness combined with roughness of the surface.

Roughness is explored by the references [7] and [22]. It can be harmful in extremes of either softness or roughness according to authors. Softness causes the animal to slip and fall whereas extreme roughness can be abrasive to the point of fracturing the horn tissue of the sole. Several roughness types of concrete were tested by her study providing a great contribution to the system. Also, the use of rubber floors that provide more friction and more compressibility than concrete can increase the speed of cow locomotion and reduce chances of slipping.

Both increased surface roughness and increased compressibility seem to contribute to this effect, although floors that are too soft may not provide secure footing. The system uses this knowledge according to friction coefficient provided by the authors adding risks to either extreme and reducing risks as the coefficient of friction reaches a secure level around 0.25 to 0.45 approximately.

The coefficient of friction is input in the type of flooring provided by the software. This way the user can choose the type of flooring on the software by selecting it from several types provided by the software through sample images of flooring types either concrete types as well as rubber types and its coefficient is associated automatically.

The association of biotin levels and flooring type improvements plays a great role in the overall performance of the system. Data supporting claw health improvement with the use of supplementation of biotin is described in several studies as we can find in the references [3]; [26] and [8].

Supplementary biotin affected the structure of the coronary epidermis; there was an increase in the density of the horn tubules in the stratum medium, the horny scales in the stratum medium were more tightly packed and the tubules were more clearly defined in the pigs receiving biotin. The width of the band of intertubular horn adjacent to the laminae was greater in the claws of control pigs [14].

Levels of biotin were added to the system as minimal, light and ideal supplementation levels ranging from 0 to 1200 ug/kg, reducing risks as the levels are increased according to the findings of the studies mentioned above and other authors ([13] and [18]).

The association of nutritional supplementation of biotin and flooring (associated with abrasion coefficients) was tested in several scenarios and performed consistently with the findings mentioned in the literature.

The other variables namely, claw area and animal weight are just as important but affects the system at a smaller level. A large claw area has an overall better force and pressure distribution just as the animal weight since heavier animals with smaller claws generate more pressure concentrations than otherwise. On the other hand, the trends imposed by these variables can be easily mitigated when associating carefully the type of mattress and improving supplementation of biotin and therefore represents a lower risk in the overall system.

The contribution of animal weight and claw area was obtained from the experiments as part of the study used to develop the software and others ([4]; [6]; [5] and [24]).

The systems overall performance seemed to attend the trends tested both in literature and in the field.

4. CONCLUSION

The software generated in this project, although counting on an algorithm developed with the recent knowledge in the field of animal handling and caring, as well as facilities designs for swine production counts on an accessible and practical user-friendly interface designed specially to auxiliary all types of users.

Its use permits to create conditions to prevent hoof pathologies frequently caused by inadequate techniques of animal handling and inappropriate facilities as well as fatly nutrition methods allowing to the correction of several parameters improving animal health and longevity. This software presents itself 100% functional and its performance can be evaluated by a wide range of professional previously mentioned.

Future recommendations demand field testing for fine adjustments and should be encouraged in further research.

5. ACKNOWLEDGMENT

This work was supported by the Brazilian National Council for Scientific and Technological Development – CNPq.

6. REFERENCES

[1] ABAEI, G.; SELAMAT, A.; DALLAL, J. A. A fuzzy logic expert system to predict module fault proneness using unlabeled data. Journal of King Saud University - Computer and Information Sciences, 2018. https://doi.org/10.1016/j.jksuci.2018.08.003

[2] AMENDOLA, M.; CASTANHO, M.J.; NAAS, I.; SOUZA, A.L. Análise matemática de condições de conforto térmico para avicultura usando a teoria dos conjuntos Fuzzy. Biomatemática Brasil, Campinas, v.14, n.1, p.87-92, 2004.

[3] BRYANT, K. L., E. T. KORNEGAY, J. W. KNIGHT, H. P. VEIT AND D. R. NOTTER. 1985. Supplemental Biotin for Swine. III. Influence of Supplementation to Corn- and Wheat-Based Diets on the Incidence and Severity of Toe Lesions, Hair and Skin Characteristics and Structural Soundness of Sows

Housed in Confinement during Four Parities. J Anim Sci. 60:154-162.

[4] CARVALHO, V. R. C., NAAS, I. A., MOLLO NETO, M., SOUZA, S. R. L.. 2009. Measurement of pig claw pressure distribution. Biosystems Engineering, v. 103, p. 357-363.

[5] CARVALHO, V.; BUCKLIN, R. A.; SHEARER, J. K.; SHEARER, L.; NAAS, I. A.; MOLLO M.; SOUZA, S.; MASSAFERA Jr., V. Dairy Cattle Linear, and Angular Kinematics during the Stance Phase. E-journal. International Commission of Agricultural Engineering, v. 9, p. 1-10, 2007

[6] CARVALHO, V.; BUCKLIN, R. A.; SHEARER, J. K.; SHEARER, L.; NAAS, I. A.; MOLLO M.; SOUZA, S.; MASSAFERA Jr., V. Effects of Trimming on Dairy Cattle Hoof Weight Bearing Surfaces and Pressure Distributions. Brazilian Journal of Veterinary Research and Animal Science, USP - São Paulo, v. 43, n. 4, p. 518-525, 2006

[7] DE BELIE, N. & E. ROMBAUT. 2003. Characterization of Claw–floor Contact Pressures for Standing Cattle and the Dependency on Concrete Roughness. Biosystems Engineering, 85(3): 339-346.

[8] DE JONG, M.F. & SYSTSEMA, J. R. 1983. Field experience with d-biotin supplementation to gilt and sow feeds. Vet Q.; 5(2):58-67.

[9] DE MOL, RUDI. (2001). Automated Detection of Oestrus And Mastitis In Dairy Cows. Tijdschrift Voor Diergeneeskunde. 126. 99-103.

[10] DONALD, C.; DUNCAN, R.; AND THAKORE, S. Predictors of the need for rapid sequence intubation in the poisoned patient with reduced Glasgow coma score. Emerg Med J 2009; 26:510-512 DOI:10.1136/emj.2008.064998

[11] ENTING, J. & HUIRNE, R.B.M. & DIJKHUIZEN, A.A. & TIELEN, M.J.M. (2000). ZOVEX, A Knowledge-Integrated Computer System To Support Health Management On Pig Farms. Computers And Electronics In Agriculture 26 (2000). 26. 10.1016/S0168-1699(99)00067-8.

[12] HOGEVEEN, H.; NOORDHUIZEN-STRASSEN, E.N.; TEPP, D.M.; KREMER, W.D.; VLIET, J.H.; BRAND, A. Acknowledge-based system for diagnosis of mastitis problems at the herd level. 1. Concepts J. Dairy Sci., 78 (1995), pp. 1430-1440.

[13] HEDGES, J., BLOWEY, R. W., PACKINGTON, A. J., O'CALLAGHAN, C. J., AND L. E. GREEN. 2001. A Longitudinal Field Trial of the Effect of Biotin on Lameness in Dairy Cows. J. Dairy Sci. 84:1969–1975.

[14] KEMPSON, S.A.; CURRIE, R.J.; JOHNSTON, A.M. (1989). Influence of Biotin supplementation on

pig claw horn: A scanning electron microscope study. Vet. Rec. 124:37.

[15] MAMDANI, E.H.; ASSILIAN, S. An experiment in linguistic synthesis with a Fuzzy logic controller, Int.J. Man-Mach. Stud. 7(1) (1975) 1.

[16] MARTELLI, G.; SARDI, L.; PARISINI, P.; BADIANI, A.; PARAZZA, P.; MORDENTI, A. The effects of a dietary supplement of biotin on Italian heavy pigs' (160 kg) growth, slaughtering parameters, meat quality and the sensory properties of cured hams. Livestock Production Science, v.93 n.2, p.117-124, 2005.

[17] OJHA, V.; ABRAHAM, A.; SNÁŠELE, V. Heuristic design of fuzzy inference systems: A review of three decades of research. Engineering Applications of Artificial Intelligence. v.85, p.845-864, 2019.

[18] PENNY, R.H.C.; OSBORNE, A.D.; WRIGHT, A.I. The causes and incidence of lameness in-store and adult pigs. Veterinary Records. v.75, p.1225-1235. 1965.

[19] PENNY, RH, CAMERON, R. D., JOHNSON, S., KENYON, P. J., SMITH, H. A, BELL, A. W, COLE, J. P, TAYLOR, J. 1980. Footrot of pigs: the influence of biotin supplementation on foot lesions in sows. Vet Rec.; 107(15):350-1.

[20] RAVEN, E.T. 1989. Cattle Foot Care and Claw Trimming. Farming Press – UK. 19-33

[21] ROYCHOWDHURY, ANISH & PRATIHAR, DILIP & BOSE, NILAV & SANKARANARAYANAN, K. & SUDHAHAR, N. (2004). Diagnosis of the diseases - Using a GA-Fuzzy approach. Inf. Sci. 162. 105-120. 10.1016/j.ins.2004.03.004.

[22] RUSHEN, J. AND A. M. DE PASSILLE´. 2006. Effects of Roughness and Compressibility of Flooring on Cow Locomotion. J. Dairy Sci. 89:2965–2972

[23] SUHARJITO; DIANA; YULYANTO; A. NUGROHO. Mobile Expert System Using Fuzzy Tsukamoto for Diagnosing Cattle Disease. Procedia Computer Science, v.116, p.27-36, 2017.

[24] VAN DER TOL, P. P. J., J. H. M. METZ, AND E. N. NOORDHUIZEN-STASSEN. 2002. The pressure distribution under the bovine claws during square standing on a flat substrate. J. Dairy Sci. 85: 1476-1481

[25] VÁSQUEZ, R. P.; AGUILAR-LASSERRE, A. A.; LÓPEZ-SEGURA, M. V.; RIVERO, L. C.; RODRÍGUEZ-DURAN, A. A.; ROJAS-LUNA, M. A. Expert System Based On A Fuzzy Logic Model For The Analysis Of The Sustainable Livestock Production Dynamic System. Computers And Electronics In Agriculture. V.161, P.104-120, 2019.

[26] WARREN, JAMES & BELIAKOV, GLEB & VAN DER ZWAAG, BEREND Jan. (2000). Fuzzy Logic in Clinical Practice Decision Support Systems. Hawaii International Conference on System Sciences. 5. 10.1109/HICSS.2000.926789.

[27] WATKINS, K. L., L. L. SOUTHERN AND J. E. MILLER. Effect of dietary biotin supplementation on sow reproductive performance and soundness and pig growth and mortality. 1991. J Anim Sci. 69:201-206.

[28] ZADEH, L. A. From circuit theory to systems theory. Proceedings of the Institute of Radio Engineering, 1962, 50, 856–865.

[29] ZADEH, L. A. Fuzzy Sets. Information and Control, 1965a, 8:338-353.

[30] ZADEH, L. A. The concept of a linguistic variable and its application to approximate reasoning. Information Sciences, 1965b, 1-3, 199–249 (See also pages. 301-357, 43-80).

[31] ZADEH, L. A., FROM, L. A. Computing with Numbers to Computing with Words—From Manipulation of Measurements to Manipulation of Perceptions. IEEE Transactions on Circuits and Systems—I: Fundamental Theory and Applications, 1999, 45, 105–118.

ABC Curve Application in Materials Stock Optimization in a Restaurant in Manaus - Amazonas

Brunno Vasconcelos Costa
brunnovasconcelos7@gmail.com
Centro Universitário FAMETRO – Brasil

Fabiana Rocha Pinto
fabiana.floresta@gmail.com
Coordenação de Engenharia Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Coordenação de Engenharia Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia Centro Universitário FAMETRO – Brasil

Francisco Carlos Tavares Amorim
amorim.mao17@gmail.com
Coordenação de Engenharia da Universidade Nilton Lins – Brasil

Abstract

In a highly competitive global scenario, companies are looking for ways to optimize their processes, reducing costs and improving the quality of their products. In this context, several tools were developed to improve the companies' inventory management, one of them being the ABC Curve as a method to hierarchize the inventory according to the intrinsic value of each material, allowing the analysis of how the supply should work. from each supplier. The present work aims to perform the application of the ABC curve method in the zagaia restaurant, located in the city of Manaus / AM that will allow the stock hierarchy and will be through the classification of the raw material according to its annual demand and its Unit price. As a premise, a bibliographic research on content planning and inventory management was adopted, as well as an on-site study to catalog the items and check with the restaurant management, their values, their quantities and how the chain works. of supplies. The results presented confirm that Class A items need greater attention due to their high value, while Class C items do not impact financially as much, but need attention to be properly allocated within inventory as they represent the largest volume.

Keywords: Inventory Management, ABC Curve; Supply chain;

1. Introduction

Faced with a highly competitive market and which in many different fields, their customers will increasingly value credibility and reliability, companies seek to stand out for the quality of their products while high competition forces entrepreneurs to keep their prices low. This complexity results in a high mortality rate among enterprises: 35% of bars and restaurants close in two years, according to Abrasel. Thus, the biggest obstacle for companies is to reduce their costs and improve their reliability simultaneously. For this, organizations seek techniques for cost management and process optimization. Inventory management is a key strategy for meeting these challenges.

By the traditional equation: Price = (Cost + Profit), we have the price, usually dictated by the market and the profit, prefixed by the shareholders. There remains only the "cost" as a variable component of direct business action. To act on costs is to turn expenses into revenues by continually improving process efficiency by identifying and eliminating waste.

One of the main assets and with the best optimization and cost reduction opportunities is inventory. Second [1] means by stock any quantities of physical goods that are unproductively conserved for some time; Inventories are both finished goods awaiting sale or dispatch, as well as raw materials and components awaiting use in production.

According to [2] from a financial point of view, stocks are seen as investment and represent trapped money, which cannot be used for other purposes. Therefore, keeping them to a minimum is a guarantee that resources are not being over-invested and that the company's cash is not being compromised.

In the case of bars and restaurants the stock is operationalized in the short term, as all raw material purchased is soon converted into a finished product, the downside is that if there is a larger than necessary purchase, this MP will lose its shelf life. consequently the restaurant will need to throw the material away.

According to [3] it is necessary to use all principles, concepts and techniques to know which items to order, how much to order, when they are needed, how and where to store them. A good understanding of inventory management drives the optimization of inventory investments and capital involved, customer service, and production, purchasing, and distribution operations.

One of the main and most widespread tools in the corporate world is the ABC curve. The ABC curve consists of the separation of inventory items into three groups according to annual demand value for finished products or annual consumption value for work in process or raw materials and inputs. According to [4] these values are determined by multiplying the price or unit cost of each product by its consumption or its annual demand. The ABC curve is important because it allows the stock to be hierarchized and the manager has a view of which materials need the most. attention and control.

Thus, the objective of this paper is to analyze how the application of the ABC Curve method influences waste reduction and improves inventory management in a restaurant located in Manaus / AM. This will happen by separating the materials into 3 segments; Which are the items of greatest importance and cost, corresponding to 80% of the stock value and 20% of the items. B which are the intermediate items and correspond to 15% of the stock value and 30% of the items. C which are the minor items, but in high quantity, correspond to 5% of the stock value and 50% of the items. After collecting and sorting the data one can build the ABC curve graph.

2. Literature Review

2.1 Stock Concept

According to [5], inventory is the amount of physical goods that are held in reserve awaiting sale or use in production. Inventory goods can be understood as raw materials, semi-finished goods, finished goods and goods for sale. Inventories are items that are not being used constantly, but are stocked for future needs.

According to [6], inventories represent a means of investing resources that, if not properly controlled, can reach a large portion of a company's total assets. Because of this, companies need the inventory to be managed with maximum efficiency, keeping only the balance needed to supply the productive system for a certain period.

According to [7], managing inventories is to reconcile and resolve existing conflicts between each area, without affecting the operability of each sector, always aiming at optimizing the company's overall performance.

Inventory management is a vital task for a company's financial health as well as setting the pace of production. It is the manager's job to be able to balance the daily supply of production processes and at the same time not exceed the agreed value. An extremely complex task, since if there is a lot of material, there will be a lack of physical space to store and the company will have an illiquid asset that may eventually lose its value. If the problem is a very low stock, the production process will be constantly hampered by the lack of material, generating idleness in various sectors.

2.2 Stock Types

According to [8], the stock can be classified in five different ways. They are: in transit; of speculation; regular or cyclic in nature; security and the obsolete.

In the segment of bars and restaurants, the most addressed stocks are those of a regular and obsolete nature. This is due to the fact that the short term between the acquisition of raw materials (food) and their period of validity, thus there is no space or time for large stocks.

2.3 Inventory Costs

One of the main objectives of companies when carrying out inventory control is related to costs. All material purchased and that will be stored within the company generates a stocking cost. Therefore, it is important for managers to be aware of the costs incurred by the mere existence of stocks within a company.

According to [3] the storage cost “corresponds to the costs of the physical space required to store the material, which can be rented or owned. According to [1], furthermore, the “storage cost includes the cost of the space occupied by the goods, insurance, fees, losses, material obsolescence or its deterioration. "

Inventory costs range from raw material procurement to receipt and storage of material within the company. There is also the cost of inventories that will become obsolete, as well as all the inherent cost of inventory, they will also add the cost of being thrown away.

According to [9] the main activities to reduce such costs are; reduce production and supply lead time; synchronize the delivery of materials and components in the production process; increase the speed of

receipt of orders by electronic means; reduce production planning time; develop the continuous flow of material movements.

2.4 Inventory Management

Companies have been adopting production models that focus more on reducing costs and increasing the quality of their products. Thus, improving inventory management to reduce waste and reduce costs becomes an excellent opportunity for companies to achieve their goals.

Second [10] it is important to know that when we have high inventories, to fully meet the demand, it entails the need for high working capital and leading to high costs. However, low inventories can lead to inadequate management, resulting in costs that are difficult to account for due to delivery delays, redesign of the production process, customer dissatisfaction, and especially customer loss.

According to [11], the function of inventory management is to maximize the effect of return on sales and the adjustment of production planning and scheduling. It should minimize the capital invested in inventories, as it is high cost and increases with the financial cost.

In this scenario, where companies are increasingly looking for efficient inventory management, several tools have been developed in recent decades to improve this management, such as; JIT, Kanban, PEPS, UEPS and others.

2.5 ABC Curve

According to [10] the ABC Curve, also known as the Pareto Principle or 80/20 Principle, emerged in Italy around 1897. It was elaborated by Vilfredo Pareto after studies on the distribution of income and wealth of the local population. In this study, Pareto noted that total income was largely concentrated in the hands of a small part of the population, at a rate of approximately 80% and 20% respectively, ie 20% of people controlled 80% of wealth.

According [12], the ABC curve is a very useful tool, as it is able to identify those items that deserve greater attention in the decision making process in inventory management. The curve is obtained starting from the ordering of the items according to their relative importance; and according to the authors and following Pareto's law, which is the basic principle of the ABC curve, there is a small portion of the items (about 20%) accounting for about 80% of the total stock value and a large about 80% of the items representing only 20% of the stocked values.

Second [13] states that to classify is to use a system to stratify the population into classes based on relevant criteria for the prioritization of management treatments. The most common classification in terms of inventory is the ABC that segments inventories according to the values consumed and is used when the number of distinct items stocked is large enough to the point where companies are short of human resources or timely. enough to track all stocks in detail

According to [7], companies generally keep a large number of items in stock, but few are considered the most important and require special attention. Control of the stocks by the ABC curve provides greater depth of analysis with a small margin of error.

Following the Pareto principle, items are classified into three categories A, B, and C. Table 1 shows this classification;

Table 1: ABC Curve Classes

Class	Description	% of items Qty	% of value
A	They are the most relevant items and need to receive more attention. 80% of the value and 20% of the items.	20%	80%
B	They are the intermediate items and second in importance. They correspond to about 15% of the value and 30% of the items.	30%	15%
C	These are the least financially important items. Only 5% of the value despite being in large quantities, being 50% of the items.	50%	5%

Source: Adapted from [10].

According to [10] after calculating the annual investment of each item, one must sort them in decreasing value and allocate them according to their class. Following the Pareto Rule, class A, on average, corresponds to 20% of items and 80% of stock value, class B equals 30% of items and 15% of value, and class C represents 50% of items and 5% of the value. Pozo (2007) adds that the delimitation of class percentages is not a fixed rule. The cutoff point can be defined by summing the percentage values until its result is close to 80% of the value and 20% of the total of the analyzed items. The goal, however, is to separate the important from the insignificant.

According to [14] for the elaboration of the ABC curve, first one must define the variable to be analyzed or the problem to be solved. It is common to calculate the ABC curve to know the cost value of the annual demand for inventory items. This technique can also be used for checking against average stocks, sales made, which are the largest customers, suppliers, etc.

According to [9] the ABC classification process can be divided into three steps. What are they:

• Data collection: This is a time-consuming step as it involves a large amount of information. The data collected corresponds to the item identification, the quantity consumed or projected for the period and unit value.

• Annual cost calculation: It is the multiplication of the quantity of items consumed in a period of one year by its unit value.

• Sorting items in descending order: Once items are calculated, items are sorted in decreasing value. Following the methodology applied to classification, items in categories A, B or C are appropriated, which is commonly assigned 20% of items to class A, 30% to class B and 50% to class C.

After collecting and sorting the data one can build the ABC curve graph. Figure 1 shows this graphical representation.

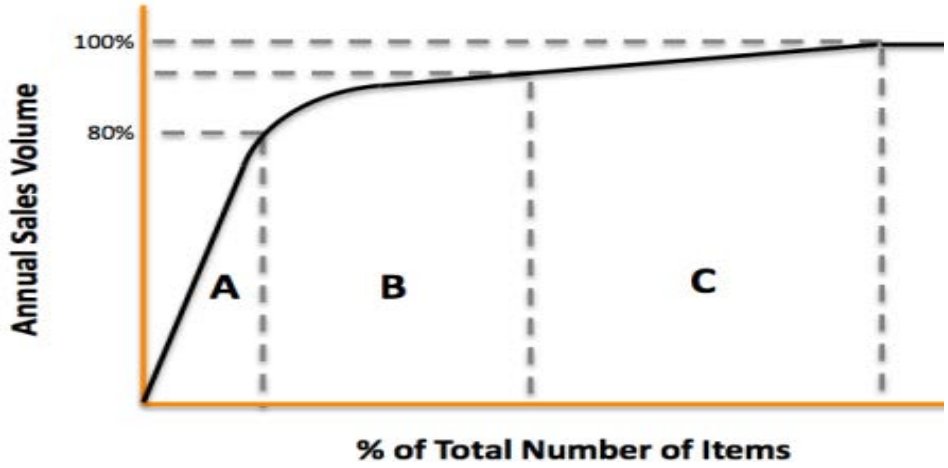


Figure 1 - Graphic Representation of ABC Curve
Source: [15]

The ABC rating can be very useful for managers as an indicator of the importance of each product in terms of value, but it has some limitations, for example: it does not reveal what happens when any of these items is missing from inventory, it only takes into account value of products not explaining production factors, replacement time, possibility of errors in demand forecasting and others.

3. Tool and methods

3.1 Methodology

The study took place in 2019 in a restaurant in the city of Manaus / AM. The survey was conducted based on all items in stock. All 220 items in stock were cataloged and classified according to the ABC curve. However, for demonstrative purposes the chart was drawn using data from the 20 most relevant items for the process.

In order to obtain the data, site visits were made at the company, so that, together with the restaurant management, it was analyzed item by item, separating them according to their unit price and weekly demand. Due to the fact that there is a constant inventory turnover in a restaurant, the weekly period for demand analysis was adopted. Subsequently to calculate the annual demand, the weekly demand value was multiplied by 52 (Number of weeks in the year).

In addition, for a better understanding of the subject, we also adopted a literature search on the concepts of inventory management and the ABC curve.

3.2 Characterization of the place of study

The Zagaia restaurant where the study took place is a famous fishmonger located in the city of Manaus in Campos Elísios, Planalto. With more than 10 years since its opening, the restaurant is a reference among fishmongers in the region. Already with a consolidated clientele, owners are looking for ways to optimize their processes and improve the management of their assets, because of this there was the opportunity to implement the concept of the ABC curve.

4. Application of the study

4.1 Classification of materials

To apply the study, 7 steps were developed to construct the ABC table, according to the flowchart presented in figure 2.

Figure 2: Steps of the ABC Table Build Process
Source: The Author.

The first step for building the ABC curve is the cataloging of inventory items. As mentioned earlier, the present study took into consideration the 20 most relevant items for the production process, namely; Tambaqui, Pirarucu, Matrinchã, Jaraqui, Rooster Olive Oil, Champignon, Titty, Beef Rump, Mayonnaise, Soybean Oil, Vinegar Virrossas, Beach Beans, Elect Milk, Mozzarella Cheese, Shoyo Sauce, Lettuce, Biju White Rice, Trigolar Flour, Extract of tomato and refined salt.

The second step is to point the unit price of each item, to perform this step was analyzed the purchase history based on the purchase invoices of these products.

The third step is to calculate the monthly or weekly demand for each of the items. In the case of restaurants and bars it is recommended that the demand be evaluated weekly as the stock turnover is constant due to the validity period of the materials.

The fourth and final step of the data collection phase is to calculate the annual demand for each item, which is given by the weekly demand multiplied by 52 (Number of weeks in the year), according to EQ1:

$$DA = DS * 52 \quad (EQ1)$$

Where DA is the annual demand. DS is the weekly demand. And 52 is the number of weeks in the year.

The fifth step is the calculation of the annual investment, which is the crucial step for assembling the ABC curve. This is when the manager can see how much is spent per year on each item. This calculation is performed by multiplying the annual demand and the unit price of each item, according to EQ2:

$$IA = DA * PU \quad (EQ2)$$

Where IA is the annual investment. DA is the annual demand. PU is the unit price

The sixth step is to break down the annual investment according to the percentage of each item. First we calculate the total investment by summing the annual investment of each item. After that the annual investment of the item in question is divided by the total. You can see this calculation in EQ3:

$$\% \text{ of } X = IA / IAt \quad (EQ3)$$

Where% X is the percentage of each item. IA is the annual investment. IAt is the total investment of all items.

The seventh and last step is the construction of table ABC, with the information obtained so far it is possible to classify the items according to their percentage value. By sorting the table downwards, from highest to lowest investment, you can view and sort items in categories A B and C following the 80/20 rule.

4.2 Implementation of ABC Table

Through table ABC, it was possible to make the distribution of priorities of inventory items, and provide the consolidation of the analysis.

Table 2: ABC table with data obtained in the restaurant.

Item	Unit Price (R $)	Annual Consumption (Units)	Annual Investment (R $)	Total Investment in%	Descending Sort	ABC classification
Tambaqui	R$ 55,00	1560	R$ 85.800,00	27,73%	20	A
Pirarucu	R$ 50,90	1456	R$ 74.110,40	23,95%	19	A
Matrinchã	R$ 41,90	1612	R$ 67.542,80	21,83%	18	A
Jaraqui	R$ 6,00	2600	R$ 15.600,00	5,04%	17	A
Rooster Olive Oil	R$ 19,99	520	R$ 10.394,80	3,36%	16	B
Champignon	R$ 12,90	624 (kg)	R$ 8.049,60	2,60%	15	B
Titty	R$ 15,00	520 (kg)	R$ 7.800,00	2,52%	14	B
Beef rump	R$ 24,99	312 (kg)	R$ 7.796,88	2,52%	13	B
Mayonnaise	R$ 4,46	1560	R$ 6.957,60	2,25%	12	B
Soy oil	R$ 3,15	2080	R$ 6.552,00	2,12%	11	B
Ferrous Vinegar	R$ 2,56	1248	R$ 3.194,88	1,03%	10	C
Beach Bean	R$ 2,79	1040	R$ 2.901,60	0,94%	9	C
Elect Milk	R$ 1,69	1404	R$ 2.372,76	0,77%	8	C
Mozzarella Cheese	R$ 5,00	416	R$ 2.080,00	0,67%	7	C
Shoyo sauce	R$ 7,00	260	R$ 1.820,00	0,59%	6	C
Lettuce	R$ 7,00	260	R$ 1.820,00	0,59%	5	C
Biju white rice	R$ 2,99	520	R$ 1.554,80	0,50%	4	C
Trigolar Flour	R$ 1,51	832	R$ 1.256,32	0,41%	3	C
Tomato extract	R$ 9,50	104	R$ 988,00	0,32%	2	C
Refined Salt	R$ 0,53	1560	R$ 826,80	0,27%	1	C
TOTAL INVESTMENT			R$ 309.419,24	100,00%		

Source: The Author.

4.2.1 Table ABC Consolidation

Consolidating the information from table 2, we have the following representation:

Table 3: Consolidated between values and items in percentage.

Class	Values in%	Items in%	Relevance
A	78,55	20	Great
B	15,37	30	Intermediate
C	6,08	50	Little

Source: The Author.

For classification, the items were selected until they reached the cutoff point established by the ABC curve. For class A, the cutoff is 80%, class B 15% and class 5% of the annual investment value. It is noticed that the results were not exact according to the 80-20 rule, however, the delimitation of the percentages of the classes is not a fixed rule. The goal is to separate the important from the insignificant.

5. Results and discussions

For the construction of the graph in figure 3, the items cataloged as X axis were taken into account, while the accumulated percentage of all items was the Y axis. As a legend is the ABC curve, segregating the items according to their financial value for the stock.

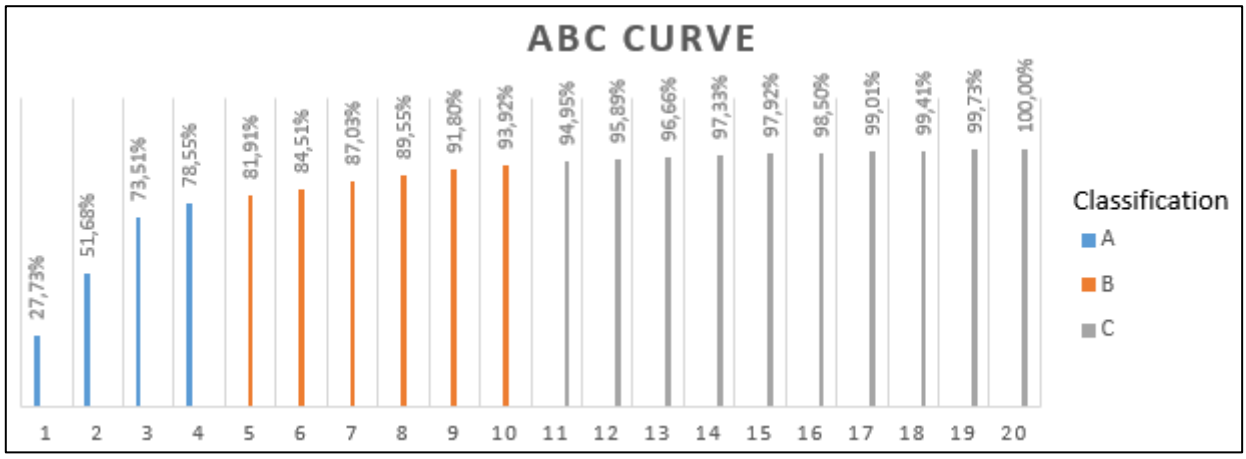


Figure 3: Bar graph, indicating the accumulated percentage of each item.

Source: The Author.

In the graph in figure 4 we can see an area representation of the ABC curve, where class A items constitute the largest advance in the accumulated percentage.

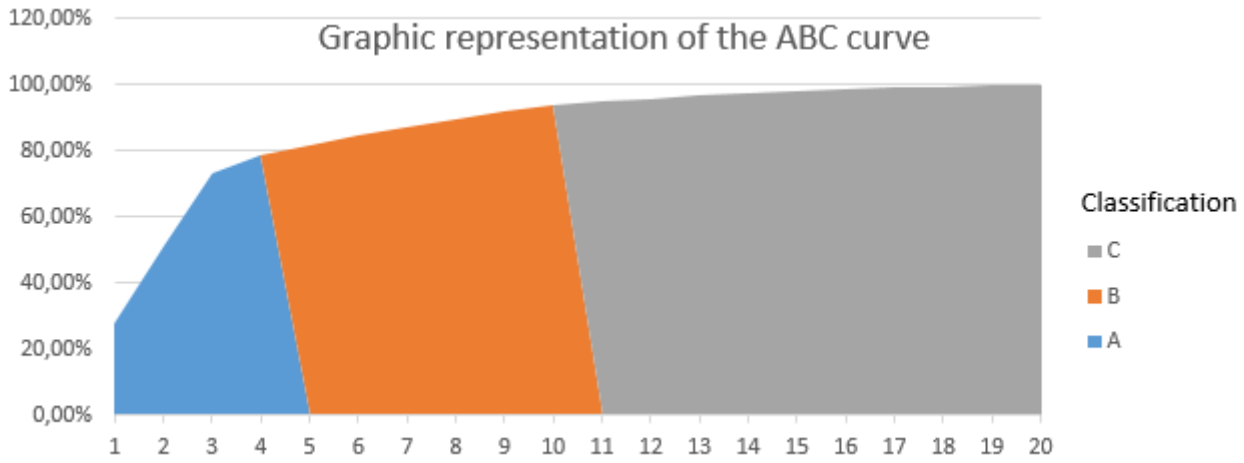


Figure 4: Graphical representation of the ABC curve.
Source: The Author.

The results of the present study revealed numbers very close to those expected by the ABC curve concept, allowing restaurant managers to be clearer where their largest investments in stock are.
Class A items are concentrated in proteins, namely Tambaqui, Pirarucu, Matrinchã and Jaraqui, which consist of 78.55% of the total stock value. However, it is only 20% of the cataloged items. We can notice that these values are due to the unit price of these assets being very high, except for Jaraqui which has the annual demand well above average.
Class B items are divided into less demanding proteins and preparation material, such as rooster olive oil, champignon, titty, beef rump, mayonnaise and soybean oil. These items constitute 15.37% of the total inventory value and 30% of the cataloged items.
Class C items are concentrated on side dishes and preparation materials that are less in demand, namely: Vinegar Virrossas, beach beans, Elegê milk, mozzarella cheese, shoyo sauce, lettuce, Biju white rice, Trigolar flour, tomato extract and salt. refined. These items make up only 6.08% of the total stock value, however they are 50% of the items and need attention when storing them properly so that the physical space is optimized.

Through the results found, several decisions can be made by management, for example, to seek loyalty with suppliers of class A products, to ensure that these products will not be lacking, given the added monetary importance to them. Since the stock has a high turnover, there is no concern about capital stock. The stock is ranked in the following order; Proteins, preparation materials and side dishes. With this information the restaurant zagaia can prepare a supply plan focused on proteins, because although they are few items, constitute the largest value of the stock.

6. Final Considerations

Inventories are assets held by companies to be sold or consumed. These assets need to be managed properly, so that there is no shortage of materials and, on the other hand, the company's finances are not damaged. Therefore, the importance of inventory management, which aims to maintain adequate levels of materials,

ensuring the balance between inventory and consumption, and the reduction of costs incurred, is highlighted.

For a restaurant there is no finished product stock, as all production is done under the demand of a customer. However, it is of the utmost importance that all the material needed to prepare a meal is in stock, because in case of lack of any item, it will generate unavailability of some dishes, frustrating customers.

By applying the proposed methodology it was possible to classify the raw materials in stock according to their monetary value, taking into account their annual demand and the unit price of each item. With this information was constructed the chart with the ABC curve, hierarchizing the stock.

ABC Curve is an important management tool. Through it, it is possible to identify the items in inventory that require more rigorous control, which represent about 80% of the resources invested and which have the largest share of costs incurred. Applying this management tool, the restaurant managers under study will be able to control the most consumed items by focusing their efforts on these materials to save money.

7. Bibliographical References

[1] MOREIRA, D. A. Administração da produção e operações. 2. ed. São Paulo: Thomson, 2002.

[2] ARNOLD, J.R Tony. Administração de materiais: uma introdução. São Paulo: Atlas, 1999.

[3] BERTAGLIA, Paulo Roberto. Logística e gerenciamento da cadeia de abastecimento. São Paulo: Saraiva, 2003.

[4] DIAS, M. A. P. Administração de Materiais: resumo da teoria, questões de revisão, exercícios, estudos de casos. 4ª ed., São Paulo: Atlas, 1995.

[5] TÓFOLI, I. Administração financeira empresarial. São José do Rio Preto: Raízes, 2012.

[6] CHIAVENATO, Idalberto. Iniciação à administração dos materiais. São Paulo: Makron, 2000.

[7] FRANCISCHINI, Paulino, GURGEL Floriano do Amaral. Administração de materiais e do patrimônio. São Paulo: Pioneira Thomson Learning, 2002.

[8] BALLOU, R. H. Gerenciamento da Cadeia de Suprimentos. 5ª ed., Porto Alegre: Bookman, 2006

[9] BERTAGLIA, Paulo Roberto. Logística e gerenciamento da cadeia de abastecimento. Editora Saraiva, 2017.

[10] POZO, Hamilton. Administração de recursos materiais e patrimoniais: uma abordagem logística. 3. ed. São Paulo: Atlas, 2007

[11] DIAS, Marcos Aurélio. Administração de materiais: princípios, conceitos e gestão. São Paulo: Atlas, 2009.

[12] BRAGA, L.M.; PIMENTA, C.M.; VIEIRA, J.G.V., Gestão de armazenagem em um supermercado de pequeno porte. Revista P&D em Engenharia de Produção, Viçosa, n. 08, p. 57-77, 2008.

[13] GASNIER, D.G., A dinâmica dos estoques: guia prático para planejamento, gestão de materiais e logística. São Paulo- IMAM, 2002.

[14] FERNANDES, José Carlos de F. Administração de material um enfoque sistêmico. 2 ed. Rio de Janeiro: Livros Técnicos e Científicos, 1984.

[15] FRITSCH, Daniel. Georg Simmel im Kino: die Soziologie des frühen Films und das Abenteuer der Moderne. transcript Verlag, 2015.

Study of the Physical Aspects of Residential Soils of Iranduba - AM

Romulo de Araujo Reis
romulo13araujo@gmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

Bruna Moraes de Oliveira
brunamoraess1@hotmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

Lívia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Manaus, Amazonas - Brasil

Abstract

The objective of this work is to study the physical indices of soil samples collected in different points of the municipality of Iranduba - Am. The parameters analyzed were moisture content, porosity, aeration degree, specific weight among others. For the physical characterization of the soil, samples with deformed structure were collected, prepared according to procedures described in the standard procedures described by the NBR 6457 standard (ABNT, 1986). The tests were performed using a high precision glass pycnometer. The tests resulted in samples with high voids and porosity, lower values of saturation degree as their low percentage. The specific grain weight presented satisfactory results meeting the criteria established by the standard.

Keywords: soil; physical aspects; Iranduba;

1. Introduction

Soil is arguably the most widely shared and abundant building material in the earth's crust. However, due to the high costs of civil engineering works, the use of soils as materials has been driven by more systematic technical specifications. The soil's physical environment assists in sustaining the passage of machines and resists tensile forces.

The significance of the soil is of prime importance. It is practical to understand the reason for different types of soils, but there are other causes for soil formation besides rock, and these causes are climate and weather, and over time, the size of the rocks decreases due to weather, that is, it promotes additions, losses,

transports and transformations of mineral and organic matter throughout its formation [1].

Currently, in the small municipality of Iranduba, many infrastructure works are being carried out, such as the widening of the highway that connects the city with the citizen of Manaus, capital of the state of Amazonas. For road and highway paving works to follow the necessary safety and reliability standards, knowing the types of soil are of paramount importance, after all, the different types of soil are determining factors for the foundations, structures and type of building. Be erected at a particular location.

Physical indices of soil present mathematical interactions between weights and volumes of elements of a soil mass, that is, between the parts of solids, liquids and gases [2].

Knowing the moisture content is essential and crucial in predicting the behavior of soils that will be used in various areas of construction, such as the construction of dams and earthworks for roads. The soil void index is directly related to the resistance of the soil, as well as its porosity defines the consistency and relation with the local humidity. The degree of saturation, the degree of aeration, the specific weight of the grains and the natural specific weight in the characterization of the soil are also extremely relevant characteristics for the success of a construction. In this sense, the objective of this work will be to characterize the soil of a region of the municipality of Iranduba from its physical indices, establishing the conditions in which the soil is at the time of its determinations.

2. Theoretical Reference

Soils are materials resulting from the decomposition of rocks by the action of chemical and physical agents. With the action of weathering the rocks are fragmented and disaggregated, originating the soil [3].

Soil texture corresponds to the proportion found across different particle sizes in a given soil mass [4]. Consistency is the intrinsic characteristic in aggregates, in sand, silt and clay particles, of staying together, making some soils harder and others softer [5] also ensures color as the most noticeable feature. Soil porosity becomes responsible for several phenomena and develops a series of mechanisms of importance in soil physics, such as air and water retention and flow, and if investigated, generates other physical properties associated with soil phase mass and volume. The importance of understanding soil physical behavior is linked to its correct use.

After a process of soil knowledge, to achieve satisfactory results it is necessary that the material goes through tests, aiming to analyze some physical indices. With this study, it is possible to determine the name of the soil. Given the above, and the little information on the physical indexes of soils of the municipality, the present work will present data of soils of the region.

2.1 Soil Types

As for their formation, we can classify the soils in three main groups: residual soils, sedimentary soils and organic soils.

Residual soils – are those that remain at the site of the source rock (parent rock), with a gradual transition from the surface to the rock. For residual soils to occur, the rate of rock decomposition must be greater than the rate of removal by external agents. Being the residual soils presented in horizons (layers) with decreasing degrees of weathering, the following layers can be identified: mature residual soil, saprolite and

altered rock [2].

Sedimentary or transported soils– are those that suffer the action of transport agents, which may be alluvial (when transported by water), wind (wind), colluvial (gravity) and glaciers (glaciers) [2].

Organic soils– derived from the decomposition and subsequent decay of organic matter, whether of a vegetable (plant, root) or animal nature. Organic soils are problematic for construction because they are very compressible. In some formations of organic soils there is an important concentration of leaves and stems in decomposition process, forming the peat (combustible organic matter) [2].

When observing the different types of soil it is necessary to know their particularities in order to better define the use of the land. It can be said that when a soil is suitable for construction, it must be unsuitable for agricultural purposes. So a very compact soil is convenient for civil works, but lousy for agriculture. Just as porous soil with lots of voids is good for agriculture but unsuitable for construction.

2.2 Physical Indexes of Soils

The soil is composed of solid particles that have voids between them. These voids may be filled with water and / or air. Thus we have 3 phases: solid phase - formed by solid particles; liquid phase - formed by water; gas phase - formed by air (vapor, gases) as we can see in figure 1.

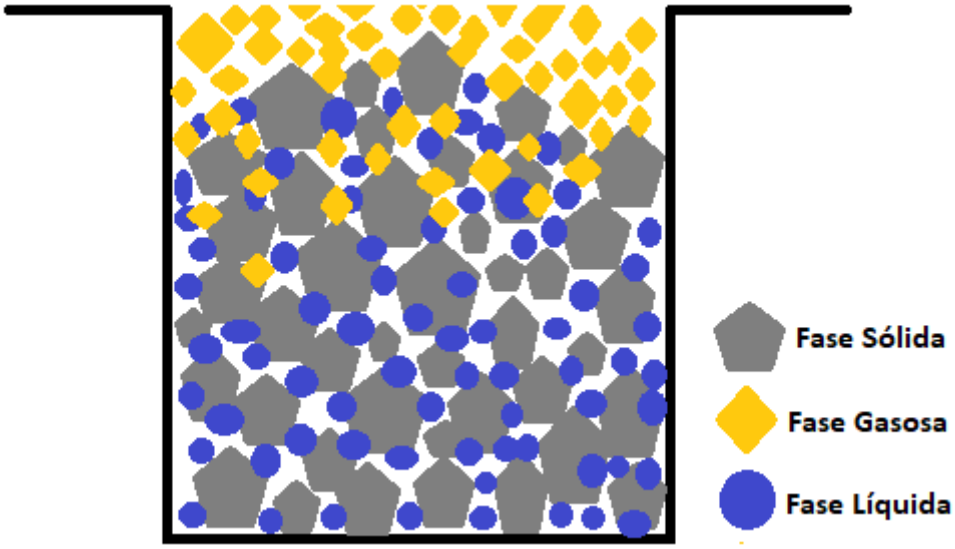


Figure 1. Scheme representative of the composition of a soil.

The behavior of a soil depends on the relative quantities of each of the constituent phases. We call physical indices the relationships between phases, characteristics that define the soil at a given moment. These are:

Moisture content(h) - It is the ratio, expressed as a percentage, between the weight of water (P_a)contained in a certain volume of soil and the weight of the solid part(P_S)in that volume.

$$h = \frac{P_a}{P_s} . 100 \qquad \text{(Equation 1)}$$

Voids Index(ε) - It is the ratio of void volume(V_V) to solid particle volume(V_S).

$$\varepsilon = \frac{V_V}{V_S} \qquad \text{(Equation 2)}$$

Porosity(η) - It is the ratio between void volume(V_V) and total volume(V_t).

$$\eta = \frac{V_V}{V_t} \qquad \text{(Equation 3)}$$

Degree of Saturation(G) - It is the percentage of water that fills the soil voids. The relationship between water volume (V_a)and void volume (V_V).

$$G = \frac{V_a}{V_V} \qquad \text{(Equation 4)}$$

Aeration Degree(A) - It is the percentage of air that fills the voids in the soil. The relationship between water volume(V_{ar})and void volume (V_V).

$$A = \frac{V_{ar}}{V_V} \qquad \text{(Equation 5)}$$

Grain Specific Weight(γ_g)- It is the relationship between the weight of solid particles(P_S) and the volume of solid particles (V_S).

$$\gamma_g = \frac{P_S}{V_S} \qquad \text{(Equation 6)}$$

Natural Specific Weight(γ) - It is the ratio between total weight(Pt) and total volume(Vt). Humidity h is non-zero.

$$\gamma = \frac{P_T}{V_T} \qquad \text{(Equation 7)}$$

In nature there are no soils with moisture content of zero. This condition is only obtained in the laboratory, yet after a certain period of time, the sample will absorb moisture from the air.

3. Methodology

The samples were collected in the municipality of Iranduba - Am. (Geographic coordinates Latitude: 3°12'40"South and Longitude: 60°10'42" West). It has an approximate length of 2,900 meters on the bank of the Solimões River (figure 2) [6].

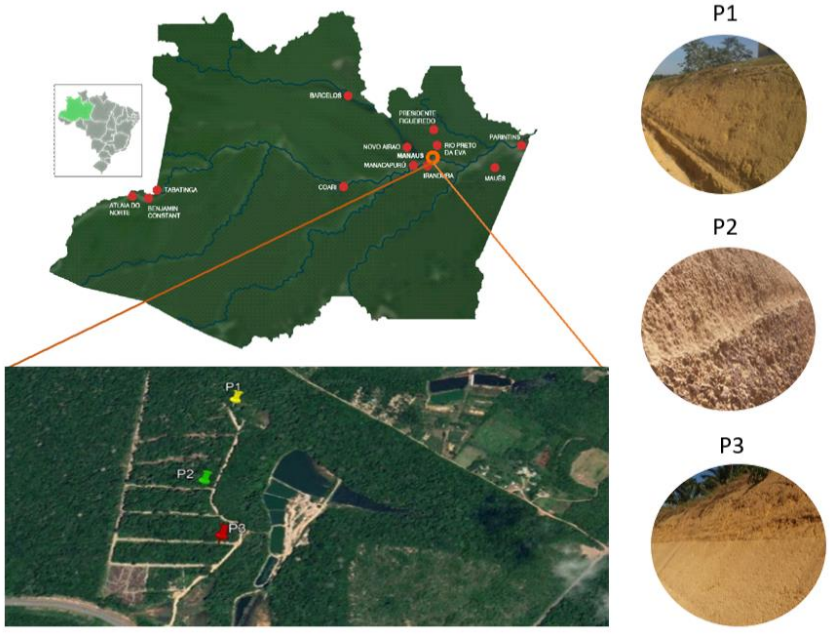


Figure 2- Location map of the sample collection points.

Source: [19]

The material was collected in three different areas, using the cuts of slopes from excavations on site resulting from the paving works being carried out in the area. Samples were collected with hoes and picks, stored in fully sealed plastic bags to prevent moisture loss from the material, identified and then sent for laboratory analysis. Samples were prepared following the procedures described by NBR 6457 (ABNT, 1986) [7].

Regarding the determination of the moisture content, the parameter used was the drying in the oven, also based on the standard procedures [7]. The kiln drying method can be used as a reference for calibration of other parameters, showing low cost of realization, requiring no exquisite equipment and or adding chemicals [8].

To determine the specific grain weight, the pycnometer method was used, following the procedures of NBR 6508 (ABNT, 1984) [9]. Initially the samples passed through the 2.0 mm aperture sieve, soon after, they were placed in the oven for drying, then each one was weighed. In order to avoid particle loss, distilled water was added to the pycnometer reference line. But before the material was added, it was weighed. Stirred to the outlet gas present, and again distilled water was added to the reference mark. Then, the set was weighed (Pycnometer + soil + water), shown in figure 3.

Figure 3. Set weighing.

4. Analysis and Discussion of Results

Three determinations of each sample were performed and the average of the measurements was considered as the final result for the analysis of the physical parameters. The values found are presented in Table 1.

Table 1- Sample moisture content.

Pattern	Soil (g)	Dry Soil (g)	Average Humidity (%)
P1	112,77	106,20	6,18
P2	34,05	32,04	6,9
P3	44,2	41,77	7,9

Source: Own Author

The results have moisture content higher than 6%, therefore, both show similar behavior when it comes to resistance. Differences between materials may occur when they dry out, this happens when the degree of saturation reaches a value of 80%, this is the presence of continuous air [10]. As the moisture content varies, the geotechnical parameters change (shear strength, deformability, conductivity) [11].
Table 2 shows the physical soil indexes for the collected soil samples, which are: natural specific weight (γnat), grain specific weight (γg), moisture content (h), void index (ε), degree of saturation (G), degree of aeration (A) and porosity (η).

Table 2- Physical indices of the soil.

Pattern	h (%)	η (%)	ε	G (%)	A (%)	γnat (g/cm³)	γg (g/cm³)
P1	6,18	44,65	0,81	20	80	1,53	2,61
P2	6,9	54,2	1,18	14	84	1,19	2,44
P3	7,9	68,92	2,21	9	91	0,87	2,6

Source: Own Author

Analyzing the results found in Table 2, it can be observed that the samples have high voids and relatively high porosities greater than 40%. The void index between 0.80-1.00 and porosity between 45-50% is called high, and above that very high [12]. Based on this, it is verified that the sample 1 is denominated with high porosity and voids index, while the samples 2 and 3 as very high. The degree of saturation between 0-25% of the soil is termed as naturally dry, and observing the three samples, both have a percentage below 25% [12]. Samples with high void indices and low degrees of saturation, seen in the literature, are lateritic tropical soils [13]. The results achieved for the specific weight are considered satisfactory as they did not exceed the considerable value by the standard.

5. Conclusion

The results provided a knowledge about the soils of the studied municipality, so that it was possible to characterize the region's soil from the soil physical indices. Based on the results it was possible to conclude that the values of saturation degree, porosity and void index presented higher results. These soils were analyzed with saturation degree between 9-20%, porosity between 44.65-68.92%. The void rates were around 0.81-2.21.For these soils it is natural to aggregate clay and silt particles, this is due to the presence of iron and aluminum oxides and hydroxides, thus presenting characteristics of mechanical and hydraulic behaviors. Based on these results, it is possible to conclude that the studied soil has resistance and deformation characteristics for the subsoil layers and can be better used as deep foundations in roads.

6. References

[1] DURÃES, I.T. B; GONÇALVES, T. S; LOPES, L.O.M. Pedology at School: The Soil Approach in the Elementary School of Geography.2012. [Accessed August 10, 2019]. Available in: http://docplayer.com.br/21926974-Pedologia-na-escola-a-abordagem-do-solo-noensino-fundamental-de-geografia-1.html/.

[2] FIORI, A.P. 2015. Fundamentals of soil and rock mechanics. 3rd ed. Text Workshop. São Paulo-SP.

[3] SILVA, F.M; CHAVES, M.S; LIMA, Z.M.C. Property of chemical and mineralogical soils. Christmas: EDUFRN, 2009.

[4] EMBRAPA.Irrigated Cotton Growing.2003. [Accessed August 11, 2019]. Availablein: http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Algodao/AlgodaoIrrigado/solos.htm&gt.

[5] LEPSCH, Igo F. Soil formation and conservation. 1. ed. São Paulo: Text Workshop, 2002.

[6] MAGALHÃES.R.C. The physical, chemical, mineralogical and hydraulic characteristics of the soil and its susceptibility to the process of fallen lands; community of the Divine Holy Spirit- Iranduba-AM.2011.23p. Dissertation (Master) - Federal University of Amazonas, 2011.

[7] Brazilian Standard. ABNT NBR 6457: Soil samples - preparation for compaction and characterization tests.1986. Rio de Janeiro - RJ. First Edition August / 1986.

[8] VIELMO, A. L. Upper limit of soil water retention: field method and estimation method. Dissertation (masters) - Santa Maria Federal University, Center for Rural Sciences, Postgraduate Program in Agricultural Engineering, RS, 2008.

[9] Brazilian Standard. ABNT NBR 6508: Soil grains that pass through the 4.8mm sieve - determination of specific mass. 1984. Rio de Janeiro-RJ. First edition October / 1984.

[10] VILLAR, L.F.S; DE CAMPOS, T.M.P; ZORNBERG, J.G.Relationship between tensile strength obtained by Brazilian test, suction and physical indexes of a soil. VI Brazilian Symposium on Unsaturated Soils. Salvador-Bahia, 2007. p.10-11

[11] TEIXEIRA, M.M.C A.D.Hydro-mechanical modeling of Petrolândia collapsible soils. Dissertation (Master) - Federal University of Pernambuco. CTG. Postgraduate Program in Civil Engineering, 2006.

[12] IAEG.Commision “Engineering Geological Mapping” Classification of rocks and soils for engineering geology mapping. Part: rock and soil materials. Bulletin of the International Association of

Engineering Geology, Krefeld,v.19,p.364-371,1979.

[13] GON, F. S. Geotechnical characterization through laboratory tests of a diabase soil from Campinas / SP. 2011. 73p. Dissertation (Master) - State University of Campinas. Sao Paulo, 2011.

[14] BENATTI, Julio César Beltrame. Collapsibility with controlled suction of a colluvial and lateritic soil of Campinas / SP. Faculty of Civil Engineering - UNICAMP, 2010. 189 p. Dissertation (Master) - Faculty of Civil Engineering, Architecture and Urbanism - UNICAMP, 2010.

[15] https://www.google.com.br/maps/place/Iranduba, 2019.

Use of RCDs in the Making of Interlocked Pavements with Waste Collected at the Federal Institute of Amazonas – CMC

Willians dos Santos Teixeira
santos.twillians@gmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

Giselle Cunha do Nascimento
giselle.engc@gmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

Lívia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO - Manaus, Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Manaus, Amazonas - Brasil

Abstract

The area of construction is responsible for a large portion of non-renewable natural resources that generate environmental impacts, since the extraction of materials and extend in large scale as waste from renovations, works and demolitions, causing construction and demolition waste, known as RCDs. The aim of this study is to analyze the feasibility of reusing recycled waste from mortars, concrete and ceramic bricks in civil construction, as aggregates in the manufacture of interlocking blocks, in order to simulate the reality of the conventional block produced in the civil construction sector. For the tests, 6 concrete load specimens were molded with coarse aggregate and fine aggregate percentages, respectively: 50% and 25%, following the parameters of NBR 5738. It was possible to conclude that the interlocking pavement made with RCDs is useful. to improve the permeability of land, sidewalks and streets, enabling ordinary people within their homes to produce and apply them.

Keywords: construction waste; alternative aggregate; reuse;

1. Introduction

The Civil Construction is one of the major responsible for impacts on the environment today, the CONAMA resolution [1], aims measures to mitigate the problems caused by the incorrect disposal of construction waste, these wastes, according to [2], mostly come from demolitions, repairs and civil works. In the city of

Manaus the problems caused by the improper disposal of the RCDs is imminent, representing about 40 to 70% of solid waste, due to the lack of a National Solid Waste Policy directed exclusively to these problems [3] [4]. Currently, the application of techniques and reuse of materials at construction sites and systems implementation in the city of Manaus, is an activity that is being carried out through the Construction Solid Waste Management Plan (PGRSCC). With [5], the generator of a waste can distinguish the risk potential of the same, as well as distinguish alternatives for its final destination. Based on bibliographic surveys, the study aimed to analyze the reuse of recycled aggregates for paving in concrete blocks, interlocking pavements. Through this survey it was possible to apply the recycled aggregate, originated from mortars, concrete and ceramic bricks, collected at the Amazonas Federal Institute - CMC (Campos Manaus Centro), located in the city center of Manaus, where this application contributed to obtain interlocked pavement prototypes, being analyzed and tested as an aid in the waste reuse process in civil construction.

2. Theoretical Referential

In Brazil, the use of recycling construction waste in paving began in the 1980s [6]. In Europe and the United States this kind of work began after World War II, but it was no longer attractive. During the 1990s, recycling plants were installed in cities in Brazil, being managed by city halls and private companies. In several European countries, the disposal of construction waste to landfills has been less and less tolerated; As a way to inhibit it and encourage recycling, new laws have been introduced and a landfill tax policy has been adopted [7]. Environmental issues and the scarcity of natural resources are directly linked to the economic development of the country, and Manaus is among the capitals with the highest growth rate in the construction industry [3]. In the capital of Amazonas, the most common waste construction waste is ceramic bricks, mortar, ceramics, tiles, paint materials and concrete blocks from demolitions and constructions. It is noteworthy that in Manaus it is common to find waste deposited in inappropriate places, such as clandestine boots, on vacant lots far from the city and on the banks of streams. This generates siltation of watercourse margins, as well as clogging of culverts and galleries, producing environmental and social problems [3].

3. Methodology

To carry out this study, the production of the prototypes was divided into two stages, collection and preparation of construction and demolition waste (RCDs), and preparation of specimens (cylindrical and hexagonal shape) with percentage of recycled aggregates. The residues were obtained from the collection of samples in the site of the Federal Institute of Amazonas - CMC of Manaus city, having as aggregates: ceramic bricks; mortar and its components; and concrete blocks. All samples were milled using the Los Angeles machine (figure 1).

Figure 1 - Los Angeles Machine.

Figure 2 – Mechanical Peneirament

After grinding the samples, their characterization was performed. Where they were separated by size by the sieve method with the mechanical sieves (figure 2) of sizes respectively: 9.5, 4.8 and 2.4 mm, being 9.5 and 4.8 mm coarse sieve (figure 3 and 4) and 2.4 mm fine aggregate (figure 5), respecting the determination of the fineness mode established by Standard 248 - Determination of particle size composition. According to [8], mechanical agitation of the set should be promoted for a reasonable time to allow the separation and prior classification of the different grain sizes of the sample.

Figure 3 – Graded aggregate - 9.5 mm.

Figure 4 – Graded aggregate - 4.8 mm.

Figure 5- Mud aggregate - 2.4 mm.

For the tests, 6 concrete load specimens were molded with coarse aggregate and fine aggregate percentages, respectively: 50% and 25%, following the parameters of [9]. The preparation of the specimens was obtained through the composition of the residues by the tactile-visual characterization process that determined the composition of the residues. The water / cement factor tested initially was 0.5, but the mixture was dry, later to have a better use it was used the water / cement factor of 0.8 which showed a good behavior in the mixture of the trace.

For the production of interlocked was adopted the 1: 3: 3 dash (in volume). The choice of this trait was made because it is a very usual and efficient in practice, something that would facilitate the use in case of interest for its execution.

One of the most important performance parameters of a structure and therefore of pavers is the compressive strength test [10]. The pieces were submitted to this test in the Materials Testing Laboratory of the Federal Institute of Amazonas (IFAM-CMC), Manaus-AM.

4. Analysis and Discussion of Results

With the completion of sample preparation, the specimens were removed from the submersion to perform

the tests according to established concrete cure reference standards [9]. The specifications conclude the usual 28-day cure for compressive strength, and the results achieved at 28 days of this study were used in the analysis. Checking Tables 1 and 2, it is possible to observe that none of the prototypes reached the minimum resistance of 35 MPa, established by [11]. Regarding the results, after the compression tests, it was possible to analyze that the maximum compressive strength obtained in the samples reached 4.73 MPa, for the cylindrical specimens, as observed in Table 1. All the tests were established by [12], which has as a parameter to determine and define the test of compression of the specimens, in order to evaluate its resistance in relation to the molds already established by [9].

Table 1. Characteristics of cylindrical specimens.

Pattern	Age	Breaking force	Section	Breaking stress
RCD 01	10	2.657 (kgf)	31,17 (cm²)	3,32 (MPa)
RCD 02	14	3.294 (kgf)	31,17 (cm²)	4,11 (MPa)
RCD 03	28	3.785 (kfg)	31,17 (cm²)	4,73 (MPa)

Characteristics of cylindrical specimens after compression tests for three cure periods - 10, 14 and 28 days.

In municipalities where recycling facilities are in place, the results have been positive and most of the tailings are used for paving, but they can still be successfully applied in erosion control, drainage layers, landfill cover, etc. rip-rapetc [13].

Evaluating the results obtained, according to Table 2, it was observed that the compressive strength was higher in the samples contained in hexagonal forms, reaching 7.50 MPa when compared to those contained in specimen cylinders, this is due to these pieces have a larger diameter.

Table 2. Characteristics of hexagonal specimens.

Pattern	Age	Breaking force	Section	Breaking stress
Bloco RCD 01	10	1.538 (kfg)	31,17 (cm²)	4,84 (MPa)
Bloco RCD 02	14	2.038 (kgf)	31,17 (cm²)	6,41 (MPa)
Bloco RCD 03	28	2.383 (kgf)	31,17 (cm²)	7,50(MPa)

Characteristics of cylindrical specimens after compression tests for three cure periods - 10, 14 and 28 days.

It was observed that the higher the proportion of substitution by recycled aggregate, the greater the resistance reduction, ie, the 40% substitution always resulted in lower resistance values when compared to the 20% substitution values [14] [15]. .

The substitution for recycled aggregates in the study was 75% being divided and placed as small and large aggregates. According to figure 6 it is possible to verify that the use of recycled aggregate was higher than 40%, percentage obtained through the study according to [14], as follows: Ceramic brick: 32%; Mortar and its components: 15%; Concrete blocks: 28% [16]. Even though the results obtained through this substitution

and the mechanical resistance were not promising in relation to the rupture stress described by the standard [11], it is possible to use RCDs to make pavers, that is, there is no impediment to that there is the production of these floors.

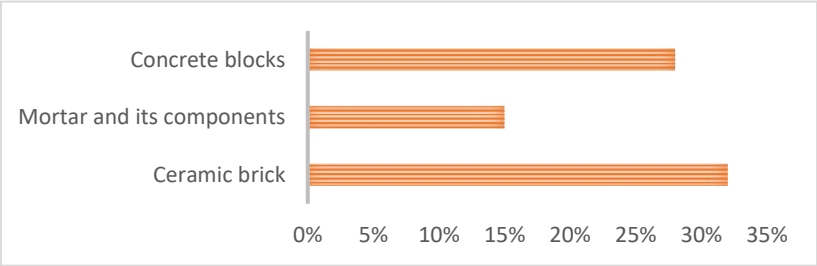


Figure 6. Quantification of RCDs in specimens.

Because it is concrete, its use for the manufacture of interlocking pavements for use in sidewalks, slow-moving streets, gardens and for architectural increments, should not be influenced by compression tests that did not have a minimum resistance of 35 MPa, according to [11] [17].

5. Conclusion

In view of the arguments presented, it was observed that the generation of waste happens on a large scale, especially when it comes from major demolitions and renovations, since the aggregates exhibit good behavior when they are reused in the process of " pavers ". The study aimed to simulate the reality of the conventional block produced in the construction sector and to demonstrate to the population the environmental impacts that are caused by its incorrect disposal.

Environmental awareness about RCDs is slowly taking place [18], policymakers have more reason to think about recycling because cities do not have space to store waste, and have perspective on recycling budget gains, and are able to higher markenting if they invest in environmental protection.

Therefore, although interlocking blocks used as prototypes do not achieve good strength, their application can still be useful for improving the permeability of terrain, sidewalks and streets, enabling ordinary people within their homes to produce and apply them. correctly by collaborating with the community and encouraging the implementation of less impermeable soils.

6. References

[1] CONOMA (National Environment Council). RESOLUTION No. 307, JULY 5, 2002. Criteria and procedures for the management of construction waste. DOU No. 136, 07/17/2002.

[2] Brazil. Law No. 12,305 of August 2, 2010. Establishes the National Policy on Solid Waste; amends Law No. 9,605 of February 12, 1998; and makes other arrangements. Art. 13 National Policy on Solid Waste. Official Journal of the Union - Section 1, of 03/08/2010.

[3] J.R. Mota. The destination of solid construction waste in Manaus: from the construction site to the final destination. Dissertation (Master) - Federal University of Pará. Belém, 2014.

[4] B.B. Matuti, G.P. Santana Reuse of construction waste and demolition in the manufacture of ceramic brick - a review. Scientia Amazonia, 2019. [access August 15, 2019]; volume 8: 1-13. Available at: http://www.scientia-amazonia.org ISSN: 2238.1910.

[5] Brazilian Standard, ABNTNBR 10.004: solid waste - classification. 2004. Rio de Janeiro- Rj. Second Edition May 31, 2004.

[6] LIMA, J. A.R. Proposed guidelines for the production and standardization of recycled construction waste and its applications in mortar and concrete.1999. 246p. Dissertation (Master) - School of Engineering of São Carlos, University of São Paulo. São Carlos, 1999.

[7] MOTTA, R. S. Laboratory study of recycled solid construction aggregate for low traffic paving. São Paulo, 2005. 161p. Thesis (Master's degree). Polytechnic School, University of São Paulo.

[8] Brazilian Standard. ABNT NBR 248: Aggregate - Determination of particle size composition. 2003. Rio de Janeiro - RJ. First Edition 30/07/2003.

[9] Brazilian Standard. ABNT NBR 5738: Concrete - Procedure for shaping and curing specimens. 2015. Rio de Janeiro- Rj. Second Edition 01.01.2015.

[10] TAVEIRA, A. F. S. Evaluation of the use of recycled concrete aggregate (ACR) as a substitute for fine aggregate in the manufacture of mortar and paving concrete parts. Manaus, 2010. 107p. Thesis (Master's degree). Federal University of Amazonas.

[11] Brazilian Standard. ABNT NBR 9781: Paving concrete parts - specification and test methods. 2013. Rio de Janeiro- Rj. SecondEdition 07.01.2013.

[12] Brazilian Standard. ABNT NBR 5739: Concrete - Compressiontestofcylindricalspecimens. 2018. Rio de Janeiro - RJ. Third Edition 05/30/2018.

[13] J.R.A CARDOSO. Use of Manaus - AM Civil Construction Rubble Aggregate to Obtain Cellular Mortar Block. Dissertation (Master) - Postgraduate Program in Mechanical and Materials Engineering, Federal Technological University of Paraná, Curitiba, 2010.

[14] S.F. BITTENCOURT. Evaluation of the compressive strength of pavers produced with construction and demolition waste aggregates and foundry sand. Dissertation (masters) - State University of Campinas, Faculty of Technology, Limeira-SP, 2012. 108 p.

[15] T.T. Lime; R.M. Castro; M.N. Castro Influence of recycled content on compressive strength and porosity of concrete. International Journal of Sciences. 2018. [access August 15, 2019]; Rio de Janeiro, v.

08, no. 01, p. 129 - 147, January-June 2018. Available at: http://www.e-publicacoes.uerj.br/ojs/index.php/ric.

[16] R.D. Barreto. Production of interlocking pavement with the use of construction waste as a small aggregate. Dissertation - University of Vale do Paraíba Faculty of Engineering, Architecture and Urbanism. Sao Jose dos Campos - SP, 2016.

[17] M.E. CAVALCANTI; P.R AMORIM; S.G. JUNIOR. Interlock paving: use of construction and demolition waste for the manufacture and laying of pavers XV-INIC⁄ X EPG. São Paulo- Jacarei, 2011. p. 03-04.

[18] ZORDAN, S. E. (1997). The use of rubble as aggregate in the manufacture of concrete. Campinas, 140p. Thesis (Master's degree). Faculty of Civil Engineering, State University of Campinas.

Case Study on Work Safety Conditions in Carauari - Amazonas

Fabrícia Rogéria Oliveira de Mesquita
mesquitafabricia@gmail.com
Centro Universitário FAMETRO – Brasil

Pedro Paulo Justino do Carmo
pp_carmo@hotmail.com
Centro Universitário FAMETRO – Brasil

Mariana Ferreira Umbelino
mariana.engcivil2017@gmail.com
Instituto de Especialização do Amazonas ESP, Manaus – Amazonas

Sara dos Santos Santarém
engsara.santarem@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Manaus, Amazonas - Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade Nilton Lins - Amazonas - Brasil

Abstract

The construction sector is the largest generator of occupational accidents, as it directly covers the worker. The implementation of preventive actions reduces the risks and provides a healthy environment, giving more security to the worker and daily activities. Based on these data, it is observed that the city of Carauari, in the interior of the Amazon, is still adapting the conditions of work safety, regarding the use of PPE and training that should be offered to work at height, which factors minimize accidents at the construction site.

Keywords: Construction. Safety at work; PPE; Work at height;

1. Introduction

The construction sector is deduced as the sphere that most employs workers and also stands out for its productivity, but as one of the prolific sectors become dangerous, thus causing accidents and deaths due to lack of verification, collaboration and guidance for compliance. current standards that meet basic

occupational health and safety requirements.

Due to the concern with the safety and health of construction workers, in recent years the issues related to occupational safety have been gaining ground today, so that the conditions offered for the execution of activities with workers are met in a timely manner. indispensable way.

Being the Work Safety a set of sciences and technologies governed by the NR 18 - Working Conditions and Environment in the Construction Industry, where it aims to contribute to the improvement of the number of accidents and possible diseases, aiming to protect the physical integrity of the workers. employees from the construction industry, it is essential to comply with all the parameters governed by the same so that such risks and problems can be reduced and avoided at the construction site, thus improving the safety conditions of the site.

Even with the increase in the number of protection against accidents and occupational diseases, the number of victims suffering from physical and moral accidents tends to increase due to the non-use of PPE according to the regulatory standard NR 6 - Personal Protective Equipment - PPE.

Given the above, the study was conducted by applying a questionnaire to 15 workers in a simple and compact way in the construction of the metallic cover of the sports and cultural events court in order to meet the minimum safety requirements established by NR 35 - Work at Height , located in the city of Carauari in the second semester of 2019, allowed us a quantitative survey about the safety conditions in the construction site. This questionnaire consisted of 12 closed and 03 open questions.

2. Theoretical Foundation

2.1 Health and Safety at Work in Construction

Occupational safety has become known for proposing measures and setting the necessary parameters for civil servants within the building industry, with a view to improving the performance of all their tasks and preventing possible occupational accidents by taking care of the utmost importance for your good development. Such activities and improvements are applied according to the programs, equipment and specifications that Safety and Health Engineering has [1].

Also in agreement [1] large companies are investing more and more in occupational safety management in order to minimize costs, since Brazil is the country with the highest incidence of expenses resulting from construction accidents. Civil. Expenses with work accidents in Brazil amount to millions of reais, which is used to meet the needs related to days of work delays and the amount paid as a pension and compensation to family members of victims [2].

Much of the accidents that occur at the construction site are due to lack of knowledge on the part of the workers and also the rush to complete the services according to the deadline requested by the customer, as stated by [1].

According to [3], one of the largest business sectors in Brazil is the construction industry, which is one of the largest economic powers, since the employability rate in this area is quite high, however, this segment is characterized by the lack of qualification of the company. thus compromising the physical integrity of the worker and the occurrence of many accidents.

2.2 NR - 6 - Personal Safety Equipment - PPE

As mentioned [4], personal safety equipment is equipment that should be worn by all workers for the purpose of establishing protection from risks that threaten their health and safety.

It is the full responsibility of the company to provide all necessary PPE for all its employees, thus enabling them to perform their tasks safely while avoiding possible occupational richness. It is essential that PPE is in perfect condition and can meet all possible circumstances as cited in [4].

It is noteworthy that, according to [5] after the delivery of the equipment to the companies' contractors, it is their responsibility to use them only for the activities they are intended for, having the servants aware of their need and importance for the company. preservation of their own health and physical integrity, as well as being responsible for preserving them and informing their superiors of any damage or alteration that may influence the correct use of the equipment, thus avoiding possible accidents as the equipment is unfit for use.

It is up to the supervisors and guardians to receive the instructions that must be given by the company's sector or security agency so that they can awaken, assist and raise awareness, showing the need for the use of individual equipment for each of the employees that make up the jobsite. works, as quoted by [6].

2.3 NR - 35 - Working at Height

According to [7] work in height is all that is performed with elevation greater than 2.00m (two meters) from the low, provided that there is a risk that the employee may fall.

According to [8] NR - 35 brings with it the importance that the worker has to have when the requirement is work at height, since it involves planning, organization, execution of safety and health of employees.

Also according to [7], work performed at a height can only be attributed to professionals who have training and authorization for such execution. In this case [9] they have their evaluation criteria ensuring employee safety, which is only possible due to the joint assignment of the worker and employer.

According to [9] the employer has an obligation to do constant training exercises as long as there is any of the points discussed here.

a) Change in work procedures, conditions or operations;

b) Event indicating the need for further training;

c) Return from work for more than ninety days;

d) Change of company.

2.4 NR - 18 - Working Conditions and Environment in the Construction Industry

In the construction sector in general there are high levels of employee health risks, according to MTE (Ministry of Labor and Employment), poor working conditions and non-compliance with the rules that employees must follow are the biggest influences for such accidents. become constant, thus, the solution found was the use of precast structure, aiming to reduce risks and seek improvements to the work environment since, with these construction systems it is possible to eliminate stages of the work and reduce the time period. that it would take to be realized. Second [10].

The approach taken by [11] is very complex where it establishes the necessary administrative and organizational parameters for the construction industry to prevent accidents and safety in the environment.

Also highlighted in the same standard, item 18.10 regarding the metallic structure emphasizes that, to avoid unforeseen circumstances, some necessary precautions must be taken, such as the prior fixing of all parts used during the service, the implementation of provisional floor without gaps so that thus prevent the equipment from falling and also meet the specifications regarding the weight and dimensions that transport equipment requires, aiming that the transport of these equipment are also a source of accidents, many of them being fatal, according to [12].

3. Methodology

This research is characterized as a case study, which according to [13] provides a schematic view of how data collection methods will be used to formulate a research hypothesis, ie an experimental survey, in which the objective is to analyze and present the correlated data to the field of study.

Regarding the type of research applied, an exploratory-descriptive research was used where [13] classifies as a research in which the researcher does not expect to get a definitive answer, however, uses the description of the characteristics of a group to provide broad description. of the problem.

The case study arose from the need to verify the use of Personal Protective Equipment - PPE, the Working Conditions and Environment and the minimum compliance with the safety conditions of the Works performed at Height at a site in Carauari, located inland. from the state of Amazonas. Thus, the data collected in the research are quantitative for the presentation of statistical graphs for projection of the obtained data.

For data collection a field research was carried out in order to collect data that would serve to the result of such approach. Thus [14], they classify the field research as a study that aims to obtain information and knowledge about a problem in which an answer is sought, or a hypothesis that it wants to prove.

The method used in the field was the application of a questionnaire, in which 15 workers participated. According to [14], they consider the questionnaire as a data collection method, composed by an ordered series of questions that allow a greater contact with the researched field and the clarification of the methodological procedures.

4. Case Study Application

For the development of statistical techniques, a questionnaire was applied for analysis and data recording. The questionnaire applied in this research has 15 (fifteen) questions, 14 (fourteen) multiple choice and 1 (one) essay. Fifteen (15) workers from a construction site in Carauari (AM) contributed to the research. However, for the application of the questionnaire was divided into two teams, so there is no interruption in activities.

As shown in figure 1, the court cover is being assembled with metal structures. Figure 2 shows the details to be completed for the completion of the work.

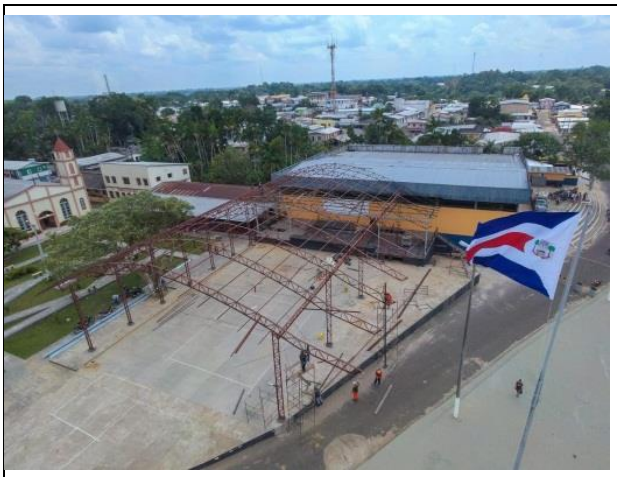


Figure 1 - Initial Metallic Structure
Fonte: Own Author

Figure 2 - Coverage Completion
Fonte: Own Author

Figure 3 shows a sample of the 15 question questionnaire, which was applied to employees.

Name: _____ Gender: Feminine ( ) Male ( ) Age: _____ Marital Status: Not married: ( ) Married: ( ) Divorced: ( ) Stable union: ( ) Widower: ( ) Degree of education: 1 incomplete degree: ( ) 1 complete degree: ( ) 2 incomplete degree: ( ) 2nd grade completed: ( ) 3 incomplete degree: ( ) 3 complete degree: ( ) What is your profession: Carpenter: ( ) Bricklayer: ( ) Servant: ( ) Helper: ( ) In charge: ( ) • Others. Which?	Work how many hours per day: Less than 7 hours per day: ( ) Between 7 and 8 hours daily: ( ) Between 8 and 9 hours daily: ( ) 9 to 10 hours daily: ( ) Between 10 and 11 daily: ( ) Between 11 and 12 hours daily: ( ) More than 12 hours daily: ( ) How long do you work at construction area? Less than 3 years: ( ) From 5 to 10 years old: ( ) 15 or more years: ( ) What equipment for personal safety (PPE) use daily? Protective gloves: ( ) Helmet safety: ( ) Protective goggles: ( ) Security Boot: ( ) Seat belt: ( ) Suitable clothing : ( ) None: ( ) Others. Which are?	Have you ever had an accident in workplace? Yes: ( ) Not: ( ) If so, how many: Only one: ( ) Two: ( ) Three: ( ) More than three: ( ) What type of accident: Fall in height: ( ) Cut / wound: ( ) Injury caused by PPE's: ( ) Other :_____ What are the reasons for the lack of using PPE's? The company does not available? ( ) Arrive late and don't give priorities to the equipments? ( ) Healthcare professionals security no inspect the conditions of impediment of I work daily? ( )	How do you rate your work environment in regarding care with collaborators? Good: ( ) Very good: ( ) Sufficient: ( ) Not enough: ( ) What are the possible improvements that you deem necessary so that you have a good execution of activities? _____

Figure 3 Questionnaire Applied
Fonte: Own Author

5. Results and Discussions

Based on data collection obtained through the application of a questionnaire to 15 workers, directly linked to the production on the construction site. It was highlighted that most of the employees are male, because it is the risk conditions of work at height.

Comparing the distribution of the age group, it is noted that the majority of the sample (80%) comprised employees aged 20 to 30 years, a young workforce. The other part of the sample (20%) belonged to the 40 to 50 year old group. Regarding marital status, (60%) entitled married and (40%) single.

All who contributed to the resolution of the questionnaire claim to have received adequate training on risk identification and the use of PPE for each activity developed. According to [6], the individual protection of the worker is mandatory and the employer's responsibility to avoid occupational accidents.

It can be seen in figure 1 that 55% of workers completed high school, while another portion of respondents, about 40% had completed or incomplete elementary school. And the 5% minority are non-literate people. And when it comes to occupational safety awareness, employees who have a higher level of education have differentiated knowledge and are aware of preventive issues. While those who are not literate neglect the visible risks resulting from the conditions for such knowledge.

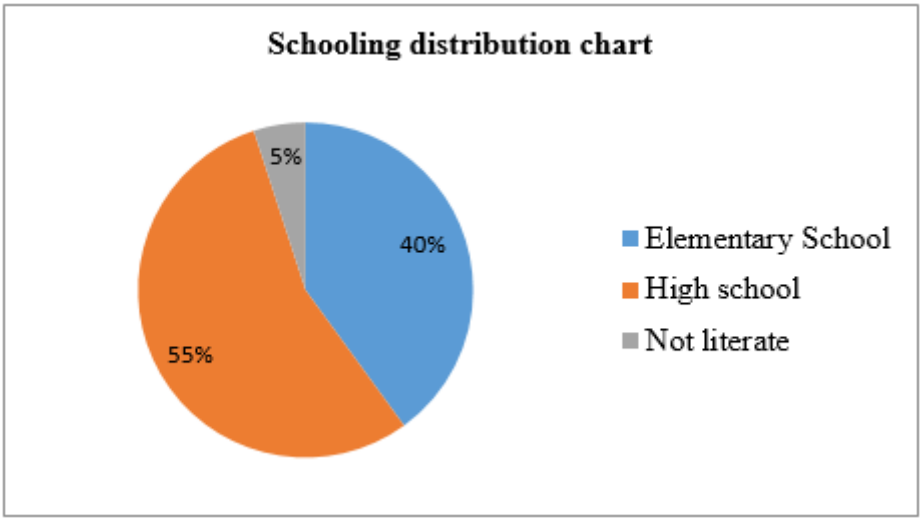


Figure 4: Graph of distribution of educational level.
Source: Own Author

The composition of the professionals and their respective roles at the construction site in Carauari-AM is shown in Figure 5.

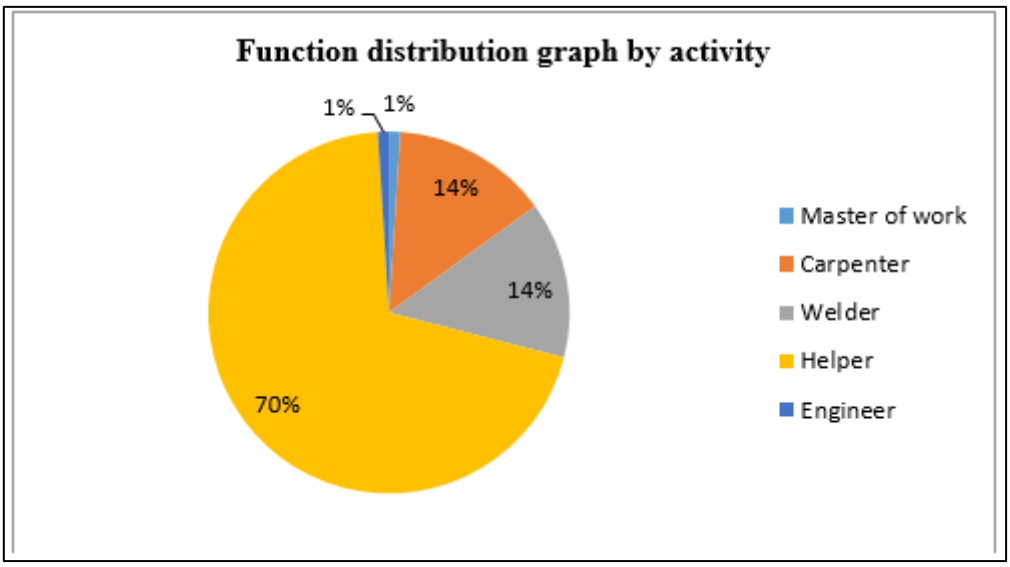


Figure 5: Graph of distribution of functions by activity
Source: Own Author

Despite all the ways sought to be safe on the construction site, every activity developed in the environment is subject to risk. From the point of view of [15] an incident at the construction site has consequences for everyone, both for the injured with human injury, who will be left with physical or psychological guidelines, and for the company, as it reduces work output and increases expenses. with overtime pay due to the lagoon that the injured employee left in addition to causing the rest of the employees a certain fear.

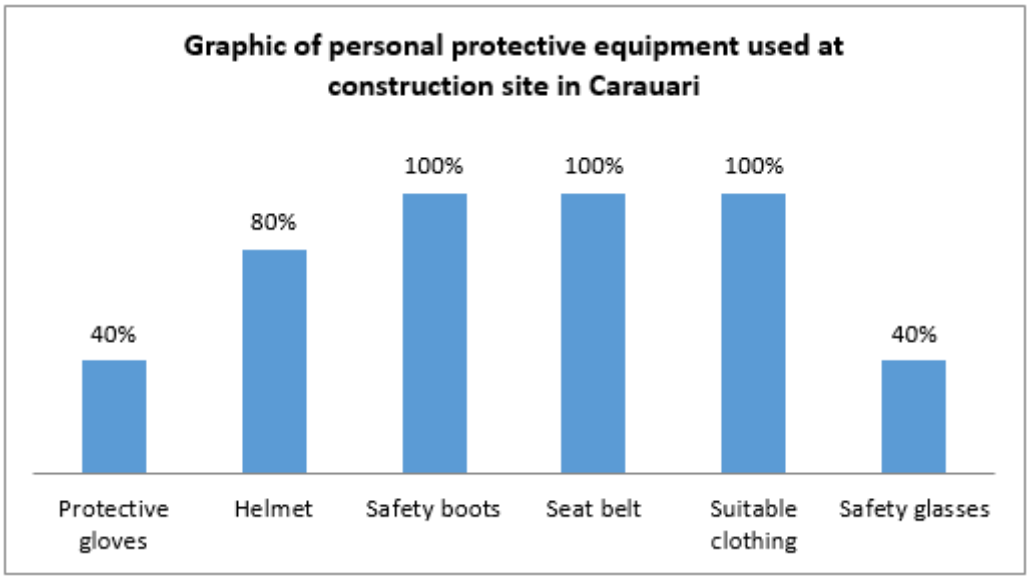


Figure 6: Graphic of personal protective equipment used at Carauari construction site
Source: Own Author

The data reported in figure 6 show that 100% of employees wear PPE such as: safety boots, seat belt and appropriate clothing. Those wearing gloves and goggles are 40% and safety helmet 80%. The lowest rate

reported for the use of personal protective equipment was protective gloves, as employees do not have the practice of using this equipment and think that it may not pose risks to the lack of use. Being that the company does its role of making available and raising awareness to all involved.

Occupational Safety has shown a large increase in occupational accident reduction rates, as the pursuit of operator safety results in the company's progress thus generating credibility in the labor market. In the view of [16], the demand for globalization preventive aspects help everyone involved directly and indirectly in the work.

6. Conclusion

Considering the presented aspects, we can observe according to the data collected through the applied questionnaire, the importance of the use of the PPE and the attention in the accomplishment of the activities, so that these factors can help to minimize the index of the errors and accidents that are made. frequent during the execution of the work through reminders, training and educational classes on the correct use of equipment, thus arousing the interest of employees related to their well-being so that everyone feels safe to perform their proper duties.

For [2] the use of training is given as one of the most important activities in terms of accident prevention, because according to the same if there is someone trained regarding the existing risks, there will hardly be accidents or even this server can help and assist other employees to anticipate accidents.

[5] mentions that even with the use and supply of individual and collective equipment and the low rate of occupational accidents, it is necessary to raise awareness of the company in providing a safe and peaceful environment for workers, as it is not only by performing the correct use of PPE or by complying with the requirements of all standards regarding such matters that the end of so many accidents at the construction site will occur.

Finally, companies are responsible for providing adequate equipment and environments, occupational safety technicians and a team that makes the necessary monitoring and inspection for a good joblessness, avoiding and correcting the occurrence of technical irregularities quickly. and practice.

7. Bibliographical Reference

[1] SILVA, L.A. ***Segurança do trabalho na construção civil: Uma revisão literária.*** Artigo submetido ao Curso de Engenharia Civil da Faculdade Evangélica de Goianésia, Goiás, 2019.

[2] RODRIGUES, F. R. ***Prevenindo Acidentes na Construção Civil***. Segunda Edição. São Paulo: Ed. LTR Editora LTDA, 2013.

[3] SILVA, A.A.R. ***Segurança no trabalho na construção civil: Uma revisão bibliográfica.*** Artigo submetido ao Curso de Engenharia Civil da Uni. Kennedy, Belo Horizonte, 2015.

[4] Norma Regulamentadora. NR 6: Equipamentos de segurança individual – EPIs. Publicação Portaria n.° 505, de 16 de abril de 2015. Disponível em: https://enit.trabalho.gov.br/portal/images/Arquivos_SST/SST_NR/NR-06.pdf. Acesso em: 15 de setembro de 2019.

[5] CISZ, C.R. ***Conscientização do uso de EPIs, quanto à segurança pessoal e coletiva.*** Monografia de

especialização da Universidade Tecnológica Federal do Paraná, Curitiba, 2015.

[6] AYRES, Dennis; CORRÊA, José. ***Manual de prevenção de acidentes do trabalho.*** 2° edição. São Paulo: Atlas, 2011.

[7] MORAES, Giovanne. ***Legislação de sugurança e saúde no trabalho.*** 10° edição. Rio de Janeiro: Virtual LTDA, 2013.

[8] SIMOES, Ligia. ***Gestão de segurança e medicina do trabalho.*** 2° edição. São Paulo: Cenofisco, 2013.

[9] Norma Regulamentadora. NR 35: Trabalho em alturas. Portaria n.° 313, de 23 de março de 2012. Disponível em: http://www.ccb.usp.br/arquivos/arqpessoal/1360237763_nr35trabalhoemaltura.pdf. Acesso em: 16 de setembro de 2019.

[10] KULKAMP, I.C; SILVA, E.D. ***Segurança no trabalho em altura na montagem de estruturas pré-moldadas - estudo de casos.*** Artigo submetido ao Curso de Engenharia Civil da UNESC, Santa Catarina, 2014.

[11] Norma Regulamentadora. NR 18: Condições e meio ambiente de trabalho na industrial da construção. Portaria n.° 3214, de 01 de novembro de 2015. Disponível em: http://trabalho.gov.br/images/Documentos/SST/NR/NR18/NR-18.pdf. Acesso dia: 16 de setembro de 2019.

[12] LIDA, Itiro. ***Ergonomia Projeto e produção.*** 2° edição. São Paulo: Blücher, 2005.

[13] GIL, A. C. ***Estudo de Caso***. Primeira edição. São Paulo: Ed. Atlas S.A, 2009.

[14] MARCONI, M. de A. LAKATOS, E. M. ***Técnicas de pesquisa.*** Sétima Edição. Terceira Impressão. São Paulo: Ed. Atlas S.A, 2010.

[15] ZAVOROCHUKA, J. V. ***Gestão em Segurança no Trabalho***. 2014. Disponível em: http://www.revistaespacios.com/a15v36n04/15360403.html. Acesso em: 16 de setembro de 2019.

[16] DE ARAUJO, W. T. ***Manual de Segurança do Trabalho***. Edição 2013. São Paulo: Ed. DCL-Difusão Cultural do Livro LTDA, 2013.

Application of AHP Method to Aid Destination Choice of Pre-Production Models in a Textile Industry

Karine Ramos
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, kakarineramos@gmail.com

Vilson Menegon Bristot
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, vilson.bristot@unesc.net

David Batista Gesuíno
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, david_bdg@hotmail.com

Márcio Carlos Just
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Curso de Licenciatura em Física, mcj@unesc.net

Bruno Brogni Uggioni
Instituto Federal do Rio Grande do Sul - IFRS, Brasil, bruno.uggioni@canoas.ifrs.edu.br

Vilmar Menegon Bristot
Instituto Federal de Santa Catarina - IFSC, Brasil, vilmar.bristot@ifsc.edu.br

Richard de Oliveira Cardoso
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, richardcardoso485@hotmail.com

Edimar Kalfeld
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, edimarkalfeld@gmail.com

Leopoldo Pedro Guimarães Filho
Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, lpg@unesc.net

Abstract

The study analyzed, through the Analytic Hierarchy Process (AHP) technique, the decision-making tool, the best resolution for the final disposal problem of pre-pruduction models of a garment company. Obtaining data was based on the identification of the problem, general understanding of how to improve and finally the application of the AHP method, it was concluded that the best decision was archiving the pieces, guaranteeing fidelity in the reproduction of the product and the aid for the development of new parts.

Keywords: Decision-Making. Analytic Hierarchy Process. Pre-Production Models, Textile Industry.

1. Introduction

The textile industry, like any other manufacturing or service industry, is faced daily with situations that require decision-making that takes them in different directions. Decision making is present not only in industries but also in the daily lives of human beings.

It is a business routine to decide between more or less rational alternatives, these alternatives may be problems or opportunities ahead. Meneguele (2000) says that the decision maker should not be taken by emotion, intuition, immediacy or fad, but should take into consideration all information and knowledge that is available to him.

Among the decision-making tools, the Analytic Hierarchy Process (AHP) method, widely used in industries as a support in multi-criteria problem solving. In addition to helping in the choice of options, it also justifies why that was the best choice.

The application of this tool in the garment industry arose from the need to make a decision about the final destination of pilot parts, since three alternatives are possible: discard, sell or file. Any one of the three alternatives, have their criteria with their respective weights from the preferences of the makers and experts in the field of clothing.

Using the AHP method, thus allowing the analysis of the three alternatives above in order to compare them, it is possible to use the knowledge of decision makers to compare attributes and convert them into quantitative data. The priority of each element or criterion that is organized in hierarchies is defined by the preferences of those responsible for evaluating the attributes, and finally the overall evaluation of each alternative can be determined.

Conversion to quantitative data refers to the priority of each element, ie its weight. This is best explained in Saaty's (2013) scale, which states that all elements are not equally important, quantifying the elements indicating how much each element dominates another.

According to Briozo and Musetti (2013) the resolution of a multicriteria problem, one must start with the construction of the structure: define the problem, then identify the constraints or criteria, and finally, which alternatives to be evaluated and selected. This occurs by crossing the criteria with the alternatives and the criteria with the ultimate goal.

The problem was related to the organization and layout to choose the appropriate final arrangement of the pilot pieces, making the main objective of the study to analyze the feasibility of the arrangement of pilot pieces of a textile industry in southern Santa Catarina, by applying the AHP method. (Analytic

Hierarchy Process). For this purpose alternatives will be identified for the destination of the pilot pieces; quantify attributes with experts and measure the priority and finally demonstrate application of the method.

No previous studies have been conducted to assign pilot parts, as they lack information for final disposal. The pieces were randomly assigned and often lost without objectivity in decision making, so it was necessary to study alternatives with certain attributes that with their respective weights help in decision making.

2. Methodology

The present study was developed in a garment company in the south of Santa Catarina - Brazil, whose volume of pilot pieces is significant, focusing on the creation of a decision making procedure to guide the pilot pieces in the best way. The AHP method was used for decision making, seeking to find possibilities of destination of the pilot pieces, aiming at the best resolution to the problem.

2.1 Methodological Framework

The research was initially characterized by a process of bibliographical exploration seeking to contemplate aspects related to decision making. This stage consisted of the necessary theoretical support for the field research.

According to Medeiros (2007), the bibliographic research is defined as the survey of the bibliography related to the subject that is intended to study, a formal process of knowledge acquisition.

After the bibliographic survey stage, the field research analyzed the use of the AHP method in the company object of study, for decision making. To achieve the goal of the final destination of the pieces, attributes and alternatives were evaluated in such a way as to be tested with the AHP method, making the decision making more assertive.

From this procedure it is understood that the research is characterized as exploratory and descriptive. Furasté (2007) explains that in descriptive research one must observe, describe, analyze, classify and record facts without any kind of interference.

The analysis of the collected data was performed under a quantitative and qualitative approach. Fonseca (2002) clarifies that the difference between quantitative and qualitative analysis is the possibility of quantifying the results. Quantitative research uses mathematical language to understand the causes of an event and the relationships between variables.

2.2 Data collection and analysis procedure

The development of the research was elaborated through an existing method, adapted to the reality of the company and thus developed and introduced in the textile industry. The problem was related to the organization and layout to choose the appropriate final arrangement of the pilot parts. As it is a confection, it is used to follow in pilot parts, which serve as a sample of how the product should be manufactured.

Before the product is marketed, a line is developed with several product samples, which are sent to the customer. After placing the purchase orders, the customer sends only samples approved for manufacturing, which will be used as an example of the finished products. These approved samples are called pilot parts,

and are important to the company during the manufacture of the product because if the batch of an order is different from the customer approved pilot part, it is cause for order disapproval and cancellation.

Over time, and due to high order demand, a large number of pilot parts were realized in stock. For in most cases, upon completion and shipment of orders, the pilot parts were left in boxes stored in the stock of raw materials. With the need for storage area, it was questioned the occupation of this space, bringing to light the decision about choosing a more suitable destination for these pilot parts. Thus, the best options for solving this problem were analyzed using the AHP method.

Based on the need for free stock space, three options have been suggested for solving this problem: disposal, sale of parts or archiving of pilot parts.

3. Results Analysis

In table 1, attributes, alternatives and degree of importance of each attribute were considered, considering all items as relevant facts that should be taken into consideration in all alternatives that may be the best option, the importance is how important this attribute is. in relation to others.

Attributes / Alternatives	Discard	Archive	Sell	Importance
Space occupied	20 m²	40 m²	45 m²	3
Product Reproduction Fidelity	1	10	3	9
Long Term Billing	Null	Excellent	Medium	7
Financial flexibility	R$5,00	R$10,00	R$3,00	3
Social and environmental responsibility	No	Good	Enough	5

Table 1 – Attributes x Alternatives

Source: Authors (2018)

The alternatives that turned out to be the options are: discard, file or sell, the pilot parts is intended for one of these three options. Attributes have their certain weights in each of these alternatives.

The attributes are: space occupied, product reproduction fidelity, long term billing, financial flexibility, social and environmental responsibility. The occupied space deals with the area used to store the part. To discard, the piece should be in a warehouse of about 20sqm until someone comes to get it to end. If it is filed will need a warehouse with 40sqm to deposit the piece, along with the others. If the option is to sell, the piece should be sent to the bazaar where sales are made in certain seasons in the year, this bazaar with 45sqm. Taking into account costs such as depreciation, cleanliness of the environment and the built space itself, the smaller the area, the better for the company.

Fidelity in product reproduction refers to the ability to reproduce in the future on a large scale, ensuring the details of the pilot piece. This can also help customers close deals more easily by ordering from viewing what has already been produced. The values of the alternatives mean that the higher the fidelity the higher the probability of accuracy in future productions.

As for the long-term billing attribute, if it discards the parts, the billing is null, since, disposing of the part, the company is subject to disburse amounts for transportation and final disposal. Archiving the parts as already mentioned can guarantee future sales for customers who wish to repeat the part. Finally, if it is

for sale, revenue is existing, but low, as it will only be for the price of the part. Financial flexibility is about how much the company will have to invest for each of the options.

Finally, the social and environmental responsibility is the concern of the company with the environment, if you decide to discard, the piece will go to recycling points, where it will undergo a process in which the fabric will be transformed into yarn, which can be used as raw material. for the manufacture of new products. However, there are few initiatives, especially in the region, that involve proper disposal. Because the recycling process is very labor intensive and most of the tissue waste stations that have been found do not offer the option of tissue recycling. Another way to dispose would be to dispose of it in a landfill or landfill, and this option is not appropriate, since depending on the composition of the fabric, the pieces would take hundreds of years to decompose and could still release gases and toxic substances into the soil and in the water table. If you come to file the responsibility for the waste, it is guaranteed, since the archiving of the part will not harm the environment, but if the option is to sell, while the part is in the hands of the company there are no risks, but after purchase it can be used and later discarded by the purchaser.

After the explanation of each item, follows for the demonstration of the calculations according to Table 2.

Attributes	Space occupied	Product Reproduction Fidelity	Long Term Billing	Financial flexibility	Social and environmental responsibility	Relative Priority
Space occupied	0,07	0,08	0,06	0,07	0,06	0,07
Product Reproduction Fidelity	0,43	0,48	0,50	0,43	0,50	0,47
Long Term Billing	0,29	0,24	0,25	0,29	0,25	0,26
Financial flexibility	0,07	0,08	0,06	0,07	0,06	0,07
Social and environmental responsibility	0,14	0,12	0,13	0,14	0,13	0,13

Table 2 – Relative Priority of Second Level Criteria Matrix

Source: Authors (2018)

After comparing the attributes, according to the degree of importance defined by experts in the area, the matrix was normalized, adding the values obtained from each attribute by columns, with the result of this sum, dividing each column item by the overall sum The column allowed the relative priority values to be obtained, which is the average of each attribute per row. What gave the highlight value was the faithfulness in the reproduction of the product.

From this we proceed to the comparison of the criteria as shown in table 3.

Alternatives	To discart	To file	Sell
To discard	1	4	6
To file	1/4	1	2
Sell	1/6	1/2	1
Sum	1,42	5,50	9,00

Table 3 – Comparison matrix criterion space occupied

Source: Authors (2018)

Likewise, as was done with the attributes, it was made for the alternatives, in Table 3 the alternative space with the others was compared quantitatively, from values defined with the degree of importance. In table 4, the priority value of the space occupied criterion was obtained.

Alternatives	To discart	To file	Sell	Relative Priority
To discard	0,71	0,73	0,67	0,70
To file	0,18	0,18	0,22	0,19
Sell	0,12	0,09	0,11	0,11
Sum	1,00	1,00	1,00	1,00

Table 4 – Matrix Relative Priority Space occupied criterion

Source: Authors (2018)

The same was done with all alternatives, product reproduction fidelity, long-term billing, financial flexibility and environmental responsibility, all with their respective relative priorities, always with outstanding value.

Finally, Figure 1 shows us all the values obtained by comparing each criterion separately and their relative priorities found, the rows were multiplied with the relative priority column of the attributes (Table 2) and their sum.

$$\begin{Bmatrix} 0{,}70 & 0{,}08 & 0{,}09 & 0{,}17 & 0{,}09 \\ 0{,}19 & 0{,}79 & 0{,}70 & 0{,}74 & 0{,}74 \\ 0{,}11 & 0{,}13 & 0{,}21 & 0{,}09 & 0{,}17 \end{Bmatrix} \times \begin{Bmatrix} 0{,}07 \\ 0{,}47 \\ 0{,}26 \\ 0{,}07 \\ 0{,}13 \end{Bmatrix} = \begin{Bmatrix} 0{,}131075 \\ 0{,}714985 \\ 0{,}153941 \end{Bmatrix}$$

Figure 1 – Global equation

Source: Authors (2018)

The value found indicates that archiving is the best choice for business. As shown by the calculations, it was found that consideration was given to the importance and weight of all items.

4. Conclusion

The aim of the present study was to analyze, through the AHP decision - making method, the most suitable destination for the pilot pieces of a textile industry located in the south of Santa Catarina. The

research used in the case study was quantitative and qualitative and we used bibliographic research, because information was taken from existing articles and manuals and field.

Three alternatives for the final arrangement of pilot pieces in a garment industry in the south of Santa Catarina state were investigated. To decide the best alternative, between discarding, archiving or selling the pieces of the showcase, the AHP decision making method was used.

The AHO method showed, quantitatively, that the alternative archiving pilot parts is the best option, with approximately 71.5% when compared to the other alternatives. From this decision the company should have a space in its factory park to organize the stock of pilot parts.

5. References

[1] BRIOZO, R. A., MUSETTI, M. A. (2015) Métodos multicretério de tomada de decisão: Aplicação ao caso da localização espacial de uma Unidade de Pronto Atendimento – UPA 24h. Gestão e Produção. v. 22, n. 4, p.805-819.

[2] FONSECA, J. J. S. (2002) Metodologia da Pesquisa Científica. 1. ed. Fortaleza: UEC.

[3] FURASTÉ, P. A. (2007) Normas técnicas para o Trabalho Científico: Elaboração e Formatação. 14 ed. Proto Alegre.

[4]MEDEIROS, J. B. (2007) Redação Científica: a prática de fichamentos, resumos e resenhas. 9 ed. São Paulo: Atlas.

[5] MENEGUELE, E. (2000) O processo decisório nas pequenas empresas de confecção cianortenses – Teoria e Prática – Sob a ótima de Herbert Simon. Anais da XX SEMAD,Universidade Estadual de Maringá, Maringá, p. 393-400.

[6] SAATY, T. L.; ZOFFER, H. J.(2013). Principles for Implementing a Potential Solution to the Middle East Conflict.Notices Of The American Mathematical Society, v. 60, n. 10, p.1300-1322.

Mobile App Interface Development for Tourism

Lucas Dias Melo
lucasdiasmelo0@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Jeann Alef Pereira Rodrigues
jeann_aleff@outlook.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Kalebe Carmo Caldas
kalebe.caldas@hotmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Bruno Pereira Gonçalves
golcalves.bruno@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Jean Mark lobo de oliveira
jeanlobolive@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Abstract

This article aims to present the development of the interface creation process for a tourism application that works from a map, presenting several routes. Based on the usability principles, a scientific investigation was developed about the idea, the target audience to be served and the flow of screens. As a result, we obtained simple screens that were designed so that the user took as few steps as possible to reach his goal, making it easier to use and understand with the application. In conclusion, it was possible, putting into practice principles of usability and user experience, to obtain a satisfactory interface that fulfills its function.

Keywords: Interface; Usability; Accessibility; Mobile.

1. Introduction

This article is about developing an interaction design project for a mobile app. Preece (2005) says that

"interaction design is the design of interactive products that support people's daily activities, whether at home or at work. Specifically, interaction design is the area that seeks to create experiences that enhance and extend the way people work, communicate, or interact. There are ways to support people, that is, users. " This follows the theme of tourism facing Brazil, where it provides destinations and how to get to the place, which was previously chosen by the user. The target audience of the project is between 19 and 40 years old. They are adventurous and practical, and are always looking for something new. The elaborative processes were performed based on the principles of interface-man machine interaction and follow the responsive model, since the Android system has numerous screen sizes and this model allows the optimization of the arranged elements.

2. Materials and Methods - Experiences

In the development of the project were used fundamental tools for a good progress. Among them the first one used was the way of research about which situations we could help people who travel around Brazil in search of knowing historical places and other places of a certain city.

A brief survey was conducted with ten known people. They were asked the following questions. From these questions, graphs were prepared containing their answers, as shown below.

3. Application Development

For the development of the application, was initially made a research on the main form of decision of tourists regarding the choice of destinations and all stages of a trip.

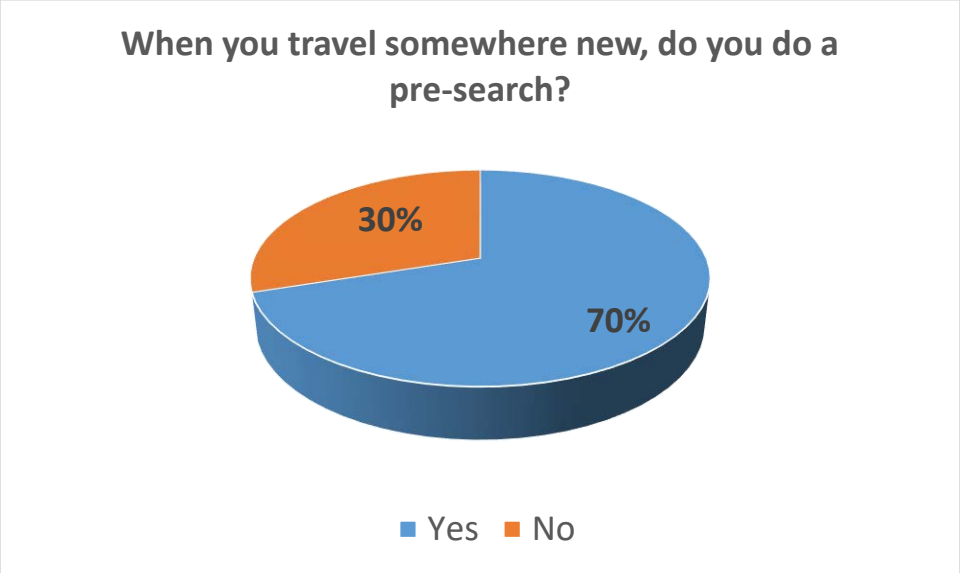


Figure 1 – Question about new destinations

Source: Own author

The question about new destinations in the chart in Figure 1 was asked why some people like to know the place and be surprised, or simply do not have time to search. Meanwhile, for safety, other people seek to know and know where they are going, familiarizing themselves with the destination even before being

there.

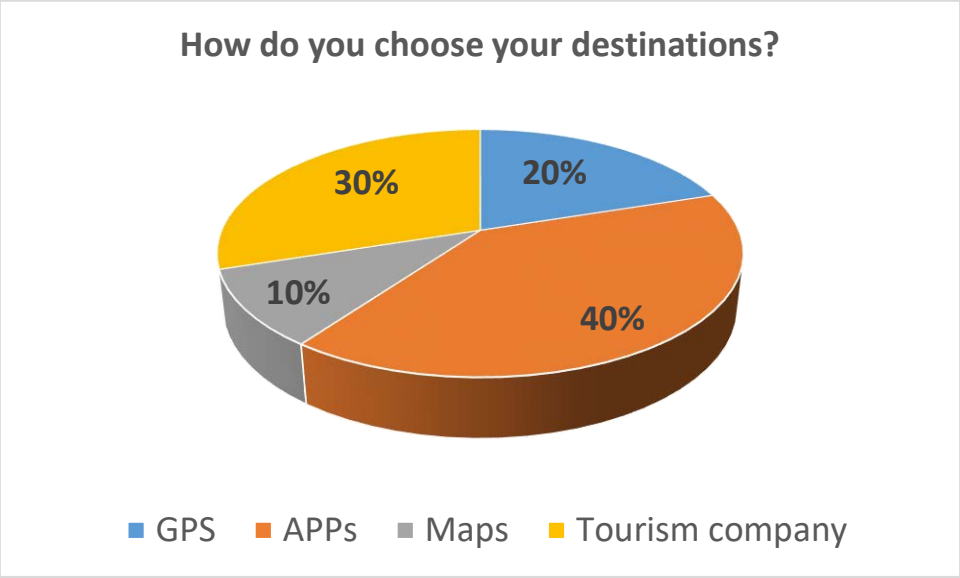


Figure 2 – Destination Choice Question

Source: Own author

With increasing technology, the number of people traveling alone is increasing as people are increasingly connected, especially through their mobile phones. This then facilitates the preference for using apps to search for locations. The graph in figure 2 shows the search results on how to choose the destination.

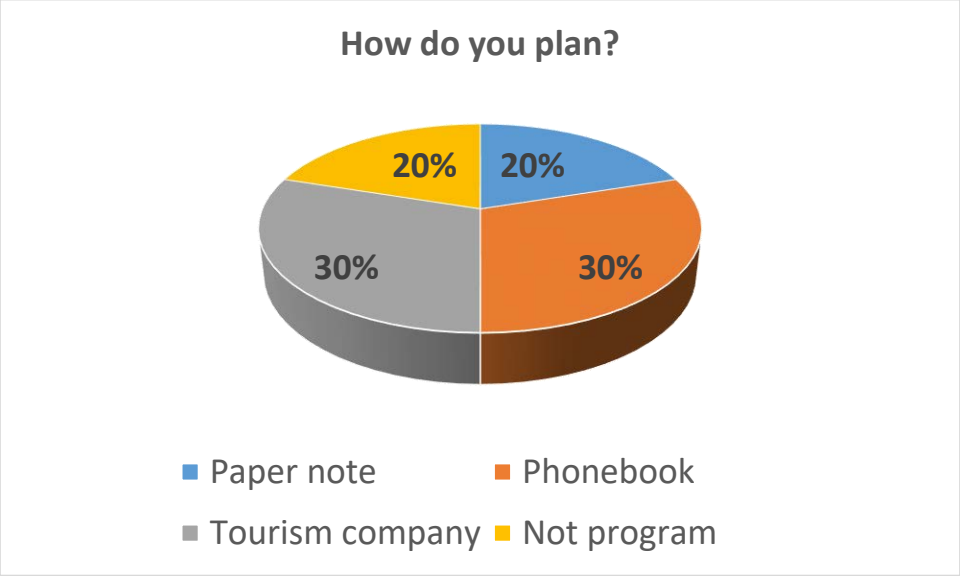


Figure 3 – Travel Planning Question

Source: Own author

Figure 3 shows the results graph of the question about forms of travel planning. Because the schedule for visiting the chosen places is often important for some, yet there are those who write down on paper, others prefer the practicality of a cell phone, which is always in your pocket. Tourism companies also usually already plan a scheme for visiting places. Other people don't really program themselves, preferring to think about what to do when they reach a new location in the comfort of a hotel.

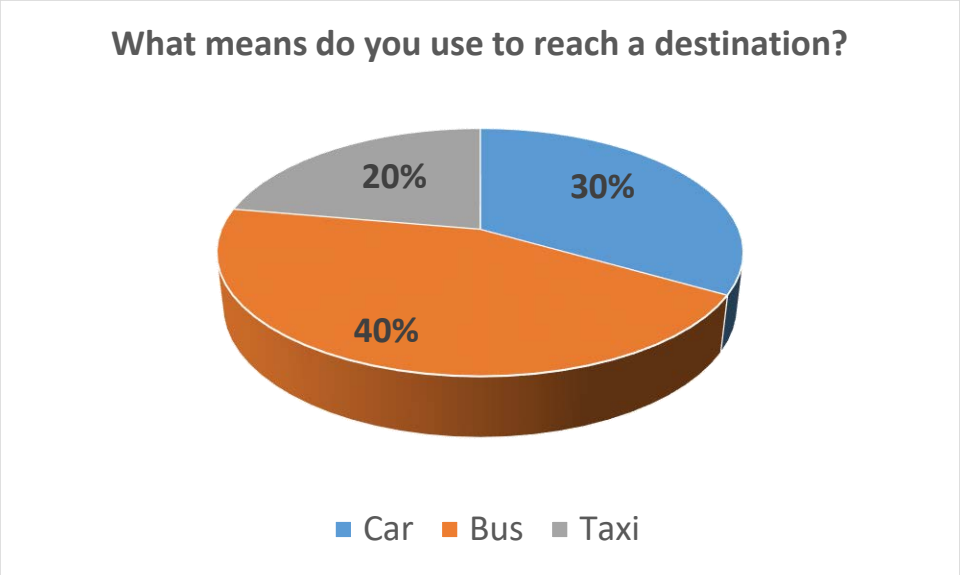


Figure 4 – Question about Travel Means
Source: Own author

Figure 4 shows that while traveling, some people choose to rent a car, while others go by bus (on their own or by the tour company) and others prefer the comfort of a taxi.

Figure 5 – Question about travel acquisition modes
Source: Own author

Figure 5 shows the preference of tourists as to how to travel, while some prefer to travel on their own, most prefer to travel through a tourism company, in the same proportion that defines according to destination. With this data, you can have the audience profile to which the application is directed. Most people, although preferring to travel alone, enjoy safety and planning before doing so. They are also people who use smartphone technology to plan themselves. In addition to the questions, some people agreed that some information from certain locations is scattered on the internet, making it difficult to find it in one place.
In the next step, we use the brainstorm technique, which consists in exploring ideas for better solutions

from a group of people. Using this group dynamics technique, we were able to explore the creative potential of the group and come up with a problem proposal to be solved. Then, a mind map was set up, which according to Pazmino (2015) is a tool for organizing ideas that radiate from a main idea, concept or content. In the mind map we put the main points that involve the users and so we could see minimal things that for some time we could not identify. Where a diagram was used to enable better understanding, memorization, learning and problem solving.

For interface was developed from a flowchart and wireframes where we put the proper tasks that the user will have and to test if the functions are in accordance with the plans so that there will not be so many revisions in the future.

And serving as a reference for developmental requirements, the flowchart comes to define, evaluate and visualize interactive sequences, possible deviations and offsets, and whether the sequence makes sense to the user. A flowchart can show more than one task, but its time is short and a more elaborate project that tends to contain more tasks is better to make a flowchart for each task.

An analysis of the tasks contained in the flowchart was also made, according to Pazmino (2015), this analysis serves to avoid problems and facilitate the development of functional products. The result of this analysis should generate needs that are listed and mention possible solutions to improve product comfort and use, making it simpler, operational and emotional.

The following is the flowchart with the following screens to display:

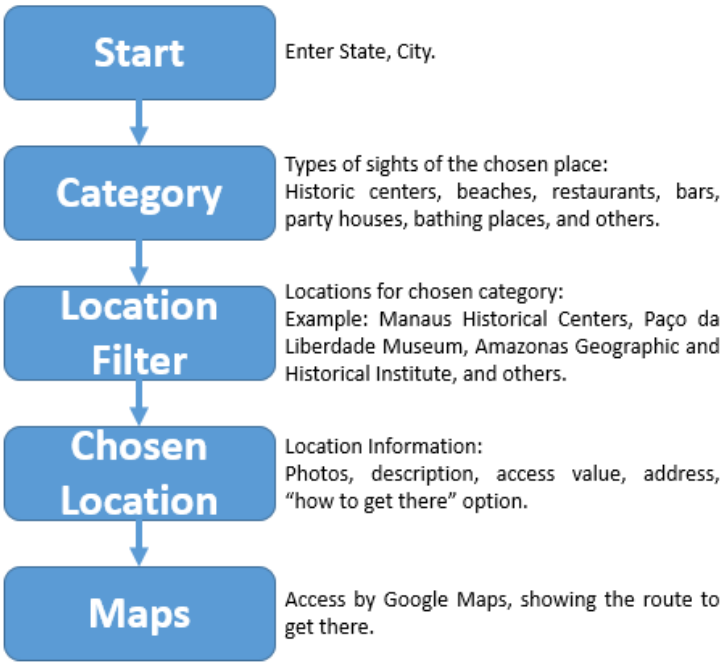


Figure 6 – Project Flowchart
Source: Own author

Another feature that is very important for the process of creating and completing the interaction design project is the so-called wireframe, which according to Treder (2016), "a wireframe is a low fidelity

representation of a design. Consider them as the skeleton of your design and remember that wireframes must contain the representation of all important parts of the final product. ”

Below are wireframes containing the following screens to be displayed to the user:

Figure 7 – Wireframe Entry Screen
Source: Own author

Figure 8 – Wireframe Category Screen
Source: Own author

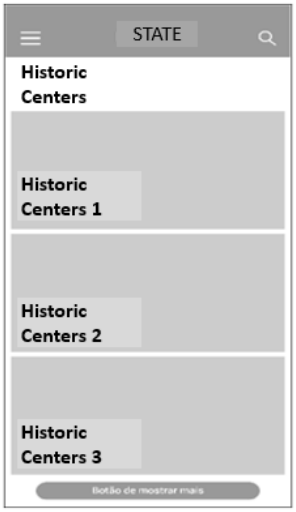


Figure 9 – Wireframe Screen with Seats
Source: Own author

Figure 7 shows the space to select the state and city where the user is located. He can type the name of the place, a menu appears showing cities with similar names. Figure 8 shows a Mosaic containing the categories presented by the app, and a brief description of the previously chosen city. And Figure 9 presents a category filter, this time showing only the locations related to the selected category.

Figure 10 Wireframe Location Info Screen
Source: Own author

Figure 11 Wireframe Location Route Screen
Source: Own author

Figures 10 and 11 show the choice of destination, where the destination, distance and a predicted arrival time are informed, also shows the initial acquisition value.

In order to develop the application interface we used tools to design visually shown in figure 12, as would

be its aesthetics through vectorization software (Illustrator CC 2015, version 19.0.0 - 64 bit).

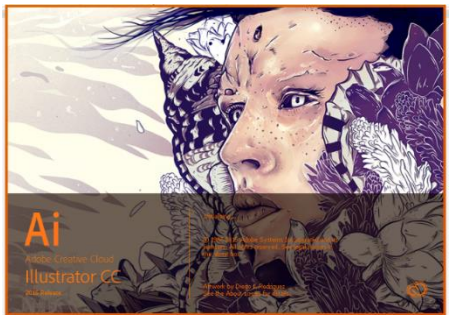


Figure 12 – Adobe Illustrator CC 2015
Source: Own author

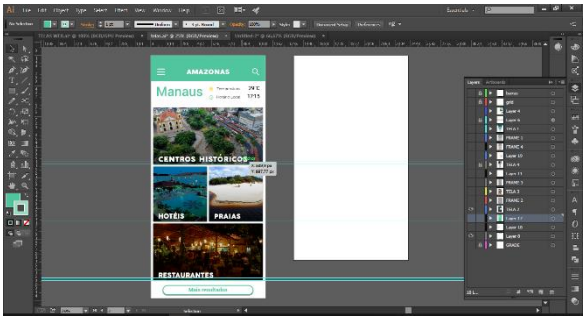


Figure 13 – Grides para a construção das telas
Source: Own author

In this tool, as shown in figure 13, grids were placed for the construction of the screens with their correct measurements and the entire interface look. In order to reach the result, knowledge of Gestalt and also Theory of Color were applied.

Gestalt, in short, seeks to study how we perceive form, explaining why some ways please more and others not. Dondis (2007) says that Gestalt psychology has contributed valuable studies and experiments in the field of perception, collecting data, seeking to know the importance of visual patterns, which may vary according to the culture of the subject.

One of the Gestalt principles that we attached importance to in this paper is alignment. With the alignment it was possible to organize the elements so that they connected in the layout, creating visual harmony for the user.

The study of colors is also very important in the development of any project, as they can generate feelings. According to Heller (2012), “no color is meaningless. The effect of each color is determined by its context, that is, by the linking of meanings in which we understand the color. ”

Following figures 14 to 18 are shown the results achieved, the clean and simple interface is presented, as it focuses on making the user comfortable and satisfied, the green water refers to the sky, sea and the most common landscapes to all places of Brazil.

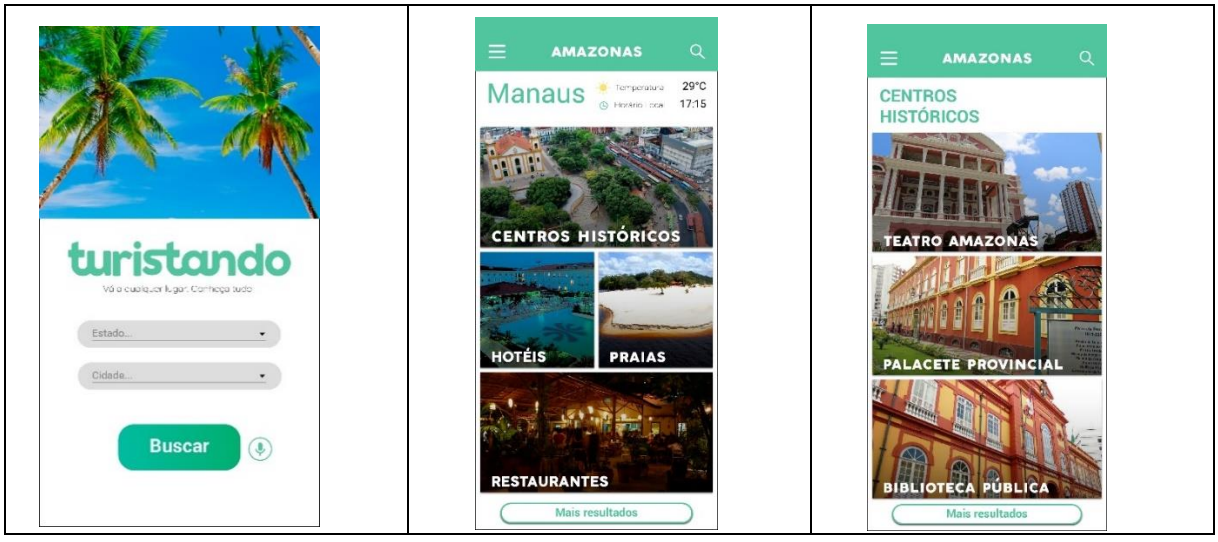


Figure 14 – Login screen Source: Own author	Figure 15 – Category Filter Source: Own author	Figure 16 – Location Filter Source: Own author

Figure 14 shows the home screen, where you enter the desired city and state search input information, the screen has a presentation with an image that represents the sensation of travel and tourism. Figure 15 shows the category filter, where you have the choice of historic centers, hotels, beaches and restaurants, and other attractions, also provides illustrations in each option, with representation of each item. Figure 16 presents the local visits location filter that are highlighted in each chosen destination, the application contains images in this area that shows the context of each choice.

Figure 17 – Chosen Location
Source: Own author

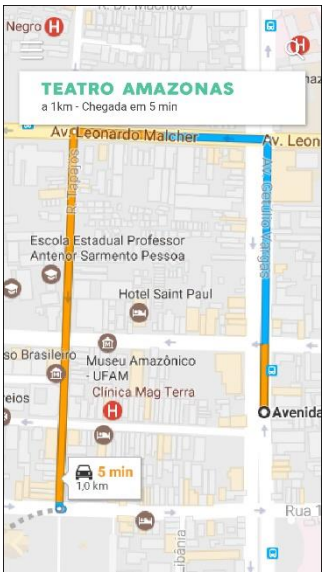


Figure 18 – Location Route
Source: Own author

Figures 17 and 18 show the choice of location and location route, give a brief description of the chosen location, and show the map with the aid of GPS.

Figure 19 – Justinmind (version 7.9.2)
Source: Own author

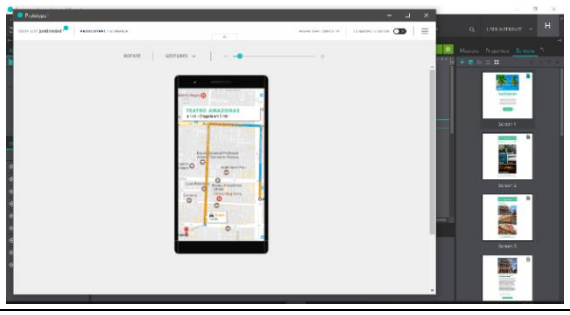


Figure 20 – Development example
Source: Own author

To simulate how the user would use the application we use the Justinmind Prototyper program which is a prototype simulator where we tested all usability of the application. It is designed to make it easy to create websites and applications for web and mobile platforms. His role within the development process is to provide tools for those involved to make prototypes and wireframes without major complications.

After all interfaces were developed, it was applied as an image, shown in figures 19 and 20, in Justinmind to have a prototype closer to the real for the user to find the places.

These were the presentations and bases of application development, demonstrating all the steps and foundation for construction.

4. Results Obtained

From the development of this project we had the opportunity to once again find a problem to be solved. We succeeded in planning the interfaces from a survey with real people, who always seek comfort when performing tasks. Each of the screens was designed for the user to use as few steps as possible.

It was also thought, at the moment the application is launched, that it is possible to know what it is easily. Who, even if it is layman, can make use of it in the first attempt. For this, we applied our knowledge about usability, Preece (2005) points out that usability will be responsible for ensuring that the products are user-friendly, pleasant and efficient from the users' point of view.

However we achieved our goal, shown in Table 1 that was to develop something with good accessibility, thinking of the public that has little contact with technology, but out of necessity uses it.

Table 01 - Statement of objectives achieved

MAIN GOAL	-Elaborate a simplified interface with a maximum of five steps to be taken;
What has been achieved	-An app with five steps to reach the main function of the app; - From an audience survey, everyone highlighted the cleanliness and simplicity of the app.

The application can become one of the best known in the market, helping tourists from all over the country to know and reach their destinations with ease.

The time taken to design the application was about four weeks, as shown in Table 2, one for the idea, another for the wireframe, one for creating the screens, and one for organizing the results in a scientific paper. Below is an explanatory table that shows the time taken and what was accomplished during it. The project was developed in a month, with exactly one week dedicated for each step to be completed.

Table 2 - application development time.

ELAPSED TIME	**WHAT WAS DONE**
Week 1	Choice of theme, application name, objectives and conceptualization;
Week 2	Audience research; Elaboration of wireframes;
Week 3	Completion of ready screen layouts;
Week 4	Application simulation to check usability errors.

4.1. Discussion Of Results

In the future, the app could be adapted to an iOS version, increasing the range of the audience. It could also be a social network, including other functions such as user profile and sharing of usability and accessibility information.

5. Conclusion

In conclusion, it was possible to develop the practice of wireframing, audience research and mainly user experience. It was possible to study how he behaves before a screen and the decisions to be made by him. Taking into consideration all the points for the development of this project, we analyzed that all the steps of conception of the interface design, addressing the concepts of usability and IHC (Human and Computer Interaction) were of paramount importance to develop the solution hypothesis.

Thus, this project allowed us to understand the concepts of interaction design and its tools as a support tool for the way people communicate and interact in their daily lives, whether at home or at work.

6. Acknowledgments

We express our sincere thanks to our family and friends who contributed to the research done for the project; to the people who expressed their opinions and ideas about the problem to be solved. Our thanks also go to the institution FAMETRO - Metropolitan College of Manaus, NoPE and the director Sueli.

7. References

AMBROSE, Gavin. Layout. Porto Alegre: Bookman, 2012.

DAMASCENO, Anielle. Web Design: Teoria e Prática. Florianópolis: Visual Books, 2003.

DONDIS, Donis A. A Sintaxe da linguagem visual 3º Edição. São Paulo: Martins Fontes, 2007.

HELLER, Eva. A Psicologia das Cores: Como as Cores Afetam a Emoção e a Razão. Barcelona: Gustavo Giili, 2012.

PAZMINO, Ana Veronica. Como se Cria. São Paulo: Blucher, 2015

PREECE, Jennifer; ROGERS, Yvonne; SHARP, Hellen. Design de Interação: Além da Interpretação Homem-Computador. Porto alegre: Bookman, 2005.

ROBERTS, Lucienne. Grids: Soluções Criativas para Designers Gráficos. Porto Alegre: Bookman, 2009.

TIMOTHY, Samara. Ensopado de Design Gráfico. São Paulo: Blucher, 2010.

TREDER, Marcin. Wireframing, Prototyping, Mockuping – What's the Difference?, 2016. Disponível em: <https://designmodo.com/wireframing-prototyping-mockuping/>. Acesso em: 24 de Maio de 2017.

WHEELER, Alina. Design de Identidade da Marca. São Paulo: Bookman, 2012.

Informational Flow of Logistics Processes: study on the process of fertilizer importation to Brazil.

Giovane Vasconcellos,
Postgraduate researcher in Strategic Business Management - UNESPAR, Paranaguá (BRAZIL)
vasconcellos.giovane@gmail.com

Dra Elaine Cristina Lopes,
Department of Administration – UNESPAR, Paranaguá (Brazil)
elaine.lopes@unespar.edu.br

Dra Luciane Scheuer
Department of Administration – UNESPAR, Paranaguá (Brazil)
luciane.scheuer@hotmail.com

Abstract

Due to the great potential of the fertilizer market in Brazil in reason of its productive characteristics, the goal of this article was to present a study about the perspective of informational flows aiming at the mapping of the relevant information inherent to the stages of the fertilizer importation process. By using the observation method, it was possible to map this information from the beginning of the process, which is the fertilizer output from the international seller to the final buyer in Brazil. The case study was conducted in an American company, with an office in the city of Paranaguá -PR (Brazil), which imports fertilizers.

Keywords: Strategic information management; Informational flow; Fertilizer import.

1. Introduction

According to a survey accomplished by the consultant Global Fert (2019), the fertilizer importation into Brazil in 2018 was 24.96 million tons, making Brazil one of the 6th largest fertilizer consumers in the world. The large consumption of the product reflects a growing worldwide demand for food since Brazil is one of the world's largest agricultural producers. Additionally, there is the potential factor of production considering that there are still large areas unexplored by agribusiness, many of which are still used as pastures and others awaiting government demarcations.

The importance of the fertilizer market for Brazil illustrates the growing concern of organizations in this context, as they are inserted in an environment where certain factors can directly impact in the financial results and market positioning; such as exchange rate variations, ship waiting lines, lack of storage space for products in rear warehouses, uncertainties related to the country political and economic contexts, as well as the changes in market regulations, among others.

In this sense, it is emphasized that this is an environment where information is an important support for decision making, especially considering its specificities. It is argued that environments with complex characteristics that suffer different influences, need special attention related to the information strategic management. By mapping the informational flow in the logistics context, especially in the scope of importation, the creation of positioning tools and strategies can be very efficient.

Considering this scenario, the present paper sought to map the informational flow of importation in a fertilizer importing organization that operates in Paranaguá-PR (Brazil), city which has the second largest Brazilian port in terms of movement volume.

2. Literature Review

2.1 Business Informational Flow

Information is a fundamental element for all organizational activities, regardless of the company sector. Since it is an important subsidy that flows across all areas as part of the organization chart, the information requires that the management can be done specifically. Such management aims to support both business processes and planning using instruments that make information and its articulation more efficient and accessible in all areas of the company.

However, in order to the organization to be able to manage strategic information, it necessary to map out its information flow so that it can understand what information is generated and for what purposes. Initially, the informational flows mapping considers the existence of formal or informal informational flows, and both of them permeate all company environments, and it may exist in registered and unregistered form. In this sense, Lopes (2010) argues that "formal flows are due to the company own structure, in other words, routines and elements applied to the productive processes, being related to the company organization chart. In this case, the recorded information goes through the formal systems of the company: corporate portals, Intranets, reports, records, documents containing rules and codes, among others. And in unregistered form through formalized meetings, courses and events, but not registered in any form of support. As for informal flows, these can arise spontaneously, in a meeting or even in a conversation between employees, being related to the intellectual structure of each individual acting in the company. It is noteworthy that informal flows, in general, take the form not recorded, considering that they come from dialogues and interactions not formalized among people and, therefore, not registered in any support." (LOPES, 2010, p. 30

In this context, it is necessary to understand the need of establishing access policies in the organizational context, but more than that, policies that provide the knowledge of the existing informational flows necessary for the productive activities. In this sense, Beal (2004) argues that for information management to be effective, it is necessary to establish a set of policies that allow access to relevant, accurate and quality information, and such information must be disseminated in a timely manner, at an appropriate cost and ease to users access.

McGee and Prusak (1994) point out that the value of information in the organizational context is determined by the user, that is, the flows exist because of the use needs. Then it can be said that the information to be useful depends on the analysis performed by the user according to his/her need and circumstances of applicability in the context.

Thus, it is argued that informational flows in the organizational context depend essentially on needs and, therefore, it is essential that before the organization conducts any strategic, tactical or operational in order to start a decision-making process, it is fundamental to map relevant information in this context.

2.2 Specific situations in the fertilizer importation process in Brazil

The main role of fertilizer is to provide the nutrients necessary for the growth of a particular type of crop during its development phase, because the soil where is cultivated does not always have all the nutrients necessary for the full development of the plants, which in any time lead to the loss of productive potential. The main nutrients responsible for crops development are: N (Nitrogen), P (Phosphorus) and K (Potassium), being the Nitrogen responsible for the plant photosynthesis and reproduction, Phosphorus is responsible for growth and Potassium mainly for plant resistance (Reetz, 2016).

Despite being worldwide among the major agricultural producers, Brazil is still not self-sufficient in fertilizer production, and about 75% of domestic demand is imported, in other words, only 25% of the fertilizer consumed in Brazil is produced in the national territory. According to Anda (2019) only in 2018 Brazil imported about 24.96 million tons of fertilizers that were distributed among several productive regions of the country.

According to Kotler and Keller (2006), the decision of buying a product is a process that goes through five steps: "recognizing the problem, seeking information, evaluating alternatives, deciding on the purchase and finally the post-purchase.

Thus, in relation to the fertilizer purchase process, in addition to the process of demand analysis based on the needs, the search for information about the best products and suppliers, the evaluation of alternatives such as choice of modal and costs of the purchase process, it is necessary to consider the need to fulfill a series of steps, so that the product can be released, be a requirement from Brazilian Federal Revenue and/or Ministry of Agriculture, for example.

The liberation process of the product initially goes through an application for Import Authorization (IA) with the consenting agency. In the case of fertilizer this document is issued by the Ministry of Agriculture. In the IA is recorded the basic information of the purchase: who is the importer; what is the country of origin and exporter information. Subsequently, the IA is released to the responsible agency, and an Import Declaration (ID) must be registered in the Brazilian Federal Revenue, which with the Siscomex system manages import information data: from the importer and exporter, means of transportation, form of payment and all relevant product information (Lopes; Gama, 2013).

2.2.1 Logistics in the fertilizer import process

The fertilizer import process has three steps in general. Each step generates a specific informational flow and involves different processes according to their specificities. The import process begins with the transportation of the producing source to Brazil and, after the internal procedures inherent to the port sector, the product goes to its final destination. Initially, it is important to highlight the relationship of this process with the transportation and the choice of the modal. According to Faria (2001), "the transportation of something is basically between its origin and its destination, and may occur in modes: Maritime, Air, Land or even combinations of modes".

Shipping is responsible for handling about 90% of all that is traded among countries around the world and because of this volume is necessary to use large ships, in addition to the need for ports to receive, loading and unloading that must be prepared to meet the demand, considering that the port efficiency directly influences to the productivity, considering the efficiency and speed in the process, besides the logistic cost reduction for the organizations (Machline, 2011).

In Brazil, according to the report done by the National Waterway Transportation Agency (Agência Nacional de Transportes Aquaviários – ANTAQ, 2019) the movement of foreign trade using maritime modal is responsible for moving the trade among countries in about 95%.

Related to the port structure, according to the report of the Administrative Council for Economic Defense (Conselho Administrativo de Defesa Econômica – CADE, 2019), only in 2018, around 998 million tons of goods were handled in the public and private ports of Brazil. "The movement was divided among: solid bulk, liquid and gaseous bulk, containers and general cargo". Specifically, the fertilizer falls within the category of solid bulk.

According to Anda's report (2019), in 2018, Brazil imported about 24.96 million tons of fertilizers, taking into account the total movement in the ports of Brazil, the importation of fertilizers represents about 3% of what is imported by maritime modal.

For the fertilizer entry to happen, the importer must choose the final destination, taking into account its logistics demand, costs and port efficiency, because due to different port terminal regulations the fertilizer ends up disputing docking preferences in ports with other products.

After choosing the port for destination of the product entrance, the importer will have, in addition to the costs with cargo handling services that depend on the *incoterm* that it was chose, costs with the following service providers, according to Figure 1.

Figure 1. Port services indicators

Service	Service Provider
Ship agency and expedition	Shipping agente
Help for navigation and use of headlights	Brazil Navy
Ship health surveillance and inspection	ANVISA (Agência Nacional de Vigilância Sanitária) - National Health Surveillance Agency
Foreign entry and exit control	Federal Police
Customs Inspection	Brazil Federal Revenue
Practice	Practicing companies or association of practitioners
Towing	Port tugboats companies
Port watchmen	Freelancers
Mooring	Terminal operator or port administration

Source: ANTAQ (2019)

Once the maritime transportation process has been overcome, the cargo that enters Brazil needs to be transported from the port structure to the final destination and for the transportation of the product. Two modes of transport stand out: the first and most popular is the road and also the rail.

The road modal transports products by road, street and highways, whether paved or not. It is the most used modal in Brazil (Alavarenga; Novaes, 2000).

This is the most widely used modal for transporting fertilizers from the port to the final producer. And according to Novaes (2007) yet, the road modal is the most expressive in the transportation of cargo in Brazil, and reaches practically all points of the national territory.

Subsequently, it is highlighted the railway modal, also used in the transportation of fertilizers. Although the costs are lower with this modal, especially considering the amount of fuel used, this modal is limited to the number of railway lines that do not receive expansion in Brazil, besides the fact that it is a transport that does not offer flexibility and speed in delivery.

In this sense, the main advantage in the use of the rail modal is the transportation of high loads, as well as low energy consumption. However, its disadvantage is the low number of routes, the delay in the route and the large exposure to theft (Keedi, 2004)

3. Results and Discussions

3.1 Materials and methods

In order to accomplish the present study, it was used the method of participant observation research and case study. For participant observation, May (2001) argues that the great advantage is that the researcher can establish a long-term relationship with the investigated ones, because the observer participates in the process that he/she is researching and thus allowing more deeply the interpretation of the context by the researcher.

As for the case study, the advantage is to have more detailed and systematic information about a given phenomenon that allows emphasizing the understandings in a context without forgetting the representativeness, which ends up focusing on the study real context understanding (Patton, 2002).

The case study was conducted at an American fertilizer trader based in Brazil. The company has a commercial office in São Paulo-SP and an operational office in Paranaguá-PR. The organization business is focused on imported fertilizer trade, and it conducts foreign purchase negotiations and sale business in Brazil.

Then, the presentation of the data will be categorized according to the points observed during the process analysis, respecting the informational and procedural flows. Therefore, the analysis considers the following categories.

3.2 Presentation of results and discussions

3.2.1 Category: Purchase Process

In order to make the product purchase, first of all, the commercial department conducts a market demand study, based on research from expert institutes that analyze the fertilizer market in Brazil. It is based on a

trend of how the demand is, in other words, if there is low, medium and or high demand for the offered product, as well as what is the trend of the offered price, if high and or low. Based on the considerations made by the institutes and allied to the market know-how and feeling, the commercial department makes the decision of buying or not the products abroad.

3.2.2 Category: Producer output

As the study was conducted in an American company, despite being in Brazil, it was found that it rigorously analyzes information about supplier countries, considering that this company does not do business with producing countries that are on the list of US trade embargoes, such as Iran and Iraq for example, and careful it do not negotiate with the sanction list countries. It was observed that it is also important to analyze information about companies that have and/or had business with the restricted countries, so the main producers who supply to the organization are located in the United Arab Emirates, Russia and China. The contact with the producer is made by an organization representative that is installed in strategic regions, close to the producer.

The main product traded by the company studied is the nitrogen fertilizer called Urea, which has the utility of supplying nitrogen to the plant helping in the photosynthesis and reproduction process. The main destination is the fertilization of corn and coffee plantations. A detail exposed by the commercial department is that often the cargo is bought abroad and between the loading and transit period, they are still working on sales, in other words, the product is not yet fully sold, which generates a "rush" to the finalization of the process so that must occur in a timely manner.

As for the modal, the cargo transportation from the country of origin to Brazil is done by ship. It is hired by the freight department, which focuses only on hiring and attendance the ship loading.

According to the average made by the director of the logistics operations, the transportation time to Brazil after loading the ship is around 45 days when it is loaded in a Chinese port, the time is about 35 days when is from Russia and it is around 40 days from the United Arab Emirates.

As for information on climate issues, they have strategic importance as they imply in the ship loading and unloading which may be affected according to the weather. For example, it is not possible to operate in a rainy day, which directly affects the cost of the ship, because the longer the ship is moored, the more cost is generated to the importer.

3.2.3 Category: Uploading attendance in Brazil

As for the ship departure time it was observed that the average loading of a ship of approximately 43,000 tons with urea is around 8 days under favorable weather conditions. The calculation made to estimate the loading time is agreed by contract, both supplier and importer, which generally corresponds to a total of 7 thousand tons loaded per day. Thus, when there is negotiation of the product purchase the importer receives the information about the *laycan*, which is the window where the supplier needs to start loading the ship. For example, *laycan* 15/06-20/06, it is understood that this period will be the mooring of the ship at the origin and the beginning of loading.

As for the information about the route, the ship route from origin to the destination is defined by the ship commander, and the principle it to program the best route which offers the best weather conditions and the

shortest transit time.

As for the product quality control during transit process, specifically during the journey from origin to final destination, there are no product quality controls, the quality control process is performed only when the ship is being loading. In this case, the importer designates a quality supervisor for the verification and monitoring of the cargo on loading, and at the unloading process another quality supervisor is appointed for verification. This procedure aims to perform a control with the purpose of minimizing quality problems during the transportation. Other relevant information is the fact that the ship charterer should carry out a checklist in order to analyze the ship history, taking into account its age, last loads and flag.

Related to the arrival at the destination, it is noteworthy that during the ship journey the captain sends notifications about the ship progress, informing the estimated day of arrival at the port of destination. At the moment that the captain moors at the port of destination, he sends a statement called: NOR, which means NOTICE OF READINESS, basically stating that the ship is able to dock at the port and it is ready to unload.

3.2.4 Category: Port terminal

Regarding the choice of terminal, it was observed that at the time of closing the ship freight with the charterer, the commercial department requests the freight price of two Brazilian ports for unloading. Although there is a variation in the freight price, this procedure is performed to facilitate the logistics of delivery to customers, since not all cargo is already sold, so the commercial department has the flexibility to meet demands. Thus, the choice of the terminal happens according to the sales negotiations of the imported fertilizer, until its conclusion, and the choice of the terminal is up to the customer. For example: customer buys 10,000 tons of urea opting for delivery at the Port of Paranaguá-PR.

As for ship scheduling, it is done according to the order of arrival at the ports. From the moment the ship arrives at the port of destination and it informs the interested parties that it is able to start the unloading, the ship enters in a mooring line and it is are attended in a sequential order, except in some specific cases of ports where there is a preferred row for mooring.

As for the port internal logistics control, the unloading process is carried out by the port operator which is hired by the ship charterer, however, the operation costs are divided among all importers. The process of moving from the port to the factories is carried out by importers.

3.2.5 Category: The admission in Brazil

Related to the process liberation, for the admission of the urea in Brazil, the analyzed organization is responsible for providing all the necessary documents for the client to make the process with the intervening agencies, including the Federal Revenue of Brazil and the Ministry of Agriculture. The customer is responsible for the liberation of the cargo.

The costs inherent to the customs process are the responsibility of the importing establishment, except in case the seller does not show the documents required by the responsible agencies.

3.2.5 Category: Transportation and the choice of modal

Regarding the modal to send the fertilizer to the final buyer, it was observed that all the importers analyzed

in the research use the road transportation modal, mainly due to its ease in terms of time and productivity gains. As for the costs, they are all paid by the importers.

4. Conclusion

This paper aimed to analyze, from the perspective of information management, how the process of fertilizer importation is carried out from its inception, through customs procedures to its final destination. Therefore, a mapping of the informational flow inherent to these processes was performed. The universe chosen for the case study was a fertilizer market trader that operates in the purchase of imported fertilizers and resale in Brazil.

As observed throughout the process, the focus of the organization is on fertilizer trade and the information flow is aligned with the information management and t is present in the organizational process, as the sectors involved communicate continuously during the process reporting deviations dealing with routine matters.

It was also observed that weekly meetings occur in each department, which are deal issues such as ongoing processes, problems and possible complications. This sharing of information facilitates the identification of possible relevant factors regarding process improvements or adjustments. It was observed that the organization has as its principle a horizontal management, a factor that contributes to information management and its dissemination. There are also shared folders on organization web servers and Sharepoints that help it to share information that is essential to building knowledge.

Finally, it is argued that information flow mapping is an important tool, since it enables the knowledge of all stages and details of the processes, which provides subsidies for managers to make decisions in a timely and assertive manner.

5. Reference

[1] ANDA (Associação Nacional para Difusão de Adubos). Disponível em: <http://www.anda.org.br/home.aspx>

[2] ANTAQ (Agência Nacional de Transportes Aquaviários). Disponível em: <http://portal.antaq.gov.br/>

[3] Anthony, R.N. Planning and control systems: a framework for analysis Cambridge: Harvard University Press, 1965.

[4] Alvarenga, A. C.; Novaes, A. G. N. Logística aplicada: suprimentos e distribuição física. 3. ed. São Paulo: Edgard Blucher, 2000.

[5] Assunpção, R. M. Exportação e Importação – Conceitos e Procedimentos Básicos. São Paulo: Ibpex, 2007.

[6] Ballou, R. H. Logística Empresarial: transportes, administração de materiais e distribuição física. São

Paulo: Atlas, 2009.

[7] Barbosa, R. R. O uso de fontes de informação por consultores empresariais: um estudo junto ao mercado de consultoria de Belo Horizonte. Perspectivas em Ciência da Informação, Belo Horizonte, 2007.

[8] Bertaglia, P. R. Logística e Gerenciamento da Cadeia de Abastecimento. 2.ed. rev. e atual. São Paulo: Saraiva, 2009.

[9] Bowersox, D. J; CLOSS, D. J. Logística Empresarial: o processo de integração da cadeia de suprimentos. São Paulo: Atlas, 2007.

[10] CADE (Conselho Administrativo de Defesa Econômica). Disponível em: <http://www.cade.gov.br/>

[11] Dias, M. A. P. Administração de materiais: uma abordagem logística. São Paulo: Atlas, 1993.

[12] Faria, S.F.S. Fragmentos da História dos Transportes. São Paulo: Aduaneiras, 2001.

[13] Global Fert. Principais Origens de Importação de Fertilizantes no Brasil em 2018. Disponível em: <https://globalfert.com.br/boletins-gf/23>

[14] Keedi, S. Logística de Transporte Internacional: veículo prático de competitividade. 2. ed. São Paulo: Edições Aduaneiras Ltda., 2004.

[15] Kotler, P; Keller, K. L. Administração de Marketing. 12. ed. São Paulo: Pearson Prentice Hall, 2006.

[16] Lopes, J. M. C.; Gama, M. Comércio exterior competitivo. 4. ed. São Paulo: Aduaneiras, 2013.

[17] Machado, M. C.; Toledo, N. N. Gestão do processo de desenvolvimento de produtos: uma abordagem baseada na criação de valor. São Paulo: Atlas, 2008.

[18] Mc Gee, J.; Prusak, L. Gerenciamento estratégico da informação. Rio de Janeiro: Campus, 1994.

[19] Machline, C. Cinco décadas de logística empresarial e administração da cadeia de suprimentos no Brasil. RAE - Revista de Administração de Empresas, vol. 51, núm. 3, maio-junho, 2011.

[20] May, T. Pesquisa social. Questões, métodos e processos. 2001. Porto Alegre, Artemed.

[21] Patton, M. G. Qualitative Research and Evaluation Methods, 3 ed. Thousand Oaks, CA: Sage, 2002.

[22] Ministério da Agricultura. Disponível em:

<http://www.agricultura.gov.br/assuntos/importacao-e-exportacao/importacao-e-exportacao-insumos-agricolas-fertilizantes>

[23] Neto, R. D. C. A., Gestão do conhecimento em organizações. Curitiba: Saraiva, 2002.

[24] Reis, P. R. R. Logística Empresarial como Estratégia Competitiva: caso do centro de distribuição da AMBEV. Florianópolis-SC, 2004.

[25] Reis, H. F. Fertilizantes e o seu uso eficiente. Edição IFA, Paris, França, Maio 2016.

[26] Sordi, J. O. de. Fundamentos. In: SORDI, J. O. de. Administração da informação: fundamentos e práticas para uma nova gestão do conhecimento. São Paulo: Saraiva, 2008.

Toxicity assessment of *Syzygium jambos* and *Solanum guaraniticum* hydroethanolic leaf extracts thru *Artemia salina* lethality and spleen lymphocyte cytotoxicity tests

Gabriela Bonfanti-Azzolin[a*], Andressa Leal Zambra[b], Bruna Morgan da Silva[b], Karine Santos De Bona[c], Paula Eliete Rodrigues Bitencourt[d], Lariane Cargnelutti[d], Raphaela Maleski Borges[d], Mayara L. De Freitas[d], Ricardo Brandão[e], Josiane Woutheres Bortolotto[b], Aline Augusti Boligon[d], Aline S. Pigatto[f], Maria Beatriz Moretto[d], Thissiane de Lima Gonçalves[d]

[a]*Programa de Pós-Graduação em Atenção Integral à Saúde, Universidade de Cruz Alta, Cruz Alta, RS, Brasil*

[b]*Curso de Farmácia, Universidade de Cruz Alta, Cruz Alta, RS, Brasil;*

[c] *Curso de Farmácia, Universidade Regional Integrada do Alto Uruguai e das Missões (URI), Santo Ângelo, RS, Brazil;*

[d] *Programa de Pós-Graduação em Ciências Farmacêuticas, Universidade Federal de Santa Maria, Santa Maria, RS, Brasil*

[e] *Departamento de Ciências Farmacêuticas, Centro de Ciências da Saúde, Universidade Federal de Pernambuco, Recife, PE, Brasil.*

[f] *Universidade Fransciscana, Santa Maria, RS, Brasil*

Abstract

The aim of this study was to investigate the toxicity of *Syzygium jambos* and *Solanum guaraniticum* leaf extracts, through *Artemia salina* lethality testing and cytotoxicity evaluations in rat spleen lymphocytes, using methyl tetrazolium (MTT), neutral red uptake (NRU), trypan blue dye exclusion, and lactate dehydrogenase (LDH) leakage assays, besides by their *in vitro* effects on acetylcholinesterase (AChE) activity. The LC50 calculated in the *A. salina* bioassay demonstrated that both extracts might well be toxic. *Solanum guaraniticum* presented cytotoxic effects against lymphocytes, as demonstrated by viable cells count reductions, NR uptake, and increased LDH leakage. *Syzygium jambos* appears to present immunomodulatory properties, increasing lymphocyte mitochondrial activity and inhibiting AChE activity. The results demonstrated the possible harmful effects of these vegetal preparations and may be helpful in therapeutic decisions and future studies with respect to the toxicology of these extracts, when used as phytotherapeutic medicines.

Keywords: Myrtaceae, Solanaceae, toxicity, vegetal extracts;

1. Introduction

Herbal medicines have received great interest as an alternative to clinical therapy. However, despite the

widespread use of these agents, safety pharmacology studies are relatively restricted and mainly limited to compounds with broad industrial use (Palozi et al., 2019).

In Brazil, different vegetal species are used as as important sources of food and medicine (Palozi et al., 2019). Certain examples such as *Syzygium jambos* (L.) Alston (Myrtaceae), and *Solanum guaraniticum* A. St.-Hil (Solanaceae), are recognized as medicinal species. The first is known by the Brazilian population as "jambolão" and its leaves are mainly used to treat diabetes (Teixeira et al. 2000). Its anti-inflammatory, antibacterial, antifungal, analgesic, diuretic, expectorant and digestive properties are also explored in folk medicines of other countries (Rajkumari et al., 2018). The second specie mentioned above, *Solanum guaraniticum*, is known by the common name "falsa-jurubeba" and is used to treat liver, anemia, and gastric dysfunctions (Penna 1964, Bonfanti et al., 2016).

One common problem regarding the medicinal use of these plants is mistaken identity and eventual use of replacements such as; *Syzygium cumini* and *Solanum paniculatum,* which already have their therapeutic properties elucidated. Safe medicinal use of *Syzygium jambos* and *Solanum guaraniticum* preparations is unsubstantiated by scientific data, and previous studies by our group have already demonstrated enzymatic inhibition caused by these vegetal extracts, and *in vitro* pro-oxidant effects on erythrocytes and tissues (Bonfanti et al. 2013, 2014).

Toxicity screening models provide important preliminary data to help select natural remedies with potentially beneficial health properties (Pour et al. 2011; Mounanga, Mewono, Angone 2015), and *in vitro* cytotoxicity assays are widely used for this purpose. Following exposure to toxic substances, neutral red uptake (NRU), trypan blue dye exclusion, 3-(4,5-dimethylthiazol-2yl)-2,5-biphenyl tetrazolium bromide (MTT), and lactate dehydrogenase (LDH) leakage assays are commonly employed to detect cytotoxicity and other negative effects on cell viability (Fotakis & Timbrell 2006).

Further, the enzyme acetylcholinesterase (E.C. 3.1.1.7, AChE) plays an essential role in the physiological events involving turnover of acetylcholine in the central nervous system. It is an important target of a large number of cholinesterase-inhibiting drugs and toxins (Pohanka 2011). The enzyme also has been acknowledged for having roles in non-neuronal tissue, including regulation of the immune functions (Kawashima & Fujii, 2003, Nizri & Brenner, 2013). Interestingly, several studies have demonstrated that natural substances and dietary components affect AChE activity, suggesting that they can modulate its activities in various tissues (Li et al., 2017; Mendonça de Assis et al., 2019).

Another alternative is to test for toxicity of chemical and natural products based on lethality to *Artemia salina* L. (Artemiidae), the brine shrimp, an invertebrate of saline aquatic and marine ecosystems. The *A. salina* lethality test has been used to determine toxicity by estimating medium lethal concentrations (LC_{50} values), for a series of toxins and plant extracts (Meyer et al. 1982; Choi, 2017).

The current study has been undertaken to investigate the toxicity of *Syzygium jambos* and *Solanum guaraniticum* leaf extracts through *Artemia salina* lethality testing, and to measure AChE activity and cytotoxicity through *in vitro* evaluations of rat spleen lymphocytes.

2. Material and Methods

2.1 Preparation and High-performance liquid chromatography (HPLC) characterization of hydro-

ethanolic leaf extracts

Leaves of *Solanum guaraniticum* and *Syzygium jambos* were collected, dried and submitted to extraction with 80% ethanol in a Soxhlet apparatus until exhaustion. After extraction, the solvent was evaporated by rota-vapor, supplying the dried crude extract. Reverse phase chromatographic analyses were then carried out under gradient conditions using a C18 column (4.6 mm × 250 mm) packed with 5 µm diameter particles; mobile phases being acetonitrile:water (95:5, v/v), and water:phosphoric acid (98:2, v/v). The presence of eleven (11) antioxidant compounds was investigated, namely; gallic, chlorogenic, caffeic and ellagic acids, and catechin, epicatechin, quercetin, quercitrin, isoquercitrin, kaempferol and rutin. Identification of these compounds was performed by comparing their retention times and UV absorption spectrums with those of the commercial standards. The chromatographic peaks were confirmed by comparing their retention times with those of reference standards and by DAD spectra (200 to 500 nm).

2.2 Animals and preparation of spleen lymphocytes

Male adult albino Wistar rats (200-250g, n = 6) were used according to the guidelines of the Committee on Care and Use of Experimental Animal Resources, Federal University of Santa Maria, Brazil (Process number 052/12). The rats were euthanized, and the spleen was aseptically removed, cut into several pieces, and gently crushed in phosphate buffered saline (PBS). Lymphocytes were then collected by centrifugation, erythrocytes were lysed (0.15 M NH_4Cl, 1 mM $NaHCO_3$, 0.1 mM EDTA, pH 7.4), and cells were re-suspended in PBS. The cell count was adjusted to contain 3×10^6 cells/mL by trypan blue exclusion.

2.3 Spleen lymphocytes treatments and experimental assays

Solanum guaraniticum and *Syzygium jambos* extracts were added to the cell suspensions at final concentrations of 100, 250, 500, 750, and 1000 µg/mL (Bonfanti et al. 2014). The lymphocytes exposed to the extracts were then incubated at 37°C for 2 h.

After incubation, the treated cells were submitted to MTT assay (Mosmann, 1983), the neutral red uptake test (NRU) (Borenfreund & Puerner 1984), and the trypan blue dye exclusion test (Mischell & Siingi 1980). The measurement of lactate dehydrogenase (LDH) leakage from cells was also performed by determining the LDH activity in the supernatant using a commercial kit (LABTEST, MG, Brazil). AChE activity was determined according to the method described by Ellman et al. (1961) modified by Fritzgerald and Costa (1993). The MTT, NRU, and LDH test results are presented as percentage of control, whereas the results of the trypan blue dye exclusion test are presented as the number of live cells. AChE activity was expressed in µmol AcSch/h/mg protein.

2.4 Artemia salina lethality test

Differing concentrations of the extract dilutions in distilled water were evaluated for lethality with *Artemia salina* (brine shrimp larvae), using the procedure described by Meyer et al. (1982). After 24 h of hatching, the larvae (10 per vial) were transferred to 10 ml vials containing the extract dilutions and saline solution (three triplicates of each concentration). The number of survivors was counted after 24 h and 48 h of incubation, and the number of dead larvae was recorded and used to calculate the 50% lethal

concentration (LC_{50}) by trimmed Spearman-Karber, the conventional Spearman-Karber method being described by Finney (1971).

2.5 Statistical Analysis

In the *Artemia salina* test, the lethal concentration fifty (LC_{50}) and 95% confidence interval were determined from the 24 h and 48 h counts using the Finney (1971) computer program. All other analyses were performed using STATISTICA for Windows, version 6.0 (StatSoft Inc. Tulsa, OK, USA). All data were analyzed using one way ANOVA, followed by Duncan's multiple range test and presented as mean ± standard error of mean (SEM). A value of $p < 0.05$ was considered statistically significant for all analyses.

3. Results and Discussion

In this study, *Solanum guaraniticum* extract gave distinct results in spleen lymphocyte viability tests (Figure 1). After the incubation period, cell suspensions treated with *Solanum guaraniticum* ranging from 250 – 1000 µg/mL presented numbers of live cells significantly lower than untreated cells; this was demonstrated by the trypan blue dye exclusion test. Further, starting from a concentration of 500 µg/mL; the extract also affected lysosomal functionality and cell membrane integrity, as was observed in the NRU and LDH leakage tests. However, no alteration was detected by MTT assay, suggesting that the extract did not affect mitochondrial activity. Considering that the neutral red cytotoxicity assay examines the ability of a cell to incorporate a water-soluble dye (neutral red) into lysosomes, a process requiring cellular energy (Putnam et al. 2002), the extract might interfere with the normal energy-requiring endocytosis processes, as well as causing membrane disruption and releasing LDH into the medium.

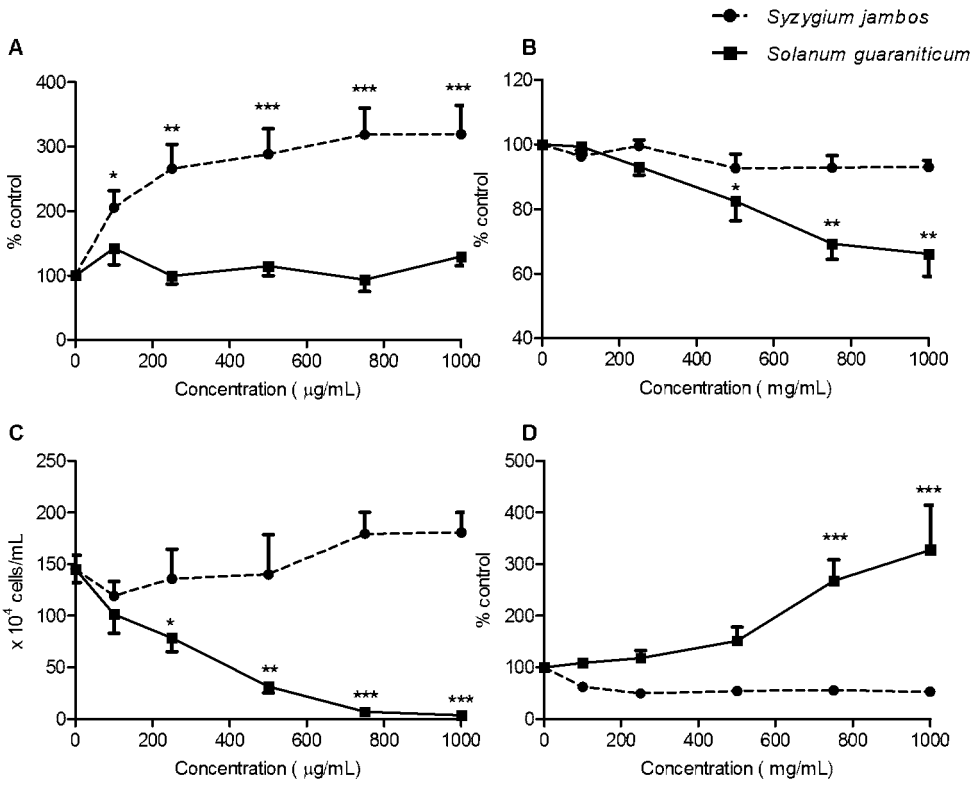


Figure 1. Viability tests of spleen lymphocytes treated with *Syzygium jambos* and *Solanum guaraniticum* extracts: MTT assay (A), neutral red uptake test (B), trypan blue dye exclusion test (C), LDH leakage (D). Results are expressed as mean ± SEM (n = 6) assessed by one way ANOVA followed by Duncan Multiple Comparison post hoc test. (*), (**) and (***) denotes $p<0.05$, $p<0.001$ and $p<0.0001$, respectively, as compared to the respective control samples (without extracts).

On the other hand, none of the viability assays used in this study suggested cell damage after incubation with *Syzygium jambos* extract (Figure 1). These data are in accordance with a previous study showing that *Syzygium jambos* ethanol extract was not toxic to human cells (Sharma et al. 2013). Interestingly, *Syzygium jambos* extract seems to have a stimulatory effect on treated cells, since it increased MTT viability. Taking into account that the MTT assay is used to monitor cell activation and to determine mitochondrial activity (Gerlier & Thomasset 1986), the result could indicate immunostimulant effects since lymphocyte activation is a central event in the inflammatory/immune response (Cavallini et al. 2001).

In line with this, the inhibitory effect of *Syzygium jambos* extract on AChE activity in spleen lymphocytes was also demonstrated (Figure 2). The function of AChE in lymphoid tissue is to regulate the amount of ACh surrounding lymphoid cells according to immunologic demands (Nieto-Cerón et al. 2004, Nizri & Brenner, 2013). In this context, AChE becomes a potential contributor to the pathway which controls inflammatory and immune responses in the blood. It has been demonstrated that AChE inhibitors reduce lymphocyte proliferation and secretion of pro-inflammatory cytokines, and may attenuate inflammation by increasing acetylcholine concentration in the extracellular space (Nizri et al. 2006). Therefore, the results presented in this study provide insight into a possible mechanism of anti-inflammatory action for *Syzygium jambos* extract, which has already been cited in previous studies (Slowing et al. 1994; Sharma 2013).

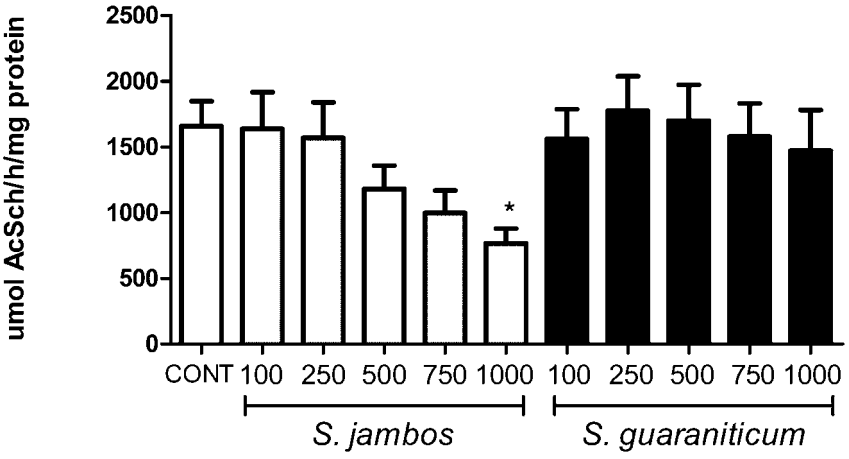


Figure 2. Effect of extracts tested on the acetilcholinesterase activity of spleen lymphocytes. Results are expressed as mean ± SEM (n = 6) assessed by one way ANOVA followed by Duncan Multiple Comparison post hoc test. (*) denotes $p<0.05$ as compared to the control (without extracts).

When assessing the toxicity of plant extracts using the *A. salina* bioassay, an LC_{50} value lower than 1.000 µg/ml is considered bioactive (Meyer et al. 1982). Both of the extracts tested in this work presented

this effect (Table 1). They therefore can be considered biologically active and may be toxic to humans. *A. salina* testing is useful for screening plant extracts in order to predict their lethality. A previous study (Logarto et al. 2011) has already demonstrated a good correlation ($r = 0.85$; $p < 0.05$) between the LC_{50} of the *A. salina* assay, and the LD_{50} of the acute oral toxicity assay in mice. Based on this correlation result, a value of $LC_{50} > 25$ µg/ml in the *A. salina* test corresponds to an *in vivo* LD_{50} value of between 2.500 and 8.000 mg/kg. Therefore, we may deduce that the *in vivo* LD_{50} of oral acute toxicities of *Syzygium jambos* and *Solanum guaraniticum* leaf extracts are likely more than 2.500 mg/kg.

Table 1. *Artemia salina* lethality test of the plant extracts under study

	24 h		48 h	
	LC_{50} (µg/mL)	95% Confidence interval	LC_{50} (µg /mL)	95% Confidence interval
Syzygium jambos	362.70	346.01 – 380.20	391.02	376.28 – 406.34
Solanum guaraniticum	557.04	458.23 – 677.16	113.31	53.37 – 240.55

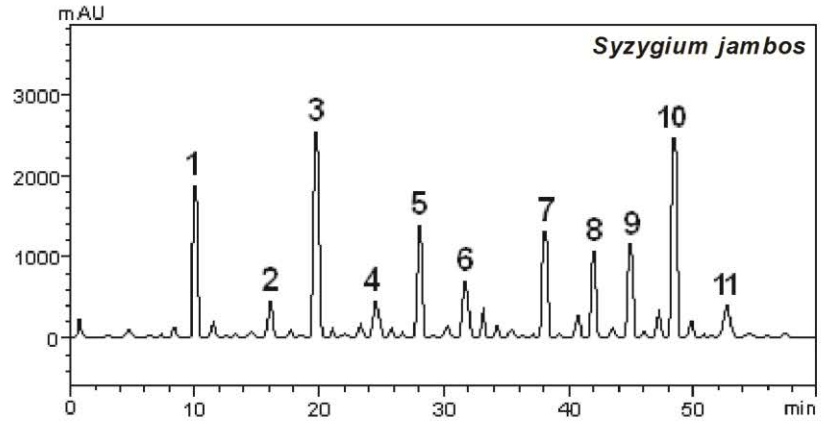
Values are expressed as an average of triplicates.

Syzygium jambos presented similar LC_{50} values when *A. saline* larvae were exposed for 24 or 48 hours to differing concentrations of extract, indicating that its toxicity is not time-dependent. The LC_{50} values (at 48h) of *Syzygium jambos* extract found in this study are also similar to those already reported for its methanolic leaf extract (Mohanty & Cock 2010).

However, the results obtained with *Solanum guaraniticum* extract showed that toxicity increased considerably with exposure time, calling attention to chronic consumption. Another interesting result is that at 24 h, the LC_{50} of *Solanum guaraniticum* was lower than the LC_{50} of *Solanum paniculatum,* already described at 953.9 µg/mL; this suggests that the plant is more toxic than *S. paniculatum* (Silva et al. 2007). This is of particular importance since these plants are frequently used without distinction.

During phytochemical screening of the extracts, HPLC analysis revealed the presence in both extracts of; gallic, chlorogenic and ellagic acids, catechin, epicatechin, rutin, quercitrin, isoquercitrin, quercetin and kaempferol (Figure 3). Further, considering the chromatographic conditions used, caffeic acid was only detected in the *Syzygium jambos* extract. Considering that natural phenolic compounds target multiple metabolic and cell signaling pathways and have several biological effects, we suggest that these phytochemicals are related to the observed effects. However, both vegetal extracts studied deserve to have their compositions explored in future studies, as well as the mechanisms of their demonstrated biological effects.

Compounds	*Syzygium jambos*		*Solanum guaraniticum*	
	mg/g	%	mg/g	%
Gallic acid (1)	27.68 ± 0.02 [a]	2.76	7.41 ± 0.03 [a]	0.74
Catechin (2)	4.47 ± 0.03 [b]	0.44	10.53 ± 0.01 [b]	1.05
Chlorogenic acid (3)	34.96 ± 0.01 [c]	3.49	26.85 ± 0.06 [c]	2.68
Caffeic acid (4)	4.83 ± 0.03 [b]	0.48	ND	-
Ellagic acid (5)	19.35 ± 0.02 [d]	1.93	20.07 ± 0.02 [d]	2.078
Epicatechin (6)	9.76 ± 0.05 [e]	0.97	4.71 ± 0.02 [e]	0.47
Rutin (7)	18.92 ± 0.01 [d]	1.89	39.85 ± 0.01 [f]	3.98
Quercitrin (8)	17.34 ± 0.03 [f]	1.73	11.36 ± 0.05 [b]	1.13
Isoquercitrin (9)	17.55 ± 0.01 [f]	1.75	19.54 ± 0.01 [d]	1.95
Quercetin (10)	36.81 ± 0.02 [c]	3.68	5.17 ± 0.01 [e]	0.51
Kaempferol (11)	4.73 ± 0.05 [b]	0.47	9.73 ± 0.05 [b]	0.97



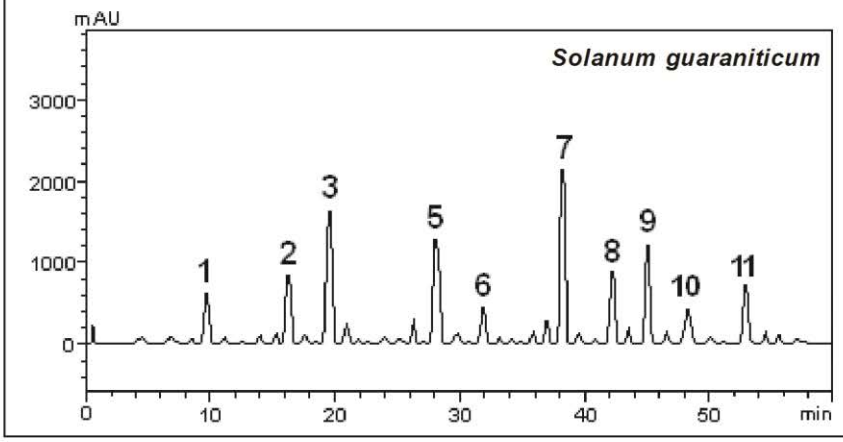


Figure 3. HPLC/DAD profile of extracts tested and quantification of phenolic compounds found at 327nm. Gallic acid (peak 1), catechin (peak 2), chlorogenic acid (peak 3), caffeic acid (peak 4), ellagic acid (peak 5), epicatechin (peak 6), rutin (peak 7), quercitrin (peak 8), isoquercitrin (peak 9), quercetin (peak 10) and kaempferol (peak 11). Quantification results are expressed as mean ± SEM (n = 3) assessed by one way ANOVA followed by Duncan Multiple Comparison *post hoc* test. Means marked with different letters are significantly different ($p < 0.05$). ND = not detected.

5. Conclusion

The present study demonstrated the bioactivity of *Syzygium jambos* and *Solanum guaraniticum* extracts in the *A. salina* lethality test, and calls attention to possible toxic effects regarding its medicinal preparations. Further, *Solanum guaraniticum* presented cytotoxic effects and appears able to affect lysosomal functionality and cell membrane integrity. On the other hand, *Syzygium jambos* extract presents stimulatory effect on lymphocytes, as well as AChE inhibition activity, which suggests immunomodulatory properties. The present results highlight the potential toxicity of these plant extracts, and may be helpful for making them promising pharmacological agents.

6. Acknowledgement

The authors acknowledge Universidade de Cruz Alta (UNICRUZ) and Universidade de Santa Maria (UFSM), RS, Brasil, for financial support.

7. References

Bonfanti G, Bitencourt PR, De Bona KS, Silva PS, Jantsch LB, Pigatto AS, Boligon A, Athayde ML, Gonçalves TL, Moretto MB. 2013. Syzygium jambos and Solanum guaraniticum Show Similar Antioxidant Properties but Induce Different Enzymatic Activities in the Brain of Rats. Molecules. 18: 9179-9194.

Bonfanti G, De Bona KS, de Lucca L, Jantsch L, Pigatto AS, Boligon AA, Athayde ML, Moretto MB, Gonçalves TL. 2014. Delta-ALA-D inhibitory potential and protective action of Syzygium jambos and Solanum guaraniticum leaf extracts on oxidatively stressed erythrocytes. Redox Rep.19: 206-213.

Bonfanti, G. et al. 2016. Safety assessment and behavioral effects of Solanum guaraniticum leaf extract in rats. Brazilian Journal of Pharmaceutical Sciences, v. 52, n. 1, p. 45-57.

Borenfreund E, Puerner J. 1984. A simple quantitative procedure using monolayer cultures for cytotoxicity assays (HTD/ NR-90). J Tissue Culture Meth. 9: 7-9.

Cavallini L, Francesconi MA, Zoccarato F, Alexandre A. 2001. Involvement of nuclear factor-kappa B (NF-kB) activation in mitogen-induced lymphocyte proliferation: inhibitory effects of lymphoproliferation by salicylates acting as NF-kB inhibitors. Biochem Pharmacol. 62: 141–147.

Choi, J.S. 2017. Larvicidal effects of grapefruit seed extract (GSE) on brine shrimp Artemia salina. Toxicology and Environmental Health Sciences, v. 9, n. 3, p. 209-214.

Ellman GL, Courtney DK, Andres V, Feather-Stone RM. 1961. A new and rapid colorimetric determination of acetylcholinesterase activity. Biochem Pharmacol. 7: 88–95.

Finney DJ. 1971. Probit Analysis. A statistical treatment of the sigmoid response curve. Cambridge, at University Press: New York.

Fotakis G, Timbrell JA. 2006. In vitro cytotoxicity assays: Comparison of LDH, neutral red, MTT and protein assay in hepatoma cell lines following exposure to cadmium chloride. Toxicol. Letters. 160: 171–177.

Fritzgerald BB, Costa LG. 1993. Modulation of muscarinic receptors an acetylcholinesterase activity in lymphocytes and brain areas following repeated organophosphate exposure in rats. Fundam Appl Toxicol. 20: 210–216.

Gerlier D, Thomasset N. 1986. Use of MTT colorimetric assay to measure cell activation. J Immunol Methods. 94: 57-63.

Kawashima K, Fujii T. 2003. The lymphocytic cholinergic system and its biological function. Life Sci. 72: 2101–2109.

Li, S. et al. 2017. Extraction and in vitro screening of potential acetylcholinesterase inhibitors from the leaves of Panax japonicus. Journal of Chromatography B, v. 1061, p. 139-145.

Logarto AP, Yhebra RS, Sardiñas G, Iglesias Buela L. 2011. Comparative study of the assay of *Artemia salina L.* and the estimate of the medium lethal dose (LD50 value) in mice, to determine oral acute toxicity of plant extracts. Phytomedicine. 8: 395–400.

Mendonça de Assis, P. et al. 2019. Plinia cauliflora (Mart.) Kausel: toxicological assays, biological activities, and elemental analysis of organic compounds. Natural Product Research, p. 1-5.

Meyer BN, Ferrigni NR, Putnan JE, Jacobsen LB, Nichols DE, McLaughlin JL. 1982. Brine shrimp: a convenient general bioassay for active plant constituents. Planta Med. 45: 31-34.

Mischell BB, Siingi SM. 1980. Selected methods in cellular immunology. W.H. Freeman Company: San Francisco.

Mohanty S, Cock IE. 2010. Bioactivity of *Syzygium jambos* methanolic extracts: Antibacterial activity and Toxicity. Pharmacognosy Res. 2: 4–9.

Mosmann T. 1983. Rapid colorimetric assay for cellular growth and survival. J Immunol Methods. 65: 55-63.

Mounanga, M.; Mewono, L.; Angone, S. 2015. Toxicity studies of medicinal plants used in sub-Saharan Africa. Journal of ethnopharmacology, v. 174, p. 618-627.

Nieto-Cerón S, Moral-Naranjo MT, Muñoz-Delgado E, Vidal CJ, Campoy FJ. 2004. Molecular properties of acetylcholinesterase in mouse spleen. Neurochem Int. 45: 129–139.

Nizri E, Hamra-Amitay Y, Sicsic C, Lavon I, Brenner T. 2006. Anti-inflammatory properties of cholinergic up-regulation: A new role for acetylcholinesterase inhibitors. Neuropharmacology. 50: 540-547.

Nizri, E.; Brenner, T. 2013. Modulation of inflammatory pathways by the immune cholinergic system. Amino acids, v. 45, n. 1, p. 73-85.

Palozi, R. A. C. *et al*. 2019. Pharmacological safety of Plinia cauliflora (Mart.) Kausel in rabbits. Toxicology Reports, v. 6, p. 616-624.

Penna M. 1964. Dicionario Brasileiro de Plantas Medicinais. Kosmos: Rio de Janeiro, Brazil.

Pour BM, Latha LY, Sasidharan S. 2011. Cytotoxicity and Oral Acute Toxicity Studies of *Lantana camara* Leaf Extract. Molecules. 16,: 3663-3674.

Pohanka M. 2011. Cholinesterases, A target of pharmacology and toxicology. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 155: 219–229.

Putnam KP, Bombick DW, Doolittle DJ. 2002. Evaluation of eight in vitro assays for assessing the cytotoxicity of cigarette smoke condensate. Toxicol In Vitro. 16: 599–607.

Rajkumari, J. et al. 2018. Anti-quorum sensing activity of Syzygium jambos (L.) Alston against Pseudomonas aeruginosa PAO1 and identification of its bioactive components. South African journal of botany, v. 118, p. 151-157.

Sharma R, Kishore N, Hussein A, Lall N. 2013. Antibacterial and anti-inflammatory effects of Syzygium jambos L. (Alston) and isolated compounds on acne vulgaris. BMC Complement Altern Med. 13: 1-10.

Slowing K, Carretero E, Villar A. 1994. Anti-inflammatory activity of leaf extracts of Eugenia jambos in rats. J Ethnopharmacol. 43: 9-11.

Silva TMS, Nascimento RJB, Batista MM, Agra MF, Camara CA. 2007. Brine shrimp bioassay of some species of *Solanum* from Northestern Brazil. Braz J Pharmacog. 17: 35-38.

Teixeira CC, Rava CA, Mallman da Silva P, Melchior R, Argenta R, Anselmi F, Almeida CR, Fuchs FD.

2000. Absence of antihyperglycemic effect of jambolan in experimental and clinical models. J Ethnopharmacol. 71: 343-347.

Non-Conformity Reduction in Painting Sector in Plastic Parts in a Company of the Industrial Pole of Manaus - IPM

Leonardo Matos Damasceno
leonardomtdamasceno@outlook.com
Centro Universitário FAMETRO – Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade do Estado do Amazonas – UEA - Brasil

Abstract

Among the focuses of industries is the reduction of waste costs, this makes the product competitive, reduces the number of failures and, consequently, the price to the end consumer. Industrial Pole of Manaus (I.P.M.) promotes the economic development of the region and brings together large and medium-sized companies that use plastic painting as one of the stages of their production process and care about quality and invest in management methodologies, resources and technologies to optimize your processes. With this in mind, improvements were proposed in a company to reduce defects in paint in plastic parts in the motorcycle sector, and the use of appropriate quality tools and management techniques, which enabled a more assertive decision-making, measured its effects and solved the causes of the problem. The type of non-conformity of the highest level of occurrence was approached, which are defects classified as impurities, from it were identified root causes found, all variations in processes that benefit the emergence of this defect and opportunities for improvements in the process. This it can be done only with behavioral changes and with minimal economic investment.

Keywords: Quality tools; Rework; Quality management; Defects;

1. Introduction

With increased competitiveness, that becomes long-term increasingly fierce and accentuated, companies have the ever increasing need to continually improve, to avoid non-conformity in their products

or processes, which may cause discomfort in the customer. According to [1] Total quality control is associated with the principle that quality is a work of all. Nowadays, it is important a high quality standard that favors market reliability, but does not affect the competitiveness of costs.

Most quality-related problems can be solved by using quality methods and tools, which can identify and resolve the root cause of the problem. They can even give, if well employed, the quality assurance, is generally the prevention of quality problems by means of planned and systematic activities, and should include the establishment of a good quality management system [2], the assessment of its suitability, the audit of the operation of the system and its revision.

With this, management seeks reliable techniques and tools that facilitate and assist decision-making regarding problems with non-compliance and over-rework. This coupled with cost reduction and as a consequence a more affordable price, favors the approximation, loyalty and customer satisfaction.

The study proposal will be to describe and analyze the methods of applying the appropriate quality tools and techniques to the company, for the reduction of defects that usually concern this type of process or production flow. In other words, the analysis will be carried out around the proposed project and employ for the reduction of rework by non-conformities in the painting process in plastic parts of motorcycles.

Accordingly, this scope, the objective of the article is to identify the actual results, and how its implantation was made, because, many improvement projects do not achieve good results due to several factors: inappropriate management, incorrect definition of the goal, lack of commitment of the team, among others [3].

Therefore, the entire flow of painting processes of the parts will be described by mapping the process flow, and will be presented the non-conformity and rework indexes of the line to demonstrate the effects of employing these techniques for resolving these types of problems.

2. Theoretical Foundation

2.1. Lean Production

Lean production is a reference to the Toyota production system of 1948 developed by Taiichi Ohno. According to [4] the “lean” production is actually a research program linked to MIT to define a much more efficient, flexible, agile and innovative production system than mass production.

Lean production is based on the premise of producing more with fewer resources, through improvement processes aimed at eliminating waste with the involvement of the company's organizational culture [5].

Regardless of the type of company or size, the concepts of Lean Production when implemented, can bring significant results in the short and medium term, therefore, its focus is to use tools to identify and eliminate wastes that only add cost to the company, but that does not add value to the product.

2.2. Quality Management

Quality Management (Q.M.) is part of every company that aims to meet customer expectations for product quality and to promote quality as an organizational culture of its production processes.

According to [6] quality management also aims to reduce waste and non-quality costs in production operations, improving business efficiency and enabling more competitive pricing, supporting QM is

product and production process related, the smaller the waste as defects in the product or rework in the productive lines, smaller cost by causing results such as increased competitiveness, with the possibility of reducing the price of the product, market gain and customer loyalty.

2.3. Process Mapping

Process mapping is important in identifying the logical sequence of operations that occur during the manufacture of a product or service provision. Additionally, it is also an important activity within the process management, it maps and describes with depth each operation developed in the processes and allows them to know in detail.

In a company, it is common for their processes to pass through so-called "addictions", which is a kind of process variation that modifies the original and that over time can become common. This is just an example of variation, but they can occur in any operation and processing step, due to raw material, work, or maintenance of the machine, cause adjustments in the process, that, over time, they are creating new procedures, new paths, which, in turn, modify the original process [7].

2.4. 5s Methodology

Started in Japan after the Second World War and that is linked to the philosophy of Lean production. 5S was created with the aim of promoting a suitable working environment to increase productivity [8].

According to [8] 5S is an educational process that aims to promote the behavioral change of people through participatory practices and knowledge of information, this change in behavior favors insertion and better understanding of the concepts of the philosophy of continuous improvement.

5S are concepts based on Japanese ideograms, where each S refers to five words that compose a consensus forming an important organizational program.

Seiri – means sense of utilization.

Seiton – means sense of organization.

Seiso – sense of cleanliness.

Seiketsu – sense of standardization.

Shitsuke – which translates as a sense of self-discipline.

For [9] the adoption and implementation of the criteria set out in the 5S program enable the achievement of relevant results.

2.5. Kaizen

Japanese origin, Kaizen is a word consisting of two ideograms: Kai, which represents change, and Zen, virtue or kindness. Bringing closer to its real representation in companies, Kaizen means change to the best and is a tool used for continuous improvement.

The Kaizen method of continuous improvement is generally described as a project focused on quality has the goal reduction of cost, waste and increased productivity.

Its execution takes into account some basic rules, such as:

- It aims to reduce cost;
- It is important that it be measured;

- It is usually applied in the form of small, medium or large project.

Kaizen is very simple, logical and obvious, but must respect some steps in its development and adoption process [8], that is, it must comply with a technical sequencing with the help of quality management tools.

2.6. PDCA Management System

The implementation of the quality management tools usually uses a general method, which may be called "Operation Logic" [7]. The most commonly used method for project management is PDCA, this method involves logical and technical sequencing activities, establishing structuring scripts that help the development by dividing the type of activity.

PDCA cycle aims at continuous improvement, and each letter determines a step of the process cycle:

Plan (P): It is the planning of actions that you want to implement. Here the action must be defined in a clear and objective way, thus, in this stage are defined the goals and objectives.

Do (D): Step in which is performed of what was planned in the previous step; activities such as training are performed at this stage. Here are also collected the data that will be analyzed in the previous step.

Check (C): This phase is present in all other stages, because it refers to the evaluation of what is being developed, it controls and analyzes the results of the previous action and coordinates the actions that will be taken in the next phase.

Act (A): At this stage, the action process is defined as agreements with the results obtained, whether the goals and objectives have been achieved or not.

Eventually, the cycle completes itself when this last step (action) finish and it is returned to planning. This logic completes the effort by continuous improvement [7].

2.7. Quality Tools

The process of continuous improvement involves important Kaoru Ishikawa seven quality tools proposed steps, such as data collection and process observation, search for root causes of problems, implementations of improvements without affecting the quality and verification of the results obtained, for this.

The quality tools assist in all these steps and in a technical and organized way facilitate the work. There are more than seven quality tools, since there are variations of the same tool [10], and there are management methods, however, only those that conform to the type of organizational culture should be employed, should be linked to the company's values and objectives. The use of only a few tools does not interfere with the quality of improvement projects; it should be available methods and techniques that facilitate the implementation of actions, using quality tools, adequate [7].

Action Plan 5W2H: This tool assists in the search for root cause of problems and helps in decision-making of actions that will be taken. It constitutes a spreadsheet with columns and lines, and divide by English words that mean why (?), what (?), when (?), where (?), how (?) and how much (?).

Flowchart: A tool shows visual and illustrative operations of a process. It is a very useful tool to record the flow of production by adopting a common language/universal language for learning purposes [10].

Cause-and-effect diagram: Developed by Kaoru Ishikawa, this tool aims to identify the root cause of problems; it has a fishbone shape and helps in quality management and control. According to [6], the diagram is structured to illustrate the various causes that lead to a problem.

Pareto chart: is a graphical resource used to establish an ordering on the causes of problems to be solved. It is a bar graph that sorts the frequencies of occurrences, from the highest to the smallest, allowing the prioritization of the problems.

Check sheet: The check sheet is a tool used to quantify the frequency with which certain events occur, in a certain period [11].

3. Tools and Methods

Through a case study, the research was conducted in a plastic injection industry of the Industrial Pole of Manaus.

For the development of the work, bibliographical bases were needed for the study to obtain a better understanding of the problems faced in the painting process with the objective of finding and eliminating root causes. Concepts focused on quality management and articles focused on strategies for eliminating problems in painting processes were researches considered relevant for the advancement of the work.

The article will divide into 4 phases for better actions management (PDCA), based on the operation logic of the Kaizen method because the focus of the work is the improvement of quality. They are: Diagnosis and planning of actions, execution, evaluation, and discussion of learning.

In the first phase (P), diagnosis and planning of actions, the current situation of the painting process has been described and was defined the quality tools and techniques that best suit the process, the company and the type of problem, to identify the main types of non-conformity in the product as well as its cause-effect.

Second phase (D), it was performed the planned and schematized actions, by choosing the pilot line to implement the actions to reduce defects.

In the third phase (C), the results obtained after the application of the improvements were check, which will show the real efficacy of this type of study in reducing defects. Here, the observed improvements and their effects on the resolution of the problem were discussed, comparing the data collected before and after the employment of the improvements.

The last phase (A); the main points of challenges and possible failures in the previous phases that may have affected the project in some way it were discussed, highlighting the action whose results were more relevant.

4. Implementation

4.1. Company Characterization

Through a case study, the research was conducted in a plastic injection industry of the Industrial Pole of Manaus, which has the processes of plastic injection, finishing and molding of EPS wedges.

The company faces various types of problems related to non-compliance and over-rework, consequently, to an increase in raw material waste and labor cost. This type of problem is one of the seven main deadly wastes. A focus was given to the type of defect that occurs in the finishing sector of technical parts injected and painted in thermoplastic resins with the use of paints and diluents, for the two-wheeled pole segment, this due to the high recurrence rates of this defect and the number of rework.

Due to the large amount of rework, the category of defect that it has been studied is characterized as impurities; ordinarily, this type of non-conformity is very common to occur in painting processes, but that

with some changes it was possible to decrease the number of parts with this type of defect in the company.

4.2. Characterization of the Painting and Finishing Sector

For a better visualization of the production process, the mapping of the painting and finishing process was carried out, every procedure was accompanied by the production leader of the line. Figure 1 shows the flowchart of the process performed.

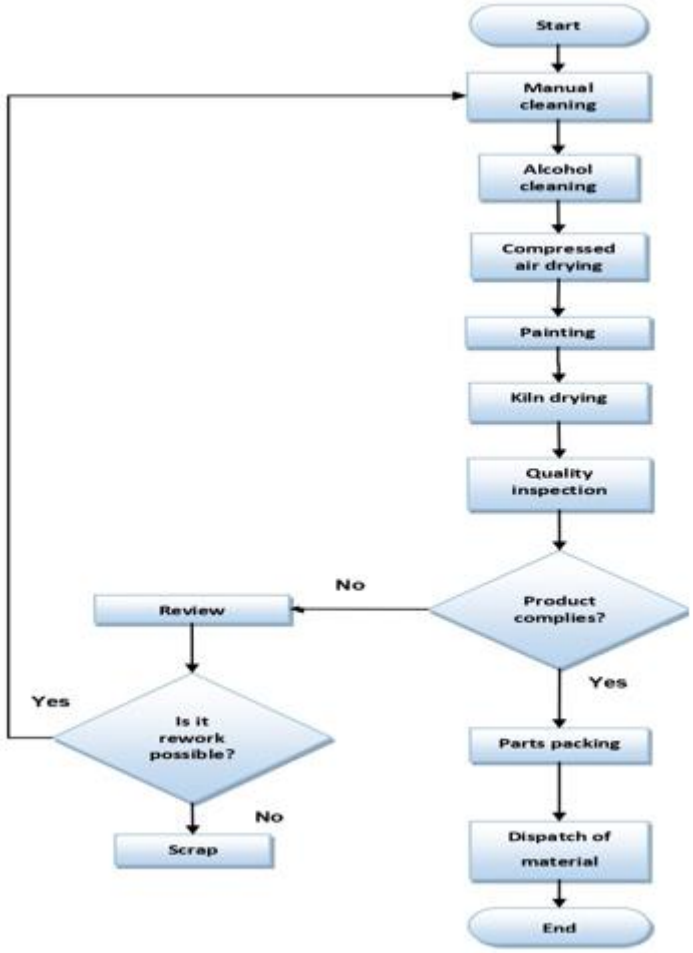


Figure 1: Flowchart of the parts painting process
Source: Author

Figure 1 illustrates the mapping of the painting process of the plastic parts. The description of each step can be seen below, following the flowchart:

1) Start: Phase of receipt of production order and arrival of material in production.
2) First cleaning: In this step with a cotton cloth, the workpiece is cleaned by the employee and placed on the treadmill.
3) Second cleaning: Still with the help of a cotton cloth, the collaborator cleans part, but this time with alcohol to take away possible remnants of oils and other debris that might be in the workpiece.
4) Drying with compressed air: A piece of liquid is removed from the workpiece; the workpiece must be 100% dry to avoid problems in the painting.
5) Painting: This step is subdivided into three other. In the first, the painting is done with the primer, this

special paint serves as preparation for painting the workpiece surface, it will allow a better adhesion of finishing paints. In the second, the painting of the first layer of the finishing paint is carried out. Third, the painting of the second layer of the finishing paint is carried out.

6) Drying in kiln: After the painting process, the parts follow to kiln for ink drying.

7) Quality check: It is checked if the workpiece conforms to the specifications and acceptable quality level. In case the part is not in conformity, the revision is made, in case workpiece can be reworked, it returns to step two, if it cannot, is considered scrap and discarded. However, if the piece is conforms to the specifications it follows to the next step.

8) Packing: Here the piece is packed and placed in cars in the form of bookcase, which when it reaches a certain quantity of parts is sent to storage.

9) Dispatch of material: In this step is made the separation and storage of pallets by part type and customer for subsequent shipment.

10) End: The product is sent to the customer and finalized the process.

The distribution of the stages of the flow of production processes of the painting of the parts can also be observed in Figure 2. The activities are distributed according to the layout of line 1, the production line in which the study was applied.

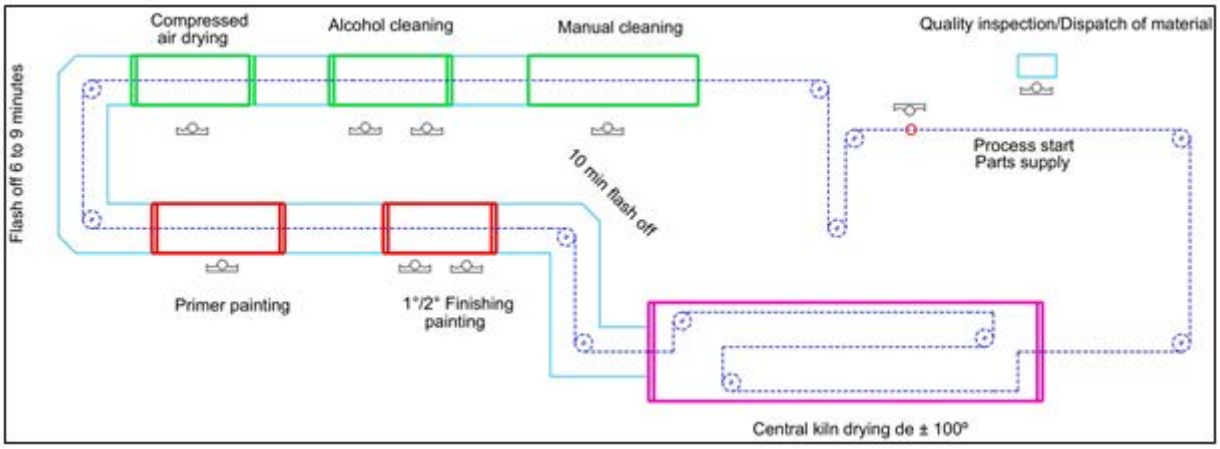


Figure 2: Mapping of line 1, process flow of parts paintings

Source: Author

4.3 Main Types of Defects Produced in the Painting Process

In the painting sector some characteristic defects occur in the part in this type of process, defects that because numerous parts be reworked by non-conformity, furthermore, depending on the degree of defect this can make the piece useless for sale and, therefore, it makes it scrap, increasing the costs. All types of defects found are cataloged by the quality sector, below are some defects identified:

Crater: Small holes, created due to the porosity of the workpiece. Figure 3.

Thin paint layer: Non-uniform painting. Figure 4.

Water mark: Paint failures due to lack of correct drying. Figure 5.

Figure 3: Crater
Source: Author

Figure 4: Thin paint layer
Source: Author

Figure 5: Watermark
Source: Author

Over paint: Caused by the malfunction of the paint gun, leaving the ink layer above the specified.
Impurities: Small particles that when the workpiece is painted are noticeable. They are classified as "fur" or "point" detritus according to figures 6 and 7.

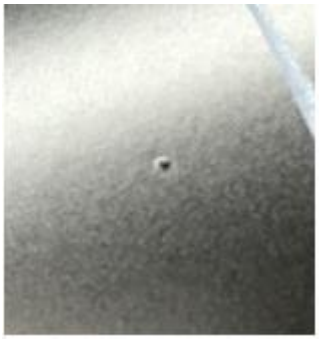


Figure 6: Point detritus
Source: Author

Figure 7: Fur detritus
Source: Author

4.4. Defect Checklist

After the identification of the most frequent failures, the verification sheet tool was used to survey the necessary data. The data are for the month of march/2019, only the parts reworked.

Table 1: Checklist

Defect	**Description**	**N° of occurrences**
Crater	Small holes due to porosity	56
Thin paint layer	Parts of the piece without ink	15
Over paint	High layer of paint	27
Water mark	Lack of drying	36
Impurities	Small debris / dirt present on the part.	227

Source: Author

4.5. Defect Index

To prioritize the resolution of a failure/defect was elaborated the Pareto chart with the data collected and

shown on the check sheet.

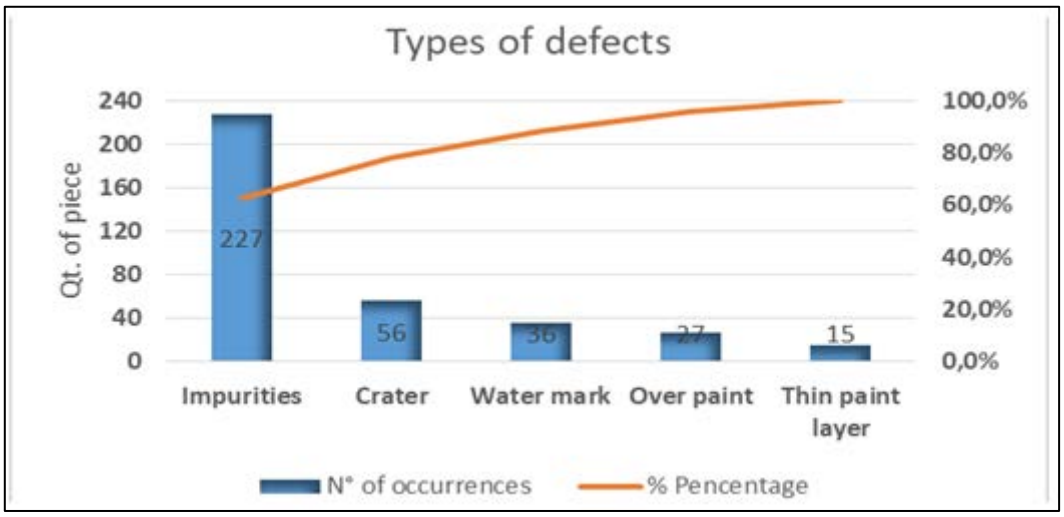


Figure 8: Pareto chart
Source: Author

The defect of the impurities type represents an average of 62.9% of the parts that are reworked in the sector.

4.6. Identification of Faults Causing the Defect with Impurities

The observation of deviations in the process that may cause defects with impurities were documented to identify their causes, possible factors influencing the rate of occurrence of impurities were distributed among 6 categories through the Lean tool cause-effect-diagram. Figure 9.

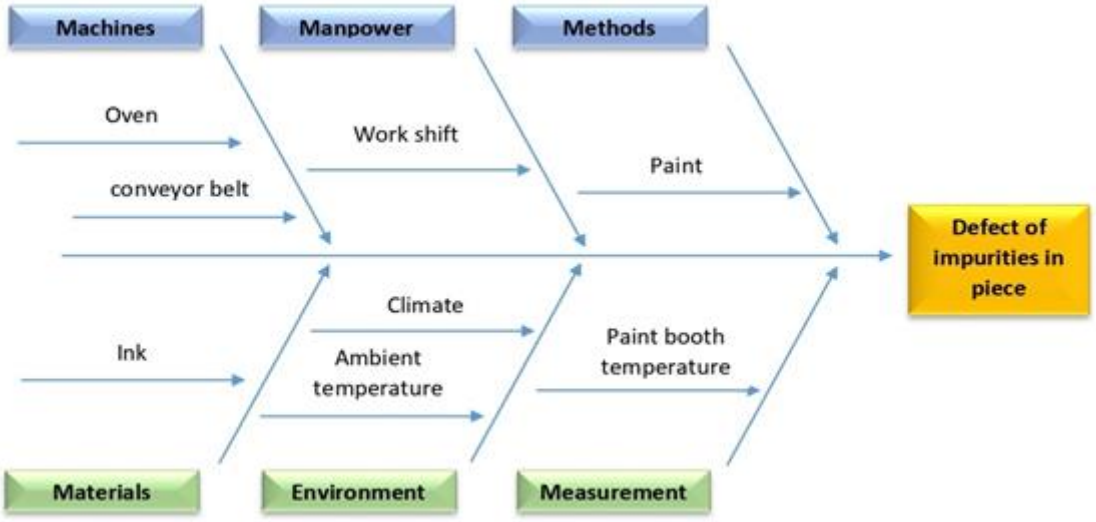


Figure 9: Cause-effect-diagram
Source: Author

The diagram in Figure 9 establishes factors that may influence the index of parts with impurities; these factors were identified through data and interview with line leaders.

5. Results and Discussions

5.1. Action Plan and Improvements Applied to the Process

After identification and monitoring of failures, action plans were carried out to improve and correct process deviations.

5.1.1. Change of cleaning routine

One of the improvements implemented was the change of the cleaning routine; this procedure improved the process to prevent dust from influencing the painting.

In the previous form, the cleaning was performed 1 hours before each work shift start. Cleaning is now performed at the end of each turn. This prevents dust from spreading in the air by the cleaning process and reaching the workpiece at the time of painting. This routine change was made in the cleaning of the whole sector (kiln, treadmill, box and paint booth).

In addition to the physical structure of the sector, cleaning should also occur in materials and tools, such as paint pistols and crawler hanger. The entire cleaning process has been patronized with working instructions, informing the correct way of cleaning.

5.1.2. Maintenance

Another measure adopted was the improvement in Preventive Maintenance Planning (P.M.P.). It was observed that the rates of impurities in the parts were higher in rainy days, and with the monitoring was detected the existence of leaks in the process, these leaks were the cause of the increase of impurities in rainy weather days. Now, the essential preventive maintenance is made on the premises of the sector.

In addition to the facilities, the work materials were also included in the Preventive Maintenance Planning, a different material (guns, hoses, etc.) should be used each work shift, and materials from the previous shift should undergo analysis and inspection to avoid failures. It is now no longer allowed the continuous use of a tool for more than one work turn without checking its performance.

5.1.3. Protective Nets

In the previous process the improvement, the parts were fixed in mat hooks and were followed suspended in the process, the pieces advanced the whole process without any type of protection facilitated contact with impurities, as shown in Figure 10.

Figure 10: Track Parts

Source: Author

The measure adopted to solve the problem was to protect the parts with protective nets. While the workpiece follows on the treadmill to the paint booth, the chosen protective net would cover the workpiece not limiting the temperature penetration, which would not affect the drying process.
Another problem that protective networks help to solve is relative to industry fans, while ventilating the environment, also spread dusts. To solve the problem, a protective screen was employed by the company; however, it was found that this screen consisted of a material that also scattered fur detritus, according to figures 10 and 11.

Figure 11: Filter Fan
Source: Author

Figure 12: Fur detritus
Source: Author

5.1.4. Ink Recirculation

The ink recirculation process was used to avoid loss of ink quality because this action prevented the ink from remaining unused for a long time. This process was done in such a way that two lines could use the same ink, through flexible hoses, which started in the dispensing pump to the pistol of each collaborator responsible for the painting.

After follow-up, it was observed that this process influenced the rate of impurities, because the distribution pump was shared with more than one line caused the ink to not have enough pressure to cross the lines.
So with this detection, it was extinguished the process of recycling ink to avoid problems with quality and the recirculation of paralyzed ink to avoid the defects of impurities in the parts, which made the company open a new parallel project to improve the recirculation process.

5.1.5. Temperature Control

Among the possible failures, the temperature was the least showed some direct relationship with the presence of impurities present in the defective parts. However, the temperature can affect the viscosity and quality of the ink, which could generate defect.
Therefore, the sector HVAC (Heating, Ventilating and Air Conditioning) system would pass through predictive, monthly maintenance. In addition to temperature control, to avoid large variations.

5.2. Results Obtained

After the implementation of the improvements, two-month data were collected for comparison and verification of the results. In the first month, it was possible to observe a reduction in the rate of defective parts, 62.9% of parts that were reworked due to impurities, to a frequency of 19.9%. In the second month there was another reduction and passed to a frequency of 11.5% of parts with defects of impurities. Therefore, it can be inferred that with the help of classical tools and techniques of quality, when worked correctly can positively affect in the company.

6. Final Considerations

As presented in the study, the tools used, proved their efficiency and efficacy in resolving and identifying the root cause of problems related to process deviations.

It was observed that in addition to the tools used, knowledge was needed in project management methodology. To better organize the defined actions, control and choice of data collected.

The non-conformity indexes caused by the impurities had an expressive reduction according to the graphs presented, and demonstrate the efficiency of the choice of tools that suit the culture and type of process of the company.

Within what was proposed, the work achieved its objectives, that is, demonstrated the best way to collect data by mapping the process, established tools in conjunction with project management methodologies and defined the type of non-conformity to be eliminated through the collected data, and with the identification of the cause-effect, applied the proposed improvements.

7. Bibliographic References

[1] BRAVO, I. Gestão de qualidade em tempos de mudanças. 3. ed. SP: Editora Alínea. 2010.

[2] OAKLAND, J. S. Gerenciamneto da qualidade total. SP: Nobel, 1994.

[3] TANAKA, W. Y.; MUNIZ JUNIOR, J.; FARIA NETO, A. Fatores críticos para implantação de projetos de melhoria contínua segundo líderes e consultores industriais. 2012. 19 f. Artigo (Projeto de pesquisa industrial) – Universidade de Talbaté, Talbaté, SP, 2012.

[4] GHINATO, P. Produção & competitividade: aplicações e inovações. ed. PE: UFPE, 2000.

[5] GUERRINI, M. F.; BELHOT, V. R.; AZZOLINI JUNIOR, W. Planejamento e controle da produção: projeto e operação de sistemas. 1. ed. RJ: Elsevier, 2014.

[6] CARPINETTI, L. C. R. Gestão da qualidade: Conceitos e técnicas. 2. ed. SP: Atlas, 2012.

[7] PALADINI, E. P. et al. Gestão da qualidade: Teorias e casos. 2. ed. RJ: Elsevier, 2012.

[8] ALVAREZ, M. E. B. Gestão da qualidade, produção e operações. 2. ed. SP: Atlas, 2012.

[9] CARVALHO, P. C. O programa 5s e a qualidade total. 5. ed. SP: Editora Alínea. 2011.

[10] BERSSANETI, F. T.; BOUER, G. Qualidade: conceitos e aplicação – Em produtos, projetos e processos. 1. ed. SP: Blucher. 2013.

[11] MARSHALL JUNIOR, I. Gestão da qualidade e processos. 1. ed. RJ: Editora FGV. 2012.

A PROJECT PROPOSAL FOR A TRUFFLE MICRO-ENTERPRISE

Letícia Bindá Gondim
leticiabinda2@gmail.com
Centro Universitário FAMETRO – Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade do Estado do Amazonas – UEA - Brasil

Abstract

The present work uses knowledge obtained in the course of Production Engineering, with the purpose of presenting a proposal of factory project of a handicraft truffle microenterprise. The study proceeds in the factory design area, as well as in the general administrative area, especially entrepreneurship. For this, market information, layout proposal, raw material used material costs, a good location, basic equipment were presented, in order to bring knowledge that helps to visualize what you need for the opening of a small homemade factory, of truffle production. All data were collected through bibliographic research, and through academic knowledge acquired during the course of Production Engineering. The study aims to collect information that help the entrepreneur to start his own business, efficiently and effectively, in view of quality and productivity, so that you can obtain a satisfactory financial return.

Keywords: Layout; Entrepreneurship; Microenterprise;

1. Introduction

For the opening of a micro enterprise, it is necessary first of all planning, alignment of ideas, market research, as it is necessary to identify opportunities and risks to be taken, thus facilitating decision making and the emergence of new ideas.

Since the late 1970s and early 1990s, Western economies have given greater importance to micro, small and medium-sized enterprises (MSMEs) in economic growth and job creation [1]. Increasingly, entrepreneurial activity has been valued by the Brazilian government, as it is one of the ways to solve the

unemployment crisis, and because it is a growing source of job creation. Nowadays, chocolate has become a promising market in Brazil and worldwide, because it is constantly growing, is seen as a good business option, after all, it is difficult to find people who do not like chocolate.

To start a business is necessary planning, obtaining market information, having financial resources, human and materials. A whole study is essential, so that the venture will flow, it is not enough just will, it takes quality and dedication for the micro enterprise to succeed.

This paper aims to present a proposal for a factory project for the implementation of a micro truffle manufacturing company, aiming to assist the micro entrepreneur in visualizing the profile needed to open a successful business.

And through this study, it will be possible to see the ideal location, layout proposal, cost analysis, raw material, among others. The information that will be presented will certainly be of great value to the individual who dreams of starting his own business.

2. Literature Review

2.1 Entrepreneurship Development

According to [2], entrepreneurship is the involvement of people and processes that, together, lead to the transformation of ideas into opportunities. To be a good entrepreneur requires thinking high, forward thinking, being innovative, because all these characteristics are essential to the success of the venture. Entrepreneurs are individuals who discover market needs and start up new businesses to meet those needs. [3]

They are the ones who take risks, bring about changes that drive the economy, generate new ideas, jobs and new talent.

The entrepreneur is the person who starts and / or stimulates a business to carry out a personal idea or project, taking risks and responsibilities and continuously innovating. [4]

The entrepreneur is a product of the environment in which he finds himself (time and place), thus being a social being. If a person is exposed to an environment where being entrepreneurial is seen as positive, then they will be motivated to start their own business. [5]

2.2 Artisan Bombs

Candy is a product made of chocolate mass or a core of various fillings made from fruit, pieces of fruit, oilseeds, sugar, milk, butter, cocoa, liqueurs and other foodstuffs, coated with a layer of chocolate or sugar frosting.[6]

Homemade chocolate candies are made from industrial chocolate with various variations depending on the type of candy produced and the recipe followed by the manufacturer. [7]

Among the main raw materials used in the manufacturing process of artisan truffles are chocolate, butter, sour cream, flavoring beverages and various spices.

2.3 Micro Enterprise

Small businesses are considered essential to the growth and maturation of the economy. In the development

process, the contribution they make in generating opportunities for harnessing a large portion of the workforce and in stimulating business development is significant [8]. Microenterprise is defined as a legal entity that reaches an annual turnover of R $ 360,000.00 or less, concept presented by the complementary Law 123/2006.

2.4 Manufacturing and Layout Design

For any type of company to achieve competitiveness and to remain in it, a solid path must be worked out for the Factory Project, which in turn is not a simple task, since it is directly linked to the improvement of structural and non-structural decisions, which are vital to the good performance of the production unit.

The factory and layout project integrates a wide range of knowledge from various areas involved in the rational planning of production activities with long-term effects, aiming at making possible the competitive advantages that the companies intend to offer to their customers and thus increase their efficiency market share [9].

2.5 Layout

According to [10], the purpose of the layout is to present the textual and visual elements in a way that the reader receives them with minimum effort. Through the layout is seen in detail where will be positioned each machine, equipment, raw material and support services.

There are two relevant aspects in the study of layout, which are economical and scientific from an economic point of view, when working with effective layout it is possible to achieve a considerable reduction in production costs.

2.6 Production Equipments

Firstly, to acquire the equipment it is necessary to define which size will be the chocolate factory, after that the most appropriate type of material to be used is taken into account. Before purchasing the machinery, you have to see what kind of service will be offered and the quality required so as not to risk spending more than you need. In addition, it is essential to use accessories that are not directly linked to production, and which are crucial to any business structure, such as computers, printers, phones, air conditioning, among others, which meet your business requirements.

2.7 Company Location

Choosing the place where the company will be installed is undoubtedly one of the most important and complex decisions to make, as it directly implies the success of the enterprise. For this reason, choosing the right location requires strategic decisions so that the business can generate sustainable competitiveness, as the opposite can create a huge market disadvantage.

It is very important to define the geographical area of business, ie the market where customers are located or where products and services will be marketed [11].

This definition will give the company the size of its distribution and customer service needs, as well as the resources needed to get products and services to their destination [12].

2.8 Commercial Market

The market is composed by the environment where the company (and what it does) is located, by the competition and consumer profile. The industry analysis should provide information on its size, growth and structure in which the company operates, and can serve as a basis for monitoring changes and thus seizing opportunities [11].

Market analysis is extremely important for those considering starting their own company, as it aims to guide entrepreneurs in relation to the compatibility with the environment in which the company is placed.

2.9 Production Costs

Productive costs are the quotations of goods and services managed in the production of other goods and services, it is of great value to companies, because it is a concept that supports decision making in relation to the survival of a company.

It is expenditure related to the good or service in the production of goods and services, ie, it is the expense made in the manufacturing area (production) of the organization. As an example of cost, we can cite the raw material used in the production process, labor used in the manufacturing area, the electricity consumed in the manufacturing area and all other expenses incurred in the manufacturing area [13].

3. Tools and Methods

The work contains a marketing analysis, which included information about the product segment.

It presented costs related to production, raw material and labor, where data were collected on the site of the Brazilian Micro and Small Business Support Service (SEBRAE). A flowchart was presented that showed in a simple and easily interpreted way the productive process of handmade truffles. And presented layout proposal, which helps precisely how to set up the establishment, specifying the positions of each machine utensils, equipment and others. It showed the choice of the location of the production unit, which is classified as one of the most important strategic business decisions.

4. Study Application

4.1 Productive Process

The truffle manufacturing process is represented in figure 1, a simple flowchart that clearly shows the sequence of activities, which are:

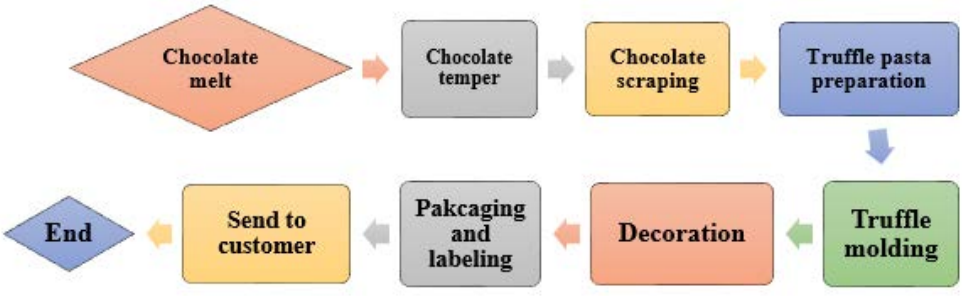


Figure 1 - Production process flowchart

Source: Author

4.2 Process description

♦ Melting chocolate: A step in which chocolate is melted at a melting temperature of 45 ° C. To check the temperature the culinary thermometer is used.

♦ Chocolate tempering: A step that requires specific attention to obtain a good quality of products, as well-tempered chocolate generates a higher brightness, hardness and contraction properties. Once seasoned, the chocolate is refrigerated to dry for approximately 10 minutes.

♦ Chocolate scraping: it is made after chocolate is seasoned and dried in the refrigerator, in this step the scraping machine is used.

♦ Elaboration of the truffle mass: put the water bath on the fire, letting the water boil, and after heating the top container is put, adding the cream, butter and glucose, mixing until turning liquid, then the When the container is removed from the water bath, the shaved chocolate is added, when it begins to melt it should be removed from the heat and stir until it becomes a homogeneous mass. The rest of the ingredients should be put when the dough is cold, it must be cold after 24 hours in the refrigerator before being molded.

♦ Truffle molding: For this step two spoons or a rotary molder are required to obtain a rounded and irregular shape. When chocolate is melted and in the ideal condition, the truffles are glazed with the help of a fork and placed on a smooth surface, covered to dry.

♦ Decoration and packaging: Immediately after being dry and crystallized (6 to 6 hours), the burrs of the candies should be removed. In addition, after the packaging process begins, packaging can be made of colored and specific papers that do not damage the product, the use of aluminum foil or insufilm is not recommended.

♦ Send to customer: After going through all the steps, products are shipped to customers.

4.3 Team Technical Profile

Prioritizing the optimization of its processes, all personnel will be trained according to the need required for the truffle industry to avoid possible human errors. Moreover, in the area of production will be prioritized professionals who have specific experience and skills in the area of production of artisan truffles.

4.4 Productive capacity

In the production of truffles, the factory will work 1 shifts of 8 hours, with a minimum cycle time of 1.20 min, the total productive capacity of the company will be 400 units / day.

$$TC = \frac{TD}{D} \; TC = \frac{480\ min/day}{400\ unit/day} = 1{,}20\ min/unit \qquad \text{(Eq 01)}$$

$$TX = \frac{D}{TD} \; TX = \frac{400\ unit/day}{480 min/day} = 0{,}83\ unit/min \qquad \text{(Eq 02)}$$

TC = Cycle time in minutes per day.

TX = Production rate in units per minutes.

DT = Time available for production in minutes per day.

D = Average demand in units per day.

The expected average demand per day is 400 truffle units, the production time has to be balanced to a cycle time of 1.20 minutes per unit, which equals a production rate of 0.83 units per minute.

4.5 Location of the production unit

The truffle candy microenterprise is located in the northern part of the city of Manaus at Avenida Camapuã – Cidade Nova. The Company is initially made up of five employees, Chocolatier, Stuffer, Packer, Administration, Sales and Service.

After going through the appraisal stages the site was chosen because it has a reasonable cost rent and documents, and because it is a main avenue has a lot of visibility, logistics is easy to access, and there are no competitions nearby.

4.6 Process Equipments

Each new company that seeks to consolidate itself in the market, to which it is employed, has the need of new technologies that serve the customer as best as possible. The main equipment and utensils used to manufacture truffles are presented in Table 1:

Table 1- Equipaments

	VALUE UNIT
ELETRIC MELT	R$ 500,98
CHOCOLATE MILLING MACHINE	R$ 249,90
FIXED COOKER 25L	R$ 352,00
FIXED CHILLER 25L	R$ 352,00
APPLIANCES (573 REFRIGERATOR 12L MIXED INDUSTRIAL BLENDER)	R$5.793, 55
INDUSTRIAL STOVE	R$1.137, 60
ELECTRONIC BALANCE	R$202,31
ELECTRIC WATER BATH	R$896,5
ELECTRIC WATER BATH	R$353,58
CULINARY THERMOMETER	R$13,00
CUTLERY	R$211,25
SHAPES / MOLD	R$231
CABINETS	R$760,50
TOTAL	R$11.054,17

Source: Author

Table 1 contains the equipment that will be used in the company, together with their unit values, which in the total of an investment of approximately R $ 11,054.17.

The micro-company of candy truffles through deep investments in the development of its products has as culture the investment also in new technologies, but that mainly seeks to attend the production process, as machines that improve the manufacturing process and increase productivity and avoid waste from outdated equipment.

4.7 Process Layout

Figures 2 and 3 show the floor plan of the microenterprise facilities, indicating the sectors where the production process stages occur.

Figure 2- 2D floor plan
Source: Own Author

Figure 2 represents the floor plan of the installations in 2D format.

Figure 3- 3D Floor Plan
Source-Own Author

Figure 3 represents the floor plan in 3D format, generating a better view of the company, which has the size of 165m2, containing raw material arrival and departure area, production area, raw material deposit, finished product deposit, cloakroom, ladies' and men's toilets, buying and selling department, financiers, and retail store.

4.8 Company Production Costs

Table 2 provides a simplified summary of the main monthly expenses that should be taken into account for the truffle microenterprise:

Table 2- Monthly Costs

COSTS WITH:	VALUE
LABOR	R$4.000, 00
TRANSPORT	R$1.000,00
TAXES	R$1.800,00
RENT, CONDOMINIUM, AND PROPERTY TAX	R$1.500,00
WATER, LIGHT AND PHONE	R$450,00
MAINTENANCE AND UPKEEP	R$250,00
CLEANING MATERIAL	R$100,00
OFFICE SUPPLIES	R$80,00
TOTAL	R$ 9.180,00

Source: [14]

Table 2 lists some of the expenses that are imposed to operate a small chocolate factory, which is equivalent to a cost of R $ 9,180.00 per month.

4.9 Company Operating Market

The market to which the company will focus is local, specifically for the supply of products to the Manaus region. However, after consolidation of the local market, there will be plans for supply to the entire northern region.

5. Results and Discussions

Starting a new business is not a simple task, it requires effort and dedication, not only wanting it, but it takes financial, human and material resources. Through this work it was possible to visualize the most relevant steps that are indispensable to start a small artisan truffle factory, from the layout to the ideal location, and potential consumer market. The advantage of being a microenterprise is that because of its small size, the amount of business-related documentation and paperwork is relatively smaller. Your legal duties are also simplified.

In the manufacture of truffles it is possible to observe through the flowchart that the production process is simple and versatile, the study had the description of each production step that begins with the verification of the quality of the raw material until shipping to the customer. It was possible to identify the main equipment used and its unit values, the raw materials used the monthly costs.

In relation to costs, expenses with labor, transportation, taxes, rent, water, electricity, telephone, cleaning supplies and office were generated, generating an approximate amount of R$ 9,180.00. Values equivalent

to equipment were also verified, obtaining an approximate amount of R$ 11,054.17.
The layout presented is a simple and sequential process, in order to avoid interference between areas.
The location was chosen based on rent evaluation, documents, visibility, and competition.
The company's productive capacity reaches 400 und / day, with a cycle time of 1.20 minutes per product.
Therefore, it is seen that entrepreneurship has become an outlet for the Brazilian, being a viable and promising alternative source of income. Among the possible ventures, small truffle factories are an affordable option.

6. Final Considerations

Considering the current economic crisis in the country, the proposal of a factory project is an essential part for the visualization of a new venture, although in short, it is essential for the future of a new business. The project proposal refers to a small chocolate factory that aims to be implemented in the Amazon market.
Based on this proposal, the entrepreneur will be able to visualize the basic structure of the truffle factory, being able to understand its operation, from the production to the choice of the location. It is also included the equipment costs and monthly expenses, giving a primordial investment margin. The layout proposal gives the glimpse of how to organize the manufacture of the product, all this information can help in the organization of the company.
Therefore, it can be considered through the project proposal presented, that the opening of the venture is something achievable and promising, that at first start as a small company and in the long run can become a large organization, and reference in manufacturing of truffles in the Amazon and national market.

7. Bibliographical References

[1] FERNANDES, Rene José Rodrigues. Entrepreneurship and promotion policies for micro, small and medium enterprises, 2018. Search: April 2019
Available at:
<http://bibliotecagigital.fgv.br/ojs/index.php/rgnn/article/viewFile/78069/74793
[2] DORNELAS, Jose Carlos Assis- Entrepreneurship: Turning ideas into business- 3 ed. - Rio de Janeiro: Elsevier, 2008. - 2 reprint
[3] LONGENECKER, JUSTIN G. W. MOORE, CARLOS. PETTY, J. WILLIAN. E. PALICH, LESLIE. Small Business Administration. Sao Paulo: Thonson Learnig, 2007.
[4] CHIAVENATO, Idalberto. Entrepreneurship: giving wings to the entrepreneurial spirit. 4. Ed. - Barueri, SP: Manole, 2012.
[5] MORAES, Luiz Eduardo Mafra; MARIANO, Paulo Henrique. Feasibility study of a craft truffle company.
[6] National Commission of Food Standards and Standards. CNNPA #
12, 1978.
[7] REIS, Elaine C. Physicochemical and Microbiological Analysis of Handmade Candy 2011. 36 f. Final Paper, Federal Technological University of Paraná. Apucarana, 2011.
[8] DEAKINS, D. Entrepreneurship and small firms. Berkshire: McGraw-Hill, 1996.

[9] NEUMANN, Clovis; SCALICE, Régis Kovacs. - 1 ed. - Rio de Janeiro: Elsevier, 2015.
[10] AMBROSE, Gavin. Layout (electronic feature) / Paul Harris; Translation: Aline Evers; technical review: Jorge Luiz Padilha Filho. 2. Ed. - Electronic data. - Porto Alegre: Bookman, 2012
[11] JAERGE, Milene. Financial viability of a chocolate shop. 2004, Florianopolis [12] SEBRAE - BRAZILIAN MICRO AND SMALL BUSINESS SUPPORT SERVICE. Search: February 2019. Available at: <http: //www.sebrae.com.br>.
[13] GUIMARÃES NETO, Oscar. Cost analysis. - Ed see. - Curitiba: IESDE Brasil S.A., 2012.
[14] ÀS MICRO, Serviço Brasileiro de Apoio; EMPRESAS, Pequenas. Sebrae. Prática de ensino: Programa de Mentoria. Brasília, 2015.

Ethics, Sustainability and Responsible Citizenship in High School

Joel Haroldo Baade (Corresponding author)
Dept. of Interdisciplinarity and Education, Alto Vale do Rio do Peixe University,
Rua Victor Baptista Adami, 800. 89.500-199. Caçador, Santa Catarina, Brazil.

Joel Cezar Bonin
Dept. of Education, Alto Vale do Rio do Peixe University,
Caçador, Brazil.

Vera Lúcia Simão
Dept. of Education, Alto Vale do Rio do Peixe University,
Caçador, Brazil.

Levi Hulse
Dept. of Interdisciplinarity and Education, Alto Vale do Rio do Peixe University,
Caçador, Brazil.

Adelcio Machado dos Santos
Dept. of Interdisciplinarity and Education, Alto Vale do Rio do Peixe University,
Caçador, Brazil.

Abstract

Citizenship defines the belonging of individuals to the society in which they live. It is understood that the complementary notions of ethics and sustainability must permeate citizenship today. Citizenship will gain greater expression when the individual leaves the household to be inserted in society through the vote and professional action. For this reason, the analysis of the profile of young people who are graduating from high school is representative. Thus, this analysis aims to characterize citizenship experiences in the city of Caçador-SC by looking at the reality of students of the third year of high school from the perspective of sustainability. Methodologically, the research is qualitative-quantitative as it uses mixed techniques. It is concluded that many young people are aware of the need for an ethical and sustainable life, but some habits still prevent them from engaging in committed actions towards the society expressed by these concepts.

Keywords: Ethics; Citizenship; Sustainability; High school; Education.

1. INTRODUCTION

Citizenship defines the belonging of individuals to the society in which they live. By representing

involvement and commitment to social causes, citizen actions lead to the construction of broader concepts such as active citizenship. There are, on the other hand, people who have little involvement in actions of collective interest; these individuals experience what is understood as passive citizenship. Another notion complementary to the idea of citizenship and is of interest to this research project is the one that expresses the concept of sustainability. Said otherwise, citizenship is not just engagement with collective causes, but the commitment towards collectivity based on the perspective of the development of a sustainable society. Citizenship, therefore, goes much beyond voting from time to time, it is rather a way of life that occurs in different spheres of existence, in public and private life, at home, at work, at school etc. Among the above-mentioned spheres, school stands out as an important social institution of collective life. Hans Jonas's notion of responsibility has been chosen as a theoretical base for this study.

Jonas is incisive regarding his formulation of a new ethical imperative for our time: "an imperative responding to the new type of human action and addressed to the new type of individual agency that operates it that might run thus: 'Act so that the effects of your actions are compatible with the permanence of genuine human life on Earth'" (JONAS, 2006, p. 47).[1] In other words, Jonas himself explains that "[...] the new imperative says precisely that we may risk our own life, but not that of humanity. [...] We have no right to choose the non-existence of future generations for the sake of the current existence, nor have we the right to endanger them" (JONAS, 2006, p. 48).

Hans Jonas provides this study with our first premise while the second one is the city of Caçador. Caçador is the largest city of Midwestern Santa Catarina. This city has a population of 75,812 people, according to the Brazilian Institute of Geography and Statistics – IBGE (2015). The same document shows that Caçador is an important cultural, economic and political center, having developed its economy through the extraction and industrialization of wood as well as through reforestation. However, this city presents development indices that show a need for attention. The last documented register dates from 2010 and shows that the city's Human Development Index is 0,735 (IBGE, 2015). This index may be improved with social agency and research aimed at citizenship and sustainability.

Caçador currently has approximately 2000 students enrolled in eight different schools, with two of those being private and six being public institutions. All schools offer regular half-day education. One of them offers Adult Education Programs and two offer full day education. Most students are enrolled in three public schools, with an average of 500 students per school. The others are enrolled in the two private institutions and in the three remaining public schools.

Caçador is not a reality isolated from others, yet, according to Santos (2005, p. 27) "globalization processes are phenomena with economic, social, political, cultural, religious and legal dimensions intertwined in a complex way." Thus, it is necessary to understand and assimilate the implications that the new world order imprints on individual and collective behavior in order to, thenceforth, grasp the meaning of what affects and happens in the society we live in and which we seek to understand and change with the aim of living well. Our current globalized world separates societies unequally: there is disproportional access to means of information as well as to means of education. Nonetheless, this reality is not completely perceived by people, although they are directly or indirectly victims of its consequences. By contextualizing such reality,

1 Translator's Note: as there is not full access to the English version of Jonas's book, most quotes are free translations of the quotes in Portuguese, presented in the original article.

this research project aims to analyze experiences of citizenship by looking at the reality of the high schools of Caçador – SC with the purpose of (1) supporting future actions of the Ethics, Citizenship and Sustainability Research Group of Alto Vale do Rio do Peixe University and (2) suggesting public policies aimed at these students in municipal and state contexts. With the proposed analysis, we aim to recognize the way in which people, teachers and students of high schools of Caçador, behave and react when exposed to inequalities of opportunity and how they respond to and integrate themselves into offered opportunities. This research is especially justified because it concerns education towards citizenship from the perspective of sustainability in Midwestern Santa Catarina, specifically in Caçador – SC. However, it is necessary to consider that human incompleteness always maintains room for improvement, and citizen education from the perspective of sustainability is allied with that purpose.

Therefore, for a person to develop themselves, there must be the conscious search to become a historical, associative and cooperative individual. The practice of cooperation educates people and replaces individualism with a participative, solidary and humane mentality. According to some authors, human beings are by nature individualistic, weak and unable to develop on their own; for this reason, individuals need to associate, cooperate and collaborate with each other in democratically making a better life in solidarity. As humanity joins together to achieve progress, history is also build and cultural bonds are outlined. “Human history is the account of the development of emerging formats of both cultures and societies” (POUTIGNAT; STREIFF-FERNAT, 1998, p. 226).

Social change stems mainly from the influence of cultural factors, the environment context and political organizations. Cultural factors are the most important ones, since they include the effects of religion, communication systems and leadership (GIDDENS, 2003). Therefore, regarding the reality of Caçador (compared with other cities in similar conditions), we see that this scenario can be improved; in this sense, the aimed evolution is only possible as long as there is empowerment. Here, empowerment is necessarily linked to the idea of education, that is, if people want emancipation (and, in this case, evolution/progress), they need, undoubtedly, to have formal education.

Consequently, we consider that the present research project is correlated with the central idea of formal education, knowledge, empowerment and life change. In addition, sometimes we may infer that this goal is too vertical. For that reason, we aim to reduce this assertion as much as possible, for we want to start from principals’ and students’ experiences. Thenceforth, we seek to implement our project based on Paulo Freire’s thoughts: it is necessary to know what people know first and then help them analyze their own life more clearly. Thus, in terms of research justification, we state its relevance because it addresses and links emancipation, education, ethics and sustainability in a single and collective research task.

2. OBJECTIVE

This analysis aims to characterize experiences of citizenship in the city of Caçador – SC by looking at the reality of third-year high school students from the perspective of the problematics of sustainability.

3. METHODOLOGY

The research population encompasses all high school units of Caçador – SC. The research subjects were

students of the third year of that level of education. Data was collected from a structured questionnaire.

The questionnaire was developed based on the fundamental categories of the project: responsibility (JONAS, 2006), sustainability (LOBE JUNIOR, 2014) and citizenship (CANIVEZ, 1991). These were divided into specific or variable questions in order to understand the practices of high school students and teachers and transcend a merely conceptual understanding of terms. Therefore, it was fundamentally important to observe the reality of these institutions; this task was predominantly done by members of the Research Group who are high school teachers in Caçador. The questionnaire was elaborated on *Google Docs* software, which allows for an automatic tabulation of results in an electronic spreadsheet. This type of archive format let us analyze and compare variables instead of merely quantifying results. Statistical knowledge allowed for a greater level of depth in the analysis and, consequently, for the acquisition of more meaningful results regarding the object of study. Quantitative models orientated this section of the research.

The documentary analysis was based on critical models of interpretation, in which doubt and the observation of the unsaid were present. The comparison with different sources was also an essential resource for the documentary analysis.

Lastly, to build the research results, we carried out a data comparison, which encompassed documental sources, observations, interviews and questionnaires. We understand that different research methodologies contribute to the understanding of the research object in different ways.

4. RESULTS AND DISCUSSION

A total of 267 students took part in the research by answering a printed questionnaire. Electronic questionnaires could not be applied due to the poor maintenance of the computer labs in public schools. Regarding the private schools, the major obstacle for electronic questionnaires was a conflict of schedules and the use of laboratories for other school activities. Moving entire classes to the laboratory could also cause dispersion and delay, for that reason, school coordinators recommended applying printed questionnaires.

4.1 Participant Profile

Third-year High school students of six institutions of Caçador – SC took part in the research. Five of those were public institutions, and one was a private school; their participation corresponded to 91% and 9% respectively. Fifty percent (50%) of the students were enrolled in the morning shift, 46% study at night and 4% in the afternoon. Fifty-one percent (51%) of the participants were male, and 49% were female. One participant did not answer that question. Most students (80%) were under 18 years old, 13% (35) were 19 or 20 and 7% were over 20 years old. Seventy-six percent (76% – 204) of the participants were born in Caçador; sixty-three (63) students (24%) were born elsewhere. Forty-nine percent (49% – 130) of the participants are full day students and have their expenses paid for. On the other hand, 47% of the students work and are financially independent, and 26% of those students are responsible for their families' sustenance. Only 4% of the students work and are not financially independent. All private school respondents are full day students, while many public school students work *and* study. The family income

of 31% of the respondents is less than two minimum wages a month; ninety-five (95) individuals (35%) have a family income between 2 to 4 minimum wages a month, and only 16% of them earn more than 5 minimum wages a month. Eighteen percent (18%) of the participants did not know the information about their family income. Fifty-five percent (55%) of the students live in households with 4 or more people.

4.2 Political Engagement

Twenty-six percent (26%) of the students became registered voters when they turned 16 years old, and 120 students (45%) have not been registered yet. In public schools, the percentage of students who hold a Brazilian Electoral Title was sensibly higher, which may be related to the need for this document for work purposes. Thirty-three percent (33%) of the respondents watch and pay attention to electoral propaganda, but the remaining 67% of them do not.

Regarding this topic, there was another open question to have participants manifest their understanding of politics. In order to analyze the results of this specific question, we used Wordle.net software, which builds word clouds based on text blocs. By inserting the answers into the software, Graphic 1 was created:

Graphic 1. The definition of politics.

Source: Research Data.

The results highlight the word “corruption”, revealing feelings and attitudes of dismay at the political scenario of Brazil on the part of high school students. This dismay may also be related to the large number of students who have not registered to have an Electoral Title yet. Fifty-nine percent (59%) of the students have also stated that they do not discuss politics with their peers. On the other hand, 68% of them talk about and are concerned with social problems that afflict society. When it comes to the open question regarding the importance of taxes, the words “steal” and “money” appear very often. According to their understanding, taxes have been unidirectional, that is to say, citizens must pay taxes to the State, but they do not get what they are entitled to receive in return.

4.3 Consumption

The research found that the 61% of the participants eat animal origin products daily (meat, fish, eggs and dairy), while 38% of them consume those in a reduced rate, but at least once a week. Only 1% of the respondents (4) affirmed they are vegetarians. Participants use personal vehicles (50%) or public

transportation (27%) as means of transportation. Only 23% of them stated they regularly walk or ride a bicycle for their daily commutes. Only 15% of the participants take 5-minute showers (or less than that); the remaining students spend 5 to 10 minutes (42%), 10 to 20 minutes (35%) and more than 20 minutes (8%) in shower. The shower temperature is for the most part kept in the "hot" position (90%). Seventy-four percent (74%) keep the water running while they are using soap. Over half of them keep the lights on in empty rooms (55%), although it does not occur all the time. Some maintain their personal computers on when not in use (27%). The practice of reusing water is present among them, but it is far from being a daily reality. Twenty-one percent (21%) never reuse water, while 46% affirm they sometimes reuse it. The practice of waste sorting is done by 55% of the participants, but 22% still does not recycle or sort waste. Only 4% of the participants affirm they have no mobile phones, while 86% own *smartphones* and 30% consider they may change their phones within the maximum period of 12 months. In terms of consumption, no significant difference was found between public and private school students.

5. Conclusion

In conclusion, we can affirm that, in general, participants have life habits that could be considered characteristic of a more sustainable citizenship. It is noted that there is greater care concerning waste sorting and disposal. Few participants would throw garbage on the floor or in inappropriate places.

It is understood that these habits are influenced by activities developed by school and focused on the development of politically appropriate behaviors. Results show that this work is more effective in the private schools that took part in the research.

However, students do not seem to be very conscious of these behaviors. Therefore, it is concluded that this set of actions is performed by the participants as a *habitus*, according to Bourdieu's concept. For Bourdieu, *habitus* is a predisposition to act in a lasting way and is beyond one's awareness. Bourdieu's *habitus* functions as a structured and structuring structure of the behavior of social individuals. Based on that, it was also possible to infer that behaviors which are not stimulated by school are usually less developed in terms of sustainability, for example, the shower time. Thus, we reiterate that conscience does not suffice to change an individuals' behaviors. There seemed to be little willingness to relinquish the amenities offered by technology and the lifestyle of today's society in favor of behaviors more closely aligned with a more sustainable lifestyle.

On the one hand, private schools seem to foster habits of sustainability more efficiently, but, on the other hand, private school students seem to depend on their parents or legal guardians for a longer time. Public school students, for instance, are more frequent users of public transportation and need to seek problem solving on their own, which is considered an essential element of active citizenship.

It cannot be categorically stated that public school students have greater autonomy than private school students. The matter seems to be relative. Thus, in some areas, the former seem to be more autonomous, while in others, the latter seem to be more independent. In all cases, public school students register to vote sooner than private school students. This research could not establish a reason for this. Eventually, the early registration of public school students as voters could be linked to their working needs. Private school students have not engaged in any paid activities yet and are full day students. At the same time, public

school students start working earlier, which, in some cases, may lead them to obtain their Brazilian Electoral Title earlier.

With respect to the students' gender, the participants were predominantly male, unlike official statistical data on population numbers. It was also observed that male students engage in paid activities earlier than female ones. In terms of gender, no significant difference was observed concerning the other questions of this research.

6. References

[1] ADORNO, Theodor W. **Educação e Emancipação**. Rio de Janeiro: Paz e Terra. 1995.

[2] ARENDT, Hannah. **Eichmann em Jerusalém**: um relato sobre a banalidade do mal. Trad. José Rubens Siqueira. São Paulo: Companhia das Letras, 1999.

[3] ASSMANN, Hugo. **Curiosidade e prazer de aprender**: o papel da curiosidade na aprendizagem significativa. Petrópolis: Vozes, 2004.

[4] BAUMAN, Zygmunt; MAY, Tim. **Aprendendo a pensar com a sociologia**. Rio de Janeiro: Jorge Zahar, 2010.

[5] BOURDIEU, Pierre. **A Economia das Trocas Simbólicas**. São Paulo: Perspectiva, 2007.

[6] CANIVEZ, Patrice. **Educar o Cidadão?** Trad. Estela dos Santos Abreu e Claudio Santoro. Campinas-SP: Papirus, 1991.

[7] FOUCAULT, Michel. **Microfísica do poder**. 15. ed. Rio de Janeiro: Graal, 2000.

[8] GUIDDENS, Anthony. **Sociologia**. 5 ed. São Paulo: Saraiva, 2003.

[9] HALL, Stuart. A centralidade da cultura: notas sobre as revoluções culturais do nosso tempo. **Educação e Realidade**, v. 22, n. 2, pp. 15-46, 1997.

[10] IBGE. **Santa Catarina**: Caçador. Available at: <http://cidades.ibge.gov.br/xtras/perfil.php?codmun=420300>. Accessed on Feb. 9th, 2016.

[11] JONAS, Hans. **O princípio responsabilidade**: ensaio de uma ética para a civilização tecnológica. Rio de Janeiro: Contraponto – Ed. PUC-Rio, 2006.

[12] LOBE JUNIOR, Wilson Guilherme. Construção social do conceito de desenvolvimento sustentável: origens, sentido e alcance. In: NONES, Nelson; SILVEIRA, Adriana Bina da; HARTKE, Suzete Habitzreuter. **Desafios para o direito empresarial**. Blumenau: Legere, 2014. pp. 219-245.

[13] MACHADO, Nilson José. **Epistemologia e Didática**. São Paulo: Cortez, 1995.

[14] MEIRIEU, Philippe. **O Cotidiano da Escola e da Sala de Aula**: o fazer e o compreender. Porto Alegre: Artmed, 2005.

[15] MORIN, Edgar. **A cabeça bem-feita**: repensar a reforma, reformar o pensamento. 21ª ed. Rio de Janeiro: Bertrand, 2014.

[16] MORIN, Edgar. **Ciência com consciência**. 14ª ed. Rio de Janeiro: Bertrand Brasil, 2010.

[17] MORIN, Edgar. **Os sete saberes necessários à educação do futuro**. São Paulo: Cortez, 2000.

[18] PEREIRA, João Victor Inácio. Sustentabilidade: diferentes perspectivas, um objectivo comum. **Economia Global e Gestão**, Lisboa, v. 14, n. 1, abr. 2009. Available at: <http://www.scielo.mec.pt/scielo.php?script=sci_arttext&pid=S0873-

74442009000100008&lng=pt&nrm=iso>. Assessed on Nov. 13th, 2015.

[19] POUTIGNAT, Phelippe; STREIFFF-FERNAT, Jocelyne. **Teorias da etnicidade**: seguido de grupos étnicos e suas fronteiras de Fredrick Barth. São Paulo: UNESP, 1998.

[20] REGO, Pedro Costa. Hábito e Liberdade. Algumas considerações sobre a natureza do ethos. **Síntese Nova Fase**, Belo Horizonte, v. 22, n. 69, pp. 179-191, 1995.

[21] SANTOMÉ, Jurjo Torres. **Globalização e interdisciplinaridade**: o currículo integrado. Porto Alegre: Artes Médicas, 1998.

[22] SANTOS, Boaventura de Souza (org.). **A Globalização e as Ciências Sociais**. 3ª ed. São Paulo: Cortez, 2005.

[23] VASCONCELLOS, Maria Drosila. Pierre Bourdieu: a herança sociológica. **Educação & Sociedade**, ano XXIII, n. 78, pp. 77-87, abr. 2002.

[24] WEIL, Eric. **Filosofia Política**. São Paulo: Loyola, 1990.

Process optimization of an emergency unit, using the quality tools, MASP and PDCA

Jordan Victor Trindade
jordanvic143@gmail.com
Centro Universitário FAMETRO – Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade do Estado do Amazonas – UEA - Brasil

Abstract

Quality is one of the main points addressed in an organization, is a differential for its survival. In addition, it has a relevant importance when it comes to customer service and satisfaction. The present study started with the question of how to improve the quality of care provided to users in an emergency care unit. Through studies will be presented in this article internal processes related to hospital care, which will be used quality tools and through the MASP tool and through the PDCA cycle identified problems, through these tools will be suggested corrective and preventive actions.

Keywords: Quality Tools; Prompt Service; MASP; PDCA;

1. Introduction

The critical situation of public health organizations has reached delicate circumstances, generating huge queues and poor quality care. This has been one of the biggest contests according to users. All of this stems from a lack of good management, limited resources, high bureaucratic costs and political processes that further aggravate the current situation.

Due to the discontent of the population with the current conjuncture, measures need to be taken in order to increase the efficiency and quality of health service. These resources need to be studied for strategic decisions to be made thoroughly on each topic.

The Manchester protocol is a practical technique that, if well applied, greatly facilitates the care process. It is extremely visual, as if it were an Eye Management to handle care, helping to save more lives and streamline the patient screening process.

In order for improvements to be implemented in the Hospital, in the emergency care sector, the need was observed due to the waiting time for clinical care and a little objective screening that became the bottleneck of care, forming long lines, exceeding the limit of Expected time. It is necessary to develop a sense of urgency to perfect the flow making it more objective and without so much waiting.

The overarching goal of this case study was to improve performance in the emergency sector through quality tools that were used to support change at minimal cost, making it possible to make better decision-making in order to meet the need for excellence of the sector enabling improvements to internal processes, so that bottlenecks are managed quickly and efficiently, optimizing the flow in the hospital. Thus stimulating employees to be able to provide adequate care, combating eventual idleness.

For this it is essential that there is the appreciation of communication with the patient, this involves a lot of learning and changes in behavior on the part of the professional. This study generates a better understanding of how risk classification works in networks, providing clients with adequate service, without much waiting to avoid worsening the situation. However, this service is not always complete and reliable, and often end up affecting its efficiency and effectiveness leaving its users dissatisfied.

2. Literature Review

In this chapter through theoretical foundation will be presented some concepts that will lead to a better understanding of the project under study, PDCA, MASP, Brainstorming, 5 WHY, Failure Verification, Pareto Graph, Cause and Effect Diagram, 5W2H, Control Items, Verification, Stratification, Tracking Chart and Flowchart Items. Therefore, this understanding served as support for analysis of the results of this research.

2.1 MASP Concepts

MASP, a method based on the PDCA (Plan, Do, Check, Act), is composed of predefined steps to choose a problem, analyze its causes, define and plan the actions that establish a solution, verify the result and generate data learning from its application [1].

Figure 1 adapted from [2] shows each of the PDCA steps, associated with the 8 (eight) MASP steps.

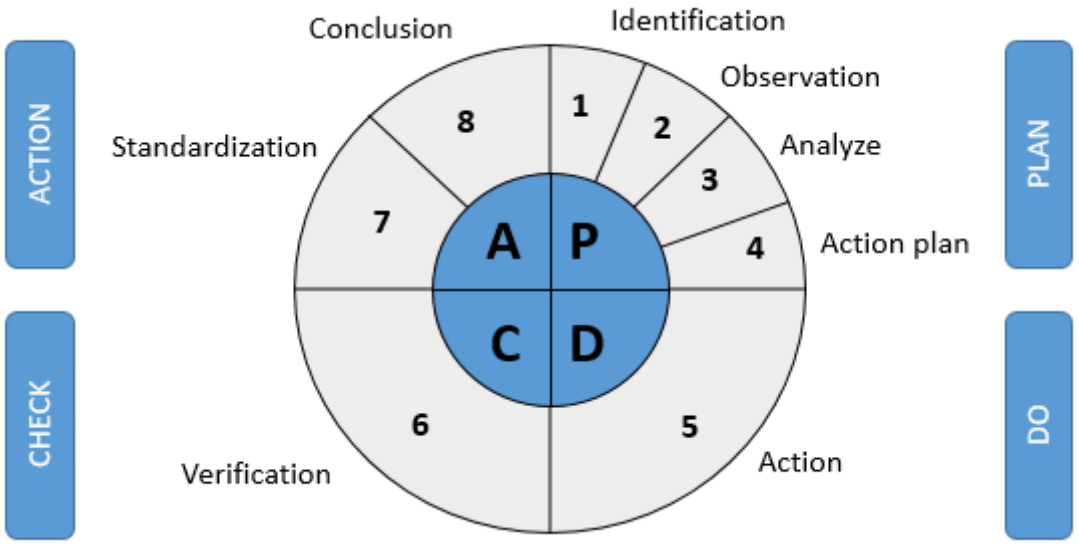


Figure 1 - Definition of MASP and PDCA steps.
Source: Adapted from [2]

According to [2], the MASP steps are defined as follows:

1- Identification of the problem: In the first step, the problem is clearly defined from a Pareto analysis, where the losses and visible gains are identified, as well as the frequency with which it has been occurring. At this stage the process controllers should also be appointed.
Note: This is the stage where the specific characteristics of the problem are investigated, with a broad view and from different perspectives. Through data collection and observation where the problem occurs, stratification is performed through Pareto graphs, thus obtaining the most important themes.
3- Analysis: From a brainstorming, the main causes of the problem are defined and the most probable are chosen. After an analysis is performed and if the causes are confirmed, one moves to the next step.
4- Action plan: In this stage, an action strategy is designed to block the root causes. But you have to make sure that the proposals do not cause any side effects.
5- Action: The action stage focuses on accomplishing what was planned in the previous phase. However, you must present the plan to everyone and perform the necessary training.
6- Verification: In this step the data collected before and after the action are compared, thus being able to verify the continuity or not of the problem. If the block was not effective, it returns to the observation step.
7- Standardization: The standardization stage is designed to elaborate or change the standard, in order to prevent the resurgence of the problem. Everyone needs to be communicated and trained, and follow-up should be done through periodic checks.
8- Conclusion: This is the stage in which the Problem Solving Method is reevaluated. What is right and wrong is identified, and even if the process did not go as planned, this step can serve as a learn- ing for future applications.

2.2 PDCA Concepts

The PDCA cycle is a tool whose main objective is to achieve control and effective results in the activities

of an organization. It is an efficient way to present an improvement in the production process. Using this tool, there is a standardization of the process and its information, thus contributing to quality control, avoiding logical errors and information that is easier to understand [3].

The PDCA cycle represents a very efficient cycle for solving problems throughout the process, thereby improving all steps several times [4]. According to [5], this method consists of four steps, which identify the expected results of a process. Being them:

Plan: This step consists of setting the goal or goal to be achieved, and how will be the path to reach the goal set.

Do: It is the work of detailing the goal and plan to achieve that goal in a way that everyone involved can understand what is being proposed and decided.

Check: During and shortly after execution there should be a comparison with the data obtained and the goal that was planned, so that you know if everything is going as planned.

Action: Transform the successful plan into a new way of doing things right.

Process control must be performed according to the method used in the PDCA cycle to achieve the goals necessary for the company's survival [6].

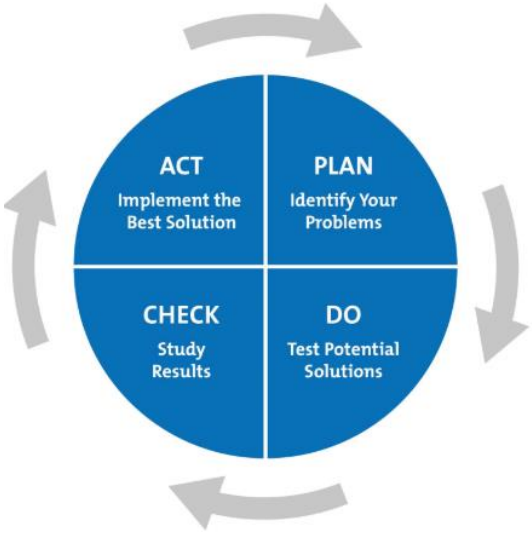


FIGURE 2 - PDCA CYCLE
Source: Adapted from [7]

2.3 Check Sheet

The Verification Sheet is a tool used to collect data, usually in real time. With it, it is possible to collect, organize and even present the results of various collections. Thus, it is simpler to analyze the variations of a process for example [7].

For its simplicity, it is considered the simplest of the 7 Quality Tools. It can be executed in table, table or spreadsheet format, which makes data collection more flexible. In addition, the Check Sheet also helps save time by eliminating the rework of collecting data from decentralized sources [8].

2.4 Paret Graph

The Pareto diagram, according to [8], uses the 80/20 principle. This quality tool is a vertical bar graphing

feature that, in addition to assisting in the most efficient visualization of existing problems, performs their ordering of importance.

In his paper [9] he further states that the Pareto diagram makes it much easier to identify which problems are really important. Most companies use the diagram to determine where their main efforts will be placed.

2.5 Cause and Effect Diagram

According to [10], also called Cause and Effect Diagram, the main functionality of this representation is to show the cause and effect relationship of quality, as well as its factors involved. In this way the main causes can be branched into secondary or tertiary causes, further facilitating problem identification.

Its structure is that all factors are involved in crafting a product or effect. According to [11], the Ishikawa Diagram is a very simple tool widely used in quality. Kaoru Ishikawa created the diagram in 1943 and used it in industrial environments to verify the dispersion of the quality of the products and processes involved. Also according [12], the tool presents the causes of a problem in the shape of fishbone: 4 M's method, labor, materials and machines. Using this diagram it is possible to identify the causes of the problems and solve them as best as possible.

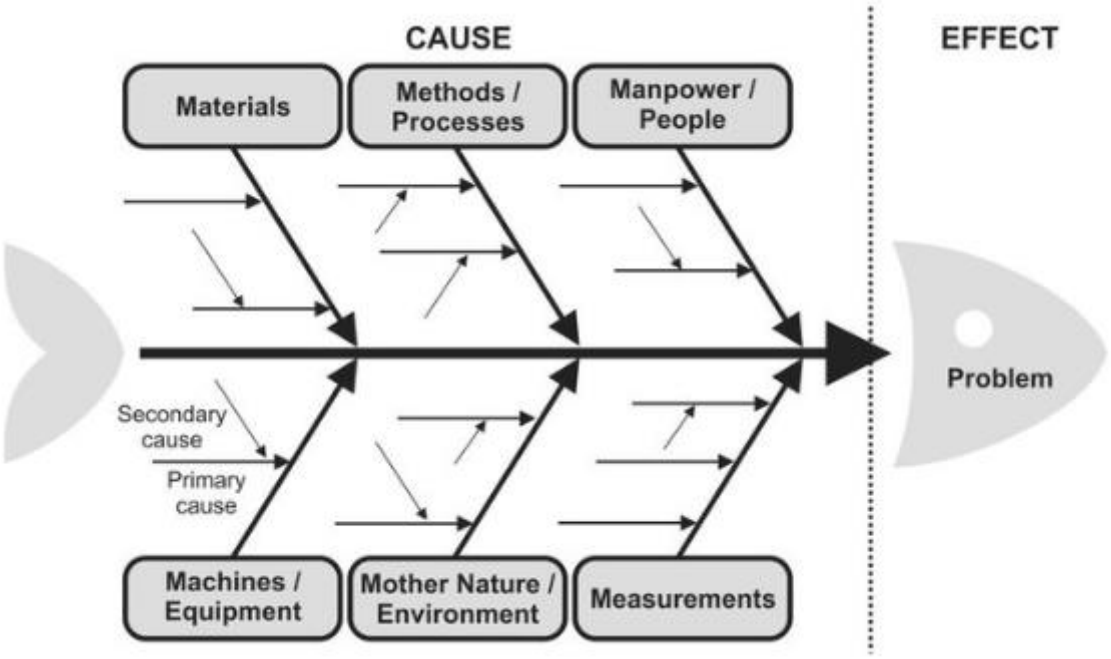


Figure 03 - ISHIKAWA DIAGRAM

Source: Adapted from [12] and [30]

2.6 Statistical Process Control

Control chart or statistical process control, according to [13], is the accompanying graphical representation, consisting of an upper line (upper control limit) and a lower line (lower control limit) on either side of the midline of the process. . It is noteworthy that these parameters are statistically determined.

This seeks to identify the sample averages on the chart to verify that the points are outside the control limits or form “undefined” patterns. If any of these cases occur, the process is considered unstable or out of control

[14].

In his work [15], he points out that the fluctuation of the points within the control limits results from the intrinsic variation of the process. This is due to common system causes and can only be changed by a change in the system itself. The points outside the control limits, on the other hand, reflect special causes, which are not original occurrences of the process and must be eliminated.

2.7 Second Check Sheet Concept

The second check sheet concept [16] is one of the quality tools that assists the administrator in presenting the history and pattern of process variations.

According to [17], the construction of the verification sheet involves the following steps: establishing exactly which event is being studied, everyone has to be observing the same thing; define about the period during which data will be collected; Build a clear and easy-to-handle form, making sure that there is sufficient space for data recording; and collect data consistently and honestly, making sure there is time for the data collection task.

From the above, it follows that, following the steps that make up the construction process of the verification sheet, the user will have an efficient tool that will assist him in the pursuit of quality.

[17] further states that the check sheet is widely used early in the process to gather as much information and data as possible and to identify problems that may occur.

2.8 Stratification

The stratification tool aims to fragment the source of a problem into factors. With this tool it is possible to take a problem such as the high waiting rate for care and fragment the possible origins of this problem, for example, the failure is occurring a specific shift, is always occurring with the same people, this always occurring with the same professional.

[18] mentions that stratification consists of dividing a large group into subgroups to facilitate the study and to provide further research into the cause of the problem. Thus the author reveals that several items may be influencing the production process and it is this tool that aims to evaluate each factor and see to what extent it can affect the process or problem in question.

2.9 Flowchart

The flowchart is used to describe the steps of a process, according to [19] this quality tool is defined as: The flowchart is for the description of processes. A process is a certain combination of people, methods, tools and raw materials that generates a product or service with certain characteristics. For example, the process of manufacturing furniture: Joiners and upholsters (people), using saws, planers, sandpaper (equipment and tools), work wood, leather and varnish (raw material), using certain sequence of operations (methods).

The flowchart describes the sequence of work involved in the process, step by step, and the key points that should be followed and the decisions that will be made, are nothing more than a graphical representation of the method or procedure in which the process is involved [19].

2.10 Brainstorming Concepts

According to [20] one of the most creative auxiliary tools used by managers, because it gives freedom to all actors who wish to contribute, without very stiff criteria, making room for stakeholders to participate actively, without pre-judgments, so that the process of creation flow lightly.

Also known as IDEAS STORM, its main purpose is to generate new ideas, discuss them, or even better, to make employees create a culture of giving suggestions, bringing solutions, instead of just being bystanders, watching from outside, often acting as ravenous critics, only leading to problems [21].

2.11 5W2H Concepts

The 5W 2H Action Plan, according to [22] is a tool used to establish a planning, execution or monitoring schedule for work or projects. Also according to the author, his name derives from seven (7) words, five with the initials "W" (What, Who, When, Where and Why), and two with the initials "H" (How and How much) [23].

In their work, [24] therefore conclude that from the use of this tool, the problem can be clearly presented by organizing the steps that help in the conclusion of the most accurate solutions.

It is noteworthy that, besides the described tools, others are also important and can be used in the application of the MASP method. However, as they were not applied to this study, its reference is irrelevant.

2.12 Manchester Protocol

The Manchester Protocol is a screening system that helps to organize the order of care of patients coming to the unit for help, facilitating their care by identifying them by color according to their degree of severity [25].

Each grading color determines a maximum time for patient care [26].

The technique is named after it because it first appeared in Manchester in 1997 and is quickly spread and applied in hospitals across the UK and Europe. Ten years later, in 2007, the method arrived in Brazil and was first implemented in the state of Minas Gerais [27].

TABLE 1 - MANCHESTER CLASSIFICATION TABLE

Source: adapted from [31]

Emergency - There is immediate risk to the patient's life and needs to be addressed immediately.

Very urgent - There is a risk to the patient's life and needs to be addressed as soon as possible.
Urgent - It is not considered an emergency, but the patient needs to go through an evaluation right away.
Low urgent - It is considered a less serious case, the patient can wait for care or be referred to another health service.
Not urgent - this is the simplest case, the patient can wait for care or be referred to another health service.

MASP is an offshoot of PDCA. This unfolding is as follows.

TABLE - 2 PDCA Troubleshooting Analysis Method Table

PDCA	FLOW	STAGE	GOAL
P	1	Problem identification	Clearly defining the problem and understanding its importance.
	2	Observation	Investigating specific characteristics of the problem.
	3	Analysis	Discovering basic causes.
	4	Action Plan	Conceiving plan to block basic causes.
D	5	Action/Execution	Blocking basic causes.
C	6	Check	Checking if the block was effective, if not, return to step 2
A	7	Standardization	Preventing against recurrence of the problem.
	8	Conclusion	Recording the entire process of solving the problem for the future.

Source: Based on study by [32]

4. Application of Study

4.1 Planning Step (P)

Phase 1: Problem Identification

As discussed by [28] and [29] we must rely on facts and data so that we can be sure that the improvement goal and the corresponding problem that will be addressed are the most important at the moment for the company.

At this stage of the study, we identify the problem and clearly define and recognize its importance. To perform this step we used the Brainstorming tool, assuming that two heads are better than one. I gathered a multidisciplinary, multidisciplinary and multi-departmental team of some collaborators, in order to identify the problems and find a solution to the cause. It was defined that criticism or judgments could not be made to causes presented.

Phase 2: Observation

It consists in recognizing the characteristics of the problem. In this phase, an observation was made to

specifically investigate the problems in question, through a detailed view of various points of view presented. Discovering the characteristics of problems through data collection and on-site observation.

First, we need to collect data: Obtaining the right data is essential for reliable process analysis, providing decision making through statistical tools.

For data collection it was necessary to: Define the purpose of data collection; Formulate the questions; Define the quantity and size of the data sample; Define the points for data collection; Prepare the statement and its instructions for recording data collection; Determine the frequency for data collection; Define responsibility for data collection and train those responsible; Conduct data collection.

Stratification: Stratify information from various points of view, such as: time, place, type, symptom, individual, etc.

Verification Sheet: All stratification factors of interest (Registration, Screening, Service Flow, etc.) should be included in the verification sheet that will be used for collecting and recording the data employed in observing the problem.

Pareto Chart: Visually disposes of information obtained from data stratification.

Phase 3: Analysis

It consists in discovering the root causes of the problem under consideration. The statistical tool presented below is widely used at this stage.

Task in problem analysis phase: Definition of influential causes; Choice of the most likely causes (hypotheses); Analysis of the most likely causes (verification of hypotheses); Root cause consistency test.

Cause and Effect Diagram: It was a tool used to present the relationship between the problem to be solved and the process factors that can cause the problem. In addition to summarizing the possible causes of the problem, it also acts as a guide for identifying the root cause and determining the actions that should be taken. Importantly, the causes listed in the diagram should be reduced by eliminating the less likely causes. This reduction can be made based on the results obtained from the use of statistical techniques in the previous phase (observation).

Phase 4: Action Plan

In this phase of elaboration of the action plan it consisted in the conception of a plan to block the main causes that were identified in the analysis phase, that is, the establishment of countermeasures to the main causes. The conclusions obtained through the use of statistical techniques to process the information involved in the fulfillment of the previous phases must always be kept in mind during the elaboration of the action strategy.

The Action Plan is presented as the product of every process related to the planning stage.

It contains, in detail, all the actions that must be taken to achieve the initially proposed goal.

4.2 Execution step (D)

Phase 5: Execution

It consists in the implementation of the action plan. In this phase, data should be collected that will be used in the next phase, to verify the effectiveness of the adopted block.

Tasks in the execution phase: Empowerment: Empowering people to perform the task.
Tools: Participatory meetings, training or orientation.
Action Execution: Perform tasks as agreed.
Tools: Inspection and audit.
Measurement: Measure the results obtained.
Tools: Indicators, control items, verification items and spot management.
The second step of MASP is to execute the established plan. Most companies fail to fail to perform their key tasks.

4.3 Verification Step C

Phase 6: Verification
It consists in confirming the effectiveness of the blocking action. This confirmation should be made by using the data collected before and after the blocking action, which will allow the comparison of results.
After the execution, compare the result obtained with the planned one and study the differences.
In this analysis it is necessary to investigate the causes of the differences that occurred.
If the result is worse than planned, you have to decide what to do to solve the problem and especially make sure that it does not recur!
If the result is better than planned, you need to investigate the causes to make sure they stick to it, so the plan gets better than it already is!

4.3.1 MASP Phases C

Comparison of results: Use data collected before and after action; Analyze the positive and negative effects.
Problem Continuity Check: Ensure that undesirable effects have actually been blocked and addressed. If not, restart MASP.

4.4 Verification Step A

Phase 7: Standardization
The PDCA standardization phase consists of the definitive elimination of the detected influential causes, ie prevention against reappearance of the problem. At this stage, the new operating procedure must be established or the old procedure reviewed. These measures mean that the new way of working should be adopted on a daily basis, with the objective of keeping the process at the new level of performance that has been achieved. In this sense, education and training at work and monitoring the use of the standard are fundamental.
Redo: Stick to the plan, fix something wrong, correct a measurement, or retrain or remotivate people.
Change: Modify the goal or correct the means, ie improve the resources or methods available.
Standardize: Equalize or standardize processes to ensure a desired outcome.
Tool: Flowchart and POP. This stage is characterized by the process of standardization of the actions performed, whose efficiency was verified in the check stage, aiming at continuous improvement.
Standardization should be based on positive results.

Tasks in the standardization phase: Elaboration or alteration of the standard; Communication; Education and training; Side dish.

4.4.1 How to standardize

Write a normative document; Establish the implementation date of the new system; Educate or train stakeholders; Broadly disseminate the new pattern to affected areas and follow up to prevent degeneration of the new system.

Phase 8: Conclusion

The completion phase consists of recapping the entire problem solving process and planning future work. In this phase, a list of remaining problems should be made and the solution planning for these problems should be elaborated. In addition, a reflection should be given on the problem solving activity itself.
Tasks at Completion Phase: List of remaining issues; Careful reflection on the solution's own activities.

5. Results and Discussions

The main difficulties pointed out in the study are related to the services provided by health professionals. It can be observed that poor management directly interferes with care, not identifying recurring difficulties in daily life, not offering adequate training to their professionals and working conditions, this somewhat interferes with other sectors, generated dissatisfaction and increased workload. .

Table 3- PDCA Cycle

P	**Indicator:** Appropriate number of classifications according to the Manchester Protocol.
	Goal: Improve screening by 80% so that ratings are more accurate.
	Features: Enhanced Equipment; Technical knowledge; Technical support; Appropriate work environment.
	Method: Accurately perform the risk classification according to the data established in the Manchester protocol.
D	**Train:** Qualified nurses with the Manchester Protocol course; Continuous updates; Nursing coordination and management meetings; Training with the SAE team
	Execution: Satisfaction survey with patients periodically; Inspection of activities through Nursing Supervisors and Coordinators.
	Measure: Through reports issued in the system.
C	**Compare:** Rotating nurses in screening; Through graphs with the indicators and results obtained.
A	**Act:** Define flow regarding the sectors involved; Equip one more screening room to treat patients when the flow is very intense.

The work process in hospital care must be performed in an agile, effective and equal manner, bringing satisfaction to the patient. Through questions made by doctors and users, about patients being classified

inappropriately with their clinical case and the delay to care. We identified that screening would need to improve evaluation for ratings to be more accurate. However, health professionals who performed this service had no training to apply the Manchester Protocol technique.

6. Final Considerations

The use of quality tools occurred in the emergency department, specifically where nursing staff provide the first patient care. From the data obtained in the previous analyzes, through the use of the MASP tool, some lines of actions that aim to solve the problems found were proposed.

The dissatisfaction level of health service users verified in this unit through satisfaction surveys is relatively high. In some satisfaction surveys conducted at the end of care, reports are seen that are common, long lines, delay in medical care, among other problems. It is essential that urgent changes are made.

The standardization of activities is a major advance in the process of seeking quality. However, before being standardized it is necessary to have firmness in purpose, delimitation of goals that can be achieved and commitment of the entire organization. Standardization tends to standardize the process implying better conditions to achieve the objectives.

Quality tools help you work safely, make it easy to understand the environment and data you need to solve problems.

It is concluded, therefore, that the organizational health system must offer the necessary support to qualify both the care procedures and the professionals in order to offer a humanized treatment, a satisfactory service to the clients, valuing the professionals and the quality of the services provided. .

7. Bibliographical References

[1] PIRES, José G. C. Aprendizagem Organizacional Através da Metodologia de Solução de Problemas – MASP. Revista de Administração da FATEA, v. 9 n. 9, p. 84-100, ago.-dez., 2014. Disponível em: . Acesso em: 26 set. 2017.

[2] CAMPOS, V. FALCONI, Gerenciamento da Rotina do Trabalho do Dia a Dia, 6ª ed., Belo Horizonte, Editora de Desenvolvimento Gerencial, 1994.

[3] TAVARES, GIEISON MARCOS. UTILIZAÇÃO DAS FERRAMENTAS BÁSICAS DA QUALIDADE COMO FORMA DE MINIMIZAR OS DESVIOS DE INSUMO NA EMPRESA JBS FOODS LAGES, SC 2015. **REPOSITÓRIOS DE RELATÓRIOS-Engenharia de Produção**, n. 2, 2015.

[4] SHIBA, Shoji; GRAHAM, Alan; WALDEN, David. **TQM: quatro revoluções na gestão da qualidade**. Bookman, 1997.

[5] DEMING, W. Edwards. **Sample design in business research**. John Wiley & Sons, 1990.

[6] QUANHONG, Li; CAILI, Fu. Application of response surface methodology for extraction optimization of germinant pumpkin seeds protein. **Food chemistry**, v. 92, n. 4, p. 701-706, 2005.

[7] AGUIAR, Silvio. **Integração das ferramentas da qualidade ao PDCA e ao programa seis sigma**. Belo Horizonte: Editora de Desenvolvimento Gerencial, 2002.

[8] MAICZUK, Jonas; JÚNIOR, Pedro Paulo Andrade. Aplicação de ferramentas de melhoria de qualidade e produtividade nos processos produtivos: um estudo de caso. **Qualitas Revista Eletrônica**, v. 14, n. 1, 2013.

[8] BRASSARD, Michael. Qualidade – Ferramentas Para Melhoria Contínua. São Paulo: Qualitymark, 2002.

[9] SALES, Matías. Diagrama de pareto. **Recuperado el**, v. 15, 2009.

[10] KAMADA, Sergio. A cadeia de ajuda para manter a estabilidade produtiva. **Lean Institute Brasil–< ww. lean. org. br>–Acesso em**, v. 7, 2013.

[11] CHIROLI, DAIANE MARIA DE GENARO; GIROTO, ANDRÉ VITOR ORTEGA; PAPPA, MARCIA FERNANDA. UTILIZAÇÃO DO CICLO PDCA ASSOCIADO AO DIAGRAMA DE ISHIKAWA COMO FERRAMENTAS DE GESTÃO EM UMA ORGANIZAÇÃO NÃO GOVERNAMENTAL. **XVIII Simpósio de Engenharia de Produção: sustentabilidade na cadeia de suprimentos. São Paulo**, p. 3, 2011.

[12] CHIAVENATO, Idalberto. **Administração geral e pública**. Elsevier Brasil, 2006.

[13] MILAN, Marcos; FERNANDES, Ricardo Alves Thomaz. Qualidade das operações de preparo de solo por controle estatístico de processo. **Scientia Agrícola**, v. 59, n. 2, p. 261-266, 2002.

[14] SAMOHYL, Robert Wayne. **Controle estatístico de qualidade**. Elsevier, 2009.

[15] COSTA, Antonio Fernando Branco; EPPRECHT, Eugenio Kahn; CARPINETTI, Luiz Cesar Ribeiro. **Controle estatístico de qualidade**. São Paulo: Atlas, 2005.

[16] LINS, Bernardo FE. Ferramentas básicas da qualidade. **Ciência da Informação**, v. 22, n. 2, 1993.

[17] PEINADO, Jurandir; GRAEML, Alexandre Reis. Administração da produção. **Operações industriais e de serviços. Unicenp**, 2007.

[18] CARPINETTI, Luiz Cesar Ribeiro Gestão da qualidade: Conceitos e Técnicas. 2 ed. São Paulo: Atlas, 2012. (estratificação)

[19] LINS, Bernado Felipe Estellita. Ferramentas básicas da qualidade. Instituto Brasileiro de Informação em Ciência e Tecnologia (ibict), Brasília, p.153-161, 22 maio 1993.

[20] SILVA, Adelphino Teixeira da. Administração e controle. 10. ed. São Paulo: Atlas, 1997. 200 p.

[21] FILLMANN, Maria Carolina Frohlich. Inovação no processo de projeto do design de livro impresso: Insumos pelo design estratégico. 2013.

[22] FERREIRA, Beatrice Andrade. Proposta de Planejamento Estratégico de uma Biblioteca de uma Organização Semi-Estatal. **Estudos em Ciências da Educação e Informação**, v. 1, n. 1, p. 13-29, 2018.

[23] SANTOS, Anderson Salmo; MACÁRIO, Anderson Pereira. Melhoria de Processo no Tratamento de Zincagem a Quente.

[24] SILVA, Allan Krysthian Johnnier da et al. Ferramentas da qualidade aplicadas a gestão de estoque: estudo de caso em um centro universitário na cidade de Marechal Deodoro-AL. 2018.

[25] DE SOUZA, Cristiane Chaves et al. Classificação de risco em pronto-socorro: concordância entre um protocolo institucional brasileiro e Manchester. **Revista Latino-Americana de Enfermagem**, v. 19, n. 1, p. 1-8, 2011.

[26] PINTO JÚNIOR, Domingos; SALGADO, Patrícia de Oliveira; CHIANCA, Tânia Couto Machado. Predictive validity of the Manchester Triage System: evaluation of outcomes of patients admitted to an emergency department. **Revista latino-americana de enfermagem**, v. 20, n. 6, p. 1041-1047, 2012.

[27] DINIZ, Aline Santos et al. Demanda clínica de uma unidade de pronto atendimento, segundo o protocolo de Manchester. **Revista Eletrônica de Enfermagem**, v. 16, n. 2, p. 312-20, 2014.

[28] CAMPOS, Gastão Wagner de Souza. A saúde pública e a defesa da vida. In: **A saúde pública e a defesa da vida**. 1994.

[29] WERKEMA, Maria Cristina Catarino. As ferramentas da qualidade no gerenciamento de processos. In: **As ferramentas da qualidade no gerenciamento de processos**. 1995.

[30] HRISTOSKI, Ilija et al. Causality of Factors Reducing Competitiveness of e-Commerce Firms. **Cataloging-In-Publication Data**, p. 813, 2017.

[31] COOKE, Matthew W.; JINKS, Sarah. Does the Manchester triage system detect the critically ill?. **Emergency Medicine Journal**, v. 16, n. 3, p. 179-181, 1999.

[32] CAMPOS, Vicente Falconi. **TQC: Controle da Qualidade Total (no estilo japonês)**. Universidade Federal de Minas Gerais, Escola de Engenharia, 1992.

Proposal of an autonomous system with sensors for the calibration and distribution of water in the Bela Vista Community - Amazonas - Brazil

Ismael Tomé Souza da Conceição
ismaelsouzatc@gmail.com
Centro Universitário FAMETRO – Amazonas – Brasil

Fabiana Rocha Pinto
fabiana.floresta@gmail.com
Coordenação de Engenharia Centro Universitário FAMETRO - Manaus - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazonia – ITEGAM - Brasil

Igor Felipe Oliveira Bezerra
igorfelipe.dss@hotmail.com
Universidade Nillton Lins - UNINILTON LINS – Manaus - Brasil

Abstract

Water consumption has increased exponentially in recent years on the planet, due to the large demographic growth that has made urban areas very dense, and with tasks that increasingly require water use, making the problem of water scarcity a reason. of growing concern. The present work aimed to analyze the water supply system of the community Bela Vista Manaus-AM. Field observation, documentary research and data evaluation allowed the identification of the main factors that make the current system present in the community inefficient. The supply system suffers from constant leaks due to high pressure in some sections, while in others, low pressure occurs, causing some consumers to stop receiving water frequently in their homes, as well as failures in supply selectivity, which is made manually. The result of the survey carried out in the community showed a high rate of disapproval of the services provided by the company that operates the local supply system, where 88% were dissatisfied with the service provided, while in the overall evaluation of the service, 62% considered it to be unsatisfactory. poor quality, 38% said it was good and no one rated the service as excellent. With all this information, it is advocated the conscious use of water and the importance of sectorization as a way to obtain better control over the supply system. In this way a system automation proposal is outlined with the replacement of some equipment with others with more specific operation accuracy and inclusion of others, as well as basically simple changes to make the current system efficient, safe, more productive and with lower operating cost.

Keywords: Water distribution system; Sectorization; Automation;

1. Introduction

Water, an essential element for sustaining life on planet Earth, is used in various segments and for various purposes, such as power generation, irrigation in agriculture, in the manufacture of products and food, and for consumption, in survival conditions [1].

Water consumption on the planet has increased exponentially in recent years, due to the large demographic growth that has made urban settlements very dense, and with tasks increasingly demanding the use of water, and consequently, the growth of industries and agriculture. , these last two factors together account for 92% of all water consumed in the world [2].

Lack of planning for the deployment and expansion of water distribution networks causes leaks, further aggravating the problem of scarcity [3]. And the great distances from the consuming centers of the springs is one of the deficiencies found in the urban water supply in Brazil [4]. Given the awareness that this is an exhaustible resource arises the need for more efficient management of this asset.

Distribution systems are composed of reservoirs and distribution networks, and the water mains are responsible for the water path from the extraction sources to the distribution networks, which in turn takes the water to the reservoirs (water tanks) or directly to the end consumer, being the system stage where the majority of leakage and theft losses occur [5].

Through technology, the most efficient use of this good is sought, since a large percentage of the water produced for urban consumption is lost in the supply systems from its collection to distribution to the final consumer. In developed countries these losses are around 8%, while in developing nations it reaches 45% [6]. In Brazil, wastewater from treated water reaches 30% according to the National Sanitation Information System - SNIS [7].

For Sousa [8], sectorization would be a solution to these problems, which consists of separating the supply system by sectors, making it easier to control and distribute efficiently, using technology as an ally to control pressure, flow, points. among others, making it even easier to maintain and repair the network, since the shutdown would be done only in the zone that presents the problem.

In areas far from springs artesian wells, together with technology, come to intervene by means of sensors, water pumps, plumbing and other components in the problem of rural or urban water supply deficiency [9]. With knowledge of signals and systems, one can envisage the calibration and control of a water supply system.

Automation can be defined as a set of techniques designed to automate, that is, automating a given process without the use of human, muscular or mental energy, replacing them with computer-controlled electronics, and their benefits to processes. They are clearly visible: efficiency, safety, higher productivity, lower cost [10], examples of automated processes: washing machine, electronic door, elevator and multifunctional robots.

The main components used in automation are: sensors, which are devices sensitive to some form of energy, light, thermal, kinetic; or in relation to physical quantities, such as temperature, pressure, velocity, current, acceleration, position and others; the actuators, which are the components that produce movements; frequency inverters, responsible for varying the voltage and frequency supplied to the motor; the valves and logic controllers - PLC [11].

Valves are components that have the function of establishing, controlling and stopping the flow in a pipeline, and are important fittings that need to be sized correctly to avoid unnecessary expense as they are expensive but indispensable devices without which the piping would be useless [12]. According to [13], valve sizing is a very important point to be addressed, as it will determine how sensitive the valve will change the flow rate of the fluid. For this it is necessary to know the flow, which is how much fluid passes through a hole in a given time, considering the loss of a pressure bar, characteristic loss of the valves. For fluids in liquid state there is a simple equation:

$$CV = 1{,}16\ Q\ \sqrt{(\rho/\Delta P)} \quad \text{eq. 1}$$

Where: CV = coefficient of flow per gallon per minute (gpm); Q = mass flow in m^3 / h; ΔP = Upstream pressure - Downstream pressure (bar); ρ = density (kg / dm^3).

Programmable Logic Controllers - PLCs, this equipment is similar to a programmable computer to perform various control functions, reducing the uses of wires, complex circuits and relays, as well as ease of programming, installation, speed control, network compatibility, verification. of defects and test convenience and high reliability [14].

The main reasons for justifying the use of automation in the water supply system are: greater control via real-time monitoring, reduction in operating cost and control of physical losses in the system. Electrical commands issued through a command center, control supply, locate network failures in real time, and remotely troubleshoot with repair time optimization. An efficient water supply system, while preserving a finite asset by eliminating leaking waste, prevents accidents that can cause everything from material loss to death in the most extreme cases.

Thus, this study aims to demonstrate the importance of automation in water distribution more efficiently, with the purpose of qualitatively analyzing the supply system of a community of Manaus, exposing its failures and causes, looking for technology provides solutions to the problems observed.

2. Material and Method

2.1. Study area

The Bela Vista community is located in the Puraquequara neighborhood, located in the east of Manaus / AM, on the shores of Puraquequara Lake. The community lives basically from family farming, through the planting and harvesting of food needed to support the family, and the use of fishing in Puraquequara Lake to supplement the food.

With 20 years of existence has 28 roads, between streets and avenues, which began to receive earthmoving, drainage and asphalting in November 2017, gradually starting at Rua Beira Rio, one of the main access roads to the community, followed by other main ones, Princess Dayana, Dom Jackson, Maria Raquel and Tim Maia, until they reach all the routes that were finalized at the end of the following year.

The Bela Vista Community has a school and municipal day care centers, as well as a soccer field, has about 300 families with approximately 1480 people, but does not have an efficient water distribution system and is not interconnected with the city's water supply system.

2.2. Kind of study

The approach used in the research was the qualitative method, which according to [15], this method explains the reason for things, specifying what needs to be done to solve a problem without worrying about the proof, because it uses various means of approaches. Regarding the research objective it was based on exploratory and descriptive. Exploratory research seeks to make the subject explicit or construct hypotheses, involving bibliographic survey, while in the descriptive researcher needs to gather various information about what he wants to research, seeking to describe facts and phenomena of a reality [16].

Documentary analysis was also observed, which requires a little more care, since it is the identification, verification and appreciation of documents that maintain a close relationship with the object investigated and that had no analytical or systematized treatment [16].

2.3. Data collect

Data were collected for this work through community visits that took place about twice a month since the beginning of the research. Residents, distribution system workers and community president were observed in order to seek satisfaction information and difficulties in the operation of the system, using the exploratory research method.

A survey of the vulnerabilities of the water distribution system was performed using the descriptive research method and the qualitative approach specified the problem of the inefficient Bela Vista Community system, to be solved.

In addition to a documentary analysis of the documents existing at the headquarters of the community secretariat with data on the implementation, and operation of the current water supply system, as well as a satisfaction survey of the services provided by the cooperative managing services performed by the Social and Educational Center of the Aleixo Lake - CSELA.

2.4. Collection Instruments

Through a pre-designed questionnaire, an analysis of the residents' satisfaction with the current water supply system was carried out, taking care to obtain a significant sampling of residents by street, with the purpose of making the result as close as possible. possible from the reality of the majority.

Also the employees, who sought to observe the difficulties encountered in their day to day, in carrying out their work activities and the most frequent defects that occur in the system.

The cooperative that manages the extraction and distribution of water in the community provided some documents regarding the implementation and distribution of the system, a list of devices and project components, as well as the results of a satisfaction survey conducted by CSELA, requested by the operators themselves cooperative.

2.4.1 Community Water Supply System

In the evaluation of the community supply system, two steps were adopted:

a) Step 1 - Satisfaction with community residents and employees of the company that manages the supply system was analyzed.

b) Step 2 - the survey of the equipment currently used in the system and existing documentation was

performed.

2.4.1.1 Step 1: Satisfaction Survey

A survey was conducted with the community residents with the intention of knowing the level of water quality assessment they are receiving, if the supply time is being sufficient and if the flow meets their needs, where Figure 1 shows the spreadsheet model. of evaluation observed in the research.

Satisfaction Survey of Water Distribution System in Bela Vista Community							
Date	Street	House Number	Sufficient water receipt time, yes or not?	Received water pressure, strong, weak or regular?	Does the street face or has it ever had problems with leaks, yes or not?	Satisfied with the supply service, yes or not?	Evaluation of the service provided: great, good or bad.

Figure 1. Evaluation model observed in the satisfaction survey.
Source: Author.

With the cooperative employees, it was raised about the difficulties in operating the system and the most frequent problems encountered to serve the community efficiently, as well as information about the difficulties in operation.

2.4.1.2 Step 2: Equipment Survey and Documentation

The cooperative was asked to list the equipment that makes up the current water extraction and distribution system, brands, models and specifications, with the aim of studying the system's extraction capacity, pressure and flow.

Of the mentioned equipment, it is worth mentioning the water pumps used in the system, which are Schneider brand IP55 Multi-stage 380 / 660V, model ME-34500 C167 and 50 HP power, and the wafer hand butterfly valves.

The cooperative also granted some documents regarding the implementation and operation of the system, such as a community map showing the points where the main and secondary pipelines pass, the location of the points where the control and flow valves are located, as well as the headquarters of groundwater extraction.

The results of the satisfaction survey carried out by the Lago do Aleixo Social and Educational Center, requested by the cooperative with the consumers of the service provided in order to know about the quality, quantity, time of reception and pressure of the water received by the water supply system. distribution.

3. Results and Discussion

We sought to detail the result of the satisfaction survey conducted with residents separated by streets in the Community, where the amount and sample of the survey was obtained considering the length of the street and locality, ie, in the longest roads there was a larger number of people. observed taking care to cover the

entire length of the space, respecting the sampling location (table 1).

During the survey, 225 residences distributed in 27 streets of the Community were visited, as shown in table 1, Princesa Dayana Street was where there was the largest number of respondents, explained by being the main and longest way and the smallest number in Pará Street. for the opposite reason.

Table 1 - Satisfaction survey of the water distribution service in the Bela Vista Manaus Community - AM.

Streets→		Airton Sena	Anselmo Duarte	Daniela Peres|Padre Calério	Denner	Dom Jackson	Dr. Alcion	Dr. Celso	Florentina Pereira	Frei Damião	Frei Tomaz	Hilário Calheiro	Irmã Dulce	Irmã Helena	Jacamin	João Paulo	José Lindoso	Júlio Damião	Luiz Gonzaga	Madre Tereza de Calcutá	Mané Garrincha	Maria Aparecida	Maria Raquel	Padre Ludovico	Pará	Princesa Dayana	Rio Unai	Tim Maia	Total	Average	%
Satisfaction questionnaire	-	10	10	7	7	9	5	10	10	8	8	5	6	8	9	10	10	9	6	10	10	7	10	5	4	15	8	9	225	-	-
Sufficient water receipt time?	yes	5	9	4	0	5	0	1	8	4	3	2	2	1	2	6	2	5	1	2	9	1	2	0	0	12	2	3	91	3,4	40%
	Not	5	1	3	7	4	5	9	2	4	5	3	4	7	7	4	8	4	5	8	1	6	8	5	4	3	6	6	134	5	60%
Received water pressure?	strong	3	5	0	0	1	0	2	4	1	0	0	0	0	1	2	2	3	0	0	4	0	2	0	0	10	0	1	41	1,5	18%
	weak	4	3	5	7	6	5	6	4	6	6	4	4	5	7	3	6	1	5	3	3	6	6	4	4	3	7	7	130	4,8	58%
	Regular	3	2	2	0	2	0	2	2	1	2	1	2	3	1	5	2	5	1	7	3	1	2	1	0	2	1	1	54	2	24%
Does the street face or has it ever had problems with leaks?	yes	9	10	6	7	9	5	8	10	8	8	5	4	8	9	10	8	9	6	10	10	7	9	5	4	2	8	9	203	7,5	90%
	Not	1	0	1	0	0	0	2	0	0	0	0	2	0	0	0	2	0	0	0	0	0	1	0	0	13	0	0	22	0,8	10%
Satisfied with the supply service?	yes	2	1	0	1	2	0	0	1	0	0	0	0	0	0	1	0	0	0	3	4	0	2	0	0	6	1	3	27	1	12%
	Not	8	9	7	6	7	5	10	9	8	8	5	6	8	9	9	10	9	6	7	6	7	8	5	4	9	7	6	198	7,3	88%
Evaluation of the service provided:	great	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0%
	good	4	5	5	2	6	0	4	6	1	3	1	2	2	2	5	3	4	0	2	5	6	4	1	0	10	1	2	86	3,2	38%
	bad	6	5	2	5	3	5	6	4	7	5	4	4	6	7	5	7	5	6	8	5	1	6	4	4	5	7	7	139	5,1	62%

Source: Author

Each road receives 4 h of daily supply, in which the time of water reception was observed. The result showed that 40% of the population indicated that it was sufficient, justifying that correctly stored water and used consciously, meets the daily need. While 60% were dissatisfied with the supply time, indicating the need for more time.

Under the pressure on which water is received, 18% think it is strong, 24% weak, while 58% of people observed indicate that it is below expectations. Analyzing the results separately by street and household position, positive responses are noted for people residing in the streets closest to the underground water catchment centers and houses at the beginning of the road. As the extraction centers move away, the pressure tends to decrease.

From Figure 2, referring to the last three observations, 90% of people say they have already seen some type of water leakage in the distribution pipes in their streets, where the other 10% indicate no occurrence. It is also noticed that these residents are present at the beginning of the observed streets and it can be concluded that the leaks mostly occur at the end of the pipes.

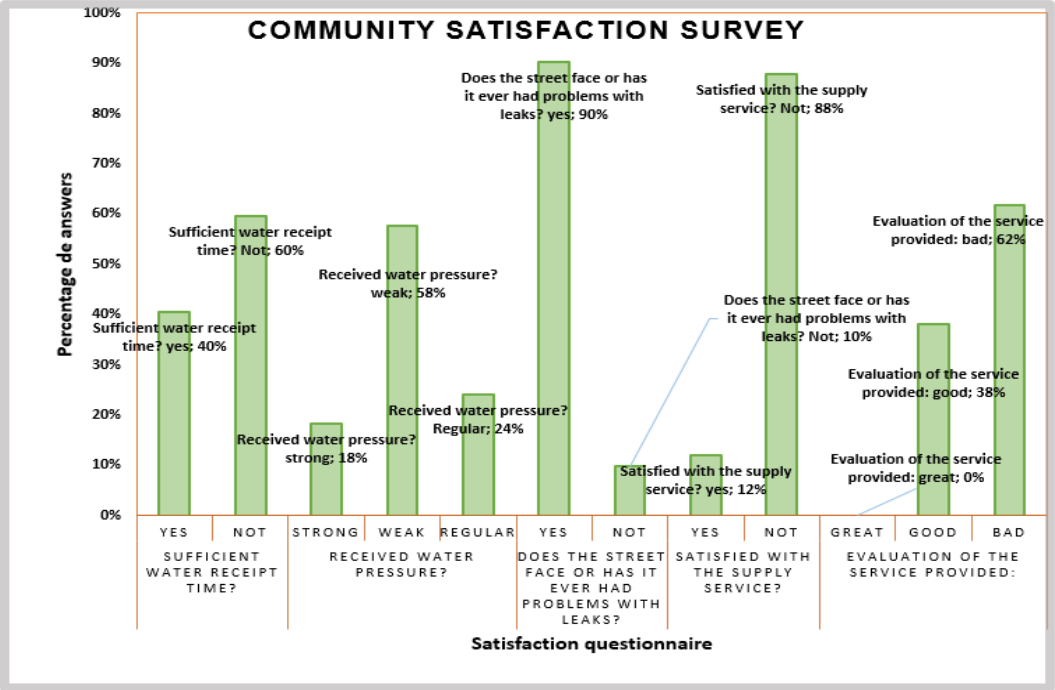


Figure 2. Result of the community satisfaction survey.
Source: Author

Of the 225 analyzed, 88% are not satisfied with the service provided in the community, and 12% say they are satisfied thinking that five (5) years ago (when the system started operating), did not have any supply system of water, each resident had to have his artesian well, either ask from a neighbor who had a little water well or travel a considerable distance carrying water from Lake Puraquequara. Overall, 62% said the service was poor, 38% said it was good and no one rated the service excellent.

The negative assessment in this case is justified because, according to [17], the operational performance and the quality of water received is essential in the evaluation of the provision of water supply services, in addition to the type of provider and size of the system.

In analyzing the results carried out by the Lago do Aleixo Social and Educational Center, requested by the cooperative with the service's consumers to expose in accountability with the municipality and justify the investment given, and comparing with the results obtained above it is possible to notice major controversies, with 73% of respondents say they receive water with strong pressure, 17% say they arrive with regular pressure and 10% weak, and overall service rating 63% of respondents rate excellent service, 30% regular and only 2 % bad.

Regarding the difficulties in the operation of the system and the most frequent problems faced to provide an efficient service to the community, the cooperative collaborators stated that the team is composed of four operators for eight water catchment and distribution bases by artesian wells. move between them to start and stop the water pumps at predefined times, and are located far from each other.

The water pumps used are brand and model that stands out among the best in the market, with pressures supplied ranging from 1 to 4 stages, allowing you to program the stage depending on the need for pressure. The difficulty of the operators in this regard is the need for manually direct pressure and flow control at the pump so that there is no shortage of supply to the last street dwellers due to low pressure and not causing

the pipes to rupture with the high.

Manual control becomes this “gambling” manual control, because if the operator releases a low pressure and all the people on the street open their taps, the latter will not be supplied, however if he releases a high pressure and few others. If they do, the pipes may not support and break.

In addition to the difficulty of distribution valves with manual valves, manual supply has to be released to a given street at predefined times.

The operator has to travel to the valves located at the beginning of the street connected to the central adductor, shown in a design drawing made in autocad in figure 3, where the red points are the locations of the flow release valves and the yellow points are. water extraction bases, which causes forgetfulness of supply release for some often.

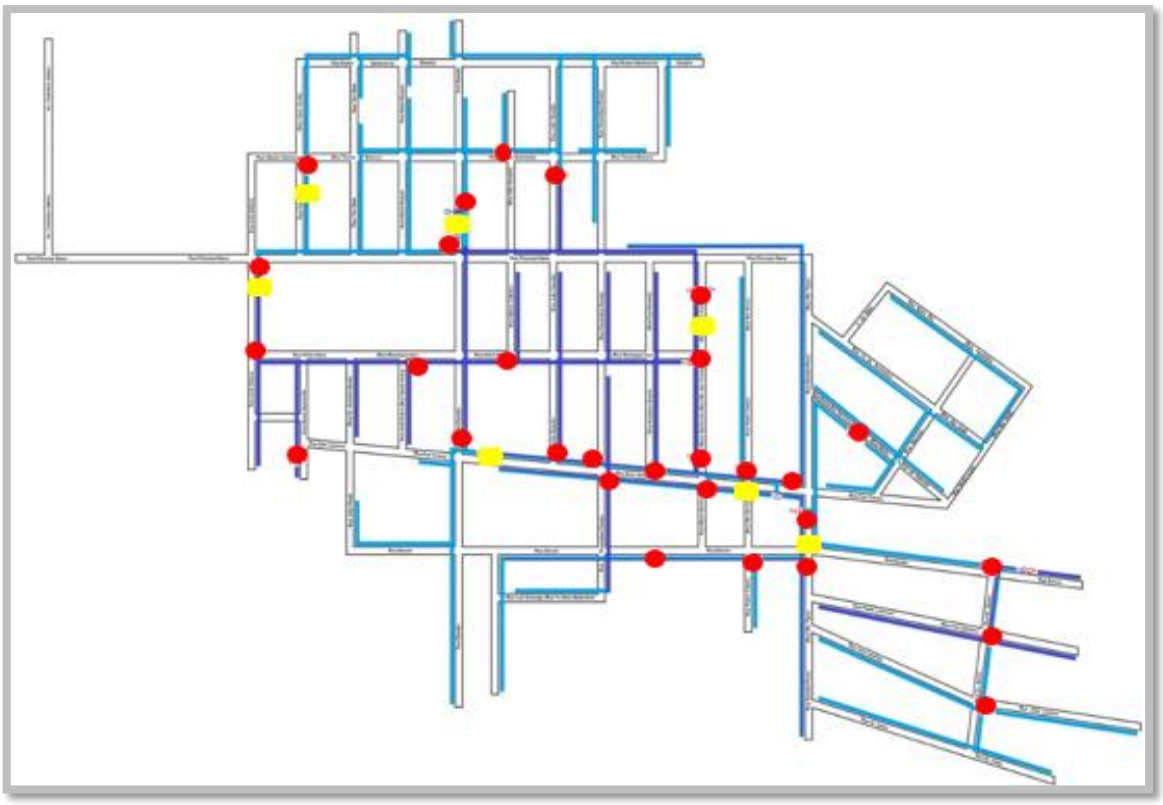


Figure 3 - Schematic drawing of flow release valves and extraction bases made by autocad.
Source: Cooperative that manages the supply system, modified by the author.

Therefore there is a need to create an autonomous system with sensors for calibration and water distribution in this community. The successful implementation and operation of this can be as a "showcase of observation" to accept the need to implement sectorization in the city's supply system. In this Community, being part of the City of Manaus, it can be concluded that this System will be as a sectorization of a larger system.

Thus, according to what was said by Sousa [8], a distribution system divided by smaller sectors with the aid of technology makes it easier to control pressure, flow flow and network leakage, making the system more efficient and reducing losses. well, that's the water.

By means of pressure sensors, monitor this physical quantity of water inside the pipelines by sending a

signal to a logic controller installed in the extraction bases, which will increase or decrease the pressure stage of the water pump as the system needs, avoiding that the pipeline will rupture in the event of too high a pressure, or if homes farther from the distribution center are no longer receiving water due to low flow pressure.

In addition to replacing the current manual valves, the electrically operated valves and commands sent by the logic controller (PLC), causing them to open or close the passage of water at predefined times for each community route, making the selectivity of the supply automatically.

Thus, we want to show that an automated system, as the one defended by [4], basically simple distribution and control of water pressure is able to replace the current and inefficient system of the Bela Vista Community, Puraquequara, Manaus - AM.

According to [18], it is common to observe many campaigns aimed at consumers for the conscious use of water, but there are actions for efficient use that do not depend on user behavior, occurring due to failures of design, execution and operation in the supply system. . Therefore the use of technology can be applied to solve these failures, promoting economy in the use of this good, avoiding waste and promoting sustainability.

An efficient water supply system has as its essential parameter the loss rate of this well, since leaks are directly related to pressure and flow losses, influencing the volume of water distributed to the population [17]. As a result of the implementation of automation in the water distribution system in the Bela Vista community, we seek to reduce the use of this feature.

In addition to generating savings, avoiding unnecessary costs with premature replacement of equipment, number of operators and inefficient use of electricity from equipment adjustment failures, equipment power oversizing, lack or failure of operational control [19].

Starting from the very concept of [10], with the action of automating the water supply system, the Bela Vista Community can obtain visible benefits using this process, such as: efficiency, safety, higher productivity and lower cost.

4. Conclusion

This work has shown the importance of separating water supply systems from large cities into smaller sectors, facilitating efficient control and distribution, using technology as an ally to control pressure and flow, and identifying and correcting water points. failures more easily.

The water supply system of the Bela Vista community was analyzed, indicating that it is an inefficient system, causing 88% of consumers dissatisfaction with the service provided, due to constant leaks in the distribution system, frequent lack of supply in some homes, forgetfulness in the selectivity, made manually by the valves installed between the main water mains connections and the secondary piping that leads water to the homes.

It was also observed that the water pumps used in its eight community-distributed water extraction bases are of a brand and model of excellent performance having four pressure stages, where it would be enough to install a logic controller - PLC in each one of them. pressure sensors inside the pipes and replace manual valves with electrically operated valves, as well as peripherals to automate the system.

The sensors will therefore measure the pressure inside the pipes, informing the logic controllers that the required pressure stage of the pump will be activated, the system will automatically selectivity at predetermined times, sending signals to the valves.

Thus, it is concluded that the automation of the Bela Vista Manaus-AM community water supply system will solve the current problems bringing efficiency, safety, higher productivity and lower operating costs.

5. Bibliographic References

[1] RIBEIRO, L. G. G; ROLIM, N. D. Planeta água de quem para quem: uma análise da água doce como direito fundamental e sua valoração mercadológica. Artigo. Revista Direito Ambiental e Sociedade, v.7, n° 1. 2017. 33p.

[2] BRASIL. Ministério do Meio Ambiente. Secretaria de Recursos Hídricos. Plano Nacional de Recursos Hídricos. Brasília. 2017. 16p.

[3] MACEDO, M. S. O mau uso da água e as suas consequências da escassez no Brasil. Trabalho de Conclusão de curso. Faculdade de Economia, Administração, Contabilidade e Atuária (FEA – USP). 2015. 16p.

[4] SILVA JÚNIOR, J. F. J. Detecção de perdas em sistema de distribuição de água através de rede de sensores sem fio. Dissertação de conclusão de pós-graduação. Universidade Federal de Pernambuco (UFPE). 2017. 167p.

[5] VENTURA, K. S.; VAZ FILHO, P.; NASCIMENTO, S. G. Plano de segurança da água implementado na estação de tratamento de água de Guaraú, em São Paulo. Artigo Técnico. Eng Sanit Ambient. v24 n.1. Jan/fev 2019. 11p.

[6] ORGANIZAÇÃO MUNDIAL DA SAÚDE (OMS). World health statistics 2018. Monitoring health for the SDGS, sustainable development goals. Genebra, Suíça. 2018. 100p.

[7] BRASIL, Ministério das Cidades. Secretaria de Saneamento Ambiental (SNSA). Sistema de Informação sobre Saneamento. Diagnóstico dos Serviços de Água e Esgotos – 2015. Brasília. 2017. 212p.

[8] SOUSA, R. Uso de válvulas redutoras de pressão na otimização de rede setorizada de distribuição de água. Dissertação de conclusão de pós-graduação em engenharia mecânica. Universidade Federal da Paraíba (UFPB). 2017. 70p.

[9] RAID, M. A. M. Soluções técnicas de abastecimento de água e modelos de gestão: um estudo em quinze localidades rurais brasileiras. Dissertação de conclusão de pós-graduação. Universidade Federal de Minas Gerais (UFMG). 2017. 225p.

[10] PELLINI, E. L. Introdução a automação de sistemas elétricos. Aula elaborada. Escola Politécnica da Universidade de São Paulo – Departamento de Engenharia de Energia e Automação Elétrica. 2017. 62p.

[11] FEHRENBACH, R. B. Desenvolvimento de sistema automatizado para controle de dosagem de ração animal. Monografia. Centro de Ciências Exatas e Tecnológicas do Centro Universitário Univates. Lajeado – RS. 2017. 67p.

[12] FERRARI, T. Conceitos e aplicações das válvulas industriais. Trabalho De Conclusão De Curso De Engenharia Mecânica. Faculdade Pitágoras. Poços de Caldas – MG. 2017. 66p.

[13] CASTRO, R. S.; ERIKSSON, K. T. Aplicação de válvulas de controle em processos industriais.

Dissertação de conclusão de pós-graduação. Centro de Pós-Graduação Oswaldo Cruz. 2014. 13p.
[14] GOMES, W. Controladores lógicos. Material Didático. Instituto Tecnológico de Aeronáutica. 2018. 59p.
[15] FANTINATO, M. Métodos de pesquisa. Apresentação de aula, USP 2015. 50p.
[16] KRIPKA, R. M. L; SCHELLER, M; BONOTTO, D. L. Pesquisa documental na pesquisa qualitativa: conceitos e caracterização. Artículo de revisión. Revista de Investigaciones – UNAD.v14. n° 2. Julio-Diciembre 2015. 19p.
[17] HAMDAN, O. H. C. Avaliação de indicadores aplicados a sistema de abastecimento de água em Minas Gerais segundo portes populares. Dissertação de conclusão de pós-graduação. Universidade Federal de Minas Gerais (UFMG). 2016. 139p.
[18] LANDI, F. D. N; DEBS, M. S; OLIVEIRA, P. M. Gestão de Recursos Hídricos na Indústria da Construção: Conservação de água e Gestão da demanda. Comissão de Meio Ambiente (CMA). Confederação Nacional da Indústria. 2017. 118p.
[19] ANDRADE SOBRINHO, R; BORJA, P. C. Gestão das perdas de água e energia em sistemas de abastecimento de água da Embasa: um estudo dos fatores intervenientes na RMS. Artigo técnico. Eng Sanit. v21. n4. Out/dez 2016. 13p.

Socio-Environmental Innovation in The Management of Urban Solid Waste in The Amazon

Eliezer de Souza Nascimento. Student on the Environmental Engineering Course at the São Paulo College (FSP); student on the Agronomic Engineering Course at the Federal University of Rondônia. Collaborating Member of the Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil. Email: souzaeliezer_ministro_@hotmail.com

Flavio de São Pedro Filho. Post-Doctor in Management and Economics from the University of Beira Interior (UBI), Covilhã, Portugal. PhD in Business Administration from the University of São Paulo, Brazil. PhD in Business Management from the Autonomous University of Asunción, Paraguay. Professor and Researcher at UNIR for the Undergraduate and Master's Courses. Coordinator of the Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil. E-mail: flavio1954@gmail.com

Vanessa Piffer. Master's Student on the Graduate Programme Master's Course in Business Administration PPGMAD/Federal University of Rondônia Foundation. Postgraduate in Engineering and Occupational Safety from Faculdade Santo André. Postgraduate in Sanitary and Environmental Engineering for the Pan American College of Ji-Paraná. Environmental Engineer from the Federal University of Rondônia. She has the post of Work Safety Engineer at the Federal Institute of Rondônia IFRO, Brazil. Member of the Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil. Email:eng.vanessapiffer@gmail.com

Sylviane Beck Ribeiro. Professor and Researcher at the Federal University of Rondônia (UNIR), Rolim de Moura Campus, Department of Forest Engineering. Research Group on the Management of Innovation and Technology (GEITEC/UNIR/CNPq), Brazil. Email: sylvianebeck@unir.br

Dalza Gomes da Silva. PhD in Phytopathology from the Federal University of Viçosa, Master in Phytosanity, graduate in Agronomy from the Federal University of Espírito Santo. Professor and Researcher at the Federal University of Rondônia (UNIR), Rolim de Moura Campus, Department of Agronomy. Email: dalza.gomes@unir.br

Valéria Arenhardt. PhD in Environmental Technology from the UNAERP – University of Ribeirão Preto, São Paulo, Brazil, Master in Business Management from the Vilhenian Association of Education and Culture, Professor of Entrepreneurship and Guidance for Research at the IFRO – Federal Institute of Education of Rondônia. Member of GEITEC/UNIR, Brazil. Email: valeria.arenhardt@ifro.edu.br

Resume

Inadequate disposal of urban solid waste (USW) contaminates the soil, groundwater, bodies of surface water and the atmosphere, due to the emission of polluting gases. It causes urban flooding due to the

obstruction of storm-water drainage systems caused by accumulated USW. Carried by rainwater, it also, among other environmental events, affects the macro- and micro-climate, raising the local and global temperature. In this scenario the present study asks how innovation in the management of urban solid waste can contribute to social and environmental innovation. The general objective of this work was to study the management of USW in the Amazon sub-region, given the advent of social and environmental innovation. To obtain its results, it took the following as its specific objectives: (1) interpreting the current management of the USW of the sub region of interest; (2) describing the ultimate destination of the USW; and (3) proposing models of socioenvironmental innovation for the management of USW in the local sub-regions. The case study method was applied, using the necessary procedures. It was observed that the management of USW in the studied sub region is restricted to public power facilities, where it employs few processes or technologies. Regarding the final disposal of the USW, the municipalities have not instituted any separation of recyclables from waste products and hence they send all domestic and industrial waste to landfill sites as if nothing was recyclable. In addition, most municipalities continue to dump contaminants in their old sites, pending decisions to close them and ask responsible bodies to supervise them. This paper is an academic contribution to the improvement of waste management. It proposes innovative USW management practices, based on the principle that the Polluter Pays; initiatives that favour socioenvironmental innovation must be substantiated. This research is of interest to scholars working on sustainability and to managers concerned with issues related to socioenvironmental management.

Keywords: Socioenvironmental Innovation. Urban Solid Waste, Shared Management. Sanitary landfill.

1. INTRODUCTION

The generation of Urban Solid Waste (MSW) in the Amazon region is progressively increasing due to the advance of industrialization, the demographic increase and the increase in the per capita generation of waste, which accelerates this process. The excess of waste is aggravated by its incorrect management, a common scenario in underdeveloped countries and regions. Urban growth in the Brazilian Amazon causes urgent concern, imposing the need for MSW management studies and monitoring to avoid the collapse of this fragile environment.

The inadequate management and disposal of MSW result in the contamination of soil, groundwater, surface water bodies and the atmosphere, due to the emission of polluting gases, while the urban sprawl due to the obstruction of rainwater drainage systems caused by the accumulated MSW and carried by the rains also interferes in the macro and microclimate raising the local and global temperature, among other environmental hazards. Therefore, the management and appropriate treatment of MSW have become topics of general interest, because they can generate social and environmental innovation and present an economic alternative besides promoting environmental quality.

The general objective of the present research is to generate knowledge about the management applied to MSW in an area of the Amazon sub-region and to propose social and environmental innovation tat would improve the process. The specific objectives are (1) to learn about the way in which the MSW of the sub region under scrutiny is managed; (2) to describe the way that MSW is ultimately disposed of; and (3) to

present proposals for social and environmental innovation in managing MSW in the Amazonian region as a whole.

The question that this research seeks to answer is as follows: Is it possible to practise social and environmental innovation in the management of MSW so as to maximize the useful life of the landfills in the Amazon region? This study is divided into an introduction, a theoretical framework, methodology, results and discussions and a conclusion.

2. CONCEPTUAL THEORETICAL REVIEW

This study is based on Schumpeter's Theory of Economic Development (TDE), which highlights the mechanism of cyclical innovations capable of maintaining competitiveness through consumption patterns. It establishes the relationship between capitalism and the production of consumer goods whose cycle is discontinuous or unstable and also replaces the paradigms linked to market forces. Innovations are inserted to create and then satisfy unplanned desires in consumers. However, manufacturers try to incorporate a need for products into consumers' daily habits; in this way, as Costa (2006).points out, the productive apparatus changes under new pressures for production, focused on evanescent personal desires.

According to Oenning et al. (2012), the above process tends to increase the demand for more complex products to consume, making the generation and variety of solid waste to dispose of notorious. Rezende et al. (2013) report that the consequences of this cycle represent one of the biggest environmental problems of our day, since most Brazilian cities do not have the infrastructure to cope with the consequences of industrial growth signalled by the greater use of disposables and the other habits of hard consumerism.

2.1 Management applied to Urban Solid Waste

The National Policy on Solid Waste (PNRS), established by Law 12.305 of 2010, brings together guidelines and goals for the management of MSW, which deals with its complexity by acting on the principles of shared responsibility, the polluter pays, the preserver receives. and development must be sustainable. This law establishes that solid waste is a material that can be reused over and over and defines waste as an unusable input, raw material in a production chain. MSW is conceptualized as discarded materials, substances, objects or goods that result from human activity whose final destination should be technically and economically viable, using the best available technologies. Integrated management, according to PNRS, consists of joint actions carried out directly and indirectly in the stages of collecting, transporting, trans-shipping, treating and properly disposing of MSW in an and environmentally appropriate way, observing municipally integrated management plans which are aligned with legal standards for the environment.

The work of Reis, Freide and Lopes (2017) points out the need for a new attitude to waste with the lightest possible impact on human health and environmental quality from the life cycle of products, in which industry, commerce, public power and the final consumer participate in an attempt to transform ingrained behaviour and replace it with cognitive management in search of a balanced environment.

The National Institute of Engineering and Auditing Expertise (IPEA, 2018) notes a serious problem in waste processing; for example, few processes and technologies are employed and responsibility for it is

restricted. But the importance of shared responsibility for manufacturers, importers, distributors, traders, consumers and service holders, as demanded under the law, cannot be over-stated. In this scenario, according to PNRS, the business sector is responsible for guiding consumers in the correct disposal of the waste generated by their consumption of products. Products and their packaging must be capable of being recycled or properly disposed of. The government must adopt procedures through standards. laws and enforcement for the reuse of MSW, establishing separate collection systems and promoting proper disposal. Consumers, too, should reject environmentally risky products, join organizations or simply segregate waste. This would separate, package, reuse and properly dispose of waste materials. Table 1 below shows the stages of MSW management.

Table 1- Steps in the Urban Solid Waste Management Plan.

Stage		Features
Separation		It is the action of separating waste according to its characteristics wherever and when it is generated and placing it where it can be collected separately from other waste.
Packaging		It is the step of treating waste separately according to its characteristics for proper collection according to the type and quantity generated.
Collect		It is the act of periodically and selectively picking up separated, classified and conditioned waste.
Transport		It the act of transporting waste in a proper manner, obeying the rules and legislation in force, to avoid contamination of the environment.
Destination:	**Recycling**	It is the transformation of waste into inputs or new products.
	Reuse	It is the process of using solid waste without transforming it, biologically, physically or chemically
	Compost	It is the act of taking advantage of organic waste in the production of manure.
	Recovery	It is the act of recovering something for reuse.
	Harnessing	It is the use of waste for energy or another destination allowed by a competent body.
Treatment		This step reduces the amount of pollutants in waste by turning it into inert or biologically stable material.
Disposition		It is the orderly distribution of tailings in landfills.
Reverse Logistic		In the case of special waste such as batteries or fluorescent lamps, reverse logistics should be encouraged, according to PNRS (2010).

Source: Adapted by the author based on Andreoli et al. (2014) and PNRS (2010).

The Diagnosis of Urban Solid Waste Management (SNIS, 2017) describes the treatment and disposal of MSW produced by the population of 3,556 Brazilian municipalities, representing 80.1% of the country's population. The result of the research indicated the generation of 60,6 million tons of MSW and states that only 3 million tons went through sorting units to reach a rational destination.

A study by the Brazilian Association of Public Cleaning and Special Waste Companies cited in ABRELPE (2016) indicates that between 2014 and 2015 an approximate increase of 12,692 tons of MSW per day was generated in the Amazon and, of 450 municipalities, only 258 in the northern sub-region of Brazil maintained the selective collection programme, revealing a significant risk to the developmental advance in the scenario under review.

Caetano et al (2017) insists that, in the treatment of solid waste, its weight and volume before and after treatment should be measured to gather important information on the efficiency of the procedures applied, the amount of waste that would eventually go to landfill and the average useful life of these units. Gravimetric information would help these units to function better.

2.2 Final Disposal of Urban Solid Waste

The PNRS (Brazil, 2010) establishes that MSW should finally be put into landfills to avoid risks to public health and safety and minimize its environmental impact. But the country does not follow this guidance; instead, according to a study in ABRELPE (2017), waste is left in dumps, currently numbering 2,976 units operating in Brazilian territory; these have a negative social and environmental impact on about 76 million individuals. Table 2 below presents the three main ways used for disposing of the country's waste.

Table 2 - Characterization of the forms of final disposal given to MSW in Brazil and the percentage allocated to each of them in 2017.

Final Provision	Operational Concept	Features	Amount MSW allocated %
Dumping ground	A place where solid waste is indiscriminately disposed of in the soil, with no or minimal control measures for operations or for protection of the environment.	Affects health through endemic proliferation, basic sanitation and risk to waste pickers. Research indicates its responsibility for approximately 10% of greenhouse gases by 2025. This provision is currently illegal.	19,2
Controlled landfill	It was created to eliminate dumps by applying more developed engineering techniques, which confine the waste by a layer of inert material as each workday ends.	It causes localized pollution due to the inefficient waterproofing in the lower part that favours untreated leaks and untreated gas production due to improper handling.	10,8

Sanitary landfill	Final disposal site of the tailings after the waste has been segregated, where treatment is more efficient than n the other two. It has an effluent treatment plant (for sludge), produces no bad smell and any gas that is generated an be burnt of.	Controlled periodic coverage and the softening of recyclable materials in the dumping area. The bottom of the cells is waterproofed by a polyethylene blanket that prevents percolates from dispersing. The leachate is collected along channels and directed for treatment.	36,9

Note: According to research in SNIS (2017) 33.1% of MSW generated in the country has no recorded information about its final disposal.

Source: Adapted from Abrelpe (2017); NBR 8849 (1985); Ronaldo Filho, et al (2017); Souza and Fernandes (2016); SNIS (2017).

The deadline for the disposal of dumps, promoting environmentally appropriate actions for controlled landfills and building sanitary landfills to meet Brazilian municipalities, as established in the PNRS (Brazil, 2010) expired in 2014 and, according to the National Confederation of Municipalities (CNM, 2015), new deadlines, from 2018 to 202,1were set for the municipalities to adapt to the new rules.

A study by the District Plan for Integrated Solid Waste Management (PDGIRS) (2018) reveals the continuous irregular use of incineration by public companies and alternative proposals for using waste are still awaited. Due to legal regulations, some companies use technologies such as the autoclave to sterilize hazardous waste to prevent contaminating liquid or gaseous effluents from being generated.

2.3 Concept of social and environmental innovation

According to Figueiredo (2009), innovation implies uniting different types and parts of knowledge and transforming them into new products and services useful to the market. It should be seen as a process and not as a set of isolated events. Figueiredo reports that a successful innovation is one that returns the original investment made to develop it, plus additional returns.

Oliveira (2013) conceives that innovation can take different forms, seeking and taking advantage of new opportunities in both economic and social areas to meet human needs and wishes. The author addresses the two categories of innovation, technological (subdivided into process and product innovation) and non-technological (subdivided into marketing, organizational, inter-organizational, environmental and social). Oliveira (2013) reports in his research that the central feature of social innovation is the improved quality of life and asserts that social innovations should seek improved well-being for individuals and the community, with solutions to individual and collective problems. Environmental innovation is the process of developing new ideas and practices aimed at preserving the environment; it can involve processes, products, business models, decisions and relationships that contribute to the prevention or reduction of effects that harm the environment. Andreoli et al (2014) highlight three relevant aspects for socioenvironmental innovation in MSW management, namely, the environmental, which relates to the practice of environmental education, to train people to separate and store waste at its source and dispose of

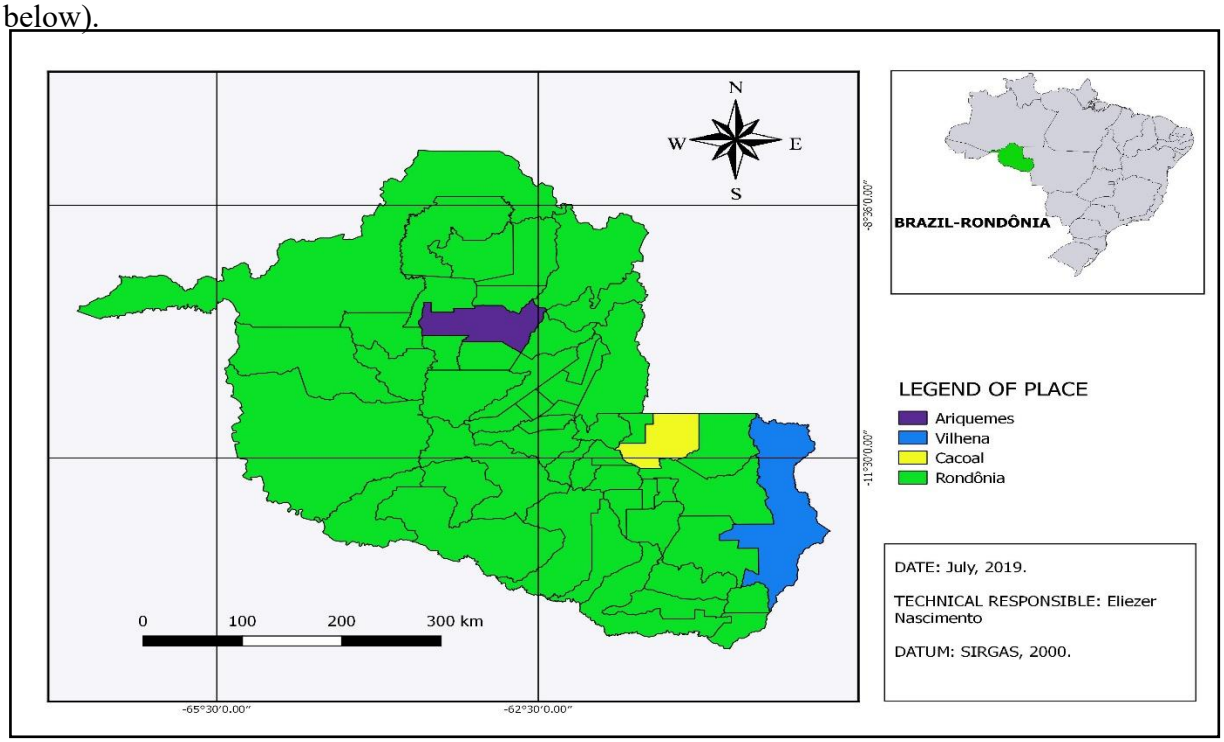
it properly later; the social, which concerns the organization of rag-pickers through cooperatives, removing them from informal work and giving them labour guarantees; and the economic, through the use of income generating technologies that help the waste handling process, sending some to centres where it is treated as raw material.

This provision is foreseen in the PNRS, which specifies that MSW must be managed in cooperation with the pickers or their associations; the Federal Government prioritizes monetary funds for use by the municipalities that do so. According to Besen (2017), this measure seeks to maintain the cooperation between public and private bodies regarding local and regional diversity if it helps eco-efficiency.

But for MSW management to benefit from social innovation and for cooperatives to co-ordinate autonomous waste pickers, the latter must be guaranteed adequate conditions of service. However, the waste picker cooperatives scattered throughout the country at present show no such thing. Ribeiro et al. (2014) base their study on an analysis of 33 cooperatives in which they identified a lack of class incentives, social vulnerability, poor working conditions, exposure to unhealthy agents and dangerous conditions without adequate protective measures.

3. RESEARCH METHODOLOGY

The present case study is located in the state of Rondônia, the northern sub-region of the country, which contains has three operating landfills, in the cities of Vilhena, Cacoal and Ariquemes (see Map 1 below).



Map 1: Map of the municipalities of the state of Rondônia that have landfills.
Source: Prepared by the authors using Qguis software.

It should be noted that this research does not include the landfill located in the city of Ariquemes, because it does not belong to the Intermunicipal Sanitation Consortium that administers the other two landfills and provides the data for this study. Companies operating in landfills located in the municipalities

of Vilhena and Cacoal provide final MSW disposal services to approximately 56% of the state's population, which, according to the estimate of IBGE (2010) has 1,562,409 inhabitants. The people served by the two latter landfills lives in 29 of the state's 52 municipalities, as can be seen in Table 1 below. This description can be taken as an example of the situation in other localities of the Brazilian Amazon.

Table 1: Estimated population in 2010 of each consortium municipality.

Town that houses the landfill	**Municipalities earmarking their MSW for the Vilhena landfill**	**Estimated population in 2010 IBGE Census**
Vilhena	Cabixi	6.313
	Cacoal	78.574
	Castanheiras	3.575
	Cerejeiras	17.029
	Chupinguaia	8.301
	Corumbiara	8.783
	Espigão D'Oeste	28.729
	Pimenta Bueno	33.822
	Pimenteiras D'Oeste	2.315
	Presidente Médici	22.319
	São Felipe D'Oeste	6.018
	Vila Bela	*
	Vilhena	76.202
	Total	291.980
Town that houses the landfill	**Municipalities earmarking their MSW for the Cacoal landfill**	**Estimated population in 2010 IBGE Census**
Cacoal	Alto Alegre dos Parecis	12.816
	Alta Floresta D' Oeste	24.392
	Cacoal	78.574
	Castanheiras	3.575
	Espigão D'Oeste	28.729
	Ministro Andreazza	10.352
	Nova Brasilândia D' Oeste	19.874
	Novo horizonte D' Oeste	10.240
	Parecis	4.810
	Particulares	*
	Pimenta Bueno	33.822
	Presidente Médici	22.319
	Rolim de Moura	50.648

	Santa Luzia D' Oeste	8.886
	São Felipe	6.018
	São Miguel do Guaporé	21.828
	Total	336.883

* Information not available.

Source: Prepared from IBGE data (2010).

3.1 Regarding the Method

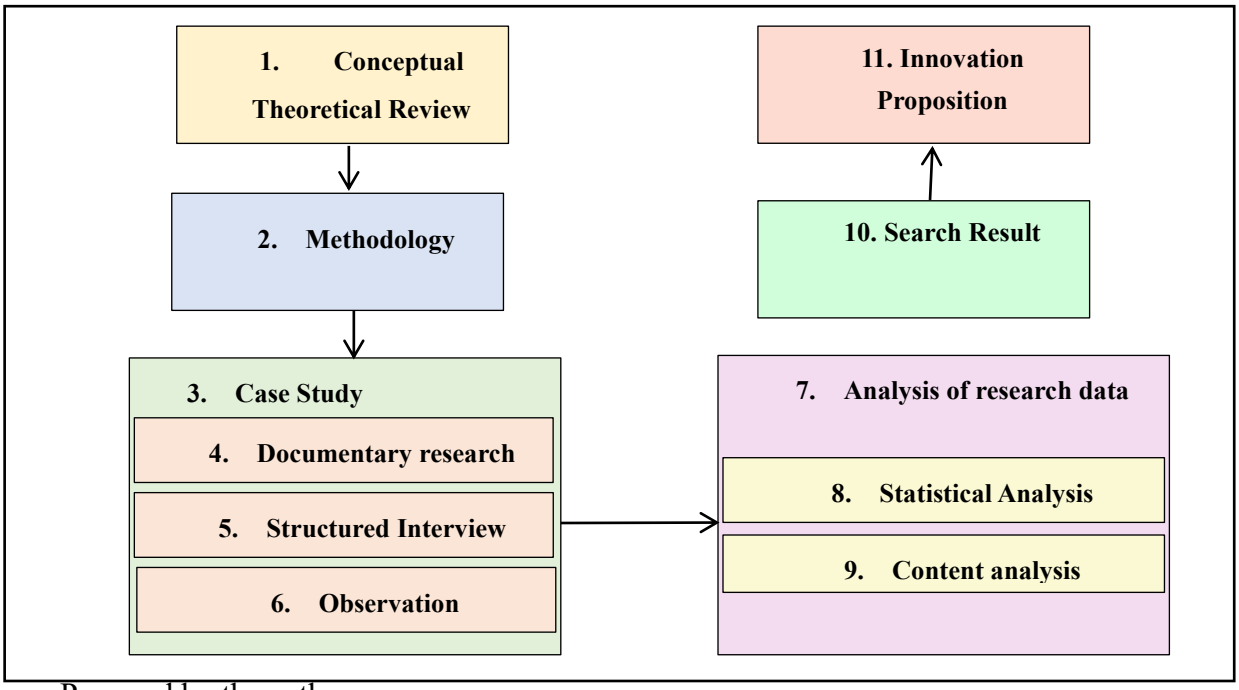
As defined by Creswell (2013), the choice of method depends on the typology of the procedure s specified by the intention of the research. However, Chiavenato (2014) reports that the Case Study Method is the most appropriate for business research, since it can substantiate reality in order to treat it scientifically. However, it must overcome the complexity of validation throughout the investigation process if it is to offer qualified results. This method is recommended when the research object is outside the research centre; for this reason, on-site information is collected to yield data for further processing. The case is a problem or a situation awaiting solution, which requires investigation, treatment and the offer of a solution that has scientific value only when supported by body of theory and concepts to guide the treatment. The decision in this research to use the Case Study Method with the related procedures and techniques is justified be its qualitative and quantitative nature.

3.2 Procedures

Cooper and Schindler (2016) state that a formal study begins when there is something that has been explored, perhaps with a hypothesis or research question. This involves precise procedures and specification of the source of data with a view to testing hypotheses or answering research questions by collecting data relevant to the intended research. Such procedures are necessary for the objectives to be achieved and for the questions which guide the research to be answered. Marconi and Lakatos (2017) believe that this procedure indicates how the research will be carried out and the investigative steps to be taken, all requiring specific techniques depending on the phenomenon to be investigated.

This research is qualitative and quantitative, descriptive and empirical. It seeks to describe and interpret facts or phenomena recorded in a given region so as to answer the research question, and expects a practical application of its findings. Figure 1 and Table 3 below detail the phases of this task.

Figure 1: Phases of the study.



Source: Prepared by the authors.

Table 3: Description of the elements shown in Figure1.

Item	Procedures Applied	What the Procedures Involve
1	Conceptual Theoretical Review	Search in reputable books and journals on the Internet for the theoretical and conceptual basis of the research to be carried out, regarding the management of MSW, final disposal of MSW and socio-environmental innovation.
2	Methodology	The collection, analysis, criticism and interpretation of the data that the researchers propose for the study.
3	Case study	A research approach in simple or applied social science.
4	Documentary research	Analysis of documents such as public or private data, reports and publications, statistics, etc.
5	Structured Interviews	Interviews with respondents in which the interviewer previously compiles a script of questions to be asked.
6	Real-life observation	Data logging as it occurs in real time.
7	Research Data Analysis	It is the transformation of data into information, meaning, in search of problem-solving.
8	Descriptive statistical analysis	A branch of statistics that applies various techniques to describe and summarize a dataset.
9	Content analysis	Analyzing the structure of a text, which may be the transcript of an interview.
10	Search results	Results achieved through the application of research and analysis of collected data.
11	Innovation Proposition	Proposed MSW management practices that address the principles and purposes of social innovation and environmental innovation.

Source: Based on survey data.

3.3 Data collection and processing techniques

The preparation of this task required several procedures; First, a bibliographic survey was carried out, cataloguing and reading texts in books, technical journals, theses and dissertations. Specialized websites were consulted, especially those of electronic journals. In this phase, it was possible to elaborate on the theoretical-conceptual body and the research methodology. In the operational phase of the research, the research environment was established, since the task demanded field research. Documentary research, which according to Chizzotti (2018) is an integral part of any systematic research that precedes or accompanies fieldwork, was given due weight. It can be a dominant aspect of works that aim to show the current situation of a subject or trace the historical evolution of a problem.

Participating city councils of the Inter-municipal Sanitation Consortium were asked for information on the disposal of their MSW in the Consortium Landfills. Other data were obtained from the municipal governments of Ministro Andreazza, Rolim de Moura, Seringueiras, Nova Brasilândia D´Oeste , Espigão D'Oeste, Parecis and Ji-Paraná, referring to the rate charged for collecting urban solid waste and the criteria adopted for it in the different sectors of the urban perimeter. Interviews complying with the protocol on ethical authorization and informed consent were then held. According to Saunders, Lewis and Thornhill (2012), interviewing may be defined as a purposeful conversation between two or more people, requiring the interviewer to ask concise and unambiguous questions, which the interviewee is willing to listen to and answer carefully. The employees of the executive sector of the Municipality of Rolim de Moura were interviewed to ascertain the amount of MSW generated, details of the local economy and the measures taken by the municipality to reduce the amount of MSW. Some managers of the company MFM Environmental Solutions provided databases regarding the treatment and amount of solid waste received from the consortium of municipalities for environmentally appropriate disposal. Finally, the company Cool Clean, which provides collection services for some municipalities of the state, was asked about the existence of gravity studies, the use of selective collection, the frequency of collection by sector and the revenue obtained from providing services leading to the disposal of MSW in a landfill.

Real-life observations, according to Araújo and Gouveia (2018), refer to the procedure by which researchers use all their senses to gather data on certain facts as they occur *in situ*. Our observation let us interpret that new models of waste management were being used by traditional waste pickers in a cooperative taken as a reference in the municipality of Ministro Andreazza; in light of this we understood the way that this cooperative worked and the income earned by the operators through the structure of an organized system extending from the collection to the sorting and dispatch of the MSW. We observed normal practices previously forgotten by social actors, which contributed greatly to the environmental quality.

The numerical data collected in the research through bibliographic surveys were treated and analyzed by means of descriptive statistics. Using Microsoft Excel software, we selected, categorized, coded, tabulated, analyzed and interpreted these data. The information collected through interviews and observations was analyzed using the interpretive technique of content analysis.

4. SEARCH RESULTS

In the sub region under scrutiny, the effects caused by Schumpeter's Theory of Economic Development (TDE) are felt mainly because of the capitalist conception of population consumption patterns. As reported by Costa (2006), in this sub region widespread consumerism of non-durable consumer goods prevails and the media contribute to the emergence and maintenance of unplanned consumer desires, which change as new products are designed and released.

The previously reported result of the above process is the increased generation of MSW, as cited by Oenning et. al. (2012), which in the region under study represents one of today's greatest environmental problems, since they all present some kind of management problem in handling and disposing of their MSW, even though they form a consortium with the Sanitary Landfill of Vilhena and Cacoal. According to Rezende et al. (2013), the problem may worsen as the population and industry increase, because the use of disposables and non-durable consumer goods will also increase.

4.1 Interpretation of the current Urban Solid Waste Management in the sub-region studied.

Information collected through semi-structured interviews of MSW collection and disposal agents and landfill representatives showed that management and integrated management contracts disobey the PNRS by having no rules for the priority action of separating waste at its source, at least into dry and wet and collecting it selectively. Hence, the companies that collect, transport and tranship MSW reported operational problems in their work. They state that because the users of the services provided do not separate organic and inorganic residues where they originate and do not package them adequately, it is difficult or impossible to apply proper treatment techniques for reusing, recycling and composting waste. They also report that it contaminates all material to mix organic waste with other waste that might have been recycled.

The lack of gravimetric studies of MSW to help calculate the useful life of waste cells and units as a whole was also observed. This makes management actions difficult and results in poor planning of landfill operations. Importantly, the absence of adequate treatment techniques results in more MSW going to landfills, which reduces their useful life and thus adds to their cost.

An interview with the pickers of the cooperative at the sorting centre in the city of Ministro Andreazza revealed that the MSW there is sorted into categories before being sent to the Cacoal municipal landfill. The pickers reported that, of the weekly volume of 32 m^3 of MSW (approximately six trucks), approximately four trucks are recovered, leaving only two full of tailings consigned to the landfill. In this municipality, the government pays a financial incentive to the organized cooperative, which contributes to the costs of the workshops.

The company that manages the landfill in the municipality of Cacoal reported the public practice of improper disposal of MSW along the road leading to the dumps, although there is a sanitary landfill in operation in the locality. This is not identified and punished by the local authority. This practice reveals legal normative regulations being disobeyed and the ignorance of the population, pending environmental education. There is no doubt that environmental education and the punishment of law-breakers would significantly reduce such behaviour in the region under scrutiny. In Colorado do Oeste, whose economic

driving force is the agricultural market, cattle deaths due to the ingestion of plastic bags from the city's dump have already been reported.

The use of few of the processes and technologies cited by the National Institute of Engineering and Auditing Expertise (IPEA, 2018) and the restriction of responsibilities to a few are also observed in the sub-region studied, where the few observable processes and technologies and few responsibilities were restricted to the public authorities. Manufacturers, importers, distributors, traders, consumers and service holders are never involved in the sharing of responsibility – everything is down to the municipalities.

We observed that the need for a new attitude to waste with the participation of industry, commerce, public power and the final consumer in an attempt to transform ingrained or omitted behaviors (Reis, Freide and Lopes (2017) applies also to the studied sub region, where measures should be taken to reduce the harm to human health from the life cycle of products and to provide better environmental quality.

4.2 Description of the final disposal of solid urban waste in the sub-region studied

Table 2 below shows recent data from the consortium municipalities on the volume of MSW disposed of as waste in the landfills of the municipalities of Vilhena and Cacoal.

Table 2: Graphic volume of MSW that each cooperated municipality consigns to landfills.

MSW Destination Landfill	County	MSW volume for Vilhena landfill (tonnes)			
		Year 2014	Year 2015	Year 2016	Year 2017
Vilhena Landfill	Cabixi	*	436	717	687
	Cerejeiras	*	*	1.160	3.331
	Chupinguaia	*	477	975	1.023
	Corumbiara	162	448	492	507
	Pimenteiras D'Oeste	191	223	213	228
	Vilhena	19.214	20.652	20.245	19.875
	Alto Alegre dos Parecis	*	*	312	925
	Alta Floresta	*	*	883	2.822
** Cacoal landfill	Presidente Médici	2.312	2.626	2.600	2.605
	São Felipe D'Oeste	79	219	261	294
	Cacoal	19.143	19.967	16.916	21.318
	Castanheiras	286	*	33	161
	Espigão D'Oeste	1.437	3.614	3.450	3.433
	Pimenta Bueno	1.811	3.172	*	3.055

	Ministro Andreazza	*	*	273	524
	Nova Brasilândia D' Oeste	*	*	366	1.228
	Novo Horizonte D' Oeste	*	*	155	512
	Parecis	*	*	87	245
	Primavera de Rondônia	*	*	*	*
	São Miguel do Guaporé	*	*	*	56
	Santa Luzia D' Oeste	*	*	206	599
	Rolim de Moura	*	*	7.171	9.293
	Seringueiras	*	*	*	*
	Teixeirópolis	*	*	*	*

* Absence of data.

** The Cacoal municipal landfill began operations in 2016. Before this date, the MSW of the municipalities already in a consortium were consigned to the Vilhena sanitary landfill, which was already in operation.

Source: Data provided by MFM Soluções Ambientais.

The table above shows that some municipalities sometimes have no data on the volume of MSW destined for the landfill, for example, the municipalities of Cerejeiras, Alto Alegre dos Parecis, Alto Floresta, Minister Andreazza, among others, lacking data for 2014 and 2015 and Primavera de Rondônia, Seringueiras and Teixerópolis, lacking data from 2014 to 2017. They lack the needed data due to their late association with the inter-municipal consortium that manages the landfills, This indicates that the final disposal of their MSW before the association occurred improperly in dumps.

According to the collection company, municipalities that dispose of their waste to the Vilhena and Cacoal landfills under study pay approximately $ 38 per tonne of waste. Table 3 represents the consortium municipalities and the volume of municipal solid waste per capita, per unit of total weight in kg, sent to the Vilhena and Cacoal landfills in 2018.

Table 3 - Quantity of MSW disposed of in landfills by a municipality in 2018.

Municipalities adopting landfills	Municipalities that allocate MSW to landfills	Estimated population for 2018 (IBGE, 2010)	Waste disposal in the year 2018 in kg	Disposition per capita in the year 2018 in Kg
Vilhena	Cabixi	5.438	709.740	130,51
	Cerejeiras	16.444	3.240.220	197,05
	Chupinguaia	10.886	1.024.240	94,09
	Corumbiara	7.567	580.630	76,74
	Pimenteiras D'Oeste	2.191	235.120	107,32
	Vilhena	97.448	21.130.310	216,84
	Alto Alegre dos Parecis	13.227	849.100	64,20
	Alta Floresta D' Oeste	23.167	2.863.654	123,61
	Subtotal	**176.368**	**30.633.014**	**1.010,36**
Cacoal	Cacoal	84.813	17.395.740	205,11
	Castanheiras	3.119	184.050	59,01
	Espigão D'Oeste	32.047	3.123.890	97,48
	Ministro Andreazza	9.762	442.660	45,35
	Nova Brasilândia D' Oeste	20.459	1.250.750	61,14
	Novo horizonte D' Oeste	8.751	506.040	57,83
	Parecis	5.947	238.210	40,06
	Pimenta Bueno	36.434	2.019.020	55,42
	Presidente Médici	19.409	84.220	4,34
	Primavera de Rondônia	2.939	2.273.960	773,72
	Rolim de moura	54.702	9.189.560	167,99
	Santa Luzia D' Oeste	6.781	585.820	86,40
	São Felipe	5.280	288.460	54,63
	São Miguel do Guaporé	22.931	76.020	3,32
	Seringueiras	11.860	377.860	31,86
	Teixeirópolis	4.384	154.080	35,15
	Subtotal	**329.618**	**38.190.340**	**1.717,67**
	Total	**505.986**	**68.823.354**	**2728,03**

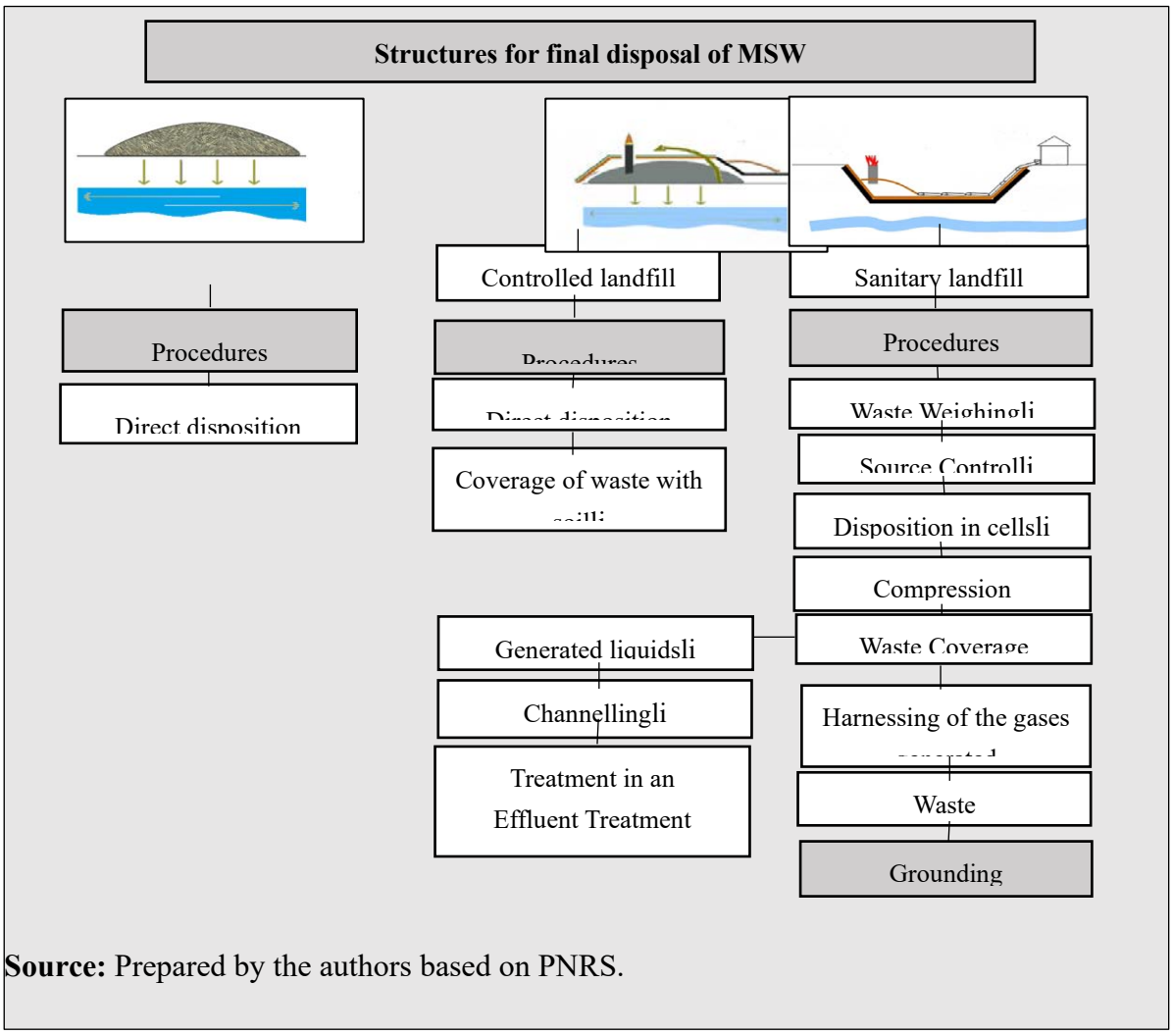
Source: MFM Environmental Solutions, 2018 and IBGE (2018).

The average per capita disposal of MSW in 2018 in all municipalities, except for Primavera de Rondônia, is lower than the results presented by the Brazilian Association of Public Cleaning and Special Waste Companies of 0.872 kg/inhabitant/day, that is, 318 kg /inhabitant/year (ABRELPE, 2017). Even so, some localities, despite being associated with the Intermunicipal Consortium for the disposal of their MSW to landfills, have contractual issues with outsourced companies which impact on the collection stage. They

also have serious cultural issues with the population, where the habit of burning MSW or other inappropriate methods of disposal is rooted in habit, consequently reducing the final amount disposed of in landfills.

Table 3 shows that municipalities, especially Primavera in Rondônia, differed greatly in the generation of waste per capita in 2018, suggesting the presence of errors in the weighing of waste destined for landfills. If so, the municipalities where waste is incorrectly measured would cost the Consortium more for the disposal of this waste. This research also involved questioning the Legislative Power in the municipalities located in the scenario under study, in order to clarify the legal regulations regarding the destination and disposal of MSW. The results indicated that the Public Prosecution Service has been notifying those who are responsible for the removal of dumps and the rehabilitation of the land to prevent the encumbrance of these inadequate structures being occupied. It was identified *in loco* that action to dispose of dumps is still awaited and involves measures coordinated by municipal managers, according to the rules provided for in PNRS (Brasil, 2010). Most municipalities continue to get rid of contaminants but have not supervised the actions being taken, making it difficult to resolve the problem. Table 4 shows the MSW disposal sites commonly used in the sub region under study and is based on the elements shown in Figure 2.

Figure 2 - Final disposal of municipal solid waste in the sub region studied.



Source: Prepared by the authors based on PNRS.

Table 4 - Description of the places where municipal solid waste is destined for the sub region under review.

Local	Description
Open access	Widely used in the scenario under study, it is a site where the disposal of MSW is prohibited, because it impacts on the chemical, physical and biological properties of the soil since the effluent is untreated and gases are generated by the waste which may contaminate nearby surface water and the water table.
Controlled landfill	Despite the compaction and periodic coverage of soil-layered residues, the possibility of soil and groundwater contamination makes it an environmentally unviable option.
Sanitary landfill	Consists of lining a pit with a soil protective blanket, the installation of channels to collect the slurry and gas channelling. This destination is the most appropriate kind, because it allows the generated byproducts such as slurry and gases to be treated.

Source: Prepared by the authors based on PNRS (Brazil, 2010).

The survey results indicate that the Cacoal and Vilhena landfill administrators take the following steps: a) they weigh the waste arriving at the landfill; b) the generating sources are controlled; c) the waste is sent to a cell suitable for the disposal of tailings; d) it is compacted and covered with a layer of clay as sanitary protection; e) the percolating liquids generated are channelled and treated by an anaerobic lagoon system, optional maturation and physical-chemical treatment; f) the gases generated in the waste decomposition process are captured and transformed by a combustion process, i.e. the gases generated are burned.

This research aimed to evaluate the effectiveness of such effluent treatment systems and operating systems in the units that took part in the study. As regards the segregation of the waste received in landfills, the manager of the company that operates the units stated in an interview that, as PNRS had determined (Brazil, 2010), it should be the responsibility of the municipal executive to collect materials chosen and divided for disposal in accordance with legal norms, i.e. it should promote the recycling, reuse and composting of materials, provide social support to waste pickers and waste pickers' cooperatives and direct waste only to landfills. However, because this function is being neglected by the municipalities, a sorting and transshipment station was being installed in the structures of the landfill located in the city of Cacoal.

4.3 Proposal for Social and Environmental Innovation in the MSW Management Process

The social and environmental innovation to be proposed in the present case study has already been practised in the city of Antwerp in Belgium and is based on the principle that the polluter pays. This is a system in which the consumer pays for door-to-door collection of. waste according to the amount. Thus, the more a citizen recycles, the less s/he will pay for waste collection.

According to information gathered from the municipal managers, most of the Consortium's member municipalities already charge for the collection of MSW and the population of these municipalities pays this fee either annually, together with the Property Tax (IPTU), or in 12 monthly payments, together with a charge for the supply of treated water. The municipalities of Cabixi, Minister Andreazza, Primavera de

Rondônia, Alto Alegre dos Parecis, São Francisco do Guaporé and São Domingo do Guaporé in the consortium currently do not charge for the service.

In the context under review, a technique proposed in this study for promoting social and environmental welfare, would be to charge the population of all municipalities for the collection of MSW on the same basis of calculation. The charge should be built into the property tax and then residents who choose to split their waste into dry and wet should be offered a discount. As determined in the PNRS, the dry waste should be collected by a specified pickup truck and transported to a cooperative in each municipality that organizes and supports them.

In the cooperatives, this waste would earn income for the waste pickers' families through recycling and composting. The waste would be sent to the landfill in Cacoal or Vilhena, along with the MSW of those residents who did not separate their household waste.

The arrangements would persuade the population to separate their waste, as part of their environmental education, and would ensure that smaller amount of waste needed to be disposed of in the environment, since the greater part would be disposed of correctly. Moreover, the families of the cooperative collectors would benefit and so would the income of the municipality, because sending less to the landfill reduces the amount paid monthly to dispose of it.

Such a proposal, as defined by Oliveira (2013) and Andreoli et al. (2014), is characterized as social innovation because it improves the well-being of individuals and the community and offers solutions to the individual and collective problems of waste pickers. of recycled materials. When disorganized and without state support waste pickers cannot organize the separation of MSW and the commercial exploitation of this material to thus generate individuals' incomes. As an environmental innovation, it is a practice aimed at preserving the environment: since recycling is a way of reusing natural resources then unused natural resources remain untouched. It spreads environmental education and contributes to the prevention or reduction of environmentally harmful human actions.

5. CONCLUSION

In the development of this research, we obtained some timely conclusions about the objects investigated. Regarding the management of MSW in the sub region studied, the main observations were as follows: no contractual clauses specifying the need for MSW equipment and means of transport for waste divided into organic and inorganic, in the contracts between the companies providing the service collection centres and the consortium municipalities. This fact causes operational problems, because the population does not separate waste items nor properly package them, alleging the lack of proper transportation. This makes it difficult or impossible to apply the proper treatment techniques that involve reuse, recycling and composting. Moreover, the MSW is not studied gravimetrically, which hinders the action taken to manage it, resulting in a failure to plan landfill operations. The useful life of waste cells and units as a whole cannot then be measured. However, it was observed that a waste picker cooperative supported by the municipal management in the city of Ministro Andreazza is in the process of separating recyclables and marketing them for profit, while the remaining MSW goes to the landfill, demonstrating the importance, both environmentally and socially, of supporting organized cooperatives of waste pickers who practise

recycling. It was noted in the consortium municipalities that the population as a whole is devoid of good environmental habits and ignorant of the need for them, because even those municipalities that host landfills, such as Vilhena and Cacoal, still find their population habitually disposes of MSW by the side of the road and/or in deactivated dumps. Few technical processes and technologies have been observed in the management of MSW, for which the public authorities are entirely responsible.

Regarding the final disposal of MSW, the per capita value in 2018 of all municipalities, except for Primavera de Rondônia, is lower than the results presented by the Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE, 2017), namely, 318 kg/inhabitant/year. Even so, some localities, despite being associated with the Intermunicipal Consortium for the disposal of their MSW to landfills, have contractual issues with outsourced companies which impact on the collection stage. They also have serious cultural issues with the population, where the habit of burning MSW or other inappropriate methods of disposal is rooted in habit, consequently reducing the final amount disposed of in landfills.

There were indications of errors in weighing the waste consigned to landfills by the consortium municipalities; if so, they are bearing the greater charges than their waste disposal costs. It was observed that the Public Prosecution Service has been notifying those in the municipalities who are responsible for getting rid of the dumps and rehabilitating the land, thus preventing these inadequate structures from being occupied. However, it was identified *in loco* that action to dispose of the dumps is still being awaited and most of the municipalities continue to dump contaminants in these units, pending the supervision and definitive solution of the problems that they present. The manager of the company that operates the Cacoal de Vilhena Landfills, reported that a sorting and transshipment station was installed at the landfill located in the city of Cacoal. The municipalities and cooperatives of organized waste pickers could have collected segregated MSW and properly dispose of recyclable materials, while composting organic material, but have failed to do so.

As a social and environmental innovation in the MSW management process in the se study, a practice was proposed based on the principle that the polluter pays and the more citizens recycle, the less they need pay for the collection of their waste. It would be charged with MSW collection services to the population of all the associated municipalities and would have the same basis for calculation, embedded in the IPTU; and residents who separated their waste into organic and inorganic would have their charge discounted. Eventually, as determined by PNRS, a specific truck would collect and transport waste to the cooperatives in each municipality that organized and supported them. The practice would encourage the population to separate their waste, thus environmentally educating them and augmenting the income for families working for recyclable waste pickers' cooperatives. It can be characterized as an initiative in social and environmental innovation and it answers the question that this research set itself; whether it is possible and viable as a social and environmental innovation in the management of MSW that can maximize the useful life of the landfills.

The difficulties encountered in carrying out the study came from the bureaucracy of the public agencies that stored the data required for the research and, in some cases, the servers' lack of knowledge about which sectors hold the requested information, or even the misleading instructions they gave. This resulted in

delays before the agents holding the information could be found. Sometimes requests for information, via email and/or telephone were not returned, even after several repetitions.

We suggest that new research could examine the gravimetric characterization of the urban solid waste that is consigned to the landfills of the State of Rondônia so that corrective measures could be taken, aiming at the energetic use of gravimetrics, thus maximizing the useful life of the units. Researchers in this area could estimate the useful life of the units and the best time for new installations, given the complexity of their environmental impact and the licensing process for their operation; thus solutions to problems such as those in the past could be avoided. To contain the volume of improperly disposed of solid waste, garbage dumps could be installed that were responsible for the invaluable social and environmental impact that is still being felt.

ACKNOWLEDGMENTS

To the Federal Institute of Rondônia (IFRO) for the consent of removal full time of one co-author for researching in the Federal University of Rondônia, on the Program Master in Administration and on the Research Group on Management of Innovation and Technology (GEITEC).

REFERENCES

[1] ABRELPE. (2016, October 04). Overview of solid waste in Brazil in 2016. Retrieved from: http://www.abrelpe.org.br/Panorama/panorama2016.pdf.

[2] ABRELPE. (2017, September 16). Roadmap for Closing Dumps. Retrieved from: http://www.abrelpe.org.br/Panorama/iswa_web3.pdf.

[3] ANDREOLI, C. V., REOLI, F. de N., TRINITY, T. V. & HOPPEN, C. (2014). Solid waste: origin, classification and solutions for proper disposal. ES. Agrinho Magazine, 531-552. Retrieved from: http://www.agrinho.com.br/site/wp-content/uploads/2014/09/32_Residuos-solidos.pdf. stos-super-a-search-cientifica-e-test-pilot/109635/.

[4] BESEN, G.R., JACOBI, P.R., FREITAS, L. (2017). National solid waste policy: implementation and monitoring of municipal waste. (1st ed.). São Paulo: Electronic publisher.

[5] BRAZIL. Law No. 12,305, of August 2, 2010. National Policy on Solid Waste. Brasilia DF. Jul 2018.

[6] BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS-ABNT. (1985). NBR 8849. Presentation of controlled landfill projects for municipal solid waste. Retrieved from: http://licenciadorambiental.com.br/wp-content/uploads/2015/01/Nbr-8.849-NB-844-Presentation-Projects-of-Earth-Controlados-RSU.pdf

[7] CAETANO, M. D. D. E., DEPIZZOL, D. B., REIS, A. by O. P. dos. (2017). Solid waste management analysis and improvement proposition: case study in a carpentry shop in Cariacica, ES. Gest Magazine Prod. 24 (2), 382-394. Retrieved from: http://dx.doi.org/10.1590/0104-530x1413-16.

[8] CHIAVENATO, I. (2014). General Theory of Administration: Descriptive and Explanatory Approaches. Barueri, São Paulo: Manole Publishing House.

[9] CHIZZOTTI, A. (2018). Humanities and social sciences research. (12th ed.). São Paulo: Publisher Cortez. E-book Retrieved from:

https://books.google.com/books?hl=en&lr=&id=OXdZDwAAQBAJ&oi=fnd&pg=EN6&dq=search+documental&ots=JwMPzF9YkN&sig=1ISlnBrn4rlAOETDMElhfdd##########

[10] CNM. National Confederation of Municipalities. (2015). National Policy on Solid Waste PNRS: obligations of federated entities, business sector and society. 2nd ed. Brasilia: 2015. Retrieved from: https://www.cnm.org.br/cms/bibl Biblioteca/Residuos%20Solids%20-%202016.pdf

[11] COOPER, D. & SCHINDLER, P. Research Methods in Management. (2016). 12th ed. Porto Alegre, RS. Amgh Publisher. Retrieved from: https://www.saraiva.com.br/search-methods-in-administration-12-ed-2016-9338966.html.

[12] COSTA, A. B. da. (2006). Economic development in Joseph Schumpeter's view. (1st ed.) Rio Grande do Sul. Publisher Unisinos. Retrieved from: http://sinop.unemat.br/site_antigo/prof/foto_p_downloads/fot_7471schumpeteb_pob_costa_pdf.pdf

[13] CRESWELL, J. W. & CLARK, V. L. (2013). Mixed method search. (2nd ed.). São Paulo: Digital Warehouse Publisher.

[14] FIGUEIREDO, P.N. (2009). Innovation management: concepts, metrics and experiences of companies in Brazil. Rio de Janeiro: LTC. p.340. Retrieved from: https://www.bdpa.cnptia.embrapa.br/consulta/busca?b=ad&bibl Library=empty&busca=author:%22FIGUEIREDO,%20P.%20N.%22.

[15] IBGE - BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS. (2010). Census of the cities of Rondônia. Retrieved from https://cidades.ibge.gov.br/

[16] IBGE - BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS. (2018). Census of cities. Retrieved from https://cidades.ibge.gov.br/

[17] IPEA - IPEA APPLIED ECONOMIC RESEARCH INSTITUTE. (2018). Regional, urban and environmental newsletter. Retrieved from: http://ipea.gov.br/portal/images/stories/PDFs/boletim_regional/180618_brua_18.pdf.

[18] MARCONI, M. de A., & LAKATOS, E. M. (2017). Fundamentals of scientific methodology. Sao Paulo: Atlas Publisher.

[19] OENNING, A. S.; CARDOSO, M. A.; PONT, C. B. D.; LIMA, B. B.; VALVASSORI, M. L. Study of the gravimetric composition of urban solid waste from the municipality of Criciúma. Scientific Initiation Journal, v. 10, no. 1, 5-18, 2012.

[20] OLIVEIRA, N. D. A. de. Sustainable development, innovation, social technology and collective entrepreneurship in intercooperative relationships: Creditag system and Rondônia agricultural production cooperatives. 2013. (Doctoral dissertation). Federal University of Rio Grande do Sul. Porto Alegre, RS, Brazil.

[21] PDGIRS. (2018, March 06). District plan for integrated solid waste management. Retrieved from: http://www.sinesp.df.gov.br/wp-conteudo/uploads/2018/03/PDGIRS.pdf.

[22] REIS, D., FRIEDE, R., & LOPES, F. H. P. (2017). National solid waste policy. Interdisciplinary Rev. of Law. 14 (1), 99-111. Retrieved from: http: // DOI: 10.24859 / fdv.2017.1007.

[23] REZENDE, J. H.; CARBONI, M.; MURGEL, M.A.D. T.; CAPPS, A. L. D. A. P.; TEIXEIRA, H. L.; SIMÕES, G. T. C.; OLIVEIRA, C. D. A. Gravimetric composition and specific weight of municipal solid waste in Jaú (SP). Sanitary Engineer ambient, v. 18, no. 1, p. 1-8, 2013.

[24] RIBEIRO, L. C. de S., FREITAS, L. F. da S., OAK, J. T. A., JOÃO FILHO, D. de O. (2014). Economic and environmental aspects of recycling: an exploratory study in the cooperatives of recyclable waste pickers in the state of Rio de Janeiro. Nova econ magazine. 24 (1), pp. 191-214. ISSN 0103-6351. Retrieved from: http: //www.scielo.br/scielo.php? Script = sci_arttext & pid = S0103-63512014000100191.

[25] RONALDO FILHO, et al. (2017). The utilization of urban solid waste through the aerobic composting process enriched with sururu bark for use in civil construction. Rev. Exact and technological sciences. 4 (2), 125-134. Retrieved from: https://periodicos.set.edu.br/index.php/fitsexatas/article/view/5207/2562

[26] SAUNDERS, M.; LEWIS, P.; THORNHILL, A. (2012). Research Methods for Business Students. 6th ed. Colombia. Bogota, New York publisher.

[27] SNIS. (2017, March 22). Diagnosis of urban solid waste management. Brasilia: Ministry of Cities. Retrieved from: http://www.snis.gov.br/diagnostico-residuos-solid.

[28] SOUZA, F.H.F., & FERNANDES, A.J.M. M. (2016). The problem of environmental impacts caused by the operation of the dump of the municipality of Imperatriz-MA. Retrieved from: http://www.firs.institutoventuri.org.br/images/t045_a_problem%c3%81tica_of_environmental_impacts_caused_by_the_lixing_operation_of_the_empressor__ma.pdf.

The redefinition of female identity and the conquest of spaces in brazilian society

Bruna Sinigaglia
Master in Sociocultural Practices and Social Development by Unicruz
Brazil

Carla Rosane da Silva Tavares Alves
Doctor in Letters – Comparated Literature by UFRGS
Coordinator of the Postgraduate Program in Sociocultural Practices and Social Development of the University of Cruz Alta – Unicruz
Brazil

Vânia Maria Abreu de Oliveira
Doctor in History by PUCRS
Teacher of the Postgraduate Program in Sociocultural Practices and Social Development
University of Cruz Alta – Unicruz
Brazil

Abstract

This qualitative social and bibliographic research aimed to discuss the redefinition of female identity throughout history, covering women's submissive identity in a patriarchal society until achieving multiple identities in contemporary society, in which women accumulate roles and domestic tasks with the competitive professional life. The study started from the social position of women in Brazilian colonial society until current days, and for this reason, we discuss the main factors and events that have contributed to the social restructuring and the emancipation of women in contemporaneity. In this context, women achieved several conquests, such as the right to education, to vote, to salaried work and, especially, the right to equality between men and women. Although notable advances, women still face difficulties in asserting their new social roles, since the changes are still not consolidated in our society.

Keywords: Woman. Subordination. Reset. Identity

1 INTRODUCTION

We live in a complex society marked by evolution, where women's struggle for the recognition of many rights and equality is still constant. History has shown, in the course of time, women's fight against inequalities suffered resulting from gender issues, often arising from their arduous resistance in the midst of a patriarchal society of essentially sexist origin. Given the complexity of such inequalities in the social, cultural and economic spheres, we also observe that the envisioned equality, currently, is not yet full.

The History of Humanity and gender issues go together, in some times with more intensity and in others, with less, however, they have always based a series of discussions about which roles men and women, as distinct beings, are responsible for exercising in society. For a long time, the role that each one should run was defined by a social judgment, i.e., women should only devote themselves to the household, while men were responsible for working to provide for their family.

Women, in turn, carry in their history the subordination and inferiority, because they were considered as hierarchically inferior to men. The sexist vision of society excluded women from social life and their role consisted only in procreation, home organization, children's education and subordination to their husbands.

Over time, women gradually changed their identities, previously unique, since they dedicated solely to the domestic life, and began to assume different identities, in today's society, being housekeepers, wives, mothers, daughters and professionals, all at the same time. This redefinition of identities results from women's emancipation, fruit of social movements, such as feminism, and of many other movements in which many women have sacrificed their lives in the name of an egalitarian future between genders.

In the course of this work, we sought to analyze some of the aspects that allowed for the social transformation and the conquest of social spaces by women. We began the analysis with patriarchal cultures of colonial societies, in which the woman was totally submissive to the male power (father, husband), in addition to observing in relation to the Church, for an evolution of the imperial society, where the system of patriarchy began to fragment, and women won the right to education.

The female empowerment is achieved throughout history because of some social events, which include, in addition to the right to study and the fall of the patriarchy, the insertion of women in the labor market, a consequence of the industrial revolution, as well as, more recently, globalization and multiculturalism. Throughout the development of the Brazilian society, the woman won political, social and labor rights, on the same scale as men, entering, in a significant way, the labor market, as well as in the context of the most diverse social spaces, however, the woman still faces a series of barriers that hinder the achievement of substantive equality.

In order to perceive the redefinition of women's identity in contemporary society, the main objective of the present study, we need to go through historical, social and cultural events that contributed and drove these transformations. In this way, by means of literature and documentary review, we discuss and analyze the evolution of women and the redefinition of their performance in contemporary society, having as main theoretical bases: Castells (1999), Freyre (1996), Saffioti (2005), Oliveira (2012), Hall (2002), Tavares (2007), among others.

2 METHOD

This text presents a qualitative, bibliographical and documentary social research, with discussion and analysis about the feminine evolution and the redefinition of its performance in the contemporary society, having as main theoretical contributions: Castells (1999), Freyre (1996), Saffioti (2005), Oliveira (2012), Hall (2002), Tavares (2007), among others.

3 LITERATURE REVIEW

3.1 Women's path in the history of Brazilian society

Women's path, not only in Brazil, but in all parts of the world, carries with it a history marked by subordination to men and women's disregard by the family and society. Historically, the female gender was considered a synonym of fragility, obedience to the father and husband and with little capacity to perform activities that were not linked to the home.

In the national scene, since the Brazilian colony until the transition to the republic, women have suffered numerous difficulties and discrimination regarding the male sex, with the achievements and rights acquired and consolidated by them in the current Democratic State of Law, resulting from years of struggle and suffering. A great part of the Brazilian history was built only with the presence of the male figure, while women were on the margins of historical records, leaving them only the domestic scenes, which extends up to the end of the 19th century, beginning of the 20th century, when the first historical transformations began to slowly occur.

During the colonial period, Brazil was marked by the agricultural economy driven by slavery system, which began shortly after the discovery in 1500, more precisely from the period of sugar cane mills and only ended with the signing of the *Lei Áurea* by Princess Isabel on 13 May 1888. The slave was considered a good, a property of a lord, had no autonomy, nor rights. The legislation of the period considered the slave a thing, *res nullius*[2], a commodity that could be negotiated and transferred by means of legal transactions, such as: donation, sale, loan, rent, mortgage, in addition to the condition of slavery being hereditary, thus, children of slaves were already born tied to slavery.

In this way, one may also realize that "Parental ties often made captives vulnerable, as they feared being away from their group, on the other hand, they became emotionally strengthened, in particular as a consolation, in the midst of the bonds of the slave system" (TAVARES, 2007, p. 27).

During this period, women did not have any value in society, because the white and free belonging to the bourgeoisie or connected to the Portuguese Crown remained stuck inside their homes without instruction and submissive to their weddings, while black women were enslaved, working in farming along with male slaves and also serving to household chores in the main house (where the owner lived with his family), also exercising the role of attendants of milk. The slaves were subject to all the offices of slavery, even to punishment, of which the most common were: the whip, the trunk, the handcuffs, the mask of iron and some instruments of iron stuck to the feet, hands or neck, not even sparing pregnant slaves.

The patriarchal society of the colonial era accentuated the distinctions between sexes and implemented them in almost all sectors, in both public as private sectors. The pattern, created by the Patriarchate, provided men a free life, enjoying the social life and the power of command over wife and children, since women were seen only as "[...] men's objects of sexual satisfaction, a breeder for heirs, labor force and breeder again", being responsible only for taking care of the house, the husband, children and giving orders to the slaves (SAFFIOTI, 2005, p. 42).

While black women were oppressed by slavery system, white women were subordinate to the

[2] Latin term corresponding to a thing with no owner, an object that does not belong to anyone.

patriarch, usually married early, leaving the power of their fathers for the power of their husbands. Women's fate, since their birth, was the wedding, because they had no purpose other than domestic care, so the only way to avoid unwanted marriages was the convent, which sometimes was also the fate of those who could not marry and procreate.

The patriarchate was a political and social system responsible for giving rise to the hierarchy and domination of men over children and women, making them less both within the family as in the social sphere. The patriarchate was much more than an ideology; it was a structure introduced in society as a whole, reaching culture, religion, politics and social spheres, and even economy. Castells (1999) mentions that the present society carries the historic elements of the patriarchy, being the analysis of this system essential for the understanding of the social relations of domination:

> [...] patriarchalism is one of the structures upon which all contemporary societies rest. It is characterized by the institutionally imposed authority of men over women and children in the family. For this authority to be exercised, patriarchalism must permeate the entire organization of the society of production and consumption to politics, legislation, and culture. (CASTELLS, 1999, p. 169).

Women in the patriarchal society were submissive to both man as society in general, hostages of their homes, they could not go out, work, they were free only to go to the church, since accompanied. The female sex, fragile and with little capacity, was in all instances conditioned to the wills of strong, noble and ruler sex of men (FREYRE, 1977).

During the colonial period, and during a long history, education was a key element of little value, especially in relation to women, who had no access to it, could not read or write, because, for the society, the instruction was unnecessary for performing domestic tasks. The few literate girls, daughters of lords of sugar cane mills, field marshals and noblemen, were sent to convents in Portugal, where they learned the female roles, restricted to a house to govern, a husband to make happy and children to educate, limiting themselves to read, write, count and sew (OLIVEIRA, 2012, 02).

The Jesuits had the role of instruction, however, their goals were to catechize settlers and indigenes with the intention of teaching them to read and write, and sending them to the religious career, but, women did not receive any guidance other than submission to the Church and to marriage. The arrival of the royal family allowed for a small change in the social scenario, allowing women of the higher classes a greater interaction with society, beginning to attend parties, theaters and even go to the churches alone. However, the instruction was still undervalued, because, for women, the important was education, not instruction.

The education given to women, highlighting here that these women belonged exclusively to elites, focused on the training of dames that knew how to behave in social events, as well as wives who honored their husbands and added nobility to their homes, what mattered was the knowledge about etiquette and good manners. Women who were not slaves, but belonged to the poorest strata, had no opportunity of any type of education, not even domestic education. They learned, since very young, to develop crafts, such as sewing and handicraft to help provide for the house, because low-stratum women, unlike other classes, have always worked.

Gradually, women began to have access to education, but still very restricted, since their main

occupations in the work world were only teachers and writers, crafts naturalized as feminine. Many factors contributed to the advancement of women throughout the history of Brazilian society, among them, the main ones were: the end of slavery in the imperial period, the expansion of industries, the fall of the patriarchate, the contraceptive methods, access to education and, more recently, globalization and multiculturalism.

The industrial revolution was responsible for major changes in Europe and, consequently, reflected in all parts of the world during the 18th and 19th centuries, because it represented the transition from a manual production system for a system in which the machine began to replace part of the human labor. In this context, the woman found space to leave the restricted home tasks and join in factory work, which became interesting from a business point of view, having in view that it was a low-cost work force.

In the industrial phase, women and children started to be the most sought public to carry out the work in factories. Nevertheless, despite having been a period that allowed for women to enter the labor market, it was also hard, since women and children were exploited by their employers, with work days that ranged from 12 to 16 daily hours, low wages and poor working conditions. The supply of labor in the factories came to meet the need of livelihoods of numerous families, which, due to World War I and II, became women's duties, whereas many of the men remained long periods in battles and others never returned (PROBST, 2005).

In Brazil, a large part of the framework of workers of the first factories was composed by women who migrated from Europe (Italian, German, Polish, etc.). They worked in industries and farms, especially in the coffee plantations, and under a regime of submission that resembled slavery.

The society used to believe that only men had competence to exercise the tasks involving economics, commerce, politics, while women should stay locked in their homes, performing housework and caring for the well-being of their family. This context guided the historical construction of society for many years, until women began a slow process of social recognition.

The social transformations driven by capitalism provided a new reality for women, who left a life restricted to the house and became workers, along with housekeeping. The entry into the labor market represented a conquest, however full of conditions of exploitation and suffering, later resulting in demands for better working conditions (COSTA; ANDROSIO, 2012).

With the separation of domestic work and non-domestic employment, the families were gradually breaking with the patriarchal structure, since, now, the woman left a portion of the submission and went out to conquer her space in social life. Cattells (1999) points out that, with the fall of family structure, the patriarchal system of society began to fall apart, as there occur "[...] transformations of female work and awareness of women", allied to the "[...] growth of global informational economy, technological changes and the process of reproduction of the species" (CATTELS, 1999, p. 170).

In this scenario of cultural transformations, the medicine also collaborated to the emancipation of women and the rupture of male domination and of the Catholic Church, which, until then, gave the woman the role of breeder. With the contraceptive methods and the availability of contraceptives in the public network, women began to have dominion over their body, with fully possible family planning, thus, with less children, women can reconcile more easily the household chores and professional career (VENTURA, 2011).

Women's access to school, and in the future, to the university, was also a great milestone for the independence of women in social context, even more in a society that, historically, was born and developed denying the importance of instruction as occurred in Brazil. Initially, they began to have access to basic instruction for the domestic and religious life, and the women learned to read, write and also received some notions of mathematics, in order to maintain the family control of spending, because the social paradigm stated that "[...] a woman is already well educated when she reads correctly her prayers and know how to write the recipe of guava paste. More than that would be endanger the home" (harpsichord, 1973, p. 11). In relation to domestic education, Vidal (1996) emphasizes that:

> Thus, female schools were used to produce certain manual skills in order to facilitate the entry of female students from the lower classes into the labor market, providing them with a profession consistent with what was conceived as "activities related to women's nature", always related to the domestic service [...] or still, as a worker of the textile industries, reliving in the factory the customs acquired inside the homes. These disciplines reveal, in the girl, the expectation of her future social performance as a woman (VIDAL, 1996, p. 32).

Until the end of the 19th century, the education of Brazilian women followed the Portuguese heritage, considering essential only the education to marriage and to the maintenance of the home. The study was one of the arduous achievements of women, who restricted to learn techniques of cutting and sewing and crafts and, later, the magisterium, whereas men could attend schools and universities.

In Brazil, only in 1827, the woman began to have the right to attend regular schools, and only later, in 1879, by means of the authorization of an imperial decree, she began to have access to the university, with Rita Lobato Velho Lopes as the first woman that finished medical school in the year 1887. The obstacles faced by women in the pursuit of knowledge are "[...] examples that confirm the male desire at the time to leave women stuck to the private life of the households", characteristic of the patriarchal system (SCARANTTI; FRONZA, 2016, p. 93).

More recently, with the rise of multiculturalism and globalization, the groups historically excluded, as is the case of women, began to gain more strength and gradually conquered their social emancipation and the recognition of their roles in society and in the family. The cultural diversity, combined with technological innovations, meant that women could occupy spheres that, until then, were exclusively male, proving that they have as much ability as men to perform male-labeled functions, combining domestic life with the public life, which demonstrates a true autonomy of women in Brazilian society.

3.2 Achievements and obstacles of women in contemporary society

The differentiation between genders and tasks created by the culture of society, characterized as a macho culture, went through a long process of social and personal transformation of the women themselves, who took on the challenge to delineate their lives according to their desires. The women were gradually redefining their identities, leaving behind the domination and subordination and assuming a new identity that values their independence and their role as mother, wife, housekeepers, student and professional.

The woman of contemporary society is guided by new references that allow playing various social

roles, previously exclusively occupied by men. The transformations of societies, of production systems, culture, as well as the globalization, allowed for a restructuring of women's identities, who began to be seen otherwise both inside their homes as well as in the labor market. In this direction, Hall (2002, p. 88) highlights that:

> Everywhere, cultural identities are emerging, which are not fixed, but suspended, in transition between different positions; which draw their resources from different cultural traditions at the same time; and which are the product of these complicated crossings and cultural mixtures that are increasingly common in the globalized world.

The social changes and the new roles assumed by women throughout history did not please a large part of society, since, in a patriarchal culture, the insertion of women in sectors beyond the doors of home proved to be a scandal. The rupture of the paradigm that the woman should be restricted to domestic tasks, while the man could have a public life and should provide for the family, was seen as a social crisis, as can be seen in the passage in which Freyre (1996, p. 72-73) addresses the cooking crisis related to the new generations of women who do not dedicate exclusively to the kitchen:

> [...] the new generations of young women no longer know, among us, except among the most modest people, how to make a sweet or a traditional and regional stew. They no longer have the taste and time to read the old family cookbooks. When the truth is that, after religious books, candy and stew recipe books should receive the most careful reading from women. The sense of devotion and obligation must be completed in the women of Brazil, making them good Christians and, at the same time, good grocers, in order to better raise their children and contribute to national happiness. There are no happy people when women lack cooking. It is a fault as serious as that of religious faith.

The feminist movement was, undoubtedly, an important watershed that has transformed women's condition in various countries, as well as in Brazil. Among the ideals of feminism, there were the pursuit of equal rights, equal pay, appreciation and recognition of women in society and the eradication of all forms of discrimination and embarrassment, as well as the fight of the image of women imposed by man (TOURAINE, 2007).

In this context of struggle for freedom, the Bra-Burning, an event that occurred at the end of the 1960's in the United States, gathering approximately 400 women, activists of the Women's Liberation Movement, marked the initial phase of feminism in the world. In protest against the Miss America contest, held on 7 September 1968, shoes, makeup, bras, false eyelashes, magazines and other objects that symbolized the standard of beauty, were scattered on the ground with the goal of being burned, which did not occur because it was a private space. (Peter, 2010).

In Brazil, the movement developed in the late 19th century, early 20th century, and was inspired by the fight of the European women who fought for changes that went beyond the gender equality, but, above all, for the release of male domination and of the devaluation in society in general. Nisia Floresta and Bertha Lutz are considered the pioneers of the movement in Brazil. They fought for political rights and for changes

in the labor legislation in relation to the feminine and child work, as well as for the social emancipation of Brazilian women who were still under the influence of the patriarchy (ALVES, 2013).

One of the main achievements of women was the right to vote in the year 1932, moment when women begin to build their citizenship, which had been denied for many years. Initially, the vote was restricted to married women, since authorized by husbands and widows and single women who provided for themselves, and, only in 1934, such limitations were overcome and the vote became mandatory for women, as already long standing for men. Currently, women represent more than 50% of the electorate, and even with affirmative actions, such as the Law of Quotas, the number of female candidates is still low in comparison to other countries. (PIOVESAN, 2011, p. 67-69).

The cultural changes, along with those driven by social movements, provided women the conquest of new spaces and breaking of disregard paradigms socially imposed. In the view of some theologians, the woman had no soul, but, considering the important changes, she became the "actress" of her own life, with the objective of building up herself, seeking to be free, leading and valuing in relation to herself (TOURAINE, 2007, p.31).

The main changes in the labor market occurred from the 1980's and 1990's, when the female participation increased in the sectors of commerce, offices, public services, careers related to health and advocacy, spaces once occupied exclusively by men. One of the factors that contributed to the insertion of women in unheard labor spheres was the training by means of technical and higher courses, i.e., the knowledge was an important ally for the conquest of independence for women.

Currently, Brazilian women are reaching higher levels of education than men are and are achieving employment with greater ease, in comparison with the male sex. Although there are impasses for women to assume positions of greater prestige, gradually, they are expanding their professional performance and conquering new spaces, in the public and private sectors (TEYKAL; ROCHA-COUTINHO, 2007).

Nonetheless, even with the significant rise of women in the Brazilian economic scenario, they still integrate an affected group. The discrimination of women in the labor market is still a harsh reality that urgently needs to be combated, because the wage gap and the difficulty to achieve higher positions are still fruits of a culture that make women inferior in comparison to men.

While women find greater difficulties in the context of private companies, in the public sector, this reality is a little different, since the entrance through public service exams is providing an increasing number of women who achieve their professional careers "[...] which prevents discrimination by subjective and prejudiced reasons" (ARAÚJO, 2011, p. 102).

From the 20th century and more specifically in the 21st century, women began to occupy sectors until then exclusively male. They began to work at the same intensity as men, performing the same tasks and, sometimes, reaching educational levels higher than the male public, which proves that there really was a redefinition of the woman's labor role in contemporary society. The woman, even occupying the same functions, is not valued at the same level as the man, in both social as economical spheres.

According to article 5, paragraph I of the Federal Constitution of 1988, "[...] men and women are equal in rights and obligations". This equality expressed by the constitutional text deals with formal equality, i.e., regardless of the differences of sex, race, color or other peculiarities, all people shall be treated in the same way, without distinction. However, we know that we are not all equal, as the purely formal equality

does not provide an actual equality (BRAZIL, 1988).

The material equality "[...] implies the unequal treatment of unequal situations of life, according to their inequalities". The differentiated treatment between genders, races and classes are not discriminatory, but a means to promote equality between individuals who are in a situation of disparity, complying with the understanding of Aristotle, who already said "[...] equality consists in the same treat of similar persons" (TAVARES, 2012, p. 602-603).

In relation to material equality, we highlight the considerations of Rui Barbosa in his work *Oração aos Moços:* "The human appetites designed to reverse the norm of universal creation, intending not to give to each one, concerning what matters, but assign the same to everyone, as if everyone were equal" (BARBOSA, 2000, p. 25).

Although the constitutional text and the sparse laws bring a catalog of rights and guarantees for the female gender, both in relation to the labor market, as well as in family relationships and with society, there is need to leave the formal plan of the legal text and enter concrete actions that can provide equality of gender in its material sense. The lack of effectiveness of material equality, in the Brazilian legal system, is visible from the barriers that women still face in the labor market, such as wage inequality and difficult professional advancement.

The wage gap is one of the issues that denounces the inequality between genders in the Brazilian labor market. According to data from a research carried out by CATHO, published on the eve of International Women's Day, 07 March 2017, the wage gap between men and women is increasing; in 200, it was approximately 52% and until the first few months of 2017, it had already achieved approximately 75.38%. The research evaluated management internship functions, pointing out that the higher wage difference is in the position of consultant, in which men earn 62.5% more than women do. According to the research, women earn more than men in only three areas: gyms and sports, social communication and production of events (CATHO, 2017).

The report of the International Labor Organization (ILO) "Women at Work: Trends to 2016", published by the UN (United Nations), concluded that, from the analysis of 178 countries, at the pace at which inequality between men and women in the labor market has persisted, there will be necessary 70 years to reach equal pay in the world. We realize that inequality between genders is a problem that is far from your solution, moreover, the rates of wage differences are increasing rather than decreasing, which signals a social regression at world level, which will increase even more the number of years for this issue to be overcome (ONUBR, 2016).

The issues involving gender are cultural constructs of each society in each period. In this context, it is possible to check that women's labor redefinition in the contemporaneity was possible from historical, social, cultural and economic changes of society, driven by social movements. Still, there are many obstacles to be overcome, having in view that the culture of male domination is still present in the social environment.

Within a new perspective, the wife of contemporary society has a voice, has autonomy, freedom, is dedicated to her work, and when back home, devotes herself in the same intensity to her household chores of mother and wife. The freedom and autonomy achieved by women is the fruit of years of struggles to deconstruct concepts naturalized in society ruled by men, which considered them biologically and

intellectually inferior (PROST, 2003, p.4).

Although the aforementioned achievements have occurred in current days, assuming an identity of woman, in the current social context, is a challenging task, considering that the conquest of the labor market did not exclude the roles assigned to women. The double work shift is a reality that affects a large part of Brazilian women, because, in addition to being mothers and wives, they also need to devote themselves to professional career and, many times, reconcile all these functions with studies, which demonstrates that, historically, women have been presenting themselves as true warriors who do not flee from domestic roles and perform with praise the offices of professional life.

FINAL CONSIDERATIONS

There is no doubt about the social relevance of issues related to gender and the emancipation of women in society, because between advances and setbacks, currently, women act not only in the private sphere, but also in the public sphere. Because of the many transformations, the role of women in society today is being reconsidered, once the identity that society has imposed for years has been restructured and women began to be the main responsible for their fates and choices, writing their stories, regardless of what the sexist society judged correct.

Men and women were born in full condition of equality, but the society, through its culture, plotted the discrimination between the sexes, not by biological issues, but by ideologies that preached the disregard of woman and attributed her only domestic roles. Today, we live in times marked by a formal equality between genders, but we are still far from reaching a substantial equality, in which both men and women can play the same roles, either within their homes, whether in the labor market, with the same appreciation.

The numerous achievements of women reveal how unfair and unequal the society was, in which only the man had rights, while the woman had only the duties of obedience and zealing for the house and the marriage. Currently, men and women have equal rights and obligations, but not all these victories have been consolidated, since there are several cases of discrimination and inequality between genders.

The process of redefining women's role gradually is being rethought and recognized by society, while their identity is being constructed. The difficulties encountered by women to assert themselves in the social sphere are reflections of a culture which, for many centuries, preached the male domination. Unfortunately, the paradigms constructed and naturalized by society will still extend for some time, because only the awareness and the change of the new generations will allow for a full insertion and the overcoming of obstacles that still exist.

REFERENCES

ALVES, Ana Carla Farias; ALVES, Ana Carina da Silva. **As trajetórias e lutas do movimento feminista no Brasil e o protagonismo social das mulheres**. IV Seminário CETROS. Neodesenvolvimentismo, Trabalho e Questão Social. Fortaleza – CE, Mai. 2013. Disponível em: < http://www.uece.br/eventos/seminariocetros/anais/trabalhos_completos/69-17225-08072013-161937.pdf>. Acesso em: 17 Jul. 2017.

ARAÚJO, Clara. As mulheres e o poder político – desafios para a democracia das próximas décadas. *In:* **O Progresso das mulheres no Brasil – 2003 – 2010.** Organização: Leila Linhares Barsted, Jacqueline Pitanguy, Rio de Janeiro: CEPIA; Brasília: ONU Mulheres, 2011. p. 90-141. Disponível em: < http://onumulheres.org.br/wp-content/themes/vibecom_onu/pdfs/progresso.pdf>. Acesso em: 17 Jul. 2017.

BARBOSA, Rui. **Oração aos moços**. Editora Rocket Edition. Editado por Ricardo Castigt Mores, 2000. Disponível em: < http://www.ebooksbrasil.org/adobeebook/aosmocos.pdf>. Acesso em: 17 Jul. 2017.

BRASIL. **Constituição da República Federativa.** 1988. Disponível em: http<://www.planalto.gov.br/ccivil_03/Constituicao/Constituicao.htm>. Acesso em: 17 Jul. 2017.

CATHO EMPRESAS. **A diferença salarial entre homens e mulheres**. Disponível em: < http://www.catho.com.br/salario/action/artigos/As_diferencas_salariais_entre_Homens_e_Mulheres.php>. Acesso em: 17 Jul. 2017.

CRAVO, V. L. Z. A influência da mulher na independência. In: **Boletim do Instituto Histórico, Geográfico e Etnográfico Paranaense**, v. XVIII, 1973, p. 9-17.

CASTELLS, Manuel. **O poder da identidade.** São Paulo: Paz e Terra, 1999.

COSTA, Irla Henrique; ANDROSIO, Valéria de Oliveira. **A transformação do papel da mulher na contemporaneidade.**2012.Disponível em: http://www.pergamum.univale.br/pergamum/tcc/Astransformacoesdopapeldamulhernacontemporaneidade.pdf>. Acesso em: 17 Jul. 2017.

FREYRE, Gilberto. **Sobrados e mucambos:** decadência do patriarcado rural e desenvolvimento do urbano. 5 ed. Rio de Janeiro: J. Olympio- INL, 1977.

_____, Gilberto. **Manifesto regionalista**. 7 ed. Recife: FUNDAJ, Ed. Massangana, 1996.

HALL, Stuart. **A identidade cultural na pós-modernidade**. 7 ed. Tradução de Tomaz Tadeu da Silva e Guaraciara Lopes Louro. Rio de Janeiro: DP&A, 2002.

OLIVEIRA, Ana Carla Menezes de. **A evolução da mulher no Brasil do período da colônia a República.** VI Colóquio Internacional "Educação e Contemporaneidade". Universidade Federal de Sergipe, Sergipe, Set. 2012. Disponível em: < http://educonse.com.br/2012/eixo_02/PDF/103.pdf>. Acesso em: 17 de Jul. de 2017.

ONUBR (Nações Unidas no Brasil**). OIT**: no ritmo atual, são necessários mais de 70 anos para fim da

desigualdade salarial de gênero. 2016. Disponível em: https://nacoesunidas.org/oit-no-ritmo-atual-sao-necessarios-mais-de-70-anos-para-fim-da-desigualdade-salarial-genero/. Acesso em: 17 Jul. 2017.

PEDRO, Claúdia Bragança; GUEDES, Olegna de Souza. **As conquistas do movimento feminista como expressão do protagonismo social das mulheres**. Anais do I Simpósio sobre estudos de gênero e políticas públicas. GT 2. Gênero e Movimentos Sociais – Coord. Renata Gonçalves, Universidade de Londrina – Paraná, p.10, jun. 2010. Disponível em: <http://www.uel.br/eventos/gpp/pages/arquivos/1.ClaudiaBraganca.pdf>. Acesso em: 17 Jul. 2017.

PIOVESAN, Flávia. Direitos humanos, civis e políticos: a conquista da cidadania feminina. *In:* **O Progresso das mulheres no Brasil – 2003 – 2010.** Organização: Leila Linhares Barsted, Jacqueline Pitanguy, Rio de Janeiro: CEPIA; Brasília: ONU Mulheres, 2011. p. 304-345. Disponível em: < http://onumulheres.org.br/wp-content/themes/vibecom_onu/pdfs/progresso.pdf>. Acesso em: 17 Jul. 2017.

PROBST, Elisiana Renata. **A evolução da mulher no mercado de trabalho**. Disponível em: <http://www.posuniasselvi.com.br/artigos/rev02-05.pdf>. Acesso em: 17 Jul. 2017.

SAFFIOTTI, Heleieth I. B**. Gênero, patriarcado: a necessidade da violência.** *In:* CASTILLO-MARTÍN, Márcia; OLIVEIRA, Suely de. **Marcadas a ferro – violência contra a mulher:** uma visão multidisciplinar, 2005.

SCARANTTI, Regina Danielli, FRONZA, Maíra. O reconhecimento da igualdade e os direitos da mulher. **ANIMA: Revista Eletrônica do Curso de Direito das Faculdades OPET**. Curitiba PR - Brasil. Ano VIII, nº 14, jan/jun 2016. Disponível em: <http://www.anima-opet.com.br/pdf/anima14/artigo-6.-o-reconhecimento-da-igualdade-e-os-direitos-da-mulher.pdf>. Acesso em: 17 Jul. 2017.

TAVARES, André Ramos. **Curso de Direito Constitucional.** 10 ed. São Paulo: Saraiva, 2012.

TAVARES, Aparecida de Fátima. **Família escrava em Juiz de Fora: negociação e resistência (1850-1870).** 2007. f.53.Monografia de Final de Curso. Universidade Federal de Juiz de Fora. Juiz de Fora - MG, 2007.

TEYKAL, Carolina Macedo; ROCHA-COUTINHO, Maria Lúcia. O homem atual e a inserção da mulher no mercado de trabalho. **Revista Psico**, Rio de Janeiro, v. 38, n. 3, p.. 262-268, set./dez. 2007 Disponível em: <http://revistaseletronicas.pucrs.br/ojs/index.php/revistapsico/article/viewFile/2888/2183>. Acesso em: 17 Jul. 2017.

TOURAINE, Alain. **O mundo das mulheres**. Rio de Janeiro: Vozes, 2007.

VENTURA, Miriam. **Saúde feminina e o pleno exercício da sexualidade e dos direitos reprodutivos.**

2011. Disponível em: <http://www.senado.gov.br/atividade/materia/getPDF. asp?t=108224&tp=1>. Acesso em: 17 Jul. 2017.

VIDAL, D. G. "Educação doméstica": e a reforma da educação pública no Distrito Federal. *In:* **Caderno de Pesquisa**, São Paulo, n. 99, 1996. p. 30-35.

Digital Observation: An Analysis of Patriarchal Comments in the Web

Larissa Gabriela Lins Neves[3];
Sônia Maria Lemos (PhD)[1];
Tirza Almeida da Silva (Msc)[4];
Daniel Cerdeira de Souza (Msc)[5];
Eduardo Jorge Sant'Ana Honorato (PhD) [1];

ABSTRACT

Through the journey of the plurality of feminisms, we find ourselves today in the fourth wave, in which cyberactivism predominates, with feminist articulations going through the street/network axis. Thus, we sought to consolidate the arguments in defense of feminism from the analysis of the opposite reactions found online. The locus was the cyberspace itself, where comments were found in web news posts that contained controversial contents linked to themes worked out by feminism in their plurality. The qualitative approach was defined based on non-participant systematic observation and content analysis. Nine categories were extracted, including blaming the victim of violence, discrediting female accusations of violence, stigma of prostitution, social concept of Marianism, objectification of the female body, myth of female hysteria, myth of maternal love, sexual and reproductive rights, demerit the relevance of female representativeness, among other subjects. It has been found that chauvinism and misogyny are social reproductions engendered regardless of gender; whereas the demands on female behavior are mostly associated with an accusatory tone, with responsibilities reversed; that there is still the view that women do not have emancipatory capacity to achieve their successes and that, thus, they must take hold of what man has achieved from his privileges; that sexist attitudes are detrimental to society as a whole and not only to women and; Thus, most of society still does not understand the relevance of female representativeness in the various spaces.

Keywords: feminism, internet, machismo, misogyny

1. INTRODUCTION

1.1 The Plurality of Feminism

Feminism (among diverse approaches, contexts, and groups) can be mentioned in the plural. Saffioti (1986) clarifies that "the term feminisms must be emphatic, since there is a multiplicity of academic organizations and positions throughout the history of women's organization." Thus, she points out that "although there is not a single position of the feminist movement, it is possible to identify certain

[3] UEA – Amazon State University
[4] UNIP
5 UFSC – Federal University of Santa Catarina

predominant paradigms or ideologies that are revealed in claims and agendas of a given time, revealing the European hegemony there."

Therefore, the world history that will be recorded will be the one told by the dominant view. Thus, according to Monteiro and Grubba (2017), it appears that "the first wave of feminism (nineteenth century until the mid-twentieth century) in Brazil was manifested through the struggle for the vote, in which the "Brazilian suffragettes were led by Bertha Lutz." According to the authors, "the suffragettes (or suffragettes) were the first activists of nineteenth-century feminism for the right to female voting in Brazilian politics." Then, according to Melo and Schumaher (2003), "the second feminist wave in Brazil fought against the military dictatorship, against male supremacy, sexual violence and the right to pleasure." Thus, national meetings emerged in various parts of the country, bearing in mind the perception that there was a complex universe of claims. It was then that women from other organized sectors of civil society in the 1980s began to make their specific issues visible, such as black women and lesbian.

At the beginning of this second period of feminism in Brazil, Mendes et al. (2015) point out that "it was a difficult time, since the repression of the military dictatorship was threatening and violent. In this way, the activists of the time joined the underground or guerrilla groups. " Thus, the authors reflect that "the insertion of women in the guerrilla war characterized an important break of taboo to the detriment of the female stereotype" (such as the "queen of the home", from which it is assumed that all women must know how to perform the house chores and not being able to do any other activities she desired), for seeing a woman carrying a gun and going into confrontation with the military was surprising.

As a result, "the third phase of feminism (the 1990s) came with the proposal of concentrating on the analysis of differences, alterity, diversity, and the discursive production of subjectivity" (Narvaz & Koller, 2009). Thus, the authors emphasize that "the focus is on women and the sexes for the study of gender relations, demystifying women as" biological beings "and understanding the various women in society, including transgender women".

Mendes et al. (2015) adds that "in this long course of the feminist struggle, many rights were won in the pursuit of guaranteeing female citizenship." Although one of the most significant victories was the sanction of the Maria da Penha Law in 2006, about violence against women, especially domestic violence, remains a serious problem and in this context it is necessary to create new mechanisms to curb and penalize aggressors.

In the midst of this, the use of information and communication technologies to propagate feminist manifestation content and to assure affirmative action for women within their environments, not having to take to the streets to know and be part of the causes, is beginning to be most present (Rodrigues et al., 2014).

The reason, according to Castells (2013), is "today the space of movement is always made of an interaction of the space of flows on the internet in wireless communication networks with the space of occupied places and symbolic buildings aimed at their acts of protest." In this context, the cyberactivism is inserted, about which Scherer-Warren (2013) reports that "what contributes to this new mode of activism is that social networks regiment current forms of mobilization of intense political potential."

Thus, according to Lemos (2009), although he never used the term cyberfeminism directly, Donna Haraway (2009) had his ideas chosen by different groups as a theoretical basis by suggesting an

analysis of feminism from the perspective of new technologies, including media, proposing the network organization and appropriation of these technologies as a form of political activism. It is then, through this scenario, that the fourth wave of feminism (21st century) is known, interspersed with the phenomenon of digital activism, "where the social changes brought about by information technology and the panorama in favor of the promotion and dissemination of ideals constitute this most current facet of feminist social movements "(Rocha, 2017).

Therefore, it is understood that "information and communication technologies (ICTs) currently represent alternatives to the content conveyed by traditional mass media, enabling new forms of activism through the network, commonly called digital activism or cyberactivism" (Rodrigues et al., 2014).

Thus, "feminist articulations in the present necessarily pass through the street/network axis. Urban space, the street, private and public space, is on its way, coming and going, imagining itself as a space to/for all "(Dias et al., 2014).1.2 O

1.2 Cyberactivism

This research looked at anti-feminist movements among news spread via the web that contained in its framework topics still controversial today. However, the characterization of controversial or controversial news is relative, since for feminist profiles the same issues have apparent conclusions, but in a context of a specific cyberspace of journalism (where the message must come without prior direction) the news is taken as conducive to discussion. Thus, we had the choice to observe the comments made in journalistic cyberspace (where cyberactivism was found, as well as the reactions of others) and not in spaces already considered as cyberfeminists. For Alcântara (2016), "cyberactivism represents a new communicative pattern that implies the generation of new confrontational dynamics, temporalities and spatialities for contemporary collective action, as well as political subjectivities."

According to Ugarte (2009), we could define cyberactivism as any strategy that pursues the change of the public agenda, the inclusion of a new theme on the agenda of the tremendous social discussion, through the diffusion of a particular message and its spread through "word of mouth to mouth "multiplied by the media and personal electronic publishing.

Amid these definitions, Silva and Paiva (2013) conclude that "it is pertinent to examine the importance of cyberactivism today and verify it as an instrument of preservation of democracy for its innovative communicational character, bearing complexities that require new methodologies of analysis." Based on that, it is crucial to focus on the relevance of investigative scientific activities that are based on the records found in this current and most used means of communication: the digital.

2 METHODOLOGY

This research consisted of the analysis of reactions against feminist causes in web news posts that contained controversial content that could provide spaces to themes worked by feminism in their plurality. Ten news articles were selected on journalism websites or social networking profiles, all published in the Brazilian domain and the public access mode. Therefore, it was intended to observe reactions in a busy cyberspace and with expressions of different orders. Considering the intention to analyze the content of the

discourses present in the comments found on the web, the qualitative approach was presented as more appropriate, since "it does not concern itself with numerical representation, but with the deepening of the understanding of a social group, of an organization. "(Goldenberg, 1997). Moreover, it underlines the importance that "the analysis of the collected expressions was capable of producing new information and that the operationalization of variables was not reducible" (Deslauriers, 1991; Minayo, 2001).

Regarding the methodology for data collection, we opted for the systematic non-participant observation of the reactions to the news, extracting those that denote sentences or paragraphs of contradiction to the feminist guidelines.

According to Marconi and Lakatos (2009), "a systematic observation occurs when the observer knows what he is looking for and is objective in his investigations." From the same source, "non-participant observation represents an investigation in which the researcher is in contact with the researched group, but does not engage in the observed situations."

As a methodology of analysis of the collected sentences, we applied the Content Analysis. According to Campos (2004), "this method is understood as a set of research techniques whose objective is the search for the meaning of the content in question." Bardin (2011) configures content analysis as "a set of communication analysis techniques that uses systematic and objective procedures to describe message content; therefore, the importance of semantics for the development of the method is highlighted in this field." Thus, "the present method of analysis consisted of five steps: information preparation, unitarization or transformation of content into units, categorization or classification of units into categories, description, and interpretation" (Moraes, 1999). We used comments that contained adverse reactions to feminist positions. Therefore, when they typed and sent such phrases in publicly accessible profiles, they made their sayings also public, consisting of their connivance with the unlimited scope of their messages, according to article 4, item II, of the Brazilian Law 12.965 of April 23, 2014. Therefore the Informed Consent Term, commonly used in research with human beings, became correctly replaced in this research by the behavior of the Internet's adherence to sharing their opinion in a public profile. As for the researchers, they signed Terms of Responsibility that contemplated ethical commitments.

The digital medium was established as the location of the research. The regulation of which is based on Brazilian Law No. 12,965 / 2014 (known as Marco Civil da Internet). Thus, the locus of research was the cyberspace itself. Monteiro (2007) concludes that "cyberspace is an environment that allows us countless possibilities of a" real "world. It is a virtual universe, plastic, fluid, full of becomings. Finally, cyberspace "is a great abstract machine, because it is semiotic, but also social, where not only symbolic exchanges are carried out, but economic, commercial transactions, new communication practices, social and affective relations and, above all, new cognitive assemblages" (Monteiro, 2007).

The actions were in accordance with the ethical precepts of Resolution 466/2012 of the Brazilian National Health Council. We obtained approval from the Ethics Committee under number 98919218.7.0000.5016. Therefore, it is essential to note that the messages collected were not fully transcribed in this final version of the research, nor had their names or nicknames of the authors revealed. Regarding the news, only its content was highlighted without indicating or exposing the people involved in the fact

The risks foreseen in this research refer to the reader to acknowledge their authorship or to identify with the opinions of the comments cited and analyzed, leading, after coming across the analyzes and discussions resulting, to feel uncomfortable that interfere with their personal/moral content. In this case, the researchers committed to inform their e-mails in the body of this article in order to be called to provide psychological support as a repair for the impact caused. However, a greater probability of benefits than risks was foreseen in the conduct of this research activity, because, as direct gains, it is intended that reflections in the area of digital media combined with the observation of what is said by the language. It makes it possible to have positive impacts in combating the incitement triggers of violence. Finally, it is worth mentioning that this research had the peculiarity of the existence of inclusion and exclusion criteria for two elements: for news in journalistic web profiles, as well as for the comments posted in these publications.

Thus, as inclusion criteria of the news, it was considered: to consist of news published via the web, of Brazilian domain, in journalistic profile, whose content could give rise to dialogues or discussions that involved themes related to feminism.

To exclude the news, we had: news that met all the inclusion requirements, but which were published in restricted (non-public) access profiles or not written in Portuguese. Regarding the comments posted in these selected news items, the following inclusion criteria were considered: to consist of comments found on the web, which were content contrary to feminist guidelines, which was posted as a comment on a news site or journalistic social network profile selected for analysis and that had been published no more than six months prior to the date of collection. Moreover, the following were considered as exclusion criteria: comments that fit all the inclusion criteria mentioned above, however, that were not written in the Portuguese language or that the reasoning, although tending to contradict feminist guidelines, did not constitute a clear sense capable of to be analyzed in depth. Through this methodological path, the objective was to consolidate the arguments of the defense of feminism from analyzes of the opposite reactions found via the web, having as stages the search of the meanings in the discourse and, then, the establishment of correlations of the analysis of the contradiction messages with the most appropriate feminist references. With this in mind, here are the results and the respective discussions, separated by subthemes related to several controversial guidelines originated by the critical incitement of feminisms.

It is noteworthy that the titles of the subtopics below were prepared by the researchers, not representing literally the comments of Internet users, but what was intuited as a representative phrase for each set of manifestations found online.**3**

RESULTS AND DISCUSSIONS

3.1 SHE ACCEPTED A RIDE FROM A UNKNOWN PERSON? OH, SHE WAS ASKING FOR IT

This first category of analysis reflects the judgment focused on the content of blaming the victim and the assumption of lack of intelligence on the part of women at first. Moreover, in a second moment, comments were also found containing insinuation of sex work.

In context, it is noteworthy to report that the news referred to a woman from the northern region of the country, who was the victim of attempted rape after accepting a ride from a man she did not know.

The contents of the first moment greatly emphasized the recommendations that are given from an early age to children (especially girls) about not accepting anything from a stranger, therefore, this woman's attitude was so childish and naive, that all behavior of man is forgotten and made invisible by this, according to what was perceived from the vision of these Internet users. These judgments represent content that transits in social spaces, being said personally and not only anonymously written in technological locus, since they are considered apparent conclusions, which leaves behind the attitude of the aggressor and the suffering of the victim. In line with this, Haraway (2009) points out that "technology is not neutral, because we are inside what we do and what we do is inside us. Finally, it further emphasizes that we live in a world of connections. " Regarding the accountability of the victim, Cardoso and Vieira (2014) portray that "in the news headlines about sexual violence, the aggressor is seldom in focus." Instead, what we see is a potential demoralization of the victim, which is considered to cause the act of violence, either from their behavior, place frequented, or decision made.

Then, because it was reported throughout the story that the girl had left a purse with two hundred reais (Brazilian currency worth less than U$50 today) in the car, there were comments of speculation that she was lying and that she was a sex worker, but was not admitting.

The probing and speculative behavior of netizens is in line with what Haraway (2009) argues by stating that "the cyborg is committed to bias, irony, and perversity. He (cyborg) is oppositionist, utopian, and not innocent at all. " Clarifying what Haraway presents, the cyborg is nothing more than all of us, who live in the social and technological hybrids. Thus, we speculate and distrust behind the screen in a cruel and strongly opposing way, representing social experience as a mask war.

However, it is important to point out that if it were not for the marginalization of the stigma of prostitution, these suspicions about the female story would continue to exist, but would probably not be addressed, since the social priority is to find a substitute plot that embarrasses the victim.

3.2 REPARATION WITHOUT PROOF FROM THE WOMAN? HOW ABSURD!

The report in which the comments are analyzed here, a proposal of a bill was mentioned. In case of domestic violence against women, the judge could indemnify for moral damages without the need for evidence, but for this purpose there should be an express request of the prosecution or the offended party, even if the amount is not specified.

Through this information, insinuating comments emerged about the falsifiability of information by women and how this would be made easier for them. The contents showed an idea that many women represented losses in men's lives, who wanted to build situations that would affect their successful life. It is, even more, at these moments that feminist practices need to work towards the construction of a form of consciousness, as pointed out by Haraway (2009), "so that self-knowledge is structured in women of a self that is not "Thus, even within their differences, women will know what they are not, thus fostering a movement of defense against accusations of levity and simulation, often present in sexist repertoires.

There is not only the attitude of distrust of people outside the situation (including men and women as well), as well as eventually the decision of the victim to withdraw the complaint, feeling impelled to it. Thus, Brandão (2009), during an analysis of results about complaints to the specialized police station to women, portrays that "the suspension of the complaint is paradoxically censored and favored, because the

understanding that this act can manage the marital and family crisis is mobilized, that underlies the reported crime." Comments were also directed to connotations that women needed to use illicit subterfuges, such as slander and defamation, to get men's desired financial resources.

Therefore, going further into this "construction of a nonbeing or a non-subject" cited in Haraway's (2009) work, it is urgent to jointly build an affinity for women's capacities to recognize that they are not destined to be not successful in the field of labor and finance. Thus, from this conviction of what is not, accusations of female existence as an obstacle to male "natural success" may also be more easily dismissed and challenged by feminist practices.

3.3 AND WHEN THE WOMAN IS THE ABUSER?

In this situation, the comments stemmed from a story in which a female teacher admitted to having abused an underage student because he resembled the physical appearance of her former boyfriend. The idea projected by some expressions was related to passivity, even in this case, continuing to be the woman's, since (according to the supposition of netizens) the underage student could have allowed this to happen, choosing to face a challenge with the intention of benefiting from good school grades.

The attitude of creating substitutive plots, in this case represented by a plaster of patriarchal gaze in a situation involving gender issues, meets what Haraway (2009) attests as "the cyborg policy, which allows insisting on noise and advocate pollution." However, still for Haraway (2009), "this same possibility allows everyone to be inside in the play of a text that has no finally privileged reading or any salvation story." Thus, there is, for example, the chance of the evolution of cyberfeminism as a technological structure of resistance.

Even though there may be other glances, the patriarchal logic still stands out in the situation in question that there is inherent passivity in the feminine, being the woman, therefore, an instrument of use and enjoyment. Barcinski et al. (2013) rescue the social concept of Marianism, that is, “a gender ideal symbolized by the Virgin Mary, which brings together expected characteristics of women: subservience, sexual passivity, renunciation, subordination and sacrifice.”

In this scenario, it is impossible to see a woman as aggressor and cause pain to another. The objectification contents of the female body also emerged, since even within a negative connotation, the position of women is held to be dominant. Thus, messages appeared representing the idea that sexual abuse by women is considered as pleasurable to the infantile male body, removing any connotations of possible trauma to this child in detriment of the suggestion of a bonus event, of justifiable indulgence of this boy and enviable to adult men who did not have this experience in their childhood.

Thus, it is interesting to note in this particular case that chauvinist culture also harms men, since this boy, even with latent suffering due to sexual violence, could not manifest such an expression by being coercively placed with him as the winner in history.

Finally, given this context, it is understood why Haraway (2009) concludes that “from the sexual objectification, the woman, in a profound sense, does not exist as a subject, not even as a potential subject, since she owes her existence as a woman to sexual appropriation.”

3.4 SHE IS USING MADNESS AS EXCUSE!

The news in question portrayed the case of a mother who abandoned her son at a bus stop in the southeastern part of the country after a psychotic break. The resulting comments ranged from ironies to judgments that rejected its attitude. In the ironic context, the psychotic state was compared as a 'natural' state of every woman, and mockery was written that indicated that sexual activity with men, thus having contact with the male sexual organ, was balm for female mental health. Patriarchal comments tend to misrepresent female plurality, indicating a unique pattern of behavior, implying predictability.

However, Haraway (2009) recalls that "women (and men) are not natural, but built, and therefore can be rebuilt." According to Junior (2009), "the idea of penis envy and feminine hysteria obviously cannot grasp the essence of the feminine", but on the other hand presents the sprout of the aforementioned Haraway's (2009) finding, the to know: "femininity is a process, to become something that has to be built on an unavoidable anatomical reality, which is of the order of an absence."

Some people linked the outbreak to the possible use of illicit substances, thus bringing the blame for it through the argument of free will to use and, consequently, the volition to abandonment of the child. It can be seen from the comments collected that every female attitude comes with a sense of obligation of care to the other, where any illnesses and/or impossibilities of the same are obscured by this imposition (taken as natural) always to be care taker.

Thus, Haraway (2009), in a contestation way, states that "she prefers to be a cyborg rather than a goddess." Within this same logic, Zanello et al. (2015) indicate that "the sphere that belongs to women is that of the family, where their ideal of existence is to live for others. Being outside this space is not only considered a social violation, but seen as a "denaturalization".

Finally, many judgments still occurred in relying on the myth of "maternal love," which is imposed on every woman, so that any carelessness with descendants, even unintended, represents monstrosity.

Given this, Badinter (1985) exposes that maternal love is treated as an instinct, as an innate feminine tendency; but that, in fact, this feeling is like any other and, therefore, is fragile and uncertain, may or may not exist, be strong or fragile, prefer one child to another, among innumerable variations.

3.5 SHE WAS BORN ... AND IT IS SO DEFENSELESS!

We must clarify first that abortion is illegal in Brazil. It is considered a crime but is available mainly to women who have money. We have thousands of abortions per year, but those who died from it are mainly black and poor women who can not afford doctors to perform it illegally.

On the controversial subject of abortion, comments were analyzed regarding a report in which a famous actress confessed to having had an abortion at the age of 17 and ends by stating that she never regretted her choice.

Most of the demonstrations held the view that this was an unfair attitude towards the child, since the actress had the right to life and that this was taken from a defenseless fetus. Finally, women were characterized as aggressors, thus highlighting the expropriation of women from their bodies. It becomes usual to perceive the disregard of the woman's will in the various decisive moments of her life, and one of these is whether or not to be a mother. Therefore, "the woman is based on the desire of another and not on the production of self" (Haraway, 2009). Mello (2016), in his documentary, reports that "since the beginning of human history, motherhood has been compulsory for women." After much feminist struggle,

the right to vote and occupation of the labor market were achieved with greater freedom, but being a mother remains one of the inevitable destinations when it comes to social demands.

Other comments emphasized the lack of prevention of women and, of course, only women, not including men in this accountability. As a consequence of this lack of responsibility considered feminine, the figure of the woman was hinted at as a hindrance to public funds, as well as a usurper of resources for a socially unacceptable purpose (in cases where they need hospital care after an unsuccessful abortion attempt).

It is noted that "from the increasing commodification, women's days become more arduous because their responsibilities have not diminished, and their reproductive situations become more complex" (Haraway, 2009). In fact, this complexity is noticeable through the transitory applicability of decision-making power: while the woman is not a mother, the social firmly decides for her; however, when she becomes a mother, the responsibility is complete.

Also, finally, there are still those who consider the naturalization of "maternal love" to be immutable, denying every woman who supports, desires, or has performed abortion.

In addition of being forced to want to be a mother, according to the comments reviewed, the woman needs to be a "good mother". This spread of the myth of maternal love contributes to the father's lack of responsibility for childcare and involvement, which is also shared and encouraged by women themselves and society at large, who exalt and criticize the good and bad mother, respectively (Cúnico et al., 2013).

The majority obligation of women to strive to be qualitatively superior as a mother than in any other social role is perceived by Martins et al. (2014). According to them, in most couples, "mothers are aware that they are the main caretakers and caregivers of their children, but they do not seem to be bothered by this as they preserve their husbands' welfare by sparing them." Also, men, by assuming themselves as secondary caregivers, end up legitimizing the ideology that caring is a female task.

3.6 COMPLAINING EVEN ABOUT A CONDOM!

The news story in question portrayed the situation of a young woman who found a used condom in her purse while on a train in Sao Paulo. There were many comments to intend to force a misrepresentation of harassment from the idea that the girl was lying because she needed to cover up having sex. From the technological evolution and, consequently, the breadth of possibility of communication, many untrue information propagate in the social environment and are legitimized as accurate.

Through mass deductions, facts change; especially when public opinion tends mainly to a particular view and even to a certain prejudice. This is why Haraway (2009) points out that “the cyborg is a matter of fiction and also of lived experience.” However, considering the hypothesis that the woman mentioned in the news had, in fact, committed a sexual act, what would be the reason for her covering up and needing to lie, according to public opinion?

According to Barcisnki et al. (2013), “the conception formed by Marianism brings the outline of the pure and chaste woman, as the Virgin Mary portrayed by the Church, not only repressing her sexual desires, but not having them”. Such a view still endures, having male sexuality socially stimulated and regarded as a merit of virility, while female sexuality is segmented into a shameful category worthy of hiding and denying..

There were also comments from women, who mentioned carelessness and lack of responsibility for leaving the bag open, which showed that the focus was to blame the woman in detriment of the attitude of the violator. Haraway (2009) reports that "we need to learn to interpret the networks of power and social life created by the impact of social relations mediated by new technologies." Analyzing these locus, one verifies the woman's place in a context of care and zeal.

Therefore, once she is hit, the tendency is to accuse her as not be careful enough and therefore worthy of aggression. Within an authentic analysis, it sounds cruel, but in the social lines, this accountability occurs daily. According to Peixoto and Nobre (2015), it is noticeable in everyday life that, "when someone learns of a case of violence against a woman, it is common to seek a justification for such atrocity in that woman's previous behavior." Therefore, doubt prevails in most people's minds as to the existence of a possible "indirect guilt" of such a victim, even if there is any remnant of facilitation for the event.

3.7 THE MAN RAPED HIS SISTER-IN-LAW.AND HIS WIFE FORGAVE HIM! SHE IS A MONSTER!

Comments by netizens were about the news of a couple who had been living together for 15 years. The wife, even after her husband's conviction for the rape of her sister, forgave him and remained married to him.

By her attitude, the comments emphasized judgment on the wife's behavior rather than the husband's attitude. As already mentioned in previous categories, we once again see the bias and perversity to which the cyborg is committed, as Haraway (2009) makes explicit. "The cruelty of maintaining the partiality of patriarchal society makes invisible any other attitudes than female ones as targets for judgment." As already brought by Zanello et al. (2015), "women must be an unconditional source of love and care." In this sense, other minimum social obligations of coexistence of man are obscured, reaching the level of atrocities to be invisible under the conduct (whether considered wrong or not) of a woman.

3.8 WHAT IS IMPORTANT IS THE COMPETENCE!

The story emphasized the fact that a woman had achieved the Nobel Prize in Chemistry for the fifth time in history. Many netizens were bothered by the text of the story to emphasize that prize was achieved by a woman.

In this sense, they commented that what matters is competence, and it was not a man or woman who succeeded. Misunderstanding about the importance of female representativeness in a contemporary context of gender inequalities persists and is noted in the comments from the moment when Internet users consider it irrelevant to emphasize the gender of the winner.

As mentioned earlier, this is why “feminism is much more about building the self-not-of-women than a single conceptualization of being a woman” (Haraway, 2009). From the moment one discusses what women are not, it opens up a space for understanding the differences concerning the male gender; that is, they clarify the privileges they do not have to the detriment of what they have. The privileges mentioned here can be exposed by Prado and Fleith (2012), when they reflect that “the Brazilian system of science and technology does not include benefits that help the scientist to reconcile career and family.” This is

noticeable when the requirement to meet scholarship deadlines and maintain productivity rates is not attenuated during periods when women are engaged in maternity. Only recently, in Brazil, women researches were allowed to take maternity leave. Before that, they had no exceptions during pregnancy, labor, or the subsequent months.

In addition, "if the breastfeeding researcher reduces her activities to devote herself to family issues, this may result in a drop in her scientific output, leaving her in worse conditions on the defined criteria of academic productivity and scientific merit" (Tavares, 2010).). Another very striking point was to extol the conquest of the reported woman by arguing that this was the right way to be a feminist, for she fought for success rather than protesting without clothes.

Other comments also revolved around the notion that it was right to be like the Nobel Prize winner, who was not a feminist and used her time productively. "Prejudice toward feminist movements stems from an earlier misunderstanding also founded on previously formed judgments, which is: feminists are unloved, hysterical, frustrated, angry, moody women" (Sorj, 2009), as if these personality attributes were monopolies of feminists and were not randomly distributed between genders and in any political, professional or religious group.

Thus, not recognizing the successful scope of feminist movements, many people fail to realize the logical connection that a female achievement in the scientific field (so patriarchally dominated) also represents a feminist attitude. Thus, as also clarified by Sorj (2009), "a large part of society is so resistant to identifying with feminism, while being so pleased with the change in mindset it promotes."

3.9 What do these feminists want?

Two reports mentioned protests with feminist contexts in the city of Manaus, Brazil, during the presidential pre-election period. In this context, many comments emphasized female nudity in the protests as a lack of self-respect, lack of morality, always tending to eroticize the female body. Nudity was interpreted as being an attempt to call for attention, as these women, according to their view, had no argument to debate, so they took off their clothes. In this sense, the theory of MacKinnon explained by Haraway (2009) suits the understanding of the behavior of Internet users. In this, it is understood that "there is no marginalization of women's speech authority and political action, but there is something greater than this: an elimination." The vision of a jumble of people passing through the streets and making noise is still interpreted by society as people strayed from the formal commitments of buildings and offices, which are harassing social silence and disrupting a static civilized pattern. However, they do not understand that there is an internal organization designed for such activist actions.

Gohn (2011) states that the movements perform diagnoses about social reality, construct proposals and collective actions that act as resistance to exclusion, fight for social inclusion, develop the so-called empowerment of organized civil society actors as they create social subjects for the purpose of networking.

Along with this unfamiliarity, following the logic of the eroticization of the female body to the detriment of the representativeness of nudity in a protest for rights guarantee, there were teasing based on imposition of beauty standards. Complementing these opinions, some netizens also commented that, in cases of harassment to these protesters, they would not have the right even to complain. Then there is the trivialization and disregard of the voice of women, from which, according to Haraway (2009), "the feeling

is built that they do not exist except as a product of men's desire". Therefore, we do not see the representation of nudity as a protest, because it is always hidden by the sexualization of female bodies as a product of evaluation and consumption. As such, they must fulfill an obligation to be included within a standard of what is socially dictated "beautiful body." This is even more necessary if these bodies are to be exposed, regardless of the reason, function, or intent of this exposure. According to Souza et al. (2013), "the pursuit of aesthetic standards is no longer a social duty, which already represents an exclusion, and has become a moral duty, for which women should strive enough to conquer." And thus, failing to fulfill this moral obligation, it is understood that it deserves social punishment, in which public constraints are arbitrarily applied, and its rights to repudiate them are denied by a sadistic inversion of values, in which It is imputed that the one who is disturbing the order is the one who is claiming for rights and not the one who is embarrassingly surrounding them.

Finally, other demonstrations contained the argument that naked protesting women were in favor of abortion and drug legalization and therefore not worthy of being considered representative.

Here is the distorted understanding that a manifestation of a social group is perceived as a single identity set, with identical opinions in every field.

In other words, one cannot see the possibility of electing as a goal a common agenda, with a view to build a general good in the midst of diversity and adversity. As stated by Haraway (2009), "identities seem contradictory, partial, and strategic, because there is nothing about being a" woman "that naturally unites women." There is not even such a situation - "being" a woman. It is itself a highly complex category. Therefore, affinity is sought rather than identity.

4 CONCLUSION

With the objective of consolidating defense arguments to attacks on feminist agendas, it was important during this research to observe and study the lines of reasoning used in the comments of netizens. The logic that interweaved the findings was patriarchal, although the comments came from men and women, thus highlighting that chauvinism and misogyny are social reproductions engendered regardless of gender.

The analysis categories showed that the demands related to female behavior are mostly attached to an accusatory tone, from which there is no room for them to express (or even realize) their position as victims in cases of gender violence.

In this way, an immediate sequence of obligations is produced that it should fulfill in order to avoid the event, reversing the responsibility of the actions. The blaming attitude is so intense that in the social imagination, by accusing the woman of violence, the first hypothesis is always the falsification of the information, since it is a trap against the successful male life, where woman wants to take advantage of it in some way.

This view is crystallized in the idea that women do not have emancipating capacity to achieve their successes and, thus, need to take hold of what man has achieved from his privileges.

It has been seen that sexist attitudes are detrimental to society as a whole and not only to women, since the expression of emotional distress is denied to men, which also causes mental and physical illness to the male public.

The segregation of people living with mental illness becomes even more cruel when it comes to gender issues, as one absorbs the stereotype of the "hysterical woman" who fell ill due to the "absence of the phallus," Female mental health is seen as coming from and dependent on male performance. "Female hysteria" is also mentioned in cases where women do not keep silent by rape, which in some situations is pejoratively referred to as "mimimi" (a word in Portuguese that represents complaints in a pejorative way) in the language of social networks.

In this sense, any expression of denunciation coming from a woman receives intense pressures to be socially disregarded. Intentionally, passivity taken as inherent in the female is forgotten in cases where, for example, an unwanted pregnancy occurs, which results in male non-responsibility. This purposeful change is strategically crafted to make several illegal or immoral male attitudes invisible, overcoming the culpability of the deeds mostly to the woman involved in the context. This does not mean that there are no situations in which there should be female accountability, but what is observed is that, regardless of the amount of reparation due, the embarrassment towards the female figure is always more significant.

Moreover, yet, through all these peculiarities that are part of female existence, most of society still does not understand the relevance of female representativeness in the various spaces, unaware of the concept of equity and rejecting activist manifestations that fight for feminist purposes. Therefore, this research contributes to studies in the area of human and social sciences that involve issues of gender, human rights and social justice, solidifying the foundations for a society based on fairness and healthy living in the midst of human diversity, among the many ways to be a woman.

5 REFERENCES

Alcântara, Lívia Moreira de (2016). *Ciberativismo e a Dimensão Comunicativa dos Movimentos Sociais: repertórios, organização e difusão*. Política e Sociedade, Florianópolis, vol 15, nº 34;

Badinter, Elisabeth (1985). *Um amor conquistado: o mito do amor materno*. Editora Nova Fronteira;

Barcinski, Mariana; Capra-Ramos, Carine; Weber, João L. A.; Dartora, Tamires (2013). *O marianismo e a vitimização de mulheres encarceradas: formas alternativas de exercício do poder feminino*. Pontifícia Universidade Católica do Rio Grande do Sul, Brasil, n.º 28;

Bardin, Laurence (2011). *Análise de conteúdo*. São Paulo: Edições 70;

Brandão, Elaine Reis (2009). *Renunciantes de direitos? A problemática do enfrentamento público da violência contra a mulher: o caso da Delegacia da Mulher*. PHYSIS: Rev. Saúde Coletiva, Rio de Janeiro, 16(2):207-231;

Campos, Claudinei José Gomes (2004). *Método de análise de conteúdo: ferramenta para a análise de dados qualitativos no campo da saúde*. Rev. Bras. Enferm., Brasília, DF;

Cardoso, Isabela; Vieira, Viviane (2014). *A mídia na culpabilização da vítima de violência sexual: o discurso de notícias sobre estupro em jornais eletrônicos*. Revista Eletrônica de Estudos Integrados em Discurso e Argumentação, Ilhéus, n. 7, p. 69-85;

Castells, Manuel (2013). *Redes de Indignação e Esperança: Movimentos Sociais na era da internet*. Tradução Carlos Alberto Medeiros. Rio de Janeiro: Zahar;

Cúnico, Sabrina Daiana; Arpini, Dorian Mônica; Cantele, Juliana (2013). *A impossibilidade no exercício da paternidade: algumas reflexões*. Psicologia em Revista, Belo Horizonte, v.19, n.3;

Deslauriers, J.; Kérisit, M. *O delineamento de pesquisa qualitativa*. In: Poupart, Jean et al. (1991). *A pesquisa qualitativa: Enfoques epistemológicos e metodológicos*. Petrópolis, RJ: Vozes;

Dias, C.; Barbai, M. A.; Costa.G. C. (2014). *Movimentos da contemporaneidade: a rua, as redes e seus desencontros*, Revista do Laboratório de Estudos Urbanos do Núcleo de Desenvolvimento da Criatividade, Campinas, São Paulo;

Gohn, Maria da Glória (2011). *Movimentos sociais na contemporaneidade*. Revista brasileira de Educação, v.16, n.47;

Goldenberg, Mirian (1997). *A arte de pesquisar: como fazer pesquisa qualitativa em ciências sociais*. Rio de Janeiro: Record;

Haraway, D; Kunzu, H. (2009). *Antropologia do ciborgue: as vertigens do pós-humano*. 2. ed., Belo Horizonte : Autêntica Editora;

Júnior, Ronis Magdaleno (2009). *A construção do feminino: um mais-além do falo*. Jornal de Psicanálise, São Paulo, 42(77): 89-106;

Lemos, Marina Gazire. *Ciberfeminismo: Novos discursos do feminino em redes eletrônicas*. (2009). 129 f. Dissertação (Mestrado em Comunicação e Semiótica). Programa de Pós-Graduação em Comunicação, Pontifícia Universidade Católica de São Paulo (PUC - SP), São Paulo;

Marconi, Marina de Andrade; Lakatos, Eva Maria (2009). *Técnicas de pesquisa: planejamento e execução de pesquisas, amostragens e técnicas de pesquisas, elaboração, análise e interpretação de dados*. 7 ed. São Paulo: Atlas;

Martins, Cristina Araújo; Abreu, Wilson Jorge Correia Pinto de; Figueiredo, Maria do Céu Aguiar Barbieri de (2014). *Tornar-se pai e mãe: um papel socialmente construído*. Revista de Enfermagem Referência, Série IV, n.° 2;

Melo, Hildete Pereira de; Schumaher, Schuma (2003). *A segunda onda feminista no Brasil*. In Dicionário Mulheres do Brasil, Rio de Janeiro, Zahar;

Mello, Caroline Balduci de (2016). *Documentário: Maternidade Compulsória – uma revisão do que significa a maternidade sob o ponto de vista do feminismo*. Universidade Estadual Paulista "Júlio de Mesquita Filho". Faculdade de Arquitetura, Artes e Comunicação. Bauru;

Mendes, Raiana Siqueira; Vaz, Bruna Josefa de Oliveira; Carvalho, Amasa Ferreira (2015). *O Movimento Feminista e a Luta pelo Empoderamento da Mulher*. Periódico do Núcleo de Estudos e Pesquisas sobre Gênero e Direito - Centro de Ciências Jurídicas - Universidade Federal da Paraíba;

Minayo, M. C. S. (Org.) (2001). *Pesquisa social: teoria, método e criatividade*. Petrópolis: Vozes;

Monteiro, S. D. *O ciberespaço: o termo, a definição e o conceito*. DataGramaZero, v. 8, n. 3, p. A03-0, 2007. Disponível em: <http://www.brapci.inf.br/v/a/4482>. Acesso em: 07 Jul 2018;

Monteiro, Kimberly Farias; Grubba, Leilane Serratine (2017). *A luta das mulheres pelo espaço público na primeira onda do feminismo: de suffragettes às sufragistas*. Direito e Desenvolvimento, João Pessoa, v. 8, n. 2;

Moraes, Roque (1999). *Análise de conteúdo*. Revista Educação, Porto Alegre, v. 22, n. 37, p. 7-32;

Narvaz, Martha Giudice; Koller, Sílvia Helena (2009). *Metodologias feministas e estudos de gênero: articulando pesquisa, clínica e política*. Psicologia em Estudo, Maringá, v. 11, n. 3, p. 647-654;

Peixoto, Aimê Fonseca; Nobre, Bárbara Paula Resende (2015). *A responsabilização da mulher vítima de estupro*. Natal, v.3, n.1;

Prado, Renata Muniz; Fleith, Denise de Souza (2012). *Pesquisas brasileiras: um equilíbrio entre talento, ciência e família*. Arq. bras. psicol. [online]. vol.64, n.2, pp. 19-34;

Rocha, Fernanda de Brito Mota (2017). *A quarta onda do movimento feminista: o fenômeno do ativismo digital*. Dissertação de Mestrado. Unisinos;

Rodrigues, Alexsandra Gato; Gadenz, Danielli; Rue, Letícia Almeida de La (2014). *Feminismo.com: o movimento feminista na sociedade em rede*. In: www.derechoycambiosocial.com, ISSN 2224;

Saffioti, Heleieth B. (1986). *Feminismos e seus frutos no Brasil*. In: SADER, Emir (Org.). Movimentos sociais na transição democrática. São Paulo: Cortez;

Scherer-Warren, Ilse (2013). *Redes e movimentos sociais projetando o futuro*. Revista Brasileira de Sociologia. Vol. 01, n. 01;

Silva, Irley David Fabrício da; Paiva, Cláudio Cardoso de (2013). *Ciberativismo e democracia nas redes sociais. Um espaço de reivindicações e direitos.* XV Congresso de Ciências da Comunicação na Região Nordeste, Mossoró – RN;

Sorj, Bila. *O estigma das feministas*. Jornal O Globo, 13 mai 2009;

Souza, M.R.R.; Oliveira, J.F.; Nascimento, E.R.; Carvalho, E.S.S. (2013). *Droga de corpo! Imagens e representações do corpo feminino em revistas brasileiras*. Rev. Gaúcha de Enfermagem;

TAVARES, I. (2010). *A participação feminina na pesquisa: a presença das mulheres nas áreas do conhecimento*. In: Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Org.), Simpósio gênero e indicadores da educação superior brasileira (pp. 31-62). Brasília: Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira;

Ugarte, David de (2009). *O poder das redes. Manual ilustrado para pessoas, organizações e empresas chamadas a praticar o ciberativismo*. Porto Alegre: EDIPUCRS;

Zanello, Valeska; Fiuza, Gabriela; Costa, Humberto Soares (2015). *Saúde mental e gênero: facetas gendradas do sofrimento psíquico*. Dossiê Políticas Sexuais e de Gênero no Contemporâneo, Fractal: Revista de Psicologia, v.27, n.3, Universidade de Brasília.

Dimensioning and Economic Feasibility Analysis of a Photovoltaic System Installed in a Manaus-AM Commercial Area

Esdras Ramos da Silva
esdrashramos13@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM – Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade do Estado do Amazonas – UEA – Brasil

Igor Felipe Oliveira Bezerra
igor.bezerra@uniniltonlins.edu.br
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

This study aims to demonstrate the application of sizing and an analysis regarding the economic viability of a grid connected Photovoltaic System for a trade located in a commercial area of Manaus - AM, considering the agents that influence the initial investment analysis. and end of project. Exposing the relevant concepts around grid-connected photovoltaic systems (SFCR) establishing regulatory standards governing insertion for distributed generation micro and mini connection systems and methods for project investment analysis. Presenting the analysis effect of the economic viability of the system using the discounted payback investment methods, the energy consumption, in kWh, in the trade and investment profit and, finally, the results and conclusions obtained through the method of Discounted Payback analysis, which shows the viability of the project from a technical and economic point of view, in order to meet and contribute to sustainability and conservation of the environment.

Keywords: photovoltaic system; energy consumption; on grid.

1. Introduction

One of the alternative sources of energy found for electric power generation was solar energy, since it does

not pollute the environment, which occurs through the photovoltaic effect, a phenomenon discovered in 1939, Edmond Becquerel verified the emergence of the photovoltaic effect Through the metal plates, platinum or silver, dipped in the electrolyte produced a potential difference in the exposed semiconductor material when subjected to light [1]. As this is a location of the intertropical convergence zone cut to the north by the equator line, this gives Brazil a great advantage in the potential of solar energy generation during the whole period of the year. through solar radiation [2].

The most common semiconductor material for their production and pure silicon offers conduction, silicon when it is in pure state and a material with low efficiency, and may have a poor conduction capacity, however, and precise goes through a step purification and subsequently by a doping step. The module is the generator device, consists of a set of interconnected and connected photovoltaic cells, generating electricity through sunlight. Since it is made up of photovoltaic cells constructed from the main existing technologies, monocrystalline silicon (c-Si) is the most efficient, polycrystalline (p-Si) and its efficiency is slightly lower than that of (c-Si). having the advantage of having a lower production cost, and those of hydrogenated amorphous silicon (a-Si) which stand out for their better performance compared to others in terms of energy production [3].

In Brazil photovoltaic solar energy has been playing a significant role in the production of energy through solar panels, and may have a 44% growth in installed solar energy capacity in 2019, surpassing the 3.3 GW mark of the source in operation for projections in distributed generation (GD), Must total 628.5 MW in solar capacity to Brazil [4].

Within this context, the present work aims to expose the sizing and implementation of a grid connected photovoltaic system (SFCR), showing the importance of using solar panels and analyzing the economic viability of this system to the present day as a means of reducing consumption. energy production and increased energy production. Through implementation the project aims to show how economically viable is the investment of this installed energy source in an area, observed through the calculation of discounted Payback, along with the distributed generation of energy, which currently offers greater efficiency in the energy matrix. to attend and contribute to the sustainability and conservation of the environment.

2. Theoretical Referential

2.1 Grid connected photovoltaic systems (SFCR)

In order to reduce barriers to the connection of small power plants to the distribution grid (although using clean and renewable energy sources or energy-efficient cogeneration), laws have been created in Brazil which are governed by the National Energy Agency. Electricity by means of Normative Resolution No. 482/2012 which establishes the general conditions for Distributed Microgeneration and Minigeneration and the energy compensation systems in which the producer has the right to generate part of the electricity he consumes is and compensated the energy value. active electric. Provided the accumulation of credits over a period of days, if the surplus is not used by the producer and injected into the network, it can be used in other properties of the same holder, if met by the same concessionaire [5] [6]. described below:

• Distributed microgeneration: For generating units connected to the low voltage distribution network must meet the installed power less than or equal to 75KW and using clean energy sources such as wind,

solar, biomass, hydraulic and cogeneration, connected to the distribution network.

• Distributed Mining: For generating units connected to the low voltage distribution grid with installed power greater than 75 KW and less than 5 MW using clean power sources connected to the distribution grid.

Photovoltaic systems connected to the electric grid, known as on-grid systems, operate in parallel with the electricity grid. Its structure is made from blocks mounted on frames, usually aluminum and the material used for its blocks because of its greater rigidity and handling. Its main advantages are not requiring energy storage, they can be deployed in any harsh environment that has sufficient solar radiation to meet the desired demand, and seen as efficient and inexpensive compared to existing ones, these systems added in large amount are capable of unclog the distribution grid at peak times, as it can be installed in conjunction with the local power system, as shown in Figure 1. [7] [8].

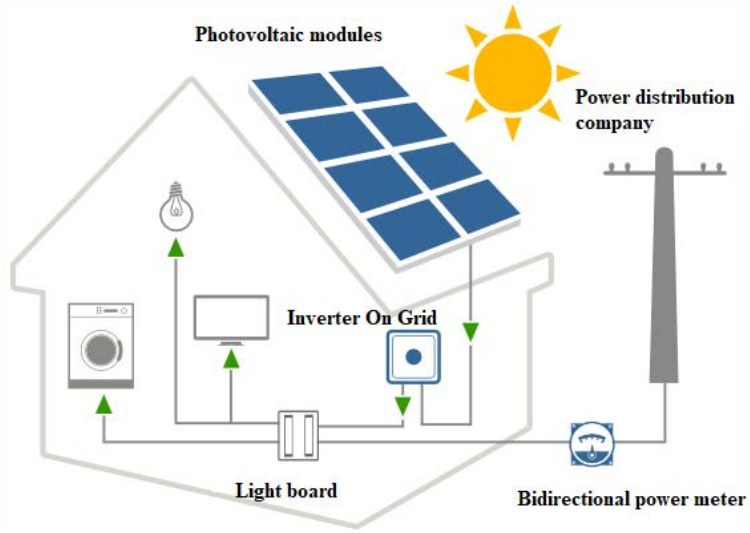


Figure 1. Network Attached Photovoltaic Systems (SFCR).

Source: Solar Energy, 2019.

This system can basically consist of one or more photovoltaic modules and a set of equipment that are part of your system the photovoltaic panel or module, DC-AC converter (inverter) system, maximum power point follower (MPPT), devices protection, electrical wiring, terminals, overvoltage and lightning systems [9].

Regarding the state of Amazonas, the concessionaire responsible for such regulations is Eletrobrás Amazonas Energia, which supplies energy to consumers [10].

3. Methodology

The area of study of the sizing and analysis of the economic evaluation and a trade of auto parts of motorcycles, located in the Cidade Nova neighborhood, in the north of the city of Manaus - AM, the trade presents in a place of easy access since the circulation of vehicles to the access of consumers who buy the goods and services offered in commerce as motorcycle parts among others. In this area there is an extremely favorable level of incidence of solar rays that was possible through tests to analyze the energy conversion from the 100% electrical effect in the studied area.

Using PVSYST V6 Software. 78 will be effective to aid in the design of the SFCR'S, which positively benefited from the survey of the solar resource at the study site and the total survey needed for photovoltaic panels, the inverter power to meet 95% of the commercial consumption. Where it was necessary for the measurement of data on the geographical coordinates of the site with a latitude measurement of -3.13 ° S, longitude of -60.02 ° W and an altitude of 72 m, the roof angle of the self-producer has an inclination of 8 °, is Azimuth and -20 ° .The data collected comprise the historical annual radiation series as well as the temperature of the respective radiation.

In Figure 2 and presented to the roof face available for solar panel installation, during the morning the left-hand face identified with red receives the lowest solar radiation. The data described above helped significantly in the first stage of system deployment in the commercial area exemplified in the figure below.

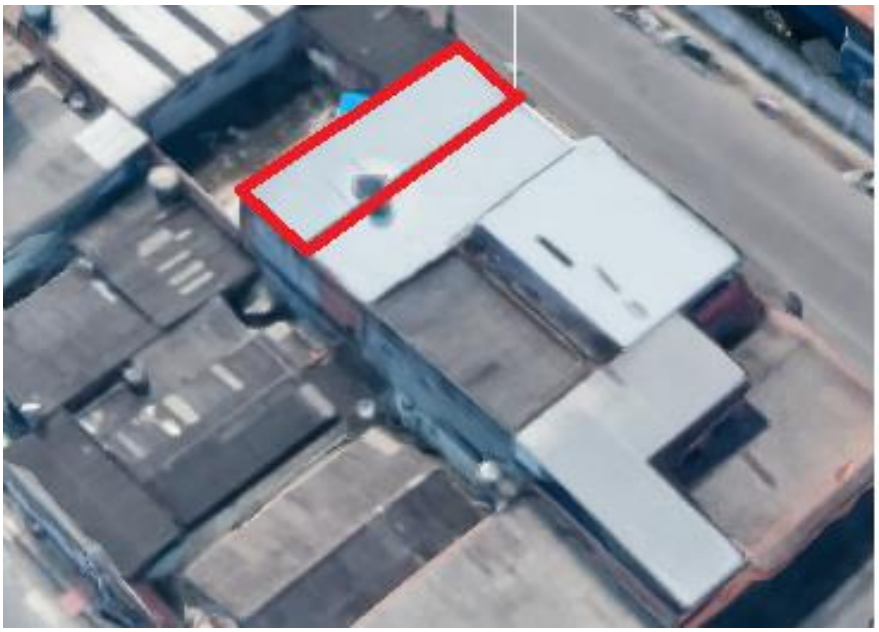


Figure 2. System installation location.
Source: Google Maps, 2019.

For the sizing of the system was evaluated the possible solar resource referring to the location of the installation of the system, analysis of electricity tariffs manifested in the commercial area, it was necessary to collect the consumption data of the commerce, to describe the cost of energy generated, making a comparison with the conventional system, and later with the photovoltaic system connected to the grid SFCR's, using the appropriate characteristics of the distributed generation system. To analyze the economic viability of the system, the investment methods were used through discounted payback.

4. Analysis and Discussion of Results

4.1 Design of grid-connected photovoltaic system

This stage presents the realization of the SFCR sizing, given through the PVSYST V6.78 software of the SFCR, which has the capacity to generate electricity to offset 95% of the annual consumption of 17,965.17 kWh / year of trade of the auto producer with main purpose is the capacity to produce 18,864.25 Mwh /

year (95%) of energy in the system, as shown in Figure 3.

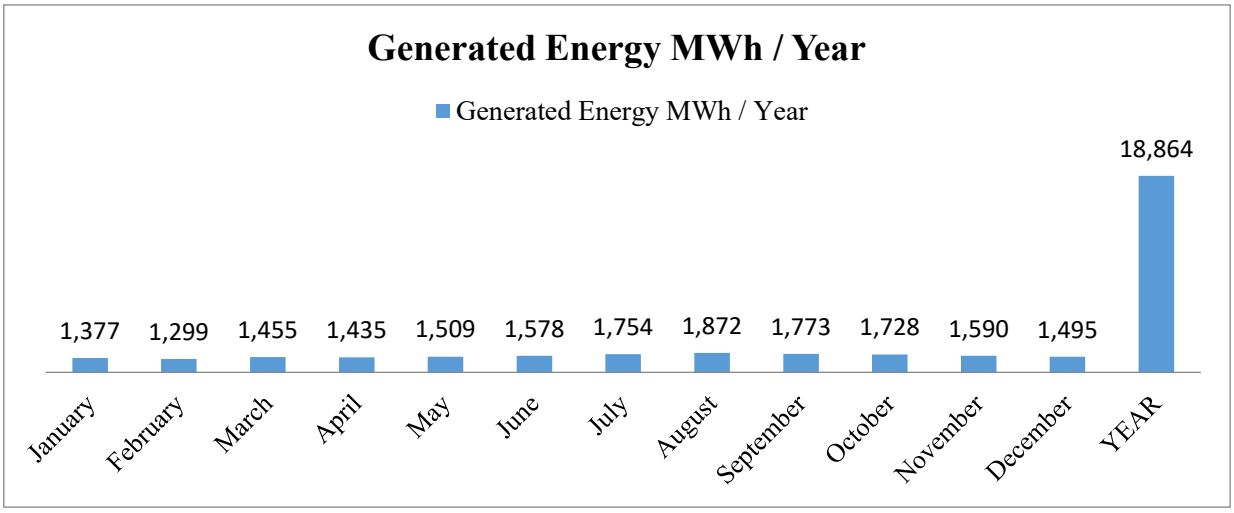


Figure 3. Economic results of the compensated generated energy of the on-grid system.

Table 1 lists the equipment required for the assembly of the SFCR, such as photovoltaic modules, the inverters and the metal structure required for fixing, as well as the physical description and the total value of the components that include the design and installation services. Based on 40 precise photovoltaic modules, byd - phk -36 model with a maximum power of 330 wp, 25 years linear performance guarantee, average cell efficiency up to 18.8%, in compliance with the 12.73 kwp total power system as well as the power of 2 on grid inverters that have anti-islanding protection and internal DC switch. The inverter used has a maximum input DC power of up to 6000 W, rated output power of 6000 VA and a maximum efficiency of 97.8%.

Table 1. Specifications and total value of components for the grid-connected solar photovoltaic system - SFCR.

40 PC 330W BYD Photovoltaic Module - PHK-36		48 PC Metal Tile Bracket - Spin
2 PC Inverter 5kW 2MPPT (Fronius Primo 5.0) 220V		8 PC Aluminum Track 2.1 meters - Spin
2 PC Stringbox 2 Inputs + 2 Output - Clamper		16 PC Aluminum Rail 4.2 meters - Spin
100 MT 6mm² Solar Cable - Black		72 PC Intermediate AL Clamp - Spin
100 MT 6mm² Solar Cable – Red		16 PC Clamp AL terminal - Spin
4 PC MC4 MC Connector – Male		16 PC Aluminum Rail Junction - Spin
4 PC MC4 MC Connector - Female		2 6.6KWP Kits
48 PC Metal Tile Bracket – Spin		Accessories and Labor
01	PHOTOVOLTAIC GENERATOR KIT 6KW	UNIT VALUE R $
Total amount without tax: R $		48.000,00
Total amount with tax: R $		**48.000,00**

* Values in Brazilian Real

The equipment used in this system is of efficient and modern technology, allowing an estimate of an average of 25 years or more of its useful life.

4.2. Local Energy Consumption in 2018.

For the design of the SFCR, it was necessary to first survey the energy consumption of the consumer unit. Table 2 shows the monthly consumption for a twelve-month period, from January to December 2018. During this period, the energy used was fully supplied by the local energy concessionaire.

Table 2. Energy consumption in trade in 2018.

Month	Monthly consumption reading (kWh / month)	Amount paid
January	1421,35	R$ 1.336,07
February	1412,56	R$ 1.327,81
March	1358,31	R$ 1.276,81
April	1351,88	R$ 1.270,77
May	1541,56	R$ 1.449,07
June	1536,52	R$ 1.444,33
July	1510,25	R$ 1.419,64
August	1589,79	R$ 1.494,40
September	1504,89	R$ 1.414,60
October	1624,02	R$ 1.526,58
November	1617,65	R$ 1.520,59
December	1496,39	R$ 1.406,61
Total	**17965,17**	**R$ 16.887,26**

* Values in Brazilian Real

Looking at the monthly consumption shown in Table 2, there is a noticeable monthly increase in the amount of energy consumed in the establishment implying a growth in financial costs. Among the factors that contributed to support this analysis of consumption in commerce, is the period of the day when there is the highest demand for energy in the concession area. It is noted that in May, from 2018, there is an increase in the energy bill, compared to previous months, because during this period there is a transition from the humid period to the dry period in the region, with the increase in temperature use. more frequently air conditioners are used. This behavior remains until the second half of November, reflecting a reduction in the value of energy consumption in December. However, it is important to emphasize that the financial costs for energy consumption increase considerably also due to changes in the energy tariff.

4.3. Characterization of Consumption and Self-Consumption Percentage

Following the installation of the SFCR at the study site, for the first two months of system implementation there was a considerable decrease in financial costs with the payment of the energy consumption tariff to the local utility. The system was installed and ready for operation in May 2019, already showing savings over the next two months, as shown in Table 3.

Table 3. Input Savings with Installing an SFCR.

Period	Monthly Consumption (kWh / month)	Amount payable with SFCR
(months)	1.444,33	R$ 299,62
June	1.419,64	R$ 181,29
July	**R$ 2.383,06**	

* Values in Brazilian Real

According to Table 3 it is possible to realize the financial savings after the installation of the SFCR. It is noteworthy that the system meets expectations, if we observe that in July 2018 the amount to be paid for energy consumption was R $ 1,419.64 and, in the same period, with the system implemented the amount to be paid by Energy consumption was only R $ 181.29. The SFCR produced a consumer power generation credit of R $ 897.40, as shown in Table 4, where we have the monthly energy consumption billing for the location, referring to the July period issued by the concessionaire.

Table 4. July energy bill analysis with SFCR installed.

Readings	**Meter**	**Current Reading**	**previous reading**	**Billed Constant**	**NPL**	**Measured Consumption**	**Invoiced Consumption**
Consumption	11162018	22353	20951	1,00000	5	1402	1402

Consumption Period: 06/30/2019 to 07/30/2019				
Billed Items	Tax Free Rate		Value	
Consumption 131 kWh to 0.941413	0.706060		123,32	
Consumption 1,271 kWh at 0.706060	0.706060		**897,40**	
Public Lighting Contribution (CLP)			57,97	
Off-End Generation Credit			**-897,40**	
Reverse Waste Off Tip - 1,271				
Description of Greatness	Current Reading	**previous reading**	Constant	Recorder
In Active Tip	0	0	1,00000	0
En Active Off Tip	22353	20951	1,00000	1402
En Reverse	0	0	1,00000	0
Calculation basis **(*)**	Aliquot **(*)**	ICMS Value **(*)**	Expiry **27/08/2019**	Amount Payable **R$ 181,29**

* Values in Brazilian Real

Siqueira, a student at the Federal University of Juiz de Fora, conducted an economic feasibility study on a photovoltaic solar energy system applied to a three-phase religious temple in the city of Juiz de Fora - MG. With the main objective of having an energy compensation in place, in which the consumer could pay up to 2,224.80 kwh of energy per month, considering the monthly amount saved in the first year of installation

of the system of R $ 11,480.12 during the first one. year. Thus, average monthly savings are R $ 956.67 enabling the SFCR Microgeneration system [11]. Finally, as the system generation projections depend only on favorable climatic conditions for the use of this type of energy generation, and are based on historical averages, it is possible to obtain positive and satisfactory results achieved with the implementation of the SFCR´S, once that meet initial expectations by solving the design hypothesis that helps reduce high transmission and distribution costs by bringing generation close to final consumption.

To perform the economic analysis of the photovoltaic system it was considered a simulation of the amounts to be paid for the energy consumption by the utility using the PVSYST V6 software. 78 presented in Table 5.

Table 5. Input savings by installing an SFCR.

Period (months)	Amount payable without SFCR	Amount payable with SFCR
12	R$ 16.887,26	2.809,86
Economy	**R$ 14.077,40**	

*Values in Brazilian Real

Thus, the discounted payback was applied to analyze the financial viability of the project, with the initial investment (I) as a result of cash flow with investment gain (F_C), and system operation and maintenance costs (M_S). . Thus, the discounted payback was applied to analyze the financial viability of the project.

$$Payback = \frac{I}{(F_C) - (M_S)} = \frac{48.000{,}00}{14.077{,}40 - 600.00} = 3{,}5\ years$$

*Values in Brazilian Real

The discounted payback calculation estimates a financial return after the implementation of the SFCR at 3.5 years proving the economic viability of the project, as the useful life for the SFCR under study is, on average, 6 years. The estimated financial return as a function of solar panel life can be observed in Figure 4, where it is possible to track the annual financial savings for a period of 25 years.

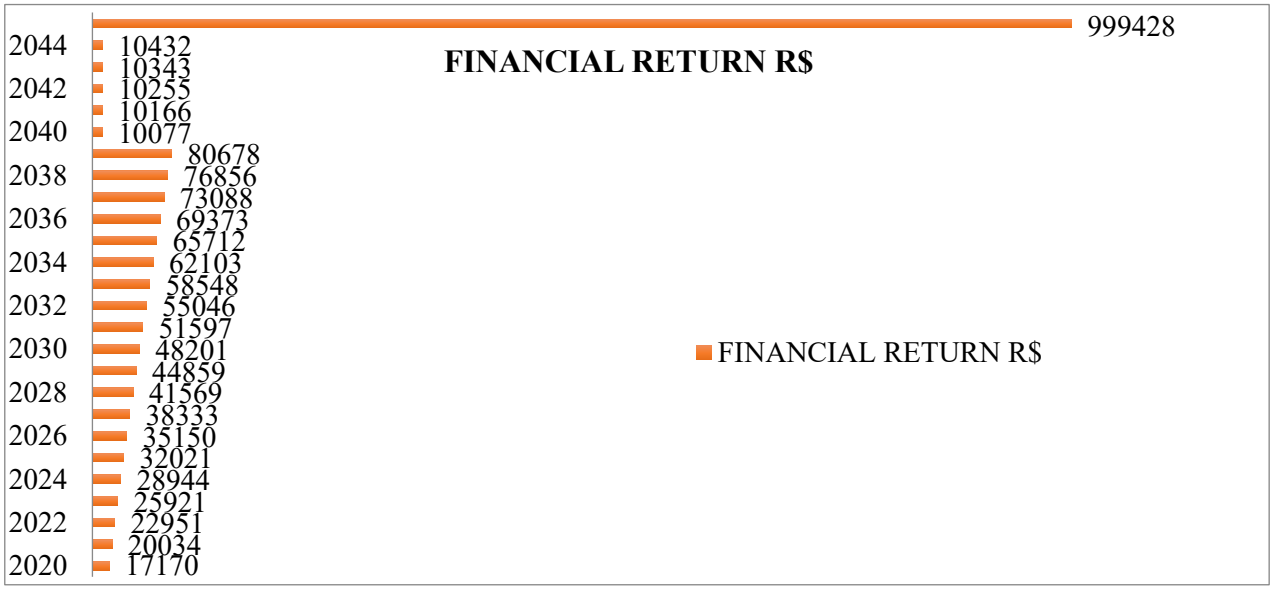


Figure 4. Economic result of the financial return of the SFCR system.
*Values in Brazilian Real

The results obtained in this system show the initial value of R $ 48,000.00 of investment for the installation and operation of the SFCR. This amount is recovered by analyzing the discounted payback method in 3.5 years. Therefore, this project is technically effective and has relevant economic viability, which can bring to the scenario under study numerous advantages, such as increased profitability of commercial activity and use of clean energy. The project becomes a model to be followed in the city of Manaus-AM.

5. Conclusion

According to the development of the project, we found that it is possible to generate pure electricity using clean and renewable energy sources or high energy efficiency cogeneration for SFCR'S to serve medium and low voltage consumers. It is concluded that with the incentive of the regulatory norm governed by the national agency of No. 482/2012, April 17, 2012 favored positively for the insertion of the self producer in the production of his own energy following the parameters of Microgeneration and Distributed Minigeneration and the systems energy compensation was cited throughout the study.

In general terms through the collected data, it was possible to carry out the economic evaluation for the project showing to be economically viable technically and economically with a guarantee of 25 years efficiency of clean energy production, which was observed by the payback method. discounted which showed an initial return on investment of approximately 3.5 years worth less than 25 years of project life.

It is valid that the power compensation connection standard in Brazil offers favorable conditions for the use of this type of power generation in the capital of Manaus-Am, not only due to its intertropical location, but also for the great availability of natural and territorial resources, and by the characteristics of your electrical system.

For future studies in the area, a study is recommended on the environmental impacts caused by poor disposal of photovoltaic technology after reaching its useful life. as is also suggested later work on the evolution of the improvement of government incentives about the low insertion of this technology for producers.

6. Acknowledgment

MSc. Livia da Silva Oliveira – Fametro
Prof. Esp. Marcello Paulino Ramos - UEA

7. References

[1] R. L. NASCIMENTO, Solar energy in Brazil: situation and prospects, Brasília-DF, 2017.pp. 6-46. Available at Camara: http://bd.camara.gov.br/bd/bitstream/handle/bdcaamaaraa/32259/energia solar limp.pdf. Accessed on: 10 Agst. 2019.18: 35: 14.

[2] B. R. D, VALE, Economic Feasibility Analysis of Implementing a Solar Parking: Case Study, Ufsj, São

João del-Rei, 2018.pp. 6-61.
[3] PINHO, J, T and M.A. GALDINO, Engineering Manual for Photovoltaic Systems, Cepel / cresesb, Rio de Janeiro, 2014, pp. 50-530.
[4] ABSOLAR. Absolar National Agency for Photovoltaic Solar Energy, absolar.org.br. Absolar, 2019. Available at: http://absolar.org.br. Accessed on: Sep de. 2019, 10:15:10.
[5] NATIONAL ELECTRICITY AGENCY, ANEEL Micro and Mini Distributed Thematic Notebook Electric Power Compensation System, ANEEL, Brasília - DF, 2016.pp. 10-32.
[6] L. T.CAMARGO, Project of Photovoltaic Systems Connected to the Electricity Network, Ueu, Londrina, 2017, pp.. 33-103.
[7] SOUZA, R.D, Photovoltaic Solar Energy Systems: Digital Introduction to Solar Systems Book, Blue Sol, Ribeirão Preto - SP, 2016 pp. 16-114.
[8] ELECTRIC RESEARCH CENTER. Reference Center for Solar and Wind Energy Sérgio de salvo brito, Cresesb, Rio de Janeiro, 2014, pp. 9-13. 12-118.
[09] J.R. P.D.S.S, PHOTOVOLTA SOLAR ENERGY: Concepts and Applications for
High School, Mnpef, Belém-Pará, 2016, pp. 66-115.
[10] ELECTROBRAS AMAZON ENERGY. Low Voltage Electricity Supply (Individual Buildings). N ° 179, Manaus, 2014. Available from Eletrobras: http://www.eletrobrasamazonas.com> Accessed: .09 Sep 2019.
[11] L. M. D. SIQUEIRA. Study of the Dimensioning and Economic Feasibility of Photovoltaic Solar Microgenerer Connected to the Electricity Network. Juiz de Fora, 2015, pp.1-52. Available at Ufjf: https://www.ufjf.br/labsolar/files/2011/05/Study-of-security-and-economics-of-Microgenerator -Solar-Photovoltaic.pdf. Access on: Sep 13, 2019.

INCIDENCE OF AUTISTA SPECTRUM DISORDER – ASD

Wnilma Silva de Souza[1], Adriana Maria Cunha da Silva[2]

[1]Department of Technology and Social Sciences at the University of the State of Bahia - UNEB, Juazeiro-BA. Post-Graduate Student in Human Ecology and Socio-Environmental Management/PPGEcoH, BRAZIL

[2] PhD in Geosciences, University of the State of Bahia - UNEB; Teacher of the Master's Degree in Human Ecology and Socio-Environmental Management /PPGEcoH / DTCS, UNEB, BRAZIL

Abstract

People with disabilities have long-term limitations that may obstruct and / or hinder their integration into society. Among the many existing deficiencies is Autistic Spectrum Disorder (ASD), which is a neurological disorder characterized by impaired communication, social interaction, and behavioral change. In this sense, the present work proposes to show the percentage of children and adolescents enrolled in the school system in the city of Paulo Afonso-Ba, in kindergarten, elementary I and II, diagnosed with ASD, besides knowing the history, the diagnosis and the treatment of autism. To this end, a bibliographic search was performed with searches in the Scientific Electronic Library Online (SciELO) databases, in the CAPES Journal Portal and Google Scholar, using the keywords: autism, ASD, autistic, and search in the Diagnostic Manual and Statistical Analysis of Mental Disorders - DSM V (2013). Then a descriptive analysis of the collected data was performed. However, according to research it is observed that the incidence of autism cases has increased significantly during the last decades.

Keywords: Disabled Person. Autism. Incidence.

1. Introduction

1.1 The Disabled Person

For a long time in the history of mankind people with disabilities were seen as incapable beings in life in society, being denied all their rights. Even being paid, discriminated against and even killed by their own relatives, they served neither to produce wealth nor to fight. With the rise of Christianity, people with disabilities were protected by the law of Constantine in 315 AD, so they could not be killed (SCHEWINSKY, 2004). Until the seventeenth century, however, people with disabilities continued to be ignored and many of them abandoned by their families, excluded from society, and beggars to survive. At this time many were taken to monasteries, nursing homes and to be studied in hospitals.

> Article 2. A person with a disability is considered to be a person who has a long-term impairment of a physical, mental, intellectual or sensory nature, which, in interaction with one or more barriers, may hinder their full and effective participation in society on equal

> terms. with the other people. (LAW 13,146 of July 6, 2015) http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2015/Lei/L13146.htm

However, it was not until the twentieth century that some inclusive public policies for people with disabilities emerged in order to ensure a better quality of life and promote equal opportunities for people in health and education. According to the United Nations - UN, Brazil is among one of the few countries that has legislation for people with disabilities. Including Constitutional Rules for people with disabilities, as well as laws, decrees and ordinances, according to the government website: https://www.pessoacomdeficiencia.gov.br/app/legislacao.

> In Brazil, social policies directed at people with disabilities emerged in the nineties, starting from the 1988 Constitution, being the responsibility of the State. However, what is still evident is that most institutions that operate in this area are inserted in the so-called private but public philanthropic sphere (ROY, 2000, p: 217 apud SOUSA, 2011, p. 220).

It is through this partnership with the participation of organized civil society and government agencies that social justice takes place. Favoring people with disabilities the right to health, education, leisure, work, among others.

2. Autista spectrum disorder - asd

Within the various deficiencies in the world is Autism Spectrum Disorder - TEA. Autism is a neurological disorder that compromises global development. The term “autism” comes from the Greek word “autos” which means “self” or “from oneself” (FERRARI, 2012, p. 5).

According to the Diagnostic and Statistical Manual of Mental Disorders - DSM V / 2013 (American Psychiatric Association - APA, 2014), the person with Autism Spectrum Disorder (ASD) presents early impairments in socialization and communication, as well as behaviors and behaviors. restricted and stereotyped interests. To Madaschi (2017), Children with ASD may also present cognitive deficit, hyperactivity, aggressiveness and anxiety, among others. These characteristics vary in their degree of intensity from person to person, some frames are lighter and others more severe.

The communication of the individual with ASD draws attention, since they present little or no verbal communication, usually have echolalia, can manifest by self-repetition of their speech or repetition of the other (MERGL; AZONI, 2015). They still present deficits in socio-emotional reciprocity, inability to engage with others and to share ideas and feelings (...). Restricted and repetitive patterns of behavior, interests or activities, these symptoms have been present since early childhood and limit or impair daily functioning. (APA, 2014, p. 53).

In this same direction are the provisions of items I and II of Law No. 12.764, of December 27, 2012, which establishes the National Policy for the Protection of the Rights of People with Autistic Spectrum Disorder in Brazil, which considers that the person with ASD features:

> I - Persistent and clinically significant impairment of social communication and interaction, manifested by marked impairment of verbal and nonverbal communication used for social interaction; absence of social reciprocity; failure to develop and maintain relationships appropriate to their level of development;

> II - restrictive and repetitive patterns of behaviors, interests and activities, manifested by stereotyped motor or verbal behaviors or unusual sensory behaviors; excessive adherence to routines and ritualized behavior patterns; restricted and fixed interests. (BRASIL, 2012)

In this scenario it is worth noting that despite the important research developed in the areas of Genetics and Medicine, there is as yet no indication of a specific cause for autism, nor cure.

2.1 Brief History of Autism

The first definition of autism was made by the Swiss physician Eugen Bleuler in 1911, when describing children who exhibited similar real-world detachment behavior as schizophrenics (CAMPELLO, 2002 apud SILVA; LIMA; SALLES, 2018). However, from 1943 Leo Kanner in the United States defined childhood autism as an emotional alteration, referring to children who lived in her world and did not interact with others. (BARON-COHEN, 1990. p. 408 apud SOUZA AND SANTOS, 2005. p. 2). Already Hans Asperger in 1944 in Austria considered autism as a mental illness, calling it "autistic psychopathy in childhood". (SOUZA; SANTOS, 2005. p. 6)

After this period there was an absence of studies on autism, only in the early 60's began deeper reflections on autism syndrome. From the 1980s onwards, the concept of autism changed, in which the expression psychosis was excluded from the nomenclature, being defined in the Diagnostic and Statistical Manual of Mental Disorder - DSM-III (1987) as: Rett Syndrome and Autistic Spectrum Disorder Syndrome.

> The DSM aims to serve as a practical, functional and flexible guide to organizing information that can assist in the accurate diagnosis and treatment of mental disorders. It is a tool for clinicians, an essential resource for training students and professionals and a reference for researchers in the field. (APA. 2014, p. 41).

However, the conceptualization and classification of autistic syndrome are not pacified as can be observed when analyzing that the World Health Organization itself (WHO) and the Diagnostic and Statistical Manual of Mental Disorder (DSM) of the American Psychiatric Association and the tenth edition of the International Classification of Diseases (ICD-10), 1991: They used different terminologies for autism.

Thus, for the DSM-IV (1994) Global Developmental Disorders encompassed five disorders characterized by severe impairment in numerous areas of development. Autistic Disorder, Rett Disorder, Childhood Disintegrative Disorder, Asperger's Disorder (name derived from researcher Hans Asperger) and Global Developmental Disorder Not Otherwise Specified. This group of disorders was characterized by severe difficulties in social interactions manifesting since early childhood. (SILVA; MULICK, 2009).

In the view of the latest version of DSM-V (2013), which brought significant changes to be observed for the diagnosis of autism and its nomenclature is now defined as Autism Spectrum Disorder - ASD, occurring with the fusion of autistic disorder, autism disorder. Asperger's disease and global developmental disorder.

2.2 Diagnosis of Autistic Spectrum Disorder

The diagnosis of Autistic Spectrum Disorder - ASD is essentially clinical, based on observations about the child's behavior and interviews with parents and / or caregivers (MACHADO et al. 2014).

> The IRCD (Clinical Indicators of Risk for Child Development) is a recommended instrument to be used by health professionals in general (doctors, health agents, speech

> therapists, nurses, among others), so that the behavior of the dyad can be observed. mother-baby and thus point out signs of risk for child development in general. (MACHADO, F. P et al. 2014).

Diagnosis does not exclude the use of neurological and cognitive examinations, speech and hearing evaluation, and genetic testing, including chromosome and neuroimaging studies, may be necessary in specific cases to identify more homogeneous subgroups according to behavioral manifestation. and the etiology (GADIA, TUCHUMAN AND ROTTA, 2004 apud SCHWARTZMAN, ORSATI and MACEDO, 2008).

The same authors also state that:

> The assessment of autistic individuals requires a multidisciplinary team and the use of objective scales. Structured techniques exist and should be used to evaluate both children's social behavior and their ability to imitate.

In April 2017, Law 13,438 was approved, which obliges the Unified Health System (SUS) to adopt the protocol for routine pediatric consultations, in order to identify signs of autism in children. M_CHAT is simple, fast and can be completed by parents, provided they are literate, and can be applied to children 18 to 24 months of age (MADASCHI, 2017).

2.3 Treatment of the person with ASD

The quality of life of the individual with ASD will depend greatly on multiprofessional treatment, that is, with several professionals, among them: psychologist, psychopedagogue, speech therapist, occupational therapist, physiotherapist and child neurologist. It is recommended that interventions take place from the first years of life, respecting their peculiarities. However, the financial and, most importantly, the emotional burden on the parents and families of affected children can also be substantial. (NIKOLOV, JONKER, SCAHILL, 2006, p. 40).

Generally, medications are not part of the treatment for children with ASD, but when necessary they can use drugs to control insomnia, aggression and agitation (NIKOLOV, JONKER, SCAHILL, 2006). The therapeutic interventions for the child with ASD are most often speech therapy and occupational therapies to address language and sensory issues, respectively.

Regarding behavioral issues according to Amorim (2011) cited by Silva; Lime; Salles, (2018), the best known interventions are: TEACCH (Treatment and Education of Autistic and Related Communication Handcapped Children); Picture Exchange Communication System (PECS); and ABA (Applied Behavior Analysis). In addition to the above it is still observed that:

> Through playful activities the child assimilates values, acquires behaviors, develops various areas of knowledge, exercises physically and improves motor skills. In living with other children, he learns to give and take orders, to wait for his turn to play, to lend and borrow his toy, to share good and bad times, to make friends, to have tolerance and respect. develops sociability. (SANTOS, 2008, p. 56).

Thus, they are also indicated to develop skills in children with ASD, some complementary or supplementary therapies such as: hippotherapy, hydrotherapy, cynotherapy, swimming, music therapy, ludotherapy, among others (DUARTE, 2016).

2.4 Autism and Education

In addition to therapies, children with ASD need to be included in society for their global development, one of the forms of inclusion is through education. In the same vein, one of the main documents that recognizes the need for the inclusion of people with disabilities in the regular education system is the Salamanca Declaration document produced at the World Conference of Special Education, in June 1994, in Spain, together with the United Nations. Educational, Scientific and Cultural Organization (UNESCO). "Inclusive education is the most effective way to build solidarity between children with special educational needs and their peers." (SALAMANCA DECLARATION, 1994).

In line with this thinking, in 2008, the Ministry of Education (MEC) launched the National Policy for Special Education from the perspective of Inclusive Education (BRAZIL, 2008). In addition, to institute Operational Guidelines for Specialized Educational Assistance in Basic Education, Special Education modality, according to Resolution No. 4 of October 1, 2009 (http://www.cesarcallegari.com.br/v1/edesp.pdf) as well as Decree no. 7,611, of November 17, 2011, which deals with special education, specialized educational assistance and other measures. (http://www.planalto.gov.br/ccivil_03/_Ato2011-2014/2011/Decreto/D7611.htm).

3. MATERIAL AND METHODS

To perform the research, in which the proposal is to show the incidence of ASD, a bibliographic search was used, and searches were made in the Scientific Electronic Library Online (SciELO) databases, in the CAPES Journal Portal and in Google Scholar, and the following were selected: articles published between the years 2000 and 2019. The following keywords were used: autism, ASD, autism. In addition, research conducted in the Diagnostic and Statistical Manual of Mental Disorders - DSM V / 2013 (American Psychiatric Association - APA, 2014). Then the descriptive analysis of the collected data was performed.

As a methodological approach, the present study had as research field the schools located in the city of Paulo Afonso-BA. For this, between June and July 2019, a survey was carried out with the Department of Education (municipal public schools) and the private schools of the municipality. The collected data were analyzed within a quantitative approach.

3.1 Inclusion and Exclusion Criteria

As inclusion criteria to participate in the research were considered only the municipal public schools and private schools with kindergarten, elementary school I and II. In addition, to establish the sample participants, only the students who had closed medical reports, ie, those still in the evaluation process, were not included in the research.

As an exclusion criterion, they were excluded from the research to state public schools, because they work with high school and private schools with a quantity of less than 200 students; as well as private schools that are located outside the perimeter of the island of Paulo Afonso-BA.

3.2 Procedure

For data collection, the school board was asked to complete a simple questionnaire, only to include the number of students enrolled in schools that were diagnosed with ASD (with medical reports), according to the teaching modality.

4. RESULTS AND DISCUSSION

According to the collected data, it was possible to identify the number of children and adolescents with Autistic-TEA Spectrum Disorder who are of school age in the city of Paulo Afonso-BA. They are presented in the table below.

Table 1. Number of children and adolescentes with Autistic – TEA are of school in the city of Paulo Afonso-BA/Brasil

INSTITUTIONS EDUCATIONAL	TEACHING MODE			PERCENT OF STUDENTS WITH TEA	TOTAL SCHOOL STUDENTS
	STUDENTS WITH TEA CHILDHOOD EDUCATION	STUDENTS WITH TEA IN ELEMENTARY SCHOOL I	STUDENTS WITH TEA IN ELEMENTARY SCHOOL II		
MUNICIPAL PUBLIC SCHOOLS	32	40	27	0.60	16.404
SEVEN SEPTEMBER COLLEGE	6	13	1	2.21	953
MONTESSORI COLLEGE	3	2	2	0.63	1.101
GOOD IDEA COLLEGE	3	0	1	0.61	650
MONTEIRO LOBATO COLLEGE	0	1	0	0,39	256
SCHOOL WHEEL PIÃO	6	5	0	3.83	287
PINGO SCHOOL OF PEOPLE	3	1	0	1.42	280

Through ethnographic technique it was possible through informal conversation with school leaders and pedagogical coordination to realize that there are in all institutions surveyed other children with suspected ASD, some who are already in the evaluation process and others who parents do not accept the disorder, therefore, still without reports, however, with some real characteristics, observed in the great majority by the pedagogical team of the schools.

On the other hand, the Specialized Educational Attendance - SEA rooms of the schools also need to attend these children (without reports), because, according to the technical note no. 04, of January 23, 2014, issued by the Secretariat of Continuing Education, Literacy, Diversity and Inclusion (SECADI), which establishes, among other things, that "[...] cannot be considered essential for the presentation of a medical report (diagnosis disability, global developmental disorders or high skills / giftedness, as ESA is characterized by pedagogical rather than clinical care (BRASIL, 2014, p. 3).

According to the following representation, it is possible to observe the prevalence of autism between 2004 and 2018. So far, it is not clear why this increase is due. However, it believed in the recent expansion of diagnostic criteria, as well as an improvement in the training of professionals. (SILVA; MULICK, 2009).

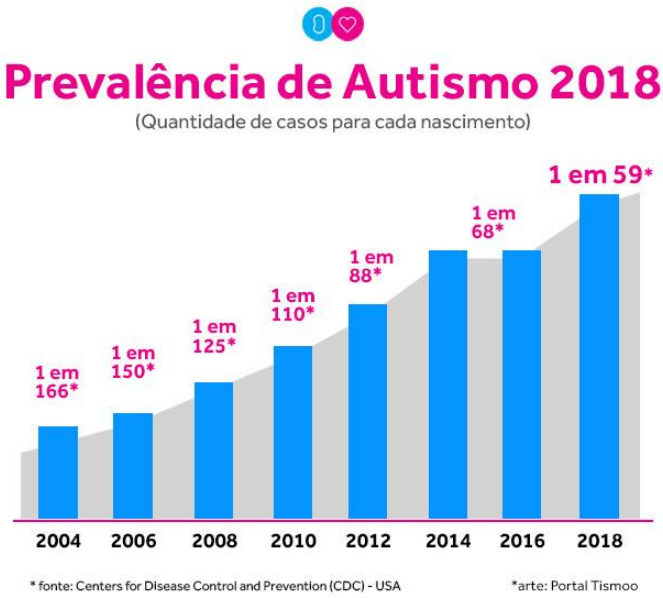


Figure 1. Prevalence in autism in 2018

Source:e https://tismoo.us/destaques/cdc-divulga-novos-numeros-de-autismo-nos-eua-1-para-59/

For Klin (2006), the increase in ASD, besides what has already been reported, is also due to the better detection of cases without mental retardation (Asperger's syndrome - AS), to the incentive to determine the services provided by this diagnosis. as well as the understanding that early identification (and intervention) maximizes a positive outcome.

From the analysis of the figure, it is observed that each year increases in number of cases of ASD. UN data (2015) show that ASD affects 70 (seventy) million people worldwide and classifies the disorder as a global public health issue. Thus, in 2007, the United Nations - United Nations Organization created World Autism Day, celebrated on April 2, with the aim of drawing attention to this disorder by disseminating information to the population about autism and thus reducing discrimination and discrimination. preconception.

However, the person with ASD is affected by:

> The condition has serious socioeconomic consequences, as it begins in childhood, is chronic, and disability can be substantial. The costs to society are significant in terms of special education programs, support services, residential institutions and loss of productivity for affected individuals as well as for family members. (NIKOLOV, JONKER, SCAHILL, 2006. p. 40)

According to Duarte (2016), "... the incidence rate seems to be four times higher in males; however there does not seem to be any known association with racial, social, economic or cultural aspects ". Because most diagnosed cases are in boys, autism is represented by blue.

5. FINAL CONSIDERATIONS

Autism Spectrum Disorder (ASD) impairs global development, affecting communication, social interaction, and behavior. According to the latest version of the Diagnostic and Statistical Manual of Mental

Disorders DSM-V / 2013 (APA-2014), this syndrome includes autistic disorder, Asperger's disorder and global developmental disorder. According to the UN every year this number has been increasing considerably.

To reach the research results, data from public and private schools in the city of Paulo Afonso-BA were used to obtain a survey of children and adolescents of school age, with diagnoses of ASD. However, according to the government website (https://www.camara.leg.br/noticias/562740-sancionada-lei-que-inclui-dados-sobre-autismo-no-censo-2020/), on On July 18 of this year, Law 13.861 / 19 was sanctioned, which obliges the Brazilian Institute of Geography and Statistics (IBGE) to insert questions on autism in the 2020 Census. With this, it will be possible to know how many people in Brazil have this disorder and how they are distributed throughout the territory.

This measure will also favor the implementation of public policies aimed at this clientele. For this reason, the Development Center was inaugurated on 10/10/2010 in the city of Paulo Afonso - BA, focused on the treatment of child mental health. More than 300 children are currently being assisted by seven professional experts.

Regardless of the strategy used to conduct the research, it is noted that the incidence of ASD is a public health issue. This number is also due to Autistic Spectrum Disorder, encompassing other disorders. Therefore, research suggests that parents and health professionals investigate the first atypical manifestations of children through specific instruments. Because studies show that early interventions bring positive results for the person with ASD.

This study also brings a reflection on the global development of people with ASD, because the school is one of those spaces of coexistence, and through interpersonal relationships that reduce discrimination and prejudice. "Although the current discourse is the valorization of the human being, one cannot deny the current prejudice." (SCHEWINSKY, 2004). For this reason, the MEC has been showing an effective interest in improving the education of students with special educational needs, despite also evidencing an oscillation in the significance of Special Education and, more recently, Inclusive Education. (MAZZOTTA, ANTINO, 2010).

Despite some achievements, especially in the legal field, there are still many questions about Autism Spectrum Disorder (ASD) that need to be unraveled, as many of us, including in the academic field, still do not know how to deal with this disorder.

6. References

American Psychiatric Association (2014). **DSM-V: Manual Diagnóstico e Estatístico de Transtornos Mentais** (5a ed.). Porto Alegre: Artmed.

BRASIL. **Constituição** (1988). **Constituição** da República Federativa do Brasil. Brasília, DF: Senado **Federal**: Centro Gráfico, 1988. 292 p.

_____. Constituição da República Federativa do Brasil. São Paulo: Imprensa Oficial, 2001. Available in: www.imprensaoficial.com.br/downloads/pdf/Constituicoes_declaracao.pdf

_____. Ministério da Educação. **Política Nacional de Educação Especial na Perspectiva da Educação Inclusiva. Inclusão**: Revista da Educação Especial, Brasília, v. 4, n. 1, p. 7-17, jan./jun. 2008. <Available in: http://portal.mec.gov.br/seesp/arquivos/pdf/revinclusao5.pdf>. Access in: JAN 2019

_____, Ministério da Saúde. **Política Nacional de Atenção à Saúde da Pessoa com Deficiência**. < Available in: http://bvsms.saude.gov.br/bvs/publicacoes/politica_nacional_pessoa_com_deficiencia.pdf.> Access in: 05 de abril de 2018

_____. **Nota técnica n. 04/2014/MEC/SECADI/DPEE**. Brasília: Ministério da Educação, Secretaria de Educação Continuada, Alfabetização, Diversidade e Inclusão, Diretoria de Políticas de Educação Especial, 23 jan. 2014. Available in: http://portal. mec.gov.br/index.php?option=com_content&view=article&id=16761&Itemid=1123. Access in: 7 fev. 2015.

Declaração de Salamanca. Sobre Princípios, Políticas e Práticas na Área das Necessidades Educativas Especiais (1994). <*Available in:* http://portal.mec.gov.br/seesp/arquivos/pdf/salamanca.pdf> *Access in: 10 de julho de 2018.*

Decreto n. 7.611, de 17 de novembro de 2011. Dispõe sobre a educação especial, o atendimento educacional especializado e dá outras providências. Available in: <http:// www.planalto.gov.br/ccivil_03/_Ato2011-2014/2011/Decreto/D7611.htm#art8>. Access in: 24 dez. 2011.

DUARTE, A. F. **Conversando Sobre Autismo Com Pais e Educadores**. São Paulo: All Print Editora, 2016.

Especialistas da ONU em direitos humanos pedem fim da discriminação contra pessoas com autismo. < Available in: https://nacoesunidas.org/especialistas-em-direitos-humanos-da-onu-pedem-fim-da-discriminacao-contra-pessoas-com-autismo/> Access in: 15 de junho de 2018.

FERRARI, P. **Autismo Infantil: O que é e Como Tratar**. 4ª. Ed. – São Paulo: Paulinas, 2012. – (Coleção Caminhos da Psicologia).

KLIN, A. **Autismo e Síndrome de Asperger: Uma Visão Geral**. Rev Bras Psiquiatr. Rev. Bras. Psiquiatr. vol.28 suppl.1 São Paulo May 2006. http://dx.doi.org/10.1590/S1516-44462006000500002. *Print version* ISSN 1516-4446*On-line version* ISSN 1809-452X **<Available in:** http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-44462006000500002>. Access in: Fev 2019

Lei nº 7.612, de 17de novembro de 2011, que Institui o Plano Nacional dos Direitos da Pessoa com Deficiência. <Available in: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/decreto/d7612.htm. >Access in: 11 de abril de 2018

Lei nº 12.764, de 27 de dezembro de 2012, que institui a Política Nacional de Proteção dos Direitos da Pessoa com Transtorno do Espectro Autista. <Available in: http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12764.htm. > Access in: 18 de abril de 2018

Lei 13.146, de 06 de julho de 2015. Institui a Lei Brasileira de Inclusão da Pessoa com Deficiência (Estatuto da Pessoa com Deficiência). Available in: http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2015/Lei/L13146.htm> Acesso: Jul 2018

Lei 13.861, de 18 de julho de 2019. Inclusão de dados sobre autismo no Censo 2020. Available in: https://www.camara.leg.br/noticias/562740-sancionada-lei-que-inclui-dados-sobre-autismo-no-censo-2020/> Acesso: Ago 2019

MACHADO. F. P, et al. **Questionário de Indicadores Clínicos de Risco Para o Desenvolvimento Infantil: Avaliação da Sensibilidade Para Transtornos do Espectro do Autismo.** *Audiol., Commun. Res.*[online]. 2014, vol.19, n.4, pp.345-351. Epub Sep 30, 2014. ISSN 2317-6431. http://dx.doi.org/10.1590/S2317-64312014000300001392.
Audiology - Communication Research. <Available in: http://www.scielo.br/scielo.php?pid=S2317-64312014000400345&script=sci_abstract&tlng=es>. Access in: FEV 2019

MAZZOTTA. M. J.S, ANTINO. M. E. F.D. **Inclusão social de pessoas com deficiências e necessidades especiais: cultura, educação e lazer.** Saúde e Sociedade**.** *Print version* ISSN 0104-1290. Saude soc. vol.20 no.2 São Paulo Apr./June 2011. http://dx.doi.org/10.1590/S0104-12902011000200010. <Available in: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-12902011000200010>. Access in: FEV 2019

MADASCHI, V. **Autismo, Diagnóstico e Intervenção Precoce.** <*Available in:* http://www.portalacesse.com/2017/09/20/autismo-diagnostico-e-intervencao-precoce/> *Access in: 08 de junho de2018.*

MERGL. M, AZONI. C. A. S**. Tipo de Ecolalia em Crianças com Transtorno do Espectro Autista.** Rev. CEFAC vol.17 no.6 São Paulo Nov./Dec. 2015. http://dx.doi.org/10.1590/1982-021620151763015. *Print version* ISSN 1516-1846*On-line version* ISSN 1982-0216. Available in: http://www.scielo.br/scielo.php?pid=S1516-18462015000802072&script=sci_abstract&tlng=pt. Acesso: Dez 2018

NIKOLOV. R, JONKER. J, SCAHILL. L. **Autismo: Tratamentos Psicofarmacológicos e Áreas de Interesse Para Desenvolvimentos Futuros.** Rev Bras Psiquiatr. 2006;28(Supl I):S39-46. Available in: http://www.scielo.br/pdf/rbp/v28s1/a06v28s1.pdf. Acesso: Fev 2019.

SALOMÃO, H. A. S. MARTINI, M. JORDÃO, A. P. M. **A Importância do Lúdico na Educação Infantil: Enfocando a Brincadeira e as Situações de Ensino Não Direcionado**. <Available in: www.psicologia.pt/artigos/textos/A0358.pdf.> Access in: 20 de Agosto de 2018

SANTOS, I. A. **Educação Para Diversidade: uma prática a ser construída na Educação Básica.** 2008. <Available in: http://www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/2346-6.pdf.> Access in: 23 de junho de 2018.

SOUSA, P. M. L, SANTOS, I. M. S. C. **Caracterização da Síndrome Autista**. 2005. <Available in: http://www.psicologia.pt/artigos/textos/A0259.pdf. > Access in: 17 de julho de 2018

SCHEWINSKY. S.R. **A Barbárie do Preconceito Contra o Deficiente - Todos Somos Vítimas.** REVISTA Acta Fisiátrica. Instituto de Medicina Física e Reabilitação. Número atual: Abril 2004 - Volume 11 - Número 1. Available in: http://www.actafisiatrica.org.br/detalhe_artigo.asp?id=251. Acesso: Fev 2019

SCHWARTZMAN, J.S, ORSATI, F.T, MACEDO, E. C. **Transtornos Invasivos do Desenvolvimento: conceituação e critérios diagnósticos.** Disponível: https://pt.scribd.com/document/362439428/Transtornos-Invasivos-do-Desenvolvimento-conceituacao-e-criterios-diagnosticos-pdf. Access in: Dez 2018.

SOUSA. C. M. **Refletindo Acerca das Organizações da Sociedade Civil e o Atendimento às Pessoas com Deficiência em Campina Grande** (PB). In DAVI, J., MARTINIANO, C., and PATRIOTA, LM., orgs. Seguridade social e saúde: tendências e desafios [online]. 2nd ed. Campina Grande: EDUEPB, 2011. pp. 219-235. ISBN 978-85-7879-193-3. Available from SciELO Books. Available in: http://books.scielo.org/id/zw25x/pdf/davi-9788578791933-11.pdf. Access in: Mar 2019

SILVA. M, MULICK. J. A. **Diagnosticando o Transtorno Autista: Aspectos Fundamentais e Considerações Práticas.** Psicol. cienc. prof. v.29 n.1 Brasília mar. 2009.
versão impressa ISSN 1414-9893. Available in:
http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S1414-98932009000100010. Access in: Mar 2019

AAUQ Asphalt Mixtures Using Carbide Lime for Low Traffic Paths in Manaus – AM

Herbert Pereira Tomé
hptcomercio@hotmail.com
Centro Universitário FAMETRO – Amazonas - Brasil

Joilson Rocha de Almeida
joilson_juruti@hotmail.com
Centro Universitário FAMETRO – Amazonas – Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO – Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia (ITEGAM) - Brasil

Camily Murrieta Vasconcelos Oliveira Bezerra
camilymv@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Abstract

The asphalt pavements of the residential streets and outskirts of Manaus city are usually made of Hot Machined Asphalt Sand (AAUQ), which is ideal for low traffic roads, not only for the flow of vehicles and use of materials, but also for the economic viability of the project. In this research we used the waste originated from acetylene gas production in factories of the Industrial District, Cal de Carbureto in the composition of asphalt mixtures of type AAUQ, replacing the usual filler, Portland cement. These mixtures were mechanically evaluated with respect to the Diametral Compression Tensile Strength, Resilience Module and Fatigue Life tests, and it was found that the alternative filler presents superior results when compared to the usual used in the asphalt plants of the City.

Keywords: asphalt mixture; paving; traffic volume;

1. Introduction

In Manaus, capital of the State of Amazonas, there is limited availability of materials for asphalt paving, implying the need for research related to new natural and recycled materials. The studied solutions should

propose the optimization of the financial resources, aiming at the viability of the project, showing that the paving of the roads in general, especially to the coating, must be carefully studied in order to result in the highest possible cost-benefit, thus fitting in. current investment limitations of the responsible agencies. With regard to low traffic volume (BVT) routes, the importance of the costs of alternative proposals is increased, assuming lower accuracy and, consequently, minimum budget percentages. BVT roads are essentially residential, where there may occasionally be truck and bus crossings of no more than 20 per day per lane, characterized by a typical "N" number of 105 standard single axle requests (80kN) for the 10 year project period [1]. In this context are the most peripheral streets and avenues of the municipality Manauara with little load request of the pavements of this region, despite the high population growth [2].

Among the solutions commonly used in Manaus for the BVT roads is the Hot Machined Asphalt Sand (AAUQ) asphalt coating, which causes early structural failure shortly after its construction, especially due to the excessive accumulation of permanent deformations in the layer. surface, caused by the absence of coarse aggregates in these mixtures, in addition to the small size of the sandy aggregates, resulting in a large surface to be covered by the asphalt binder, thus requiring a high binder content for the asphalt mixtures [3]. The early deterioration of these asphaltic pavements may cause, in addition to the aforementioned pathology, fatigue cracking, a phenomenon allusive to both the viscoelastic behavior of asphalt binders and the stress concentration at the aggregate-binder interface [2].

Aiming to overcome these regional difficulties, new technologies have been researched, among them the use of acetylene gas (Carbide Cal) residue from Manaus industrial park, as a filler in asphalt composites, through the analysis of the mechanical behavior to various temperatures. The technical literature has presented the technical viability regarding its use in asphalt composites [4] [5] [6].

Based on the above, the objective of this project is to present Carbide Lime material as a technical alternative, as it is a material to replace the usual filler (Portland cement) in asphalt mixtures, and to provide an environmental alternative for waste. industrial solids, thus avoiding disposal in landfills or wastelands, as well as minimizing the extraction of natural resources, aiming at low traffic asphalt pavement in the State of Amazonas.

2. Theoretical Referential

2.1 Asphalt Coating - Hot Machined Asphalt Sand

Also called asphalt mortar, this coating is used, especially in places where there is a shortage of coarse stone aggregates, generally consisting of sand, asphalt binder (PAC) and filler.

2.2 Tensile Strength by Diametral Compression

In the Tensile Strength (RT) test the specimens are tested in a computerized press with graphical interface, where a displacement rate of 0.8 mm / s was applied until their rupture. By obtaining this load, tensile strength by diametral compression was calculated.

2.3 Resilience Module

The Resilience Module (MR) determined by indirect loading with repeated loading in asphalt mixtures, is

the relationship between the tensile stress applied repeatedly in the vertical diametric plane of the sample and the specific recoverable strain corresponding to the tension applied at a given temperature and for a given temperature. load application frequency.

The application of the theory of elasticity to asphalt mixtures and diametral compression tests is only permissible at low tensile stress levels (40% or less of the tensile strength of the RT test) and at temperatures below 40 ° C [7]. Several works have applied loads to reproduce tensions in the order of 10 to 20% of RT and it is recommended to apply the lowest load.

2.4 Fatigue Life

Fatigue is a process of structural deterioration that undergoes a material when subjected to a state of repeated stress and strain, and may not reach the ultimate strength of the material, resulting in cracking after a sufficient number of loading repetitions. That is, fatigue is the loss of resistance that a material suffers when repeatedly bending or pulling [8] [9].

Laboratory equipment for repeated load testing allows the application of cyclic loading to the material under stress (TC) and controlled deformation (DC) regime. Thus, the great separation that can be made between the different experiments is in the mode of request. In both tests there is a reduction of the initial stiffness of the material to a level that can be pre-set in order to define the end of the test [10].

In the controlled stress test, the fatigue criterion is associated with the fracture of the sample. Therefore, Fatigue Life (N) is defined as the total number of applications of a load required for the complete fracture of the sample [10]. In the controlled strain experiment, Fatigue Life will be the number of load repetitions capable of reducing the initial performance or stiffness of the sample to a predetermined level. Some consider that a 50% reduction in Stiffness or Resilience Module defines the end of the test, ie Fatigue Life..

3. Methodology

3.1 Asphalt Binder Characterization

As binder was used asphalt oil cement - CAP 50/70, donated by the Manaus Isaac Sabbá Refinery (UN-Reman) to the present study. It was characterized by rheological analysis in the specifications of the Superior Performance Asphalt Pavements - Superpave, suggested by the Strategic Highway Research Program (SHRP) [11].

3.2 Asphalt Binder Characterization

As a small aggregate, the Sand Manaus (Areia Mao), usually used in the engineering works of the homonymous city, was selected for the composition of the asphalt mixtures. It was characterized for particle size (ASTM C 136.1995) according to ASTM C 128 (1988), which determined the Actual Specific Mass (Gsa), Apparent Specific Mass (Gsb) and Absorption [12]. According to [13], the (Rodded Unit Weight).

Portland cement, widely used for this purpose (reference material), and carbide lime for the composition of the asphalt mixtures under study, were chosen as filler material. They were characterized according to the actual specific mass - DNER ME 085 (1994) and according to particle size for acceptance or rejection as filler according to DNER specification EM 367 (1997) [14]. The researched alternative material - carbide

lime, is a residue of acetylene gas production, the present research being supplied by a Manaus Industrial Pole factory (PIM).

3.3. Characterization of Asphalt Mixtures

Hot Machined Asphalt Sand (AAUQ) asphalt mixtures were classified in Band A of the National Department of Transport Infrastructure (DNIT), through the service specification DNIT ES 032 (2005). The project content was determined by DNIT's 3rd Federal Highway District (3rd DRF) method, which is based on the Void Volume (Vv) and Bitumen-Void Ratio (RBV) values, and according to the specification of the Marshall method of dosing DNER ME 043 (1995), which is 3% to 5% Vv and 75% to 82% RBV.
In order to simulate the short-term conditioning effect, the mixtures were, before compaction, two hours in a greenhouse and at a temperature of 10 ° C above the compaction temperature (AASHTO PP-2). The Marshall DNER ME 043 (1995) Method, with 75 strokes per face, was adopted in the compaction of the specimens. Based on Test Method DNER ME 004 (1994), the preparation and compacting temperatures of the mixtures were defined. The Rice Test (ASTM D 2041) was used to calculate the Maximum Specific Density (Gmm), and binder levels were determined for Superpave (SHRP 1994a, 1994b).

3.4. Mechanical Characterization

In order to evaluate the effect of temperature, as prescribed in standard and field, the tests were performed at temperatures from 25 to 60 ºC, varying from 5 to 5 degrees. It is noteworthy that the high temperatures employed aimed to simulate the environmental conditions of the Amazon region. Figure 1 shows the specimen prepared for performing the RT test on the Universal Testing Machine (UTM 14).

Figure 1 - Performing the RT Assay
Source: Author

The MR test was performed according to the test method [14], which consists of the application of diametric compression loads on cylindrical samples, inducing in the specimen vertical and horizontal tensile stresses. Vertical loading is applied by means of a curved strip and horizontal displacement is measured by Linear Variable Differential Transducer (LVDT). Resilience Module tests were performed with loads

corresponding to 5, 10, 20 and 30% of the rupture load determined in the RT test, according to the temperature range of 25 to 60 ºC, varying every 5 ºC. The frequency used was 1.0 Hz, with a load application time of 0.1 seconds and a rest time of 0.9 seconds. Figure 2 shows the specimen in the MR assay, and the graphical interface of the program used.

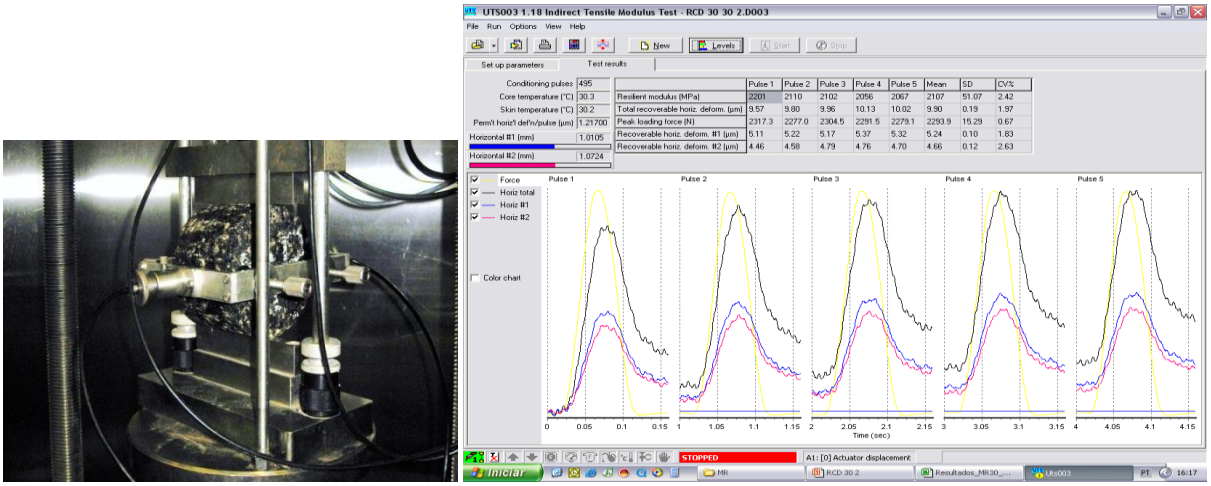


Figure 2 - UTM specimen press with MR assay graphical interface.

Source: Author

Fatigue life tests were performed at temperatures of 25, 30, 40, 50 and 60 ºC using the diametrical compression test on cylindrical specimens and at controlled stress levels of 30, 40 and 50%. the tensile strength of the RT test. The 1Hz load frequency was used, according to the load application time of 0.1 seconds and rest time of 0.9 seconds. Fatigue Life was defined as the total number of applications required for complete fracture of the sample.

4. Analysis and Discussion of Results

4.1 Asphalt Binder Characterization

The asphalt material experiments classified petroleum asphalt cement (CAP 50/70) according to Superpave criteria as PG 64-22. Therefore, such a binder may only be used for the construction of floors where its working temperature is not below 22 ° C or above 64 ° C.

4.2 Granular Material Characterization

Figure 3 shows the particle size curve for the fine aggregate (Areia Mao), where it can be observed, according to the ABNT NBR 6502 (1995), that it shows average predominance (fraction between 0.2 and 0.6 mm). . Table 2 shows the results of the characterization assays, concerning the small aggregate under study. Manaus Sand presents specific mass results according to the theoretically expected values for such material (quartz mineral).

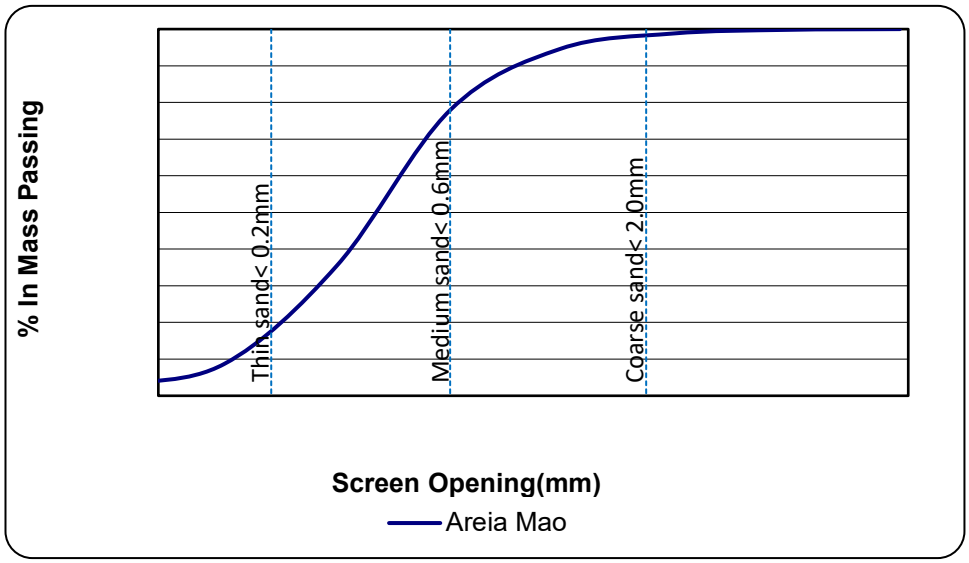


Figure 3 - Particle size curves of small aggregates.
Source: Author

Table 2. Household characterization.

Sample	Manaus sand
Gsb (g/cm³)	2,632
Gsb SSS (g/cm³)	2,692
Absorption (%)	0,00
Density (kg/m³)	1675,90

Source: Author

Figure 4 shows the particle size curve of the filler materials - Portland Cement and Carbide Lime. Regarding their actual specific masses, the values presented were 3.15 g / cm³ and 2.20 g / cm³ for the standard and alternative fillers, respectively. The results also indicated that Portland Cement passed entirely in the 0.075 mm sieve, while Carbide Lime showed only 58% passing in that sieve, outside the limits of the established specification. However, as shown in this paper, the residue from acetylene gas production has already been used in other research, proving its effectiveness technologically.

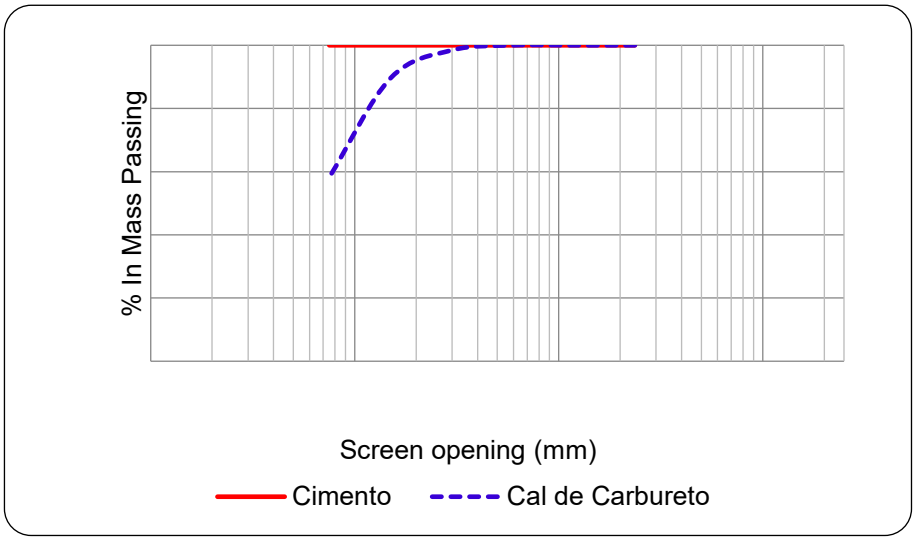


Figure 4. Particle size curves of filler materials.

Source: Author

4.3 Characterization of Asphalt Mixtures

Table 3 shows the compositions of the AAUQ asphalt mixtures, whose particle size curves were in DNIT Strip A. In order to better compare the results achieved with the mechanical tests, the mixtures were made with the same fractions of materials, changing only the filler.

Table 3. Composition of type mixtures AAUQ.

Components	Asphalt mix	
	AAUQ - Cement	AAUQ - Cal
Mao sand	95,0%	95,0%
Portland cement	5,0%	-
Carbide Lime	-	5,0%

Figure 5 shows the calculated values for T1, T2, T3 and T4, respectively 11.68%, 9.68%, 8.89% and 10.94%, with the arithmetic mean of the two central values (T2 and T4) defined the project content “T” of the AAUQ-Cement Mix, which resulted in a value of 10.3%. According to Figure 6 we have the values for T1, T2, T3 and T4, respectively equal to 11.06%, 9.11%, 8.57% and 10.51%, being the arithmetic mean of the two central values (T2 and T4). Also shown is the optimal design grade “T” of the AAUQ-Cal Mix as 9.8%.

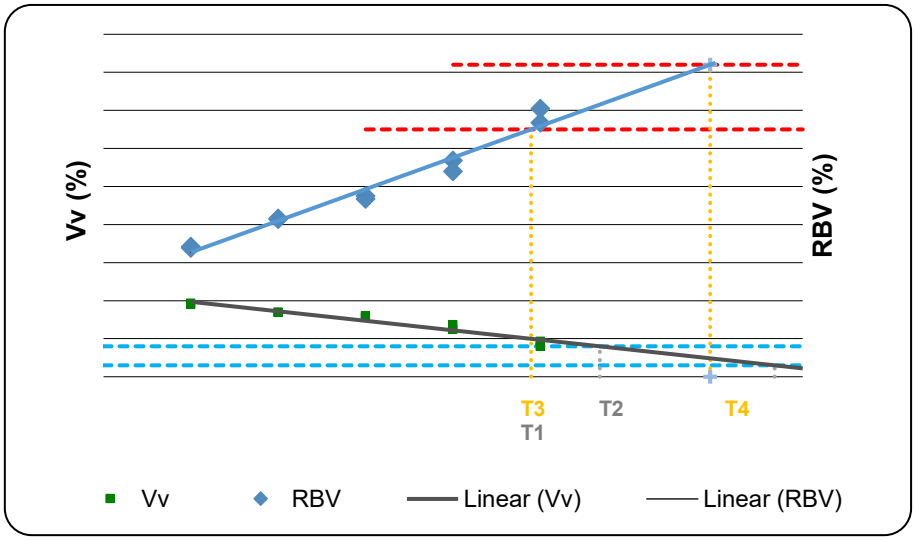


Figure 5 - Binder content of AAUQ-Cement Mix by the 3rd DRF.

Source: Author

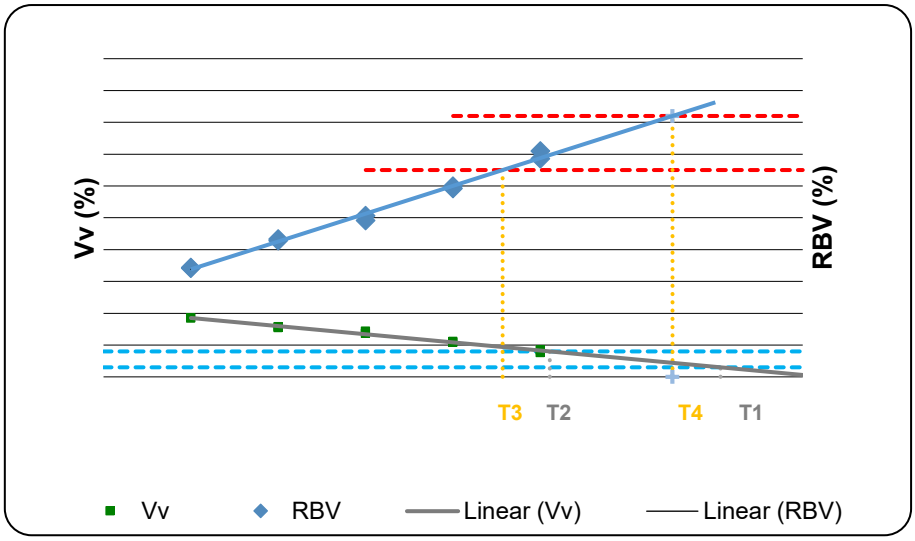


Figure 6. Binder Content of AAUQ-Cal Mix by 3rd DRF.
Source: Author

4.4 Mechanical Characterization

Tensile Strength values for all mixtures surveyed at 25 ° C indicated results greater than 0.65 MPa, as recommended by the Brazilian specification (DNIT 031/2004-ES). Particularly, the AAUQ – Cal Mix, even consuming a different portion of binder, provided satisfactory results due to the cementing properties of that residue. It is also observed that the AAUQ - Cement Mixture presented lower resistances, relative to the composites with the alternative filler, as the temperature increased (Figure 7).

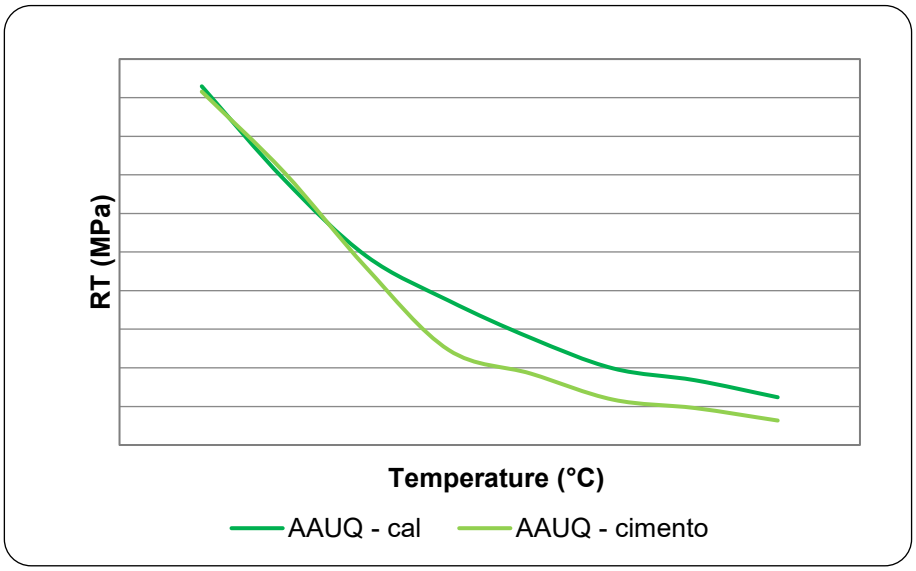


Figure 7. Tensile Strength x Mixture Temperature.
Source: Author

Concerning the Resilience Module the results are presented in Figures 8 and 9, and Table 5. It is noteworthy that although RM tests above 40 ° C have been performed, it is known from the literature that the elastic regime is no longer representative.

Regarding the behavior of the AAUQ-Cal Mix, shown in Figure 8, it is observed that: a) the MR has a significant variation with the voltage level applied at 25 ° C, around 1400 MPa, for voltages corresponding

to 5% and 10% Tensile Strength. However, increasing the load to 20% and 30% of RT causes a sudden decrease of this parameter; b) from 30 ° C, result in modules with slight variations related to changes in the percentage of RT, except for the temperature of 50 ° C outside the elastic regime; c) it was not possible to test this mixture with voltages corresponding to 5% RT at 55 ° C, because the small load values were smaller than the equipment full scale (100N); d) the highest values are indicated for the temperature of 25 ° C; e) as temperature increases, MR values decrease.

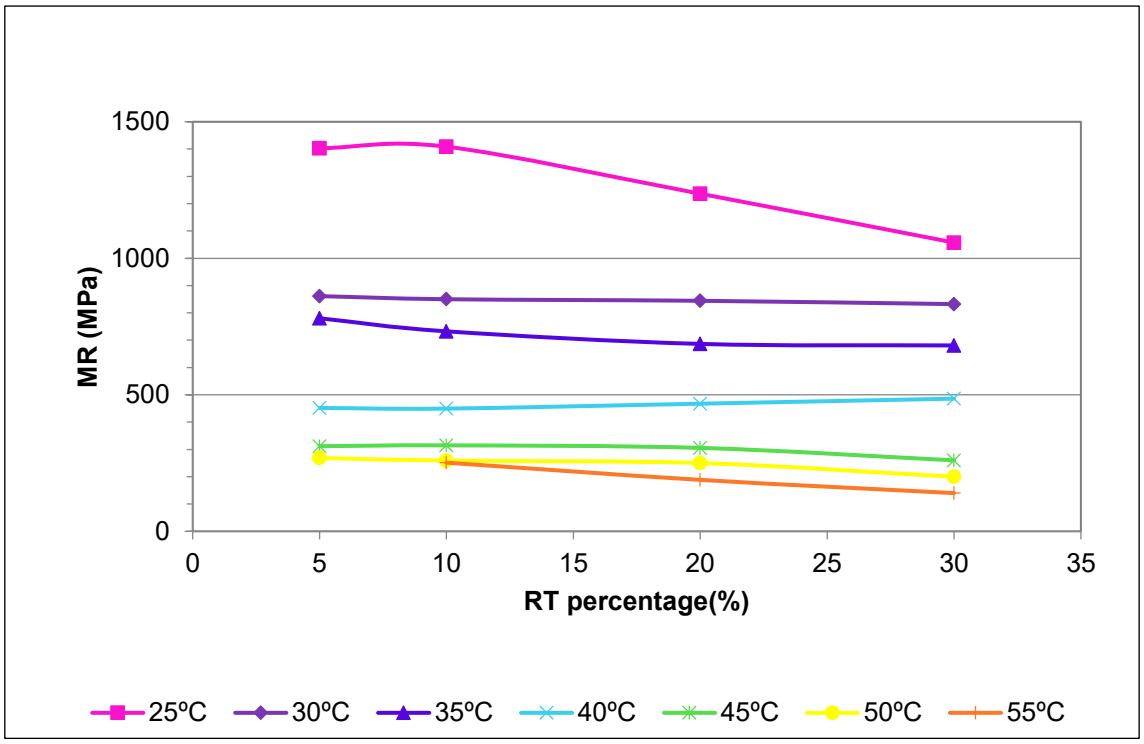


Figure 8. AAUQ-Cal Mix Resilience Modules

Source: Author

Concerning the AAUQ-Cement Mix there are: a) slight variations of the modulus values under all tested stresses and temperatures; (b) the impossibility of testing this mixture at voltages corresponding to 5% RT from 45 ° C and at voltages corresponding to 10% RT at 55 ° C because the small load values are lower than the background. equipment scale (100N); c) higher MR values for the temperature of 25 ° C; and d) as temperature increases, MR values decrease.

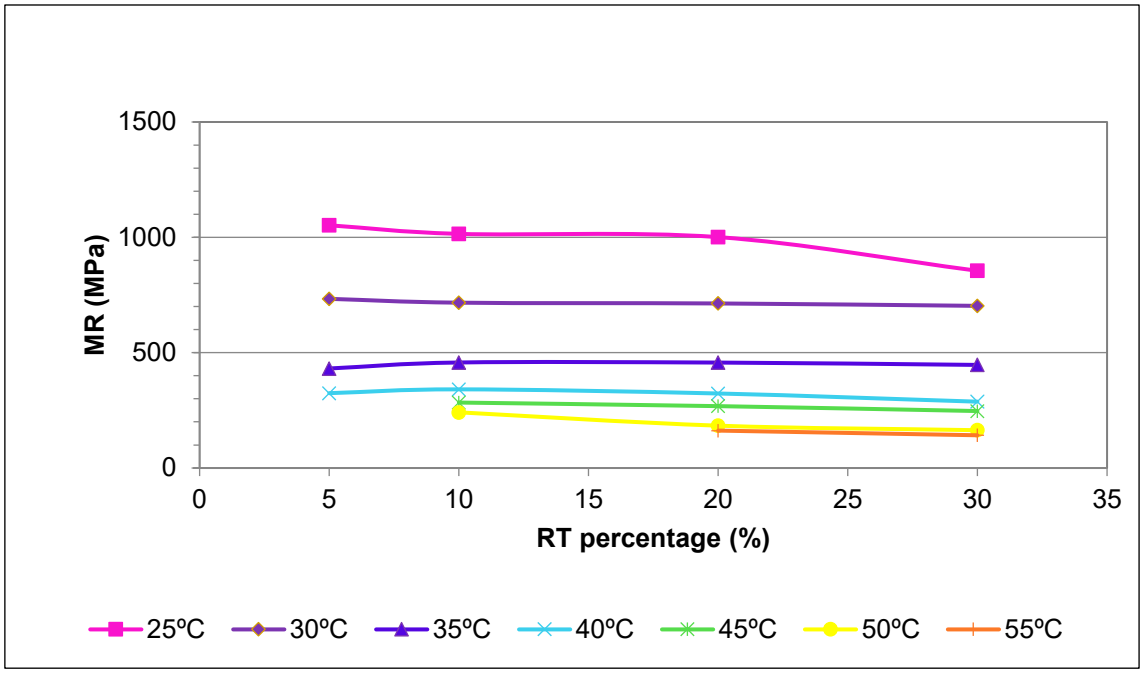


Figure 9. AAUQ – Cement Mix Resilience Modules.
Source: Author

Thus, as recommended by DNER ME 133 (1994) [14], the lowest load value was adopted, capable of generating measurable records for the determination of the Mix Resilience Module, corresponding to the load at 10% of RT. Exception AAUQ-Cement Mix tested at a temperature of 55 ° C, whose percentage of RT corresponded to a very small load (less than 100N), below the relative value of the equipment's full scale. For this mixture and for this temperature, the MR calculated for 20% of RT was adopted. Table 5 lists the MR values for the AAUQ-Cal and AAUQ-Cement Mixtures.

Table 5 - Mixture Resilience Module.

Temperature	AAUQ-Cal	AAUQ- Cement
25°C	1409	1015
30°C	850	717
35°C	732	457
40°C	449	341
45°C	315	284
50°C	259	242
55°C	252	162

In the Fatigue Life study, the number N, obtained from the predicted traffic, is related to the N determined in this test by a Field Laboratory Factor (FLC). However, due to the difficulties of considering real field conditions in the laboratory tests and in the calculation of the stresses generated in the specimens, it is common to use the results of the experiments only to compare the mixtures. Figures 10 and 11 show the Fatigue Life Curves of mixtures submitted to different temperatures, where it can be noted: a) for all

composites studied, as the temperature increases, a smaller number of load repetitions is necessary to occur. rupture under a certain stress level; b) that the Fatigue Life Curve in tests performed at 60 ° C does not follow the trend of those representing lower temperatures. This result is due to the loss of elastic properties of mixtures at high temperatures, also observed in previous tests.

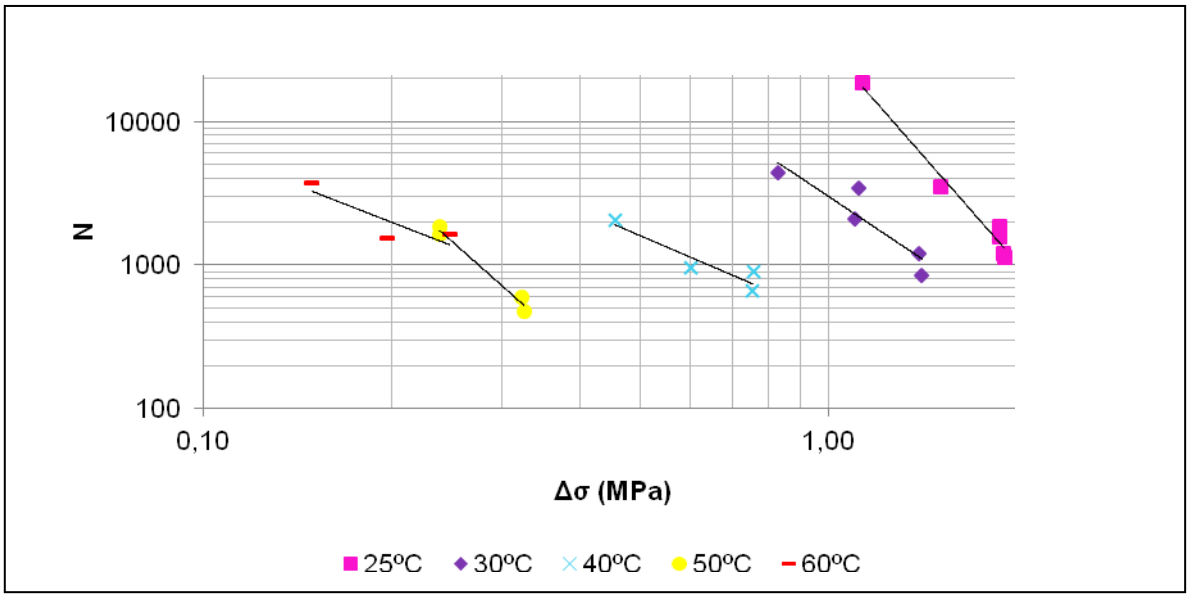


Figure 10. Fatigue Life for AAUQ-Cal Mix.
Source: Author

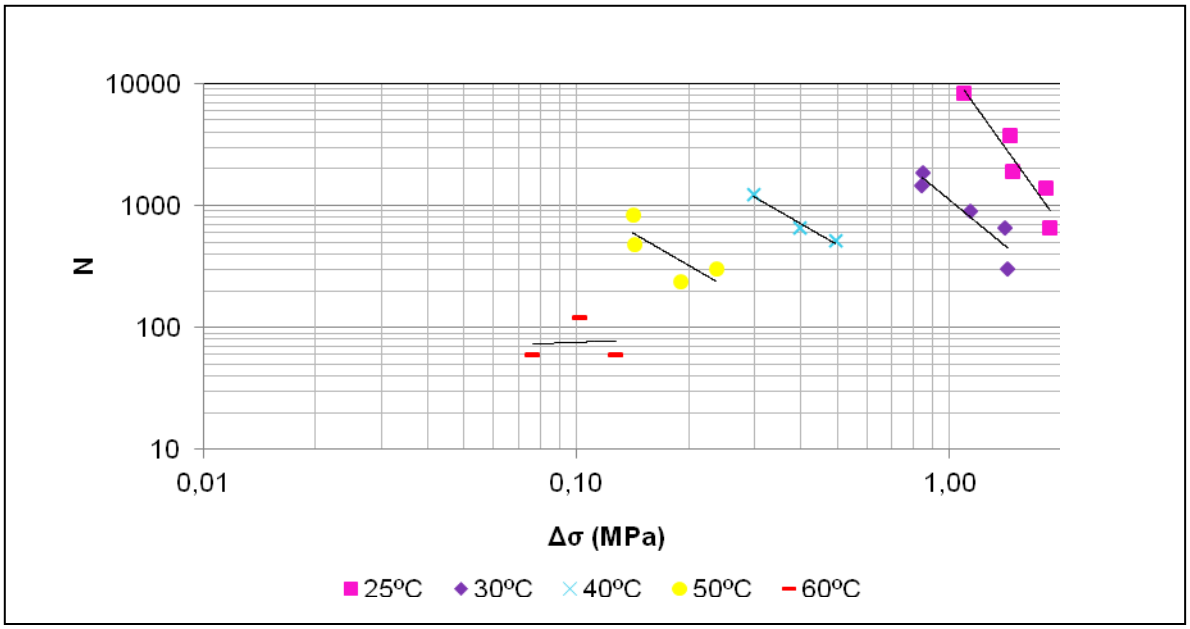


Figure 11. Fatigue Life for AAUQ-Cement Mix.
Source: Author

5. Conclusion

The analysis of the results allowed some conclusions to be drawn about this study:

Mechanical properties of asphalt mixtures (Tensile Strength, Resilience Module and Fatigue Life) have been shown to influence high temperatures (field).;

The Resilience Module generally did not vary with increasing applied stress if it remains within the elastic limit.;

- Loads according to tensions from 10% to 20% of RT are recommended for the calculation of the Mixture Resilience Module, as they presented good deformation readings and remained within the elastic regime in almost all studied mixtures;
- As the temperature increased, fewer charge repetitions were required for the mixtures to rupture under a certain stress level;
- As temperature increased, RT and MR values decreased;
- AAUQ type mixtures made from acetylene gas (carbide lime) manufacturing residue showed superior results when compared to composites usually made with portland cement as a filer;

From the above, it is concluded that the alternative filler (Carbide lime) can satisfactorily replace the traditional filler (Portland cement), reducing the thermal susceptibility of asphalt mixtures made with such material, showing as a solution to high temperature regions. - Manaus case.

6. References

[1] SANT'ANA, W.C. *Soluções de Pavimentos Urbanos para Baixo Volume de Tráfego e Cidades Pequenas.* 18ª Reunião de Pavimentação Urbana. São Luís, MA, 2012.

[2] CAVALCANTE, D.G., CRISÓSTOMO, P.H.S., SILVA, L.C.P., SOUZA, R.J.Q., GUIMARÃES, D.M.D., FROTA, C.A. *Levantamento Visual das Patologias na cidade de Manaus-AM.* Revista Teoria e Prática da Engenharia Civil, Brasil. 2012.

[3] IBP – INSTITUTO BRASILEIRO DE PETRÓLEO. *Informações básicas sobre materiais asfálticos.* Rio de Janeiro: IBP, 1999.

[4] FROTA, C. A., NUNES, F. R. G., e SILVA, C. L. "*Estudo da Substituição do Seixo por Agregados Sintéticos de Argila Calcinada*." 12ª Reunião de Pavimentação Urbana. Aracaju, SE, 2003.

[5] FROTA, C.A., SILVA, C.L., SANTOS, M.G.R., SILVA, R.V.P. "*Caracterização de Solos para Obtenção de Agregados Sintéticos de argila calcinada*." 35ª Reunião Anual de Pavimentação. Rio de Janeiro, RJ, 2004.

[6] CARDOSO, F.A.; FERNANDES, H.C.; PILEGGI, R.G.; JOHN, V.M. *Cal de carbureto como material de construção civil: caracterização*. 17º CBECIMAT - Congresso Brasileiro de Engenharia e Ciência dos Materiais. Foz do Iguaçu, PR, Brasil. 2006.

[7] MEDINA, J., e MOTTA, L.M.G. *Mecânica dos Pavimentos.* 2a. Rio de Janeiro: Imagemaker Interactive, 2005.

[8] PINTO, S. e MOTTA. L.M.G da. *Catálogo de Curvas de Fadiga*. Boletim Técnico nº 16 da ABPv, 1995.

[9] SANTOS, M.G.R. "*Estudo do Comportamento de Agregados Sintéticos de Argila Calcinada para Uso em Revestimentos Asfálticos para Manaus.*" Dissertação de Mestrado, Programa de Mestrado em Geotecnia, Universidade de Brasília - UnB, Brasília, DF, Brasil, 2007.

[10] PINTO, S., e PREUSSLER, E.S. *Pavimentação rodoviária – conceitos fundamentais sobre pavimentos flexíveis*. Rio de Janeiro,RJ.: Copiarte, Copiadora e Artes Gráficas., 2002.

[11] SHRP. "*Superior Performance Asphalt Pavements (Superpave). The Product of SHRP Asphalt Research Program. Superpave Series N°. 2*." Strategic Highway Research Program. 1994b.

[12] ASTM - American Society for Testing and Materials. "ASTM C 127-88: *Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.*" American Society for Testing and Materials. Philadelphia, Pennsylvania, 1988.

—. "ASTM C 128-93: *Standard Test Method for Specific Gravity and Absorption of Fine Aggregate*." American Association of State Highway and Transportation Officials. Philadelphia, Pennsylvania, 1993.

—. "C 131-96: *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*." American Association of State Highway and Transportation Officials. Philadelphia, Pennsylvania, 1995..

—. "C 136-95: *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*." American Association of State Highway and Transportation Officials. Philadelphia, Pennsylvania, 1995.

—. "D 2041-00: *Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures*." American Association of State Highway and Transportation Officials. Philadelphia, Pennsylvania, 2000.

[13] AASHTO - American Association of State Highway and Transportation Officials. "AASHTO T 19-93: *Standard Test Method for Unit Weight and Voids in Aggregate*." USA, 1997.

[14] DNER - Departamento Nacional de Infra-Estrutura de Transportes. "DNER ME 043/95: *Misturas betuminosas a quente - Ensaio Marshall.*" Rio de Janeiro, 1995.

—. "EM 367/97: *Material de enchimento para misturas betuminosas*." Rio de Janeiro, 1997.

—. "ME 004/94: *Material Betuminoso: determinação da viscosidade Saybolt-Furol a alta temperatura método da película delgada*." Rio de Janeiro, 1994.

—. "ME 085/94: *Material finamente pulverizado: Determinação da massa específica real.*" Rio de Janeiro, 1994.

—. "ME 138/94: *Misturas betuminosas - determinação da resistência à tração.*" Rio de Janeiro, 1994.

Development of a Mobile Application for Blood Donation Management

Matheus Cristovão González de Figueiredo Costa
mathgonzalezz@icloud.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Nathália Almeida Lima
nath.lima120997@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Bruno Pereira Gonçalves
goncalves.bruno@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Jean Mark lobo de Oliveira
jeanlobolive@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amzônia – ITEGAM -Brasil

Abstract

The creation of an application that deals with blood donation in order to facilitate knowledge about the act to its users, whether they are donors or not. Although the blood donation rate in Brazil is stable, there is always a search for ways to increase this incentive for donors to stay at or improve this level. Through a qualitative research, it was determined a knowledge of possible donors, their characteristics and limitations to donate and the benefits presented to both, the patient and the donor. The prototype presents the registration screen, information about benefits and general information about updating the registration, scheduling possible donations and how the process works. It has been found that most people have a certain fear about donating blood, as they are unaware of how the process works, and are supposed to cause some kind of harm to their body.

Keywords: Application creation; blood donation; prototype;

1. Introduction

Blood donation has become a sympathetic gesture, in which a voluntary donor has his blood collected for storage in a blood center or blood bank for use in transfusions, transplants and major surgeries, and is of

utmost importance to treat injured in disaster or emergency situations. However, the issue is still a major problem of worldwide concern, as despite the fact that there are so many scientific and technological advances, there is still no substitute for blood tissue, and the lack of blood supply in a hospital can lead to several problems, such as cancellation of surgeries and other procedures and even the patient does not resist treatment. "World statistics show that blood donations do not keep up with increased transfusions"(Rodrigues and Reibnitz, 2011, p.385).

According to Ventura (2019) the Ministry of Health shows that 66% of donations in Brazil occur spontaneously and the percentage of donors is 1.6% and is within the parameters recommended by the World Health Organization, which recommends that 1% to 3% of the population of each country is a donor. In recent years, the rate of blood donation in the country has been stable, which indicates awareness on the part of the population, but still, a greater incentive and strengthening of actions that can stimulate voluntary donations, always maintaining the maintenance in blood stocks.

The process is given by the identification of the individual, along with the presentation of all requirements and impediments, definitive or temporary, it is of utmost importance that the donor be sincere in their answers, to facilitate the process of their registration. There is a planning, evaluation of strategies and good practices that attract donors, showing the benefits acquired in their donation, how the process is done and how important it is for those who need and ensure their loyalty.

Elected as the main issue for this review: The greatest incentive for the Brazilian population about blood donation, clarifying the importance of becoming a voluntary donor, not only when a family member or acquaintance needs it and what benefits it will bring. Thus, the goal will be the creation of a blood donation application, where the person will perform a registration on the platform and reserve a day for their donation in the hospital responsible acquiring the benefits provided by law in each donation made, may have access to some information regarding what will be done with your donation, where it will be delivered and how it may become more frequent.

2. Methodology and Materials

Qualitative research will be conducted through questionnaires containing 10 questions applied to random adults, from different professions and without tattoos, being the same applied in free digital platforms (Google Forms) and in person. A proposal for mobile blood donation application will be developed to quantify frequent donors and those who donate infrequently or are in the process of making a donation.

For this proposal of mobile application will be used Android Studio, developing in Java programming language, compiled for Android version 7.1.1 and later, accompanied by a resolution 480x854mdpi.

3. Study Development

3.1 Theoretical Framework

This topic presents the theoretical aspects that approach the whole study, emphasizing the questions that make up about blood donation, the knowledge of the restricted public that was questioned and its limitations. At the end, the prototype model with its hypotheses to be treated is presented.

3.1.1 Donor fundraising

Given as the main issue of the study, donor recruitment has become one of the main points for the Brazilian health system, looking for strategies that increase this incentive among the population, not with the responsibility of donating only once, but becoming increasingly more effective in blood donation and thus promote improved health, well-being and stable conditions of people with various blood-related diseases who need this gesture of solidarity. Through this, blood donation is one of these essential components for the functioning of these health systems, having great importance and ensuring the survival of these individuals.

3.1.2 Lack of knowledge about donation and possible fundraising strategies

The system that manages the donation of this blood still presents some problems, and there are some adversities that hinder the efficient execution of the process that involves the capture of blood, because, although Brazil still maintains a stable blood donation rate according to With world rates, there are still a large number of people who are unaware of the act and are not sure of a possible donation, according to research done to the public, do not express interest in the action and thus acquire a wrong knowledge about giving, thinking it might bring some harm to you. It is understood that health organizations should always strive to attract new donors, and increasingly make the number of effective donors to meet the anticipated demand and thus avoid that there is always a more urgent search for blood type, according to the specific need of the patient.

3.1.3 Java tool

Java is an object oriented programming language. Unlike modern programming languages, which are compiled to native code, the Java language is compiled to a bytecode that is interpreted by a virtual machine (Java Virtual Machine, better known by its abbreviation JVM). The Java programming language is the conventional language of the Java Platform, but it is not its only language. J2ME For computer and mobile programs, games, calculators, or even car radio.

3.1.4 Android

According DiMarzio, android is a mobile operating system that is based on a modifield version of Linux. if was originally developed by a startup of the same name, Android, Inc. 2005, as part of its strategy to enter the mobile space, Google purchased Android, Inc. and took over its over its development work.

3.1.5 Android Studio Tool

Android Studio is an IntelliJ IDEA-based Android development environment offering expanded model for Google Services and various device types. Rich layout editor with support for theme editing. Lint tools for performance testing, usability, version compatibility, and other issues. (ANDROID STUDIO, s.d.)

3.2. Prototype

The java iteration with android is briefly explained by the Horton "after we write a program in java for android, we click on a button to change our code into another form that is understood by android".

The Donation + application must serve all donor users or not, with a simplified registration to ensure sufficient information to expedite the registration process in blood donor hospitals, but it is necessary that every user scheduled to make their donation, must bring your required documents to the medical record opening.

The functionality of the application is based on some basic procedures adopted in hospitals, such as the name of the mother, which is important data to avoid any conflict with pseudonyms. Other information extracted from the research is the issuance of the donor card linked to REDOME - National Cancer Institute, with the standard rules of HEMOAM - Hospital Foundation of Hematology and Hemotherapy of Amazonas, the main one being having 3 consecutive donations in less than one year and the renewal of the card is the frequency of at least 2 donations per year.

For this application proposal was raised some basic requirements according to the features that it will have, demonstrating them in the following table:

Table 1 - Donation and Application Requirements

1	The user must register in the application stating the full name, Social Security Number, email, password, Identification Number, date of birth and mother's name.
2	After having a registration the user can login through the email and password.
3	On the home screen, the button for “Donate now” appears to schedule the donation.
4	Pressing the "Donate Now" button redirects you to the scheduling screen.
5	The schedule the user clicks on the desired date and marks the time to make the donation.
6	From the 3rd donation completed the system issues a digital donor card.

Source: Author

To facilitate its future development, interfaces were applied to the concepts of ergonomics, similar to what is expected from the final result, with the purpose of facilitating usability for all donor users.

Figure 1 represents the login screen and with the possibility that if there is no registration in the application the user can redirect and make his registration in it. Figure 2 represents exactly which fields are required to be filled in order to register. Figure 3 shows the application home screen with some information about the benefits your donation will provide while showing that it will not affect your health. Figure 4 shows the application menu with the options of cadastral update, donation schedule, donor digital ID and general information about the application and blood donations.

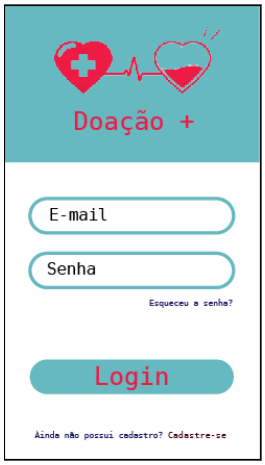


Figure 1- Login
Source: Author

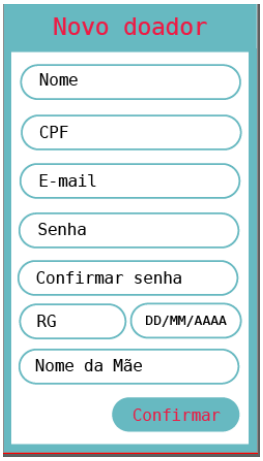


Figure 2- Register
Source: Author

Figure 3- Reserve
Source: Author

Figure 4- Update
Source: Author

In addition to these interfaces was developed the scheduling screens, additional information about donations and digital ID.

Figure 5 shows how the appointment will be made, a simplified action for the user to just select the desired date and time to attend the selected collection Hospital. Figure 6 shows other information and curiosities about donations, combinations, donor card privileges. Figure 7 shows the digital card issued by the system itself with all achievable benefits beyond its expiration date.

Figure 5- Scheduling
Source: Author

Figure 6- Informations
Source: Author

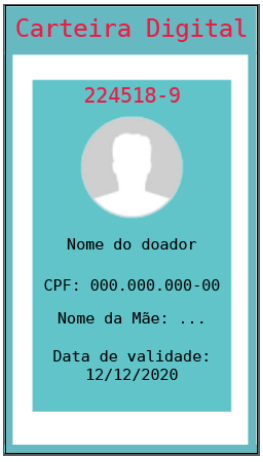


Figure 7- Digital Record
Source: Author

4. Results and discussion

4.1 Qualitative research

Questionnaire applied to people for the purpose of confirming that the person may be a blood donor or not.

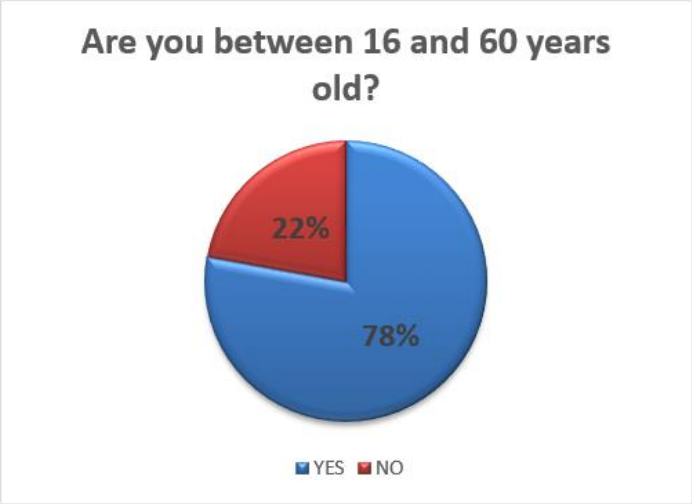


Figure 8 – Question about ages
Source: Own author

According to the responses collected from the survey sources, 78% of people between the ages allowed to make their first donation and 22% of those who cannot donate.

Figure 9 – Question about pounds
Source: Author

According to the responses collected from the survey sources, 77% of people weighing more than 50 pounds and 23% of those weighing less than 50 pounds were found.

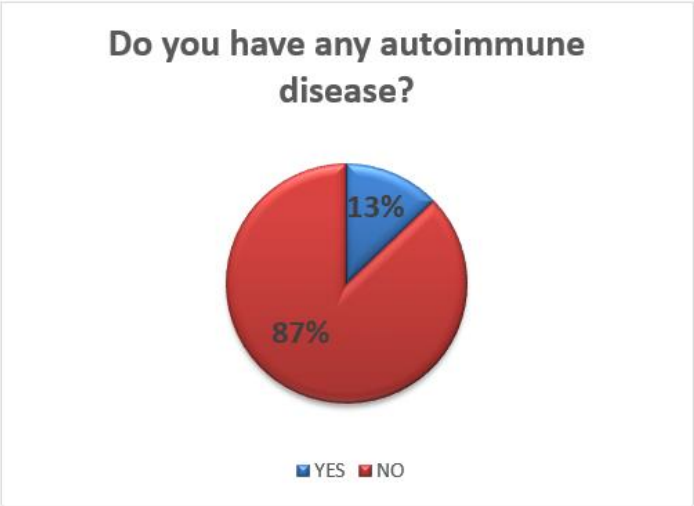


Figure 10 – Question about which ones have autoimmune diseases.
Source: Author

According to the responses collected from research sources, 13% of people with autoimmune disease and 87% of those without autoimmune disease were found.

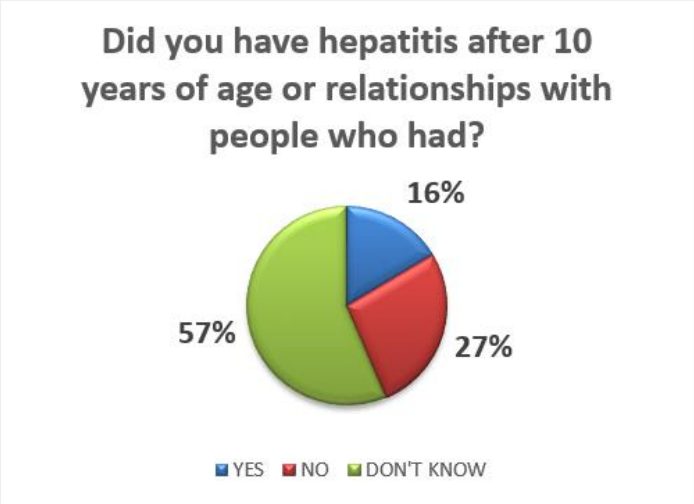


Figure 11 – Question about people who had hepatitis after 10 years or relationship with had it
Source: Author

According to responses collected from research sources, 16% of people who have some type of hepatitis or relate to people who have or have had hepatitis, 27% of those who do not have and / or did not relate to people who have or had and 57% of those who could not answer about their partners.

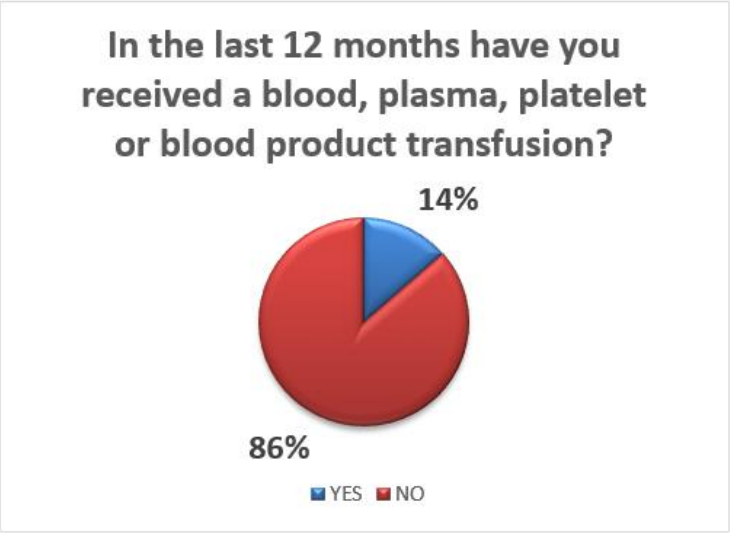


Figure 12 – Question about blood transfusion
Source: Author

According to responses collected from research sources, 14% of people who received some type of transfusion and 86% of those who did not receive transfusions.

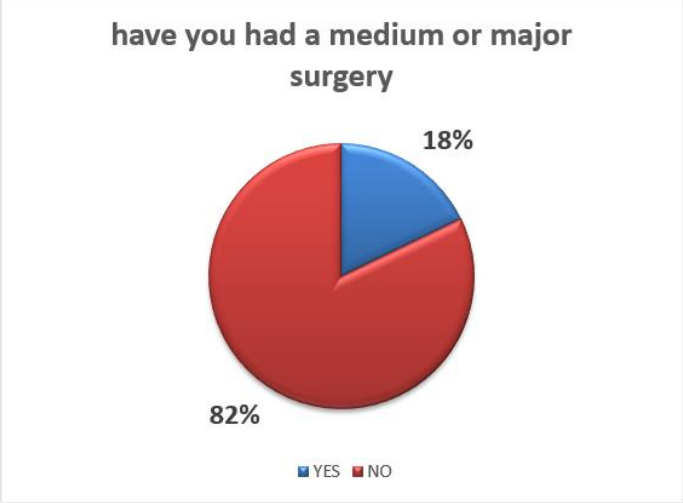


Figure 13 – Question about having had medium or large surgery in the last 12 months
Source: Author

The question, In the last 12 months have you had a medium or major surgery such as cholecystectomy, hysterectomy, thyroidectomy, colectomy, post trauma splenectomy, nephrectomy. According to the answers collected from the research sources, 18% of people who underwent any medium or large surgical procedure and 82% of those who did not undergo surgery of this size.

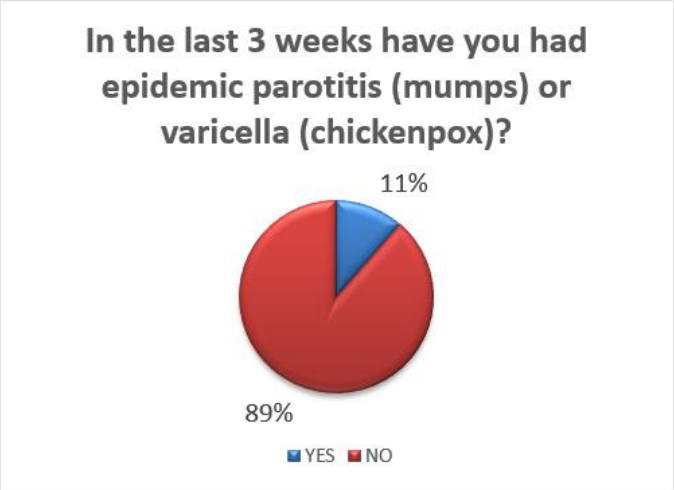


Figure 14 – Question about mumps and chickenpox
Source: Author

According to the responses collected from research sources, 11% of people who had mumps or chicken pox and 89% of those who did not.

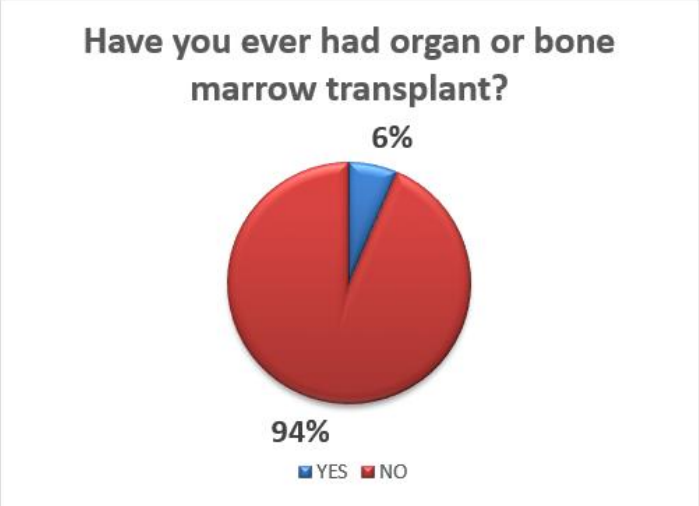


Figure 15 – Question about transplant organ or bone marrow
Source: Author

According to responses collected from research sources, 6% of people who underwent organ or marrow transplantation and 94% of those who did not.

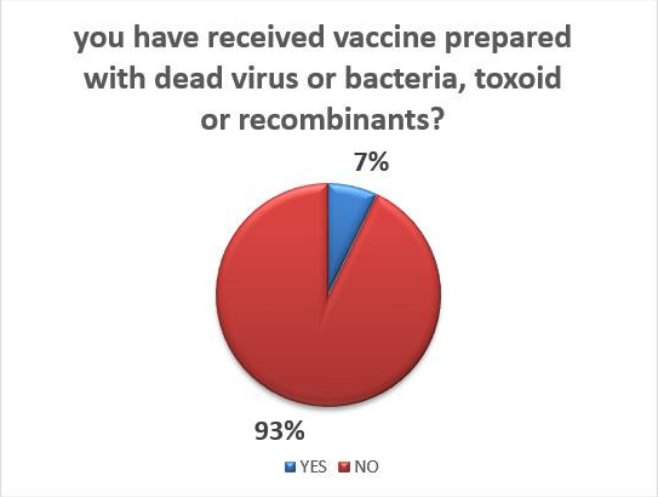


Figure 16 – Question about recent vaccination against viruses or bacteria
Source: Own author

The question, In recent weeks you have received vaccine prepared with dead virus or bacteria, toxoid or recombinants. Ex: cholera, polio (salk), diphtheria, tetanus, typhoid fever (injectable), meningitis, whooping cough, pneumococcus and / or flu vaccine? According to responses collected from research sources, 7% of people who received vaccine prepared with dead virus or bacteria were obtained, and 93% of those who did not.

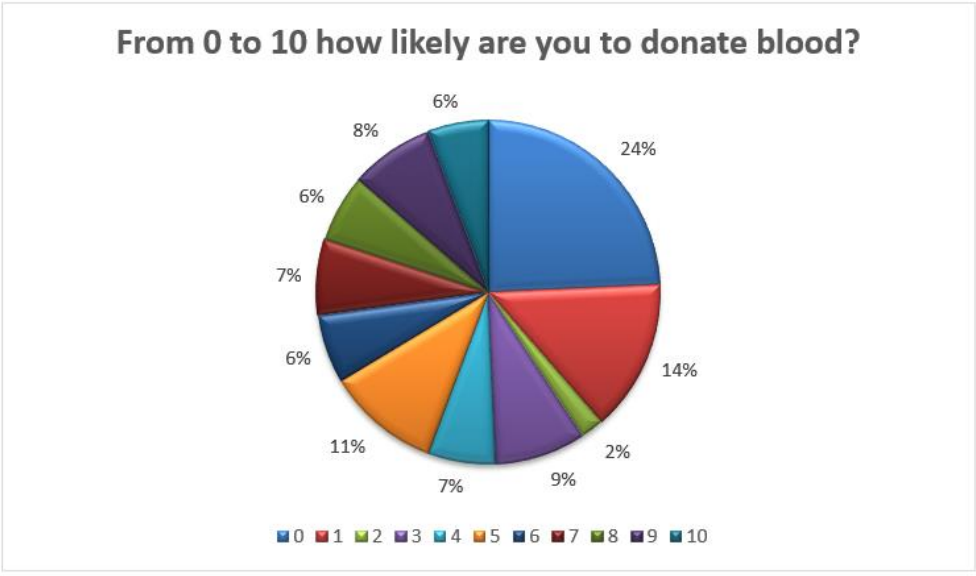


Figure 17 – Question about likelihood of donating blood
Source: Author

According to the answers obtained from the interviewees, many variants were obtained as to the certainty and willingness of people to donate blood or not.

The results found in the present study show that some people are not sure whether or not they want to donate, so there is a significant variation in the likelihood of respondents donating blood or not. It is

possible to affirm that there is a variation, especially in the extremes, if the person does not know the benefits that it can provide to the neighbor.

5. Final Considerations

Due to the revised study, the research consisted of knowledge of donors' behavior regarding blood donation, those who stopped donating and those who never donated. Qualitative research is a fundamental strategy for obtaining subsidies for directing actions to capture blood donors, because knowing their conceptions, values and feelings is essential to improve donor uptake and loyalty. Knowing the donor facilitates the fulfillment of their needs, seeks new benefits for them, contributes to their satisfaction and, consequently, to the increase in the blood donor population. Good donor service is a good practice to attract and make this person a donor effect, because offering better conditions to the donor, such as extending hours of service, greater availability of staff for their service and better collection conditions, is part of welcome to the blood donor.

In order to gain a better understanding of the population, what they think of the donation, and what their real interests are in donating, an application will be developed that will show in more detail the benefits to both donor and patient, and the importance of their donation. action and what ends will be given to it.

6. Bibliographic References

DIMARZIO, J.F.; Beginning Android Programming With Android Studio. Indianapolis: Wrox A Wiley Brand, 2017.

HORTON, J; Android Programming for Beginners, Birmingham-Mumbai Packt Publishing: Open Source*, 2015.

PEREIMA, R.M.S.R; MARTINI, G.J.; Doação De Sangue: Solidariedade Mecânica Versus Solidariedade Orgânica. Santa Catarina: Revista Brasileira De Enfermagem.

REBEN, 2009. Available on: http://www.scielo.br/pdf/reben/v63n2/24.pdf. Day access: 17/08/2019

RODRIGUES, M.S.R; REIBNITZ, S.K. Estratégias De Captação De Doadores De Sangue: Uma Revisão Integrativa Da Literatura. Florianópolis: 2011. Available on: http://www.scielo.br/pdf/tce/v20n2/a22v20n2.pdf. Day access: 17/08/2019

SERPEJANTE, Carolina. Doação De Sangue: Requisitos, Cuidados E Como Salvar Vidas. https://www.minhavida.com.br/saude/tudo-sobre/18656-doacao-de-sangue. Day access: 19/08/2019

Fundação Pró-Sangue. Available on: http://www.prosangue.sp.gov.br/artigos/requisitos_basicos_para_doacao.html Day access: 19/08/2019

Secretaria da Saúde. Available on: http://www.saude.rs.gov.br/doacao-de-sangue Day access: 19/08/2019

Fundação Hospitalar de Hematologia e Hemoterapia do Amazonas – HEMOAM. Available on: http://hemoam.am.gov.br/?secao=viewnoticia&codigo_noticia=524 Day access: 22/08/2019

Java. Available on: https://www.significados.com.br/java/ Day access: 17/08/2019

Android. Available on: https://developer.android.com Day access: 17/08/2019

The Analysis of Water Availability as an Important Factor for Farmers' Permanence in the Field: A Study in Southern Brazilian Countryside

José Luis Perlin
Master's degree student in Sociocultural Practices and Social Development*

Dieison Prestes da Silviera
Master's degree student in Sociocultural Practices and Social Development*

Jana Koefender
Professor at the Postgraduation Program (Professional Master's) in Rural Development*
Professor at the Postgraduation Program (Master's) in Sociocultural Practices and Social Development*

Roberta Cattaneo Horn
Professor at the Postgraduation Program (Professional Master's) in Rural Development*

Juliane Nicolodi Camera
Professor at the Postgraduation Program (Professional Master's) in Rural Development*

Vania Abreu de Oliveira
Professor at the Postgraduation Program (Master's) in Sociocultural Practices and Social Development*

Patrícia Dall'Agnol Bianchi
Professor at the Postgraduation Program (Master's) in Sociocultural Practices and Social Development*

Diego Pascoal Golle (corresponding author)
Professor at the Postgraduation Program (Professional Master's) in Rural Development*
Professor at the Postgraduation Program (Master's) in Sociocultural Practices and Social Development*
*University of Cruz Alta, Cruz Alta, RS Brazil

Abstract

Water availability in rural areas is essential to production activities and quality of life. The aim of the current study is to evaluate the key role played by water resources in rural properties as a factor for farmers' permanence in the field in Southern Brazil. The research followed a qualitative and quantitative approach, which encompassed the application of semi-structured questionnaires to family farmers living

in Marmeleiro and Fontana Freda communities, in the rural area of Jaguari County, Rio Grande do Sul State, Brazil. Based on collected data, participants have shown knowledge about aspects such as water quality and availability, as well as about the preservation of this resource. Nevertheless, it was clear that water availability is a fundamental factor for farmers to remain in the field.

Keywords: water resources, social development, Family farming

1. Introduction

Water is a fundamental resource for humanity, either for consumption or for the economic and social development of populations. Water quality and availability are essential factors for human health and social welfare. However, the relationship between society and natural resources has been showing disturbing unsustainability in recent decades, a topic that has been discussed worldwide. According to Beck (1992), the topic 'sustainable consumption' comprises politicization of different issues, as well as interdependence between human insertion scales and problems generated at global context. The aforementioned study also emphasizes the growing unsustainability between production and consumption patterns in the world economy, mainly differences between rich and poor countries.

Water is a major element in agricultural production, mainly in small family farms. These places often integrate agricultural production focused on animal breeding, which demands great water consumption. However, the inappropriate use of this resource leads to environmental imbalances that, in their turn, impair production activities. This outcome discourages the maintenance of family farming and farmers' permanence in rural areas.

In light of the foregoing, the problem addressed in the current research refers to the knowledge about, and analysis of, the main aspects involving the relationship between water resource availability in rural areas and the quality of life necessary to encourage farmers to remain in the countryside, where water management is under the responsibility of landowners, but also depends on public policies developed at governmental sphere. According to Abramovay (1997), family farming refers to properties whose management and individuals belonging to the same family core do most of the work.

Therefore, the aim of the current study was to evaluate the key role played by water resources in rural properties as a determining factor for farmers' permanence in the countryside.

2. Theoretical Reference

Water resources are directly linked to life preservation on the planet. Biodiversity depends on water, human health depends to the quality of the water and the global economy is influenced by water availability. In short, we depend on this natural resource (PELLACANI, 2005). Agriculture is the sector that most uses water resources, mainly for irrigation purposes. Population growth itself requires increased food production (ALMEIDA, 2005). It is worth emphasizing that such high agricultural demand for water does not happen because farmers like to consume water or because they are not concerned about its availability; it happens because water is intrinsic to agricultural production processes. Water in rual areas is used for countless purposes such as irrigation, human and animal consumption, agricultural practices and animal breeding for

slaughter, among others (VILAS, 2003).

According to the 2010 National Water Agency (ANA) report about the water resources scenario in Brazil, 61% of water withdrew from Brazilian springs is usedfor rural activities, 54% of it is used in agricultural irrigation; 6%, in animals' drinking fountains; and 1% is used for domestic consumption. Thus, although irrigated areas are associated with increased productivity levels in rural areas, adopting appropriate irrigation practices is not a priority in them, since irrigation is sometimes disorderly done. This process can damage the soil-plant system and lead to increased waste of water resources.

In addition, among different water uses adopted in rural areas, it is worth mentioning its use for human supply in rural schools, where a significant number of children and young people spend a significant part of the day; consequently, they consume water, either through direct (intake / diet) or indirect (personal hygiene and other forms) manners. Water quality in rural schools is of paramount importance, since students, mainly young ones, are more susceptible to several diseases because they have lower immunity (CASALI, 2008). According to the aforementioned study, the main water contamination sources in rural areas comprise animal feces and urine, dead animal carcasses, inappropriate garbage disposal in the environment, organic material on soil surface, intensive fertilizer applications, and abusive use of insecticides, fungicides, herbicides, among others. These contaminants eventually get to these water sources and pollute them.

According to Beck (2011), risks go beyond the environmental scope, since they may endanger the living conditions on the planet. However, the aforementioned study does not rule out the environmental crisis, which is one of the most serious problems triggered by risk situations in contemporary society. This crisis can lead to significant changes in social landscape, as well. As man dominates natural resources, human activities gradually replace natural elements, and it is the cause of risks to production. Brazil ranks the 5th position in the world list of the largest pesticide and herbicide consumers; the country uses close to two hundred thousand metric tons of these products per year – most of this application is not controlled (REBOUÇAS et al., 2006). These compounds are extremely harmful to human health, at levels often not covered by the analysis methods available in most drinking water quality-determination laboratories in Brazil.

According to the study by Mélo (2014) about social and environmental unsustainability, what one calls environmental issue, either in the academic discourse or in citizens' daily discourse, is actually an economic issue (political economy), since the development of capitalism and intensified territory occupations have triggered the exploitation of environmental goods . These goods have been transformed into resources or commodities; such transformation process breaks the cycle of natural goods' use, which is focused on satisfying the material or symbolic needs of man and, consequently, it creates the framework of nature humanization by capital (meaning dehumanization).

We herein address the externalities of economic-social processes, mainly negative externalities that end up generating additional costs for society, which are not borne by companies / industries or by society itself when they trigger predatory, although sometimes involuntary, processes that can severely damage the environment. According to Oliveira (1999, p. 569), in the economic context "(...) we can say that there is negative externality when the activity of an economic agent negatively affects the welfare or the profit of another agent and no market mechanism can compensate this agent".

Another factor resulting from the disorderly use and occupation of urban and rural environments in the country lies on the siltation of water bodies - rivers and dams - at very high levels, and on the non-collection or innaproproate waste disposal in the environment, which is carried away by floods and transported by rivers. The rural environment is affected by the dominant health model adopted in the cities, a fact that makes individuals' living conditions and the environmental quality in the countryside chaotic (REBOUÇAS et al., 1999). According to Khan et al. (2008), water scarcity is one of the main factors affecting man's permanence in rural areas. The aforementioned study also highlights that public policies focused on the Brazilian scenario are not allowed, or effective enough, to generate the necessary conditions for individuals to remain in rural environments. It happens because family farming (corn, beans, vegetable cultivation, etc.) is the main activity developed by rural men to assure their survival in the countryside; however, poor water quality and the sufficient amount of it hinder man's permance in them.

3. Methodology

The procedures and the methodology adopted in the current research were defined based on classic Scientific Methodology authors, mainly on research techniques and methodologies by Gil (2008), Marconi and Lakatos (1999) and Turato (2003). The present research adopted a qualitative and quantitative approach. It is qualitative because it uses quantifiable information, i.e., the number of classified and analyzed answers; it is also qualitative because it takes into consideration the relationship between the world and individuals, which cannot be translated into numbers, and because it is supported by the approach of human culture and behavior in a specific context (GIL, 2009).

The research instrument (questionnaires) was handed out to participants who had signed the Free and Informed Consent Form, which explained the research aims, as well as the risks and benefits associated with such participation. Individuals were invited to freely and spontaneously participate in the study in order to avoid hurting ethical precepts. In addition, participants received a Confidentiality Agreement, which reinforced researchers' commitment to preserve their privacy. Both instruments, as well as the project, were submitted to the Research Ethics Committee (University of Cruz Alta) prior to their application; they were approved according to Opinion N. 920.656 and CAAE 39444114.1.0000.5.322.

Thus, a collinear research was carried out based on Marconi and Lakatos (1999), who highlight that, together with questionnaires and / or other research instruments, it is essential attaching a note or letter to participants, in order to explain the nature of the survey, its aims and the importance of getting their answers, as well as arousing their interest in completing and returning the questionnaire within a reasonable time.

A Field Research was carried out in the current study. Cartoni (2007), herein understands this term based on the definition according to whom, whenever researchers base their work on applied questionnaires to collect data to answer their problem, their work becomes a field research. In addition, Chizzotti (2003) has mentioned that the qualitative research is as an empirical work, which occurs through the development of a field research and which aims to gather and organize a comprehensive data set. The questionnaire was applied on-site to enable its delivery and collection in a faster way. This contact allowed greater interaction between researcher and participants, as well as the establishment of an informal dialogic relationship to enable grasping different characteristics and meanings in participants' discourse in the

starting questions of the present study.

The study site comprised Marmeleiro and Fontana Freda communities, which are, respectively, the 1st and 3rd Districts of Jaguari County, Midwestern Santa Maria microregion, Rio Grande do Sul State, Brazil. Jaguari County is known as the "city of natural beauty" due to its rich flora and geographical features such as mountains, valleys, rivers and floodplains. According to IBGE (2007), the population in the county encompasses 11,626 inhabitants, who are mostly descendants of European settlers, mainly of Italians. Its economy is based on the primary sector, which stands out for its tobacco, soybean, rice, grape and sugarcane production. The county is also acknowledged for its wine and cachaça production.

Participants in the current study comprised the residents of these communities (landowners) - the representative sample corresponded to 20% (twenty percent) of the total number of residents. This is a valid amount in terms of results, since, according to Turato (2003), the sample comprises a portion, a piece, a fragment, which is presented to demonstrate aspects of the nature or quality of something, or even a small part or amount of something, in order to show the quality, style or nature of the whole.

A semi-structured questionnaire, with open and closed questions, was applied to landowners in order to identify quantitative and qualitative data capable of evidencing their thoughts about water availability, management practices / policies and the importance given to such resource in rural properties. It is also worth mentioning Minayo (1994), who pointed out qualitative research as the ideal approach to be adopted in studies focused on investigating realities that cannot be quantified in all aspects, such as meanings, beliefs and values.

The evaluation of quantitative aspects was mostly based on adequate information, which were used to build the scenario where the research was carried out in order to collect economic and social data.

Content analysis was adopted to treat qualitative data. According to Godoy (1995), this method allows researchers to better understand individuals' representations of their reality. It comprised three different stages (pre-analysis, material exploration and treatment of results), which were also indicated by Bardin (2011) in his approaches to the use of content analysis.

3. Results and Discussion

After the predicted methodological steps of on-site data collection were fulfilled, there was satisfactory effectiveness in researcher-participant interaction. Landowners and their families were remarkably receptive during the previously scheduled researcher visits, given the richness and detail of information provided by them.

More than 90% of completed questionnaires per planned center were returned, which, in total, corresponded to 27 of the 30 visited properties: 14 in Marmeleiro and 13 in Fontana Freda communities. These rural properties present little difference in size, as shown in Figure 1a; they are representative of the research universe and were classified based on their extension. Most (59.3%) participants claimed to keep an area in their property for environmental preservation purposes. However, such environmental preservation is lay, since it does not meet legal reserve requirements or enjoy the benefits from PPA (Permanent Preservation Area) legalization. In other words, participants referred to places that should be preserved (a concept attributed to empirical knowledge) for the sole purpose of assuring, for example, the

water resources necessary to supply their property.

The number of people living in the investigated properties is quite varying (from 1 to 9 individuals). However, the largest number of residents refers to more than one family unit living in the same rural property. There are several family units in a single family, a fact that can be attributed to tenure succession and to joint work for income generation purposes. Of the total number of landowners, only eight (08) reported the collaboration of third parties in the development of production processes; these third parties are day laborers, who were hired during tobacco and sugarcane harvesting periods. Therefore, family farming prevails in the herein investigated rural properties. The main activities performed in these properties comprise the cultivation of several food types for self-consumption. In addition, they commercially cultivate soybean, tobacco, and sugarcane. Some farms also grow grapes and watermelon, besides perfoming beekeeping activities or handcraft with stones.

Landowners were asked about the reason (s) why they live in that place (s); among the reasons listed by them, the main one was the fact that they were born there and, since they do not have, or have little, education. Living there was their only option, and so was the agricultural activity.

One participant, who lives in Marmeleiro, said: '*I think it's good, this is our life, I didn't attend school*' (Farmer N. 40). This statement, which, at first, refers to resignation, also reflects the satisfaction that, despite the lack of schooling, the landowner achieved good living conditions. The location of the property was also mentioned as a relevant factor for participants to stay in it, because, according to the participant who reported such condition, his property is well located in terms of access and proximity to the city. Another reason listed by Fontana Freda and Marmeleiro residents to stay in their properties is that living in the countryside enables them to have a better quality of life in comparison to the city, where living expenses are much higher. In addition, they mentioned the advantages of being their own bosses, such as not being at risk of underemployment or unemployment.

It is clear that participants acknowledge about the possible consequences that rural-city migratory processes may have on the quality of life of farmers and their families. They know that rural workers often leave the countryside in pursuit of better living conditions in cities, a process that, according to Casagrande and Souza (2012), is based on the possibility of having financial gains in the cities, i.e., greater convenience and less hard work than in agricultural production.

According to Mattar (2003), this very same migratory process, although rich in expectations, can also generate many social issues, such as the risk of unemployment and underemployment. Similarly, Pereira and Lopes (2013) have stated that street vendors, recyclable material pickers, car park attendants, among others, become increasingly common in the cities.

Perhaps, the description of this context leaves implicit - or even explicit - the importance of developping and applying public policies focused on changing the negative effects of field-to-city migrations in order to provide the necessary subsidies for rural producers to avoid the intensification of this migratory process.

A Fontana Freda resident, who answered the question about why he lives and stays in the rural area, was categorical: '*Because I prefer working in agriculture, because I didn't adapt to working as other people's employe'* (Farmer N. 114).

The pleasure of working in the field, whether in agriculture or livestock, and the talent for productive

work were recurring answers that denoted landowners' satisfaction in living in the rural area. '*I have the gift for agriculture and nothing lacks here in the property*' (Farmer N. 113) - this statement by a Fontana Freda resident reflects his attachment to the land and his contentment with the results of his production work, which gives him a good quality of life. It was also noticed that some residents remain in the countryside to continue the family activity and maintain their properties, either because they are attached to the land or because they need to stay in it.

Based on Figure 1C, shows that the location of the properties is the main conditioning factor for farmers' permanence in the rural area, a fact that meets the guiding questions of the current research. The origin of the water resources in the properties is shown in Figure 1D.

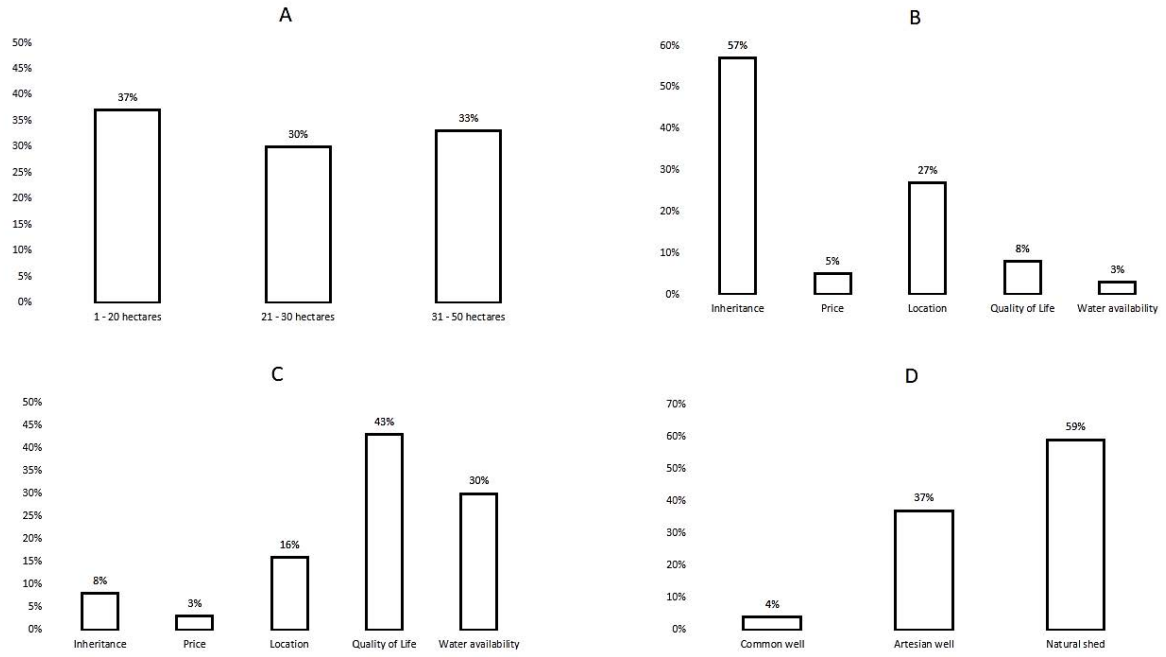


Figure 1: A- Area of rural properties, B- Reason for choosing rural, C- Factors for individuals' permanence in the field, and D- Origin of used water.

All properties use the available drinking water for family consumption, food and personal hygiene, and desedentation of domestic animals. Other sources, such as streams and dams, are used in activities such as poultry, cattle and pig farming, as well as for vegetable production purposes (vegetables and tobacco beds). Sugarcane, in its turn, does not require irrigation water for crop planting and maintenance; however, water is used to cool steam ducts during cachaça production processes.

With respect to breeding activities, each property has 17 cattle, 3 pigs and 30 chickens, on average, a fact that reinforces the need of drinking water availability in these properties. As for family income sources, the current study investigated whether there was activity diversity, i.e., other income sources besides family farming. Results showed that more than 65% of households solely rely on family farming.

The questionnaire application enabled identifying extraordinary factors that showed the strong awareness of local users about water as a common good. In other words, the joint use by five to six families of a single water source in a specific property was described by participants, a fact that highlights the social organization in pursuit of improving the quality of the consumed water and in cost sharing. Unlike

common knowledge, participants did not show resistance to sharing the natural resource in an equitable and sustainable manner.

Most (88.89%) of households consume water that has not been subjected to any previous treatment. Those who claim to treat the consumed water use the chlorination system of community wells, which was made available by the public power and is intended for countryside communities.

Participants were asked if any of their family members had already gotten sick due to the intake of water available in the property. There was no affirmative answer to this possibility, which leads to the conclusion that the quality of drinking water in the investigated region is satisfactory.

All investigated households have sewage treatment application. This reality proves the theoretical assumptions of the present research about the approach of public policies and programs focused on water resources management. According to the local administration, certain actions are no longer implemented, not because of insufficient financial resources, but due to lack of significant number of households presenting basic sanitation vulnerability issues. This reality is also reflected in the rural environment, according to collected data.

Some questions highlighted information about drinking water availability in the properties, about actions aimed at preserving such water, as well as emphisized informants' concept about the specific topic. The initial question concerned the history of drinking water availability, or not, during the dry seasons. Only 15% of the investigated families gave affirmative responses to this question. In order to solve this momentary water scarcity issue, the options and procedures adopted by participants lied on opening artesian wells in the property or transporting water from neighboring properties, which had abundant water resources.

Even nowadays, the imminence of droughts is seen as a threat to the quality of life in part of these properties because they undeniably depend on this resource to maintain their production activities, mainly for animal breeding, as well as for personal use, consumption and sanitation.

Based on the list of collected information, some participants have already received help from public agencies, such as the city hall, in times of water lack or scarcity. This assistance was based on opening drinking fountains for animal desedentation and on drilling artesian wells to for water distribution networks. Since the actions taken by the local government were set forth in specific governmental programs, they had no cost to landowners.

On average, 50% of respondent farmers reported differences in the amount of water available in their farms. Next, they answered complementary questions about variations in water volume. Most respondents stated that water volume has reduced over the years and that they were concerned about this issue.

It is clear that water is a determining factor for farmers' permanence in rural areas; however, in case of water shortage, 78% of farmers said they would continue living in the property, but they would ask for governmental help (Figure 2A). This fact demonstrates the association of their identity with rural environments but, at the same time, it highlights the key role played by water resources in such environments. Moreovre, it makes it clear that water scarcity would not only generate environmental issues, but also burden the public power.

The identity association with a place refers to already mentioned issues, such as the fact that the land passes from father to son in a continuous time cycle, the attachment to the land, the production work and,

mainly, the quality of life rural environments provide to its residents, who do not have to depend on the narrow possibilities offered by urban life.

With respect to water resource preservation (Figure 2B), respondents were aware that certain actions can affect the quality and quantity of drinking water. They also pointed out that public segments or other bodies rarely provide instructions about forms of water resource presenvation. Seventy percent (70%) of respondents, on average, said they have never received any guidance about preservationist actions; their statements were based on empirical knowledge, i.e., on knowledge resulting from their daily experiences and access to the media.

Therefore, it is evident that the herein collected data corroborate the statements by KHAN et al. (2008), according to whom the presence of water in rural areas is fundamental for families' permanence in the countryside.

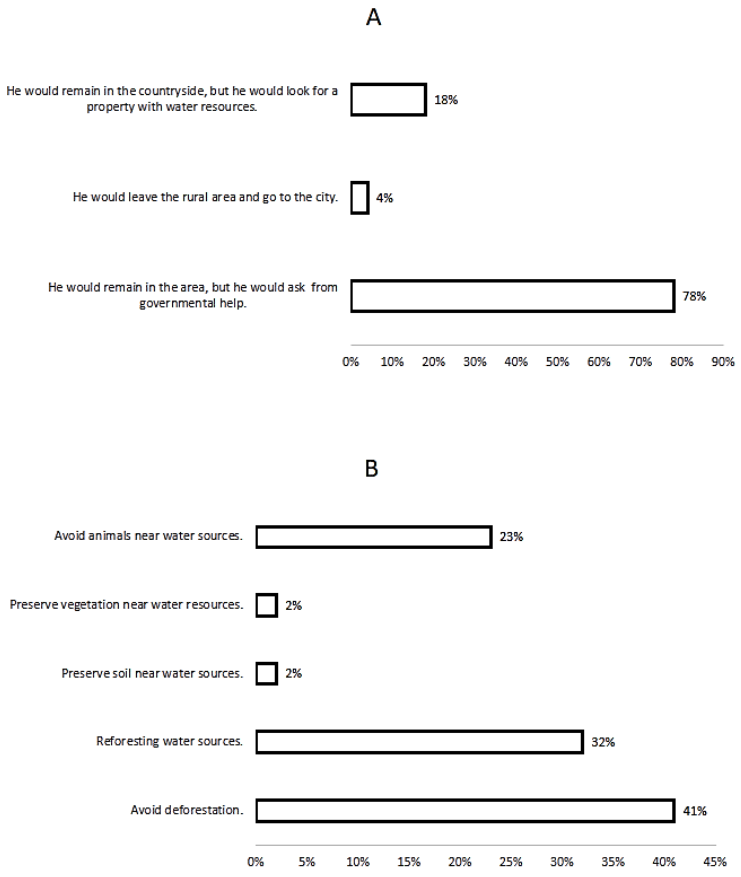


Figure 2: A- Actions taken by farmers in case of water scarcity,
B- Actions seen as priority for water conservation.

4. Final Considerations

Small rural properties visited during the current study have sufficient water resources for production activity maintenance and for household consumption. Some of them - less than 10% of the total - share the same source of funding. Overall, it is possible saying that landowners are sifginicantly aware of the importance of preserving the environment so they can continuously rely on available water resources. Thus,

they take actions focused on reducing the risk of water shortage or on avoiding the contamination of water sources. These actions are based on their empirical knowledge. However, their good sense of attitude helps them avoiding deforestation in their properties; besides, they do not use pesticides near water sources or allow animals to circulate in adjacent areas and, whenever necessary, they promote local reforestation.

In terms of local economy and quality of life, it is possible concluding that family farming prevails as the main means of subsistence in these rural properties - cases of parallel work are rare. The living standards in these properties were satisfactory. Water resource availability is essential for farmer families to live and stay in the countryside, as well as for their consumption or for the development of production activities. It is extremely important having this natural good in sufficient quantity and quality.

However, climate issues often seen during summer, mainly droughts, have significant impact onrural populations, who perceive them as a threat to their quality of life. These populations perceive differences in the amount of available water on a yearly basis; according to them, there is a negative variation in such availability, since water sources' flow has been decreasing.

5. Acknowledgement

The current study was parlty financed by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – Finance Code 001".

6. References

ALMEIDA, L. M. A. RIGOLIN, T. B. Geografia: geografia geral e do Brasil, volume único. 1. ed. São Paulo: Ática, 2005.

BARDIN, L. Análise de conteúdo. São Paulo: Edições 70, 2011.

BECK, U. Risk Society. Sage, London, 1992, in: PORTILHO, F. Sustentabilidade Ambiental, Consumo e Cidadania. São Paulo, Cortez Editora, 2005.

BECK, U. Sociedade de Risco: Rumo a uma outra modernidade, Editora 34. 2011.

BRASIL, Presidência da República. Lei Federal nº 9.984, de 17 de julho de 2000. Dispõe sobre a Criação da Agência Nacional de Águas - ANA, Entidade Federal de Implementação da Política Nacional de Recursos Hídricos e de Coordenação do Sistema Nacional de Gerenciamento de Recursos Hídricos.

CARTONI, D. M. Manual de monografia geral. Valinhos: FAV - Faculdade de Valinhos, 2007. Não publicado.

CASAGRANDE, A. E. SOUZA, E .B. C. O espaço e a demografia: o planejamento regional em perspectiva nas margens paranaenses do Lago de Itaipu. Sociedade e Território, Natal, v. 24, n. 1, p. 2- 27, 2012.

CASALI, C. A. Qualidade da água para consumo humano ofertada em escolas e comunidades rurais da região central do Rio Grande do Sul. Dissertação em Ciência do solo - Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil. 15 de fevereiro de 2008.

CHIZZOTTI, A. Pesquisa em ciências humanas e sociais. São Paulo: Cortez, 2003.

GIL, A. C. Métodos e técnicas de pesquisa social. 6 ed. São Paulo: Atlas, 2008.

GODOY, A. S. Pesquisa Qualitativa: tipos fundamentais. Revista de Administração de Empresas, São Paulo, v. 35, n. 3, p. 20-29 maio/jun. 1995

KHAN, A. S. et al. Efeitos da seca sobre a produção, a renda e o emprego agrícola na microrregião geográfica de Brejo Santo e no Estado do Ceará. Revista Econômica do Nordeste, v. 36, n. 2, Fortaleza, 2005.

MARCONI, M. A.; LAKATOS, E. M. Técnicas de pesquisa. 3ª Ed. São Paulo: Atlas, 1999.

MATTAR, M. E. O árido problema da desertificação. La Insígnia – Revista de Ecologia. Agosto de 2003.

MÉLO, J. L. B. A democracia brasileira e a insustentabilidade socioambiental. In: RUSCHEINSKUY, A.; MÉLO, J. L. B., LÓPEZ, L. C. Atores sociais, conflitos ambientais e políticas públicas. Jundiaí: Paco Editorial, 2014. p. 45-70.

OLIVEIRA, R. G. de. Economia do meio ambiente. In: PINHO, D. B.; VASCONCELOS, M. A. S. de. (org.) Manual de Economia – equipe de professores da USP. 3.ed. São Paulo: Saraiva, 1998, p.567-581.

PELLACANI, C. R. Poluição das águas doces superficiais e responsabilidade civil. Curitiba. Ed. Juruá, 2005.

REBOUÇAS, A. C.; BRAGA, B.; TUNDISI, J. G. Águas doces no Brasil: Capital ecológico, uso e conservação – 3ª edição – São Paulo - SP: Escrituras Editora, 2006.

TRIVIÑOS, A. N. S. Introdução à pesquisa em ciências sociais. São Paulo: Atlas, 1987.

TURATO, E. R. Tratado da metodologia da pesquisa clínico-qualitativa: construção teórico-epistemológica, discussão comparada e aplicação nas áreas de saúde e humanas. Petrópolis: RJ, VOZES, 2003.

VILAS, A. T. Racionalização do uso da água no meio rural, CGEE, Brasília, 2003.

Teaching Topographic Surface Concepts in Augmented Reality and Virtual Reality Web Environments

Paulo Henrique Siqueira
paulohs@ufpr.br
Department of Graphic Expression, Federal University of Paraná,
Curitiba-PR, Brazil

Abstract

This paper shows the use of web resources for the creation of Virtual Reality (VR) and Augmented Reality (AR) environments to teaching of topographic surface concepts. The mockups of the topographic surfaces were built with Sketchup software, include graphical representations of level contours, terrain cuts, topographic profiles and embankments. The terrains textures used are satellite photos available by the Digital Globe platform and contribute to improve the visualization of studied concepts. Developed environments enable students to view surfaces in AR ambient, using their webcam devices, such as smartphones, tablets, or notebooks, from a variety of points of view. Each topographic surface mockup has a link to its respective representation in VR, which allows its manipulation and detailed study of each concept. The environments presented in this work can be used in disciplines of Topography, Geography and Descriptive Geometry.

Keywords: Augmented Reality; Virtual Reality; Topographic surfaces; Virtual Mockups;

1. Introduction

The use of auxiliary resources allows students to better understand subjects in disciplines involving three-dimensional concepts. Object manipulation helps students understand, making it easier to assimilate the theoretical concepts of the subjects. Nowadays, the developing of teaching applications or web environments helps to visualize concepts of Biology [4] and Geometry [5]. The construction of physical mockups can be done using 3D printers for classes in Geography [1], Biology [2], Geometry [3] and other disciplines involving 3D representations.

The use of modeling with virtual technologies is one of the alternatives to help teaching in subjects that involve 3D concepts. Virtual Reality (VR) serves to create an immersive environment with manipulation of objects using controls and immersive goggles [6]. VR environments help the visualization of physical or biological phenomena, training simulations, visualization of planets surfaces, construction simulations, educational games and other education areas.

The Augmented Reality (AR) uses a camera device to insert objects together with the camera image environment, creating virtual layers of 3D objects and text on the camera image in real time [7]. Recent works shows interesting applications of AR to aid in teaching of various areas, such as Geometry [8], Engineering [9], Chemistry [10], Architecture [11] and others [12], [13]. The contributions of the use of AR in education demonstrate that it is a powerful tool for classroom use, as it allows for various forms of

visual interactions in learning various disciplines [14].

This paper presents the necessary elements for the construction of a web environment that uses VR and AR technologies to represent virtual models for the teaching of topographic surfaces. The models are create in Sketchup software with the texture and modeling features available from the Digital Globe platform. The drawings of terrain sections, platforms, embankments and level contours are create in Sketchup, with the insertion in the programmed environments in AR and RV, allowing a deep study of the features of the terrain and the main relief forms: valleys, hills, mountains, lakes, plains and plateaus.

The purpose of this paper is show the main elements to create an HTML page in AR, with links to pages developed in RV. On the AR page, students view mockups from various points of view and access the VR sites to manipulate topographic surface representations with mobile devices, computers, or even immerse themselves in the scene with VR goggles.The commands used to create the proposed environments in AR and VR are intuitive, and only require basic knowledge of HTML. It is a didactic resource of simple programming, which enables classroom applications without difficulties pointed out in the use of some AR technologies, as shown in [15].

The present paper is divided into 6 sections, including this introduction. Section 2 present a state-of-art of teaching topographic surface concepts. Section 3 presents modeling of topographic surface mockups using Sketchup. In sections 4 and 5 are shown the basic HTML commands for creating of Virtual Reality and Augmented Reality environments, respectively. In section 6 the conclusions are made.

2. Topographic surfaces teaching

The study of topographic surfaces can be enhanced with the aid of virtual technologies. The construction of 2D elements of terrain graphics can be complemented by 3D visualizations using various available techniques.

According to [16], Sandbox technology has been widely used in the teaching of relief forms in Geography discipline. The system reads the sand layers, creating the level contours using colors defined by hypsometric and bathymetric techniques, giving students the perception of the shape of each terrain. The work of [17] shows the use of the Sandbox tool for visualization of brazilian regions and slopes studies applications of the Topography discipline for the Civil Engineering course.

The use of Descriptive Geometry concepts to represent a simplified design of voltage line installation is shown in [18]. The initial information of the topographic map are presented to students, and used for the construction of the 3D model, with all the technical norms for the correct installation of each transmission tower.

Physical models are also important for teaching topographic surfaces. Activities to create physical mockups with the students to aid in the teaching of relief concepts and level contours are shown in papers [19], [20] and [21]. The results shown by these authors are excellent, with the interaction between students and teachers, resulting in the students' better understanding of topographic surfaces concepts.

The creation of a map of the campus of an brazilian university with Augmented Reality is shown in [22], using available cartographic information. The model was tested with Cartographic Engineering students, and most consider that the AR model improves visualization compared to traditional maps. The

AR map proposed by the authors considered only the features of the terrain and the shapes of buildings on campus.

The paper presented in [23] uses Augmented Reality for visualization of topographic surfaces using the AR-Media application. Using the printed contours of each terrain, the authors show how the application works with the surfaces that appear over the curves, complementing the teaching of relief shapes.

The use of Augmented Reality can complement the use of traditional teaching materials in the teaching of topographic surface concepts, as students can interact and visualize terrain elements more effectively and meaningfully. Virtual Reality can help students interact with 3D representations of terrain, transforming the teaching of content into a kind of field class on reliefs in various ways.

3. Modeling of Topographic surfaces

The mockups shown in this article were create on Sketchup software [24] using the feature available for Digital Globe platform [25] land surfaces. The mockups are exported to be inserted into A-frame [26] programmed web environments for use in both technologies: Augmented Reality and Virtual Reality. Thus, the static concepts of terrain relief shapes can be viewed as they are, making the contents of these classes more realistic and dynamic.

The first step to create the environment proposed in this article is to choose regions that contain interesting valleys and mountains for use in the classroom. Digital Globe's land insertion tool creates square viewports of limited side equal to 2 km, which are modeled for the land surface only, disregarding heights of buildings and vegetation. The textures used in this tool are satellite photos, ideal for modeling surfaces to be closer to reality in AR and VR.

After choosing the terrain location, the satellite photo of the region is loaded into Sketchup, as shown in Figure 1. This is the top view of the terrain from a region of Kamloops mountains, in Canada.

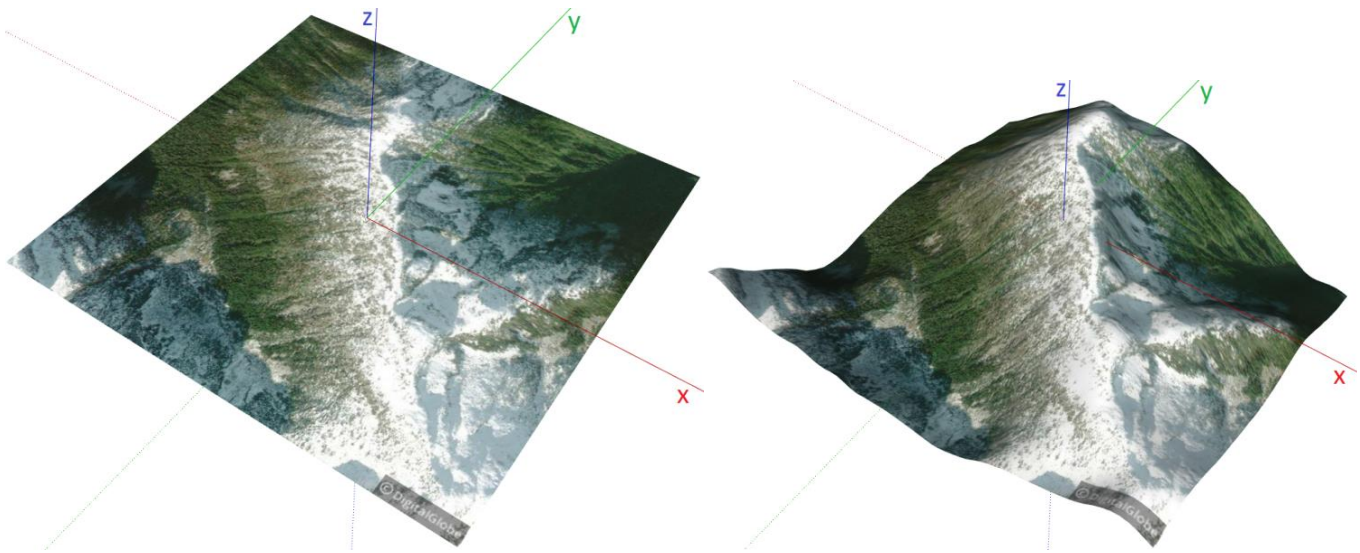


Figure 1. Satellite photo and 3D mockup of the Kamloops mountains region, Canada.

Using Sketchup's option to show terrain, the topographic surface can be modeled with the actual altitudes of the chosen region. Figure 1 shows the modeling of the Kamloops region in 3D with features of

the Digital Globe platform.

The creation of the set of level contours of each region can be made by equidistant rectangles with respect to z axis (altitudes), with sides parallel to x and y axes, measured slightly larger than the sides of the surface. These rectangles represent the horizontal sections plans of the surface. The intersections of these equidistant plans with the surface form the set of lines of level contours, as shown in Figure 2. Other important elements that can be defined in Sketchup are elevation dimensions, plans sections, topographic profiles and embankments. The top view of each surface can be used for creating teaching materials on topographic surfaces.

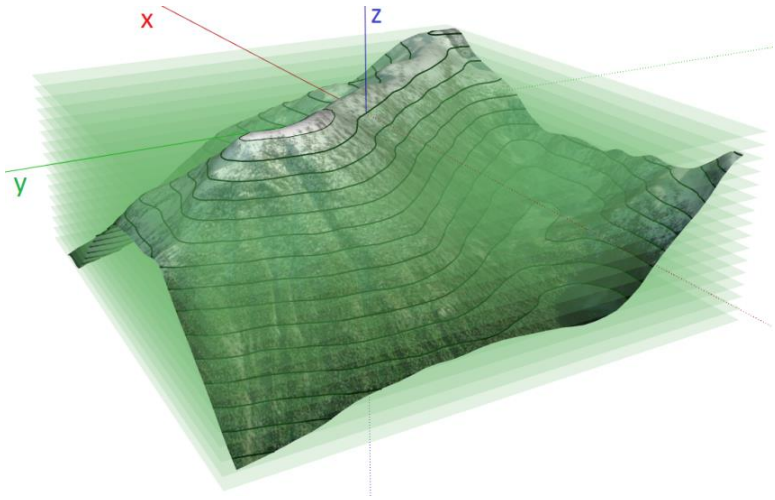


Figure 2. Construction of level contours of the Kamloops region.

If the chosen region is larger than the 2km limitation of the Digital Globe viewport, multiple windows can be created with the sub regions that cover the chosen area, and each image fits the neighboring image as a species of patchwork.

To make the use of the technologies proposed in this paper even more interesting, the region chosen for a particular activity may be tourism, such as Mount Fuji in Japan, Grand Canyon in United States, or Chapada Diamantina in Brazil. To represent a mockup of a region of the Grand Canyon in Arizona, you need 40 viewports, which are illustrated in Figure 3 in 2D and Figure 4 in 3D. In the virtual mockup, a large region of the Colorado River is represented, allowing the exploration of various forms of relief in classroom.

4. Virtual Reality

The topographic surfaces mockups shown in section 3 were inserted into Virtual Reality and Augmented Reality environments using the A-frame libraries. This is an environment developed by the Mozilla VR team [27] that uses the functions of the Java Three.js library with pure HTML tags, allowing all VR or AR programming to be done on one page of the web, which follows the composition of tags with inheritance and hierarchy principles [26].

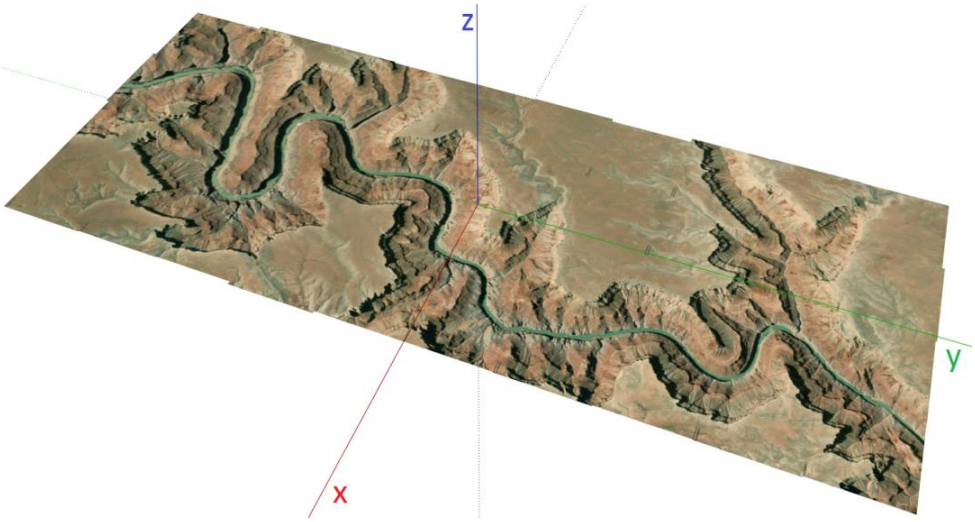


Figure 3. Grand Canyon mockup 2D view blocks.

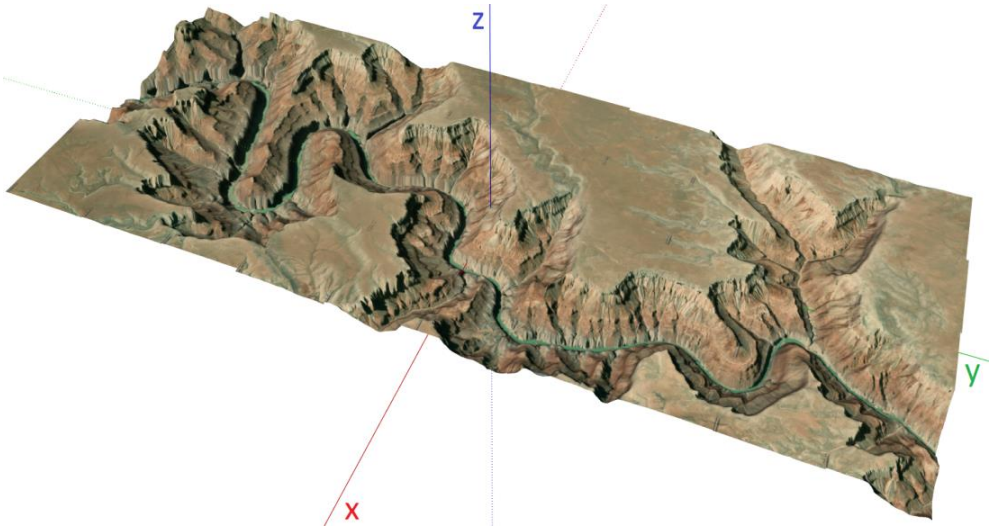


Figure 4. 3D representation of Grand Canyon mockup.

Programmed environments in A-frame support four mockup file formats. The first is obj (object file), a widely used format that can be opened in any 3D software, whose files include coordinate information, texture maps, and polygonal faces. The second format used by A-frame is collada (collaborative design activity), which is supported by many 3D software and uses the xml standard to load texture, animation and lighting information. The third format that can be used is gltf (graphic library transmission format), which has the same information as obj in a more compact way, getting faster loading in web applications. The binary version of gltf, called glb, is the fourth file type supported by A-frame.

The only format that exports lines is collada. As the visualization of lines is essential for the study of level contours and terrain sections, the environments were built with mockup of terrain in glb, gltf or obj format combined with lines of collada files.

Eight models were used in didactic materials to classes of basic Topography to study following topics: level contour lines, topographic profiles, roads, embankments, platforms and terrain sections. According to Table 1, it can be seen that the best combination of files is glb for polygons and textures and collada for lines, with 6,702 kB, which represents 28.56% of the total file size when used with collada extension. With

this combination of files, sites load on average 3.5 times faster compared to configuring collada format models only.

Table 1. Comparisons between sizes (using kB units) of files used to make mockups.

description	collada	obj and collada	gltf and collada	glb and collada
1. topographic profile	3.760	1.824	1.394	852
2. platform	3.082	1.363	1.173	909
3. road	1.929	875	992	768
4. level contours	2.232	1.125	1.030	657
5. terrain section	5.502	2.521	1.761	1.053
6. level contours	1.372	667	765	585
7. topographic profile	3.425	1.529	1.171	708
8. road with curve	2.160	1.495	1.330	1.170
total	**23.462**	**11.399**	**9.616**	**6.702**

The main tags of the modeling of one of the topographic surfaces are illustrated in Figure 5. In the header tag of the HTML page is inserted the reference to the A-frame main library between lines 3 and 5. All library references can be inserted in this header tag.

The body of the HTML page contains the programming of the other page elements. In lines 7 and 8 of Figure 5 are the definitions for user interaction with the mouse or VR control and the camera of the scene with starting position at coordinates x (right / left), y (height) and z (depth). The initial values are: x = 0 and y = 0, which center the camera on screen; and z = 6 m to distance the observer from the origin of the system.

```
1 <!DOCTYPE html>
2 <html>
3  <head>
4   <script src="https://aframe.io/releases/0.8.2/aframe.min.js"></script>
5  </head>
6  <body>
7  <a-scene cursor="rayOrigin:mouse">
8  <a-entity camera look-controls position="0,0,6"></a-entity>
9  <a-assets>
10   <a-asset-item id="estrada" src="imagens/curva16.dae"></a-asset-item>
11   <a-asset-item id="estrada1" src="imagens/curva16.glb"></a-asset-item>
12   <img id="ceu" src="imagens/ceu1.jpg">
13 </a-assets>
14 <a-sky src="#ceu"></a-sky>
15 <a-entity scale="0.003,0.003,0.003" position="0,0,0">
16  <a-entity collada-model="#estrada"></a-entity>
17  <a-entity gltf-model="#estrada1"></a-entity>
18 </a-entity>
19 </a-scene>
20 </body>
21 </html>
```

Figure 5. A-frame HTML code for VR presentation of a Sketchup mockup.

The tags that define the texture and loading of the mockup are placed between lines 9 and 13. The model is defined on lines 10 and 11, where you must enter the folder path of collada and gltf files. The blue gradient background image is set to line 12 and referenced as the 360º background image of the scene in

the <a-sky> tag of line 14.

Between lines 15 and 18 are the tags that define the position and scale of the model. To properly load it, the scale used is 0.003 in all three dimensions and the position at the origin of the system. Figure 6 shows the model programmed in VR with the tags shown in Figure 5. It is the graphical representation used for road construction study, with embankment slopes and level contours. With this VR representation, students can view constructions that are made with terrain contours to define sections and embankments positions in 2D.

Figure 6. VR representation of model with terrain sections for road construction.

The intersection of a topographic surface with the plan that defines the slope of a section or embankment can be made by matching each level contour with the respective horizontal line of this plan of the same elevation. Students can construct the cut and embankment curves of these slopes in 2D, and the concept can be complemented by 3D visualization of what was built in VR.

One way of interacting with scene elements is using the orbit function [28], which allows the camera to move around the objects in the scene. When using VR goggles, the camera's movement with orbit function is automatic. On computers, tablets, and smartphones, the camera can be moved around objects using the mouse, keyboard, or touch. All models used in this article have this orbit function, so that students can move the scene to find the best viewpoints to observe the constructed elements.

The projects shown in this article are applied in basic Topography disciplines for Civil Engineering, Environmental Engineering and Forestry Engineering projects. Other projects involving topographic surfaces are from topographic profiles, as shown in Figure 7 with a VR representation with level contours of 20-by-20 meters.

Because it is a web page, users have viewing options on tablets, computers, smartphones, as well as Oculus Rift, Oculus Vive, Daydream and gearVR. Mockup interaction commands can be programmed by immersing the VR scene with orbit manipulation [29] or teleporting to scene locations [30]. With the teleport function, students can immerse themselves on each surface with VR goggles, making the use of

VR mockups more interesting: a virtual tour of the terrain depicted.

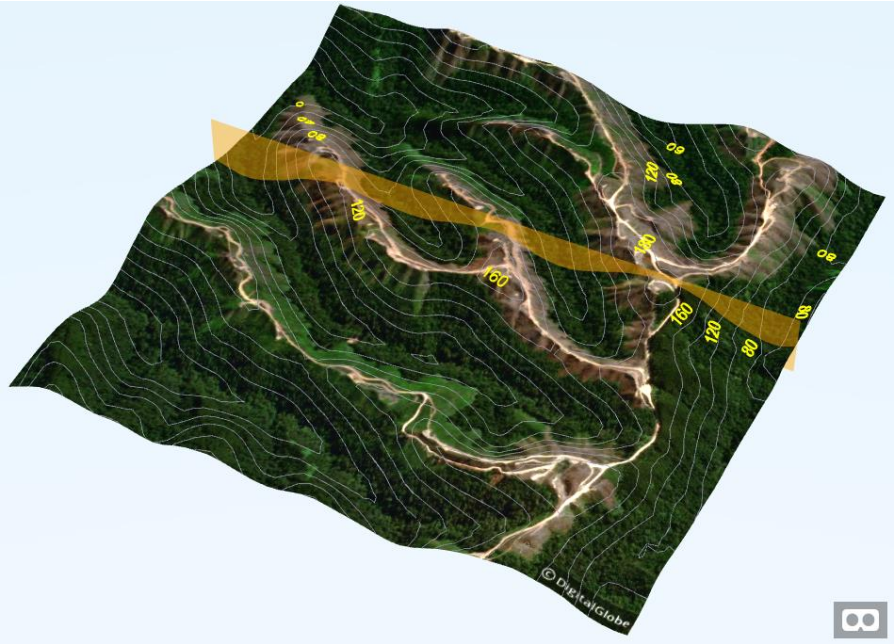


Figure 7. VR representation of a topographic profile mockup.

5. Augmented Reality

In an Augmented Reality programmed environment, elements modeled in Virtual Reality can be mixed with real objects shown using the camera of a device. Programming the AR web page uses the same structural tags shown in section 4, including the AR referential tag developed by Jerome Etienne [31], which should be inserted into the page header together the referential A-frame tag.

When a marker image is recognized in the AR scene, RV-modeled elements are activated. There are more than 80 programmed marker options in the library developed by Jerome Etienne, which are represented by tags that contains the programmed VR elements that are activated. The most common are hiro, kanji and the QR codes, shown in Figure 8.

Figure 8. Markers used by A-frame: hiro, kanji e QR codes #58 e #60.

The programmed HTML page structure with tags of two mockups is illustrated in Figure 9. The scene tags in AR include the webcam image embedding properties and mouse interaction capture or rays on linked objects (lines 7 and 8). The scene in AR has markers, which work with bit codes 0 and 1 in matrix form of images that are recognized by the webcam [32]. Markers perform as reference points, where specific positions can be set for the virtual objects that appear in the actual webcam image.

```
1  <head>
2   <script src="https://aframe.io/releases/0.8.2/aframe.min.js"></script>
3   <script src=" https://jeromeetienne.github.io/AR.js/aframe/build/
4      aframe-ar.min.js"></script>
5  </head>
6  <body>
7  <a-scene embedded cursor="rayOrigin:mouse" raycaster="objects:[link];"
8     arjs='sourceType:webcam; detectionMode:mono_and_matrix; matrixCodeType:3x3;'>
9  <a-assets>
10   <a-asset-item id="plataforma" src="imagens/curva13c.dae"></a-asset-item>
11   <a-asset-item id="plataforma1" src="imagens/curva13c.glb"></a-asset-item>
12   <a-asset-item id="splana" src="imagens/curva10.dae"></a-asset-item>
13   <a-asset-item id="splana1" src="imagens/curva10.glb"></a-asset-item>
14 </a-assets>
15 <a-marker type="barcode" value="60">
16   <a-link href="curva13c.html" title="VR"></a-link>
17   <a-entity position="-3.7,0,-5.5" scale="0.0035 0.0035 0.0035">
18    <a-entity collada-model="#plataforma"></a-entity>
19    <a-entity gltf-model="#plataforma1"></a-entity>
20   </a-entity>
21 </a-marker>
22 <a-marker type="barcode" value="58">
23   <a-link href="curva10.html" title="VR"></a-link>
24   <a-entity position="-4.4,0,-3.5" scale="0.0037 0.0037 0.0037">
25    <a-entity collada-model="#splana"></a-entity>
26    <a-entity gltf-model="#splana1"></a-entity>
27   </a-entity>
28 </a-marker>
```

Figure 9. A-frame HTML code for AR presentation of two Sketchup mockups.

With printed markers, students can access the web page using their devices. Thus, they display the programmed markers and the respective objects programmed in VR appear on AR ambient in device screens. The QR codes markers #58 and #60 were used for the AR visualization of mockups of a terrain section and a platform, respectively. The platform tag structure is between lines 15 and 21 of Figure 9. Tag <a-entity> is used to group the programming elements in VR, position them over the marker, and use scales. The coordinates shown on line 17 serve to position the model over the 2D representation of the level contour lines. In this way, students can visualize in 3D the drawing of the terrain sections constructed in 2D that represents the top view of the mockup.

The <a-link> tag, shown on line 16 of Figure 9, creates the interaction for accessing VR programmed pages through blue circles that appear over the markers. Between lines 22 and 28 are terrain section tags using the QR code #58. References for loading models are inserted in the <a-assets> tag, between lines 9 and 14. The other models are programmed in a similar way. Figure 10 shows AR views of the terrain section and the platform constructed by students using geometric concepts of Topography.

With markers printed on didactic materials, students can view 3D constructions that are made in 2D. In this case, the orthogonal projections that represent the top view of the level contours of each terrain are represented in the books, and students can overlay the objects in AR on their drawings to check the results or just view for a better understanding of the concepts studied. Using the technologies presented in this article, students are able to materialize the concepts of projections and topographic map readings more efficiently and dynamically.

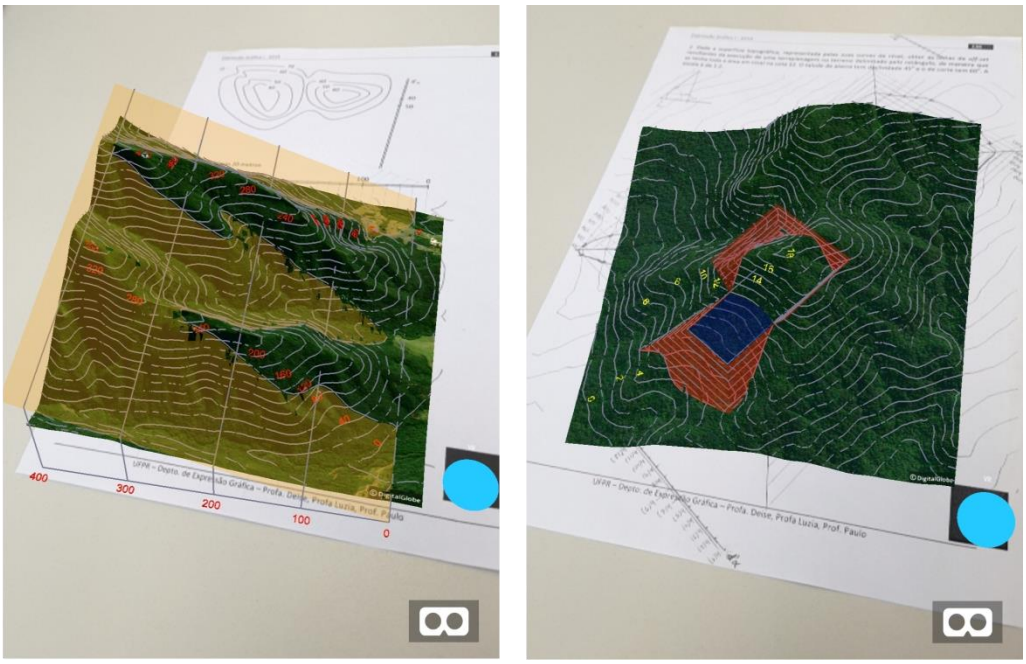


Figure 10. Mockups of the terrain section and the platform with AR.

The mockups used in this work with collada and glb formats are loaded quickly on any tested device. The VR and AR pages of the models shown in this paper are available at:

https://paulohscwb.github.io/cotadas/superficies/

The didactic materials shown in this article were used in the classroom with 5 classes of Civil Engineering and Forestry Engineering courses in the first semester of 2019, totaling 220 students. The websites programmed in AR and VR with the mockups were loaded without fail on all tested smartphones. There were no errors in loading websites on notebooks and tablets. The only notable observation is that AR sites tend to take a little longer to fully load because they use the device's webcam features. However, VR programmed sites load almost immediately on all tested devices on any operating system.

The technologies shown in AR and VR mockups for platform and terrain sections construction have helped students understand reading and geometric constructions involving topographic surfaces. Many students are able to create platform and terrain sections automatically and mechanically, without really knowing what shapes was represented in 3D. Using the proposed environments, the reading of the representation of a terrain through level contours was available to all students of the subjects tested in this work.

6. Conclusions

This article shows the steps of building a web-based environment for visualizing topographic surfaces in Virtual Reality and Augmented Reality. Using the visualization of printed markers, students can view AR terrain on any device with webcam and internet access, with links to sites in VR.

Sketchup mockups have topographic surfaces modeled using the Digital Globe platform, enabling the

creation of level contours, terrain sections, topographic profiles and embankments. These visualizations improve students' perception of constructions made in disciplines that involve projection concepts, as students can check out constructions made in 2D by overlaying the respective 3D models. Thus, the teaching of basic relief forms becomes more interesting, effective and dynamic, as it includes the simulation of reality in the drawings constructed by the students.

The result shows that developed environments are useful tools for classroom use as they allow students to view and manipulate graphical representations of mockups with their devices or employing Virtual Reality goggles for complete immersion in the scene. All devices tested by students in the basic Topography discipline loaded the sites without error, showing the versatility of the tool that works on any operating system.

The programmed environments shown in this paper can also be explored in Geography classes. All elements can be viewed in AR and VR and students can move the camera around the scene to find the best views of VR mockups with A-frame functions to orbit the camera around objects.

Some advantages of creating AR and VR environments such as classroom web pages are low cost, great performance, simplicity of programming, and operation on all types of smartphones, tablets and notebooks. By accessing the AR and VR sites, students can view virtual mockups anytime and anywhere in a very practical way, overcoming restrictions that students would have if they had only access to physical mockups.

Another advantage of the environments shown in this paper is the almost immediate loading of websites, as they are programmed in HTML with references from VR libraries developed in Java. Students do not need to download applications and multiple markers can be used on the same HTML page to create didactic materials with various topics programmed in AR and VR. Similar environments can be used in other disciplines such as Geometry, Differential and Integral Calculus, Statistics, Biology, Chemistry, Engineering and other areas that use 3D graphical representations.

7. References

[1] S.M. Attardi, and K.A. Rogers, “Design and implementation of an online systemic human anatomy course with laboratory,” Anatomical sciences education, v. 8, n.1, 2015, pp. 53-62.

[2] L.C. Cantos, J.L. Izquierdo, and E.C. Cantos, “Interactive multimedia application for teaching and learning in Analytical Geometry,” IEEE Latin America Transactions, v. 14, n. 7, 2016, pp. 3461-3466.

[3] C.C.R.G. Sena, and W.R. Carmo, “Cartografia Tátil: o papel das tecnologias na Educação Inclusiva,” Boletim Paulista de Geografia, v. 99, 2018, pp. 102-123.

[4] P.G. McMenamin, M.R. Quayle, C.R. McHenry, and J.W. Adams, “The production of anatomical teaching resources using three-dimensional (3D) printing technology,” Anatomical sciences education, v. 7, n. 6, 2014, pp. 479-486.

[5] M. Huleihil, "3D printing technology as innovative tool for math and geometry teaching applications," IOP Conference Series: Materials Science and Engineering, v. 164, n. 1, 2017, pp. 1-7.

[6] C. Moro, Z. Stromberga, A. Raikos, and A. Stirling, "The effectiveness of virtual and augmented reality in health sciences and medical anatomy," Anatomical sciences education, v. 10, n. 6, 2017, pp. 549-559.

[7] C. Kirner, and T.G. Kirner, "Development of an interactive artifact for cognitive rehabilitation based on augmented reality," International Conference on Virtual Rehabilitation (ICVR'11), Zurich, Switzerland, 2011, pp. 1-7.

[8] N.A.A.A. González, "Development of spatial skills with virtual reality and augmented reality," International Journal on Interactive Design and Manufacturing, v. 12, n. 1, 2017, pp. 133-144.

[9] P.P. Cerra, J.G. Rodríguez, H.F. Álvarez, and B.B. Parra, "Combining multimedia and self-assessment CAD tools in an interactive web environment to learn engineering drawing," Interactive Learning Environments, v. 27, n. 2, 2018, pp. 1-14.

[10] F.S. Irwansyah, Y.M. Yusuf, I. Farida, and M.A. Ramdhani, "Augmented Reality (AR) Technology on The Android Operating System in Chemistry Learning," IOP Conference Series: Materials Science and Engineering, v. 288, n. 1, 2018, pp. 233-237.

[11] F. Abdullah, M.H.B. Kassim, and N.Z. Sanusi, "Go virtual: exploring augmented reality application in representation of steel architectural construction for the enhancement of architecture education," Advanced Science Letters, v. 23, n. 2, 2017, pp. 804-808.

[12] M.E.C. Santos, A. Chen, T. Taketomi, G. Yamamoto, J. Miyazaki, and H. Kato, "Augmented reality learning experiences: Survey of prototype design and evaluation," IEEE Transactions on learning technologies, v. 7, n. 1, 2014, pp. 38-56.

[13] P.H. Siqueira, "Augmented Reality and Virtual Reality Web Environment to Visualizing the Planets of The Solar System," To Physics Journal, v. 3, 2019, pp. 167-185.

[14] M. Akçayır, and G. Akçayır, "Advantages and challenges associated with augmented reality for education: A systematic review of the literature," Educational Research Review, v. 20, 2017, pp. 1-11.

[15] J.A. Munoz-Cristóbal, V. Gallego-Lema, H.F. Arribas-Cubero, J.I. Asensio-Pérez, and A. Martínez-Monés, "Game of Blazons: Helping Teachers Conduct Learning Situations That Integrate Web Tools and Multiple Types of Augmented Reality," IEEE Transactions on learning technologies, v. 11, n. 4, 2018, pp. 506-519.

[16] G. Andrade, A.C.C.A. Oliveira, and M.C.A. Diniz, "Geografia e Sandbox: Contribuições da Realidade Aumentada para o Ensino das Formas de Relevo," 3ºCongresso sobre tecnologias na Educação, Fortaleza, CE, Brasil, 2018, pp. 258-270.

[17] R.S. Santos, R.S. Santos, C.M.S. Alencar, and C.E.S. Macedo, "Realidade Aumentada no Processo de Ensino-Aprendizagem da Topografia em Projeto de Engenharia Civil," 3ºCongresso sobre tecnologias na Educação, Fortaleza, CE, Brasil, 2018, pp. 582-589.

[18] E.T. Santos, R. Mafalda, A. Kawano, L.Y. Cheng, J.R.D. Petreche, B.C.C. Leite, S.L. Ferreira, and L.R.A. Cardoso, "Da geometria cotada ao modelamento 3D: projeto didático," Simpósio Nacional de Geometria Descritiva e Desenho Técnico e International Conference on Graphics Engineering for Arts and Design, Santa Cruz do Sul, RS, Brasil, 2003, pp. 1-7.

[19] E.L.S. Becker, and M.P. Nunes, "Relevo do Rio Grande do Sul, Brasil, e sua representação em maquete," Revista Percurso, v. 4, n. 2, 2012, pp. 113-132.

[20] C.M. Silva, and G.C. Ferreira, "Produção de material didático: jogo das curvas de nível," Boletim Goiano de Geografia, v. 28, 2008, pp. 157-170.

[21] R.R. Sousa, "Oficina de maquete de relevo: um recurso didático," Terrae Didatica, v. 10, n.1, 2014, pp. 22-28.

[22] W.O. Souza, G.M. Espíndola, A.R.A. Pereira, and L.A.C.M. Sá, "A realidade aumentada na apresentação de produtos cartográficos," Boletim de Ciências Geodésicas, v. 22, n. 4, 2016, pp. 790-806.

[23] C.C. Carrera, and L.A.B. Asensio, "Landscape interpretation with augmented reality and maps to improve spatial orientation skill," Journal of Geography in Higher Education, v. 41, n. 1, 2017, pp. 119-133.

[24] Sketchup, "3D Design Software," available in: https://www.sketchup.com, access in: 25.09.2019.

[25] Digital Globe, "Explore geospatial data in context," available in: https://www.digitalglobe.com, access in: 25.09.2019.

[26] A-frame, "A-frame documentation of Virtual Reality," available in: https://aframe.io/docs/0.8.0/introduction, access in: 25.09.2019.

[27] J.R. Oliveira, "Visualização de conteúdos multimídia num ambiente de realidade virtual," Masters dissertation: Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, 2018.

[28] T. Hinrichs, "An Orbit Controls Component for A-Frame VR," available in: https://github.com/tizzle/aframe-orbit-controls-component, access in: 25.09.2019.

[29] W. Murphy, "All-in-one natural hand controller, pointer, and gaze interaction library for A-Frame," available in: https://github.com/wmurphyrd/aframe-super-hands-component, access in: 25.09.2019.

[30] F. Serrano, "A-Frame teleport controls component," available in: https://github.com/fernandojsg/aframe-teleport-controls, access in: 25.09.2019.

[31] J. Etienne, "Efficient Augmented Reality for the Web," available in: https://github.com/jeromeetienne/AR.js, access in: 25.09.2019.

[32] H. Ishii, "Augmented Reality: Fundamentals and Nuclear Related Applications," International Journal of Nuclear Safety and simulation, v. 1, n. 4, 2010, pp. 316-327.

Agroecological Knowledge and the Need of Having an Investigative Dialogue with Elementary School Students

Dieison Prestes da Silveira*
Master's Degree student in Sociocultural Practices and Social Development

Vania Abreu de Oliveira*
Professor at the Master's Degree Program in Sociocultural Practices and Social Development

Jana Koefender*
Professor at the Master's Degree Program in Sociocultural Practices and Social Development
Professor at the Master's Degree Posgraduate Program in Rural Development

Juliane Nicolodi Camera*
Professor at the Master's Degree Posgraduate Program in Rural Development

Diego Pascoal Golle (Corresponding author)*
Professor at the Master's Degree Program in Sociocultural Practices and Social Development
Professor at the Master's Degree Posgraduate Program in Rural Development
*University of Cruz Alta, Cruz Alta, Brazil

Abstract

Schools are places where the insertion of individuals with different knowledge, experiences and life stories takes place. It is essential promoting the debate on environmental issues, with particular emphasis on agroecology for knowledge improvement, as well as for human, critical and reflective education. Moreover, it is necessary exchanging knowledge through dialogic practices. Thus, the aim of the current study is to analyze the importance of having students exchanging knowledge about environmental issues, with special focus on agroecology and on its philosophical, sociological and anthropological background, and about how it reflects on social knowledge. The study adopted a qualitative approach based on the dialectical method supported by action-research. The research project was submitted to the Research Ethics Committee (University of Cruz Alta), which issued favorable opinion to the development of it. Twenty-one students enrolled in a public school in Tupanciretã County, Rio Grande do Sul State, Brazil, participated in the study. Initially, a focus group was held in order to collect information about students' previous knowledge on the investigated subject. Results of the focus group were used to plan the action-research activities. Based on the dialogues, it is possible saying that students understand the meaning of agroecology, although they mainly associate such concept with animals and plants.

Keywords: Teaching; Learning; Environmental Knowledge.

1. Introduction

Schools are formative places that enable the insertion of individuals from different cultures, ethnicities and identities. Students and teachers, who present different knowledge levels and come from different realities, enable meaningful knowledge exchanges observed in several social contexts. However, teachers need to create ways and adopt methods to gain students' attention and to promote the teaching-learning process. Nowadays, the socio-cultural environment presents a whole variety of knowledge resulting from different experiences, beliefs, cultures and ideologies. Thus, exploring this knowledge and making it relevant to students encourage them to engage in social experiences and enable human, critical and reflective education. According to Moreira (2008), classroom investigations and debates help students expressing their knowledge during discussions in order to find the answers they look for.

The knowledge transmitted from generation to generation, in some cases, is confronted by, or added to, the scientific community. This knowledge is built through sociocultural interactions, which assurethe diversity and emergence of new knowledge. In addition, the dialogical and reflexive relationship between individuals enables the emergence of new questions and encourages reflective thinking about social environments. Thus, students become critical individuals who act in society.

The school environment enables teachers and students to improve traditional and scientific knowledge based on dialogues and activities that originate new experiences and lead to the implementation of, and reflection about, pedagogical practices. Thus, there is no dialogue without individuals and no new knowledge without interpersonal interactions.

In a global context, criticizing and reflecting about anthropic actions in the environment can help reformulating concepts and sensitizing individuals. Everyday, the media reports several environmental and social disasters affecting different populations. Educational institutions should promote debates about these topics in order to provide a humane, rational and citizenship education to students based on an epistemological perspective about environmental issues associated with sustainability, recycling, agroecology, ecology, among other concepts outspread and embodied by the social environment, but these concepts have little representativeness in daily practices. Overall, the environment is strongly associated with society; thus, controlling anthropocentric practices can help improving the quality of life of all living beings. According to Fernández and Garcia (2001), human beings must improve their understanding about, and attitude towards, nature in order to achieve environmental sustainability.

Students' education process should go beyond the classroom in order to enable the articulation between theoretical concepts and practical activities. It is necessary emphasizing contemporary environmental issues and their association with human, critical and citizenship education processes at the time to investigate elementary students' perception and sensitization about the agroecological-environmental topic. These students are at the early stage of process to acquire scientific knowledge about topics associated with different knowledge fields. This knowledge can lead students towards social and environmental understanding. According to Ribeiro (2013), learning is one of the main ways to improve ecological awareness. Accordingly, Leff (2008) states that environmental education is also a pedagogical process that guides education within the social context and, mainly, in the ecological reality individuals live in.

Based on the need of exchanging knowledge through dialogical practices, the aim of the current study was

to analyze the importance of having students exchanging knowledge about environmental issues, with special focus on agroecology and on its philosophical, sociological and anthropological background, and about how it reflects on social knowledge.

2. Methodology

According to Fachin (2003, p. 5), "*research is an intellectual procedure through which researchers aim to acquire knowledge by investigating a given reality in order to find new truths about a given fact (object, problem)*". The current research adopted a qualitative approach, since, according to Marconi and Lakatos (2004, p. 269), the "*Qualitative methodology aims at analyzing and interpreting deeper aspects and at describing the complexity of human behavior*."

The current research also followed the dialectic approach. According to Gil (2011, p. 13), the history of mankind goes through a dialectical path where contradictions transcend; however, they "[...] *give rise to new contradictions that now require solution*". Dynamic and totalizing interpretations of reality take place through dialectics. An action-research based on technical procedures was carried out. This research type enables a range of perceptions about, and relationships with, the surveyed individuals. Thiollent (1986) highlights that the action-research focuses the analysis of different forms of action, as well as structural aspects of social reality that should not remain unknown. Action manifests itself in a set of structurally determined relationships.

Action-research turns researchers into active individuals in pursuit of new discoveries. According to Thiollent (1986, p. 15), " *action-research certainly requires a participatory relationship structure between researchers and individuals in the investigated situation*". Investigating topics associated with school, teaching, curriculum and knowledge in the educational environment enables developing and improving didactic-pedagogical techniques and methods focused on improving the teaching-learning process between teachers and students.

The current research was conducted with sixth grade students in the age group 10-12 years, who were enrolled in a rural school in Tupanciretã County, Rio Grande do Sul State, Brazil. Research instruments comprised an action plan aimed at building a roadmap of developed activities, an audio recorder that was used during the focus groups, several photos, as well as a field diary, which was used to record students' interest and participation in the developed activities, as well as their commitment and responses to them.

Collected data were subjected to content analysis. According to Bardin (1997), content analysis is a technique focused on analyzing communications. Accordingly, Severino (2007, p. 121) describes content analysis as "[...] *a methodology focused on treating and analyzing information found in a given document, in the form of speeches in different written, oral, imagetic, gesture-based languages*". Content analysis helps exploring and interpreting data and it is often used in social research.

Before starting the activities, the research project was developed and submitted to the Research Ethics Committee of University of Cruz Alta, which issued a favorable opinion through the Certificate of Presentation for Ethical Appreciation n.04075118.0000.5322. In addition, different forms were taken into consideration, among them, the free and informed consent form, the research confidentiality form and the consent to mitigate harm to the ones participating in the research.

3. Results

The dialogue focused on analyzing the previous knowledge of sixth grade students about the investigated topic. It took place in the playroom of the aforementioned school, in April 2019. The conversation session involved 21 students, the researcher in charge and the teacher-mediator of the focus group. The analysis of the first focus group was used as basis to develop the action-research.

Students sat in a circle around the table where the cellphone used to audio record the conversations was placed on. Several questions were asked to encourage debates and knowledge exposure, which were mainly based on experience reports. The first question aimed at investigating whether students new the meaning of agroecology or even if they had already heard about it. Few students voluntarily, although timidly, answered this question: two students associated agroecology with plants, two did not know about it, one associated it with plants and animals, and another one mentioned the word 'ecosystem'.

With respect to sustainability, one student reported to support it, whereas another one reported to have heard that it has something to do with plants. At this point, the mediator encouraged students to think about their relationship with the planet. This topic made other students startto participate in the debate more openly. According to some students, their relationship with the planet lies on living / existing on it, on collaborating with life itself. Yet, others reported that it has to do with ecology, animals, with not polluting the streets and forests. Only one student among the ones who answered this question reported that she did not know anything about the topic.

As students expressed their ideas, opinions and experiences, they were asked about whether their homes or relatives and / or friends had gardens and whether they had already helped planting something. Most students showed interest in answering this question andthey reported their experiences in an organized way. In total, 48% of the 21partcipants reported to have a garden at home. With respect to having a home vegetable garden and to who helped planting it, student 2 reported: "*My father, my mother, my two brothers and myself*". Based on this statement, it is possible saying that vegetable gardens are used as an alternative to get healthy food and to follow diets rich in vegetables. In addition, having a vegetable garden helps mitigating costs with food.

Students also reported to have lettuce, arugula, corn, strawberry, tomato, passion fruit, orange and bergamot tree planted in ther homes. According to student 7, his family also planted ryegrass, which was used to feed chickens and horses.

The teacher-mediator asked students whether they had watchedthe news about the rupture of some ore tailing dams in Minas Gerais State. It was done to encourage students to exchange their knowledge about environmental catastrophies, in which man and capitalist ideas are likely responsible for social, environmental, cultural and economic losses. Most students reported to have known about it, whereas two students had not. Thus, an open dialogue about the topic took place to allow students to understand what had happened. Students reported that many people, animals and plants died in that event. According to student 8, because of that event, residents lost "*animals, plants and their lives*" and "[...] *many people were left homeless*". Overall, students' reports have shown that they were sad about the severity of the situation. Thus, it is possible saying that students were, and remain, overwhelmed by the consequences arising from the rupture of tailing dams in Minas Gerais State.

Another question asked to participants by the focus group mediator concerned the definition of environment. Several answers associated with trees, forests, animals, nature, water, air and birds have emerged. According to student 6, environment is "*where we live*". The exchange of knowledge and experiences among participants enabled a knowledge construction process, based on the knowledge exchange ideology by Freire (1987), according to whom, one learns from the other and builds knowledge.

Students were also asked about whether they knew who the subjects who produce organic products are. Some students responded that they were farmers, whereas others defined them as producers. Based on this question, another question was asked: Why are these food products not valued? Of the 21 participants, four did not know the answer tothis question, whereas student 11 reported that: "*The plants are valued because they put food on the table*".

Another question concerned students' diet. They were asked whether they only eat processed products or vegetables grown in their garden. Most students reported to often feed on food grown in their garden, as well as on food purchased in the market. Only one student reported to not eat plant-origin food. According to one student, his mother used old tires to build the beds in his home garden. He added that his family was helping the environment by reusing materials that could be discarded anywhere. According to the aforementioned dialogues, and to data in the previous table, students made different reports on agroecology, sustainability and environment. These reports were the guiding axis of the current study.

Although participants shyness was visible in the first focus group, it was possible observing that, over time, they were able to contribute to the activity by expressing their experiences. Overall, the word 'agroecology' was not observed in the vocabulary of sixth grade students. However, it was possible observing that words such as sustainability, preservation, care for the environment and recycling were part of their daily lives. As the dialogical discussions progressed, students explained facts / circumstances they experienced, such as having a home garden, taking care of the garden, avoiding water waste, among other experiences that underpin agroecology. Thus, these different planned actions are expected to help expanding students' knowledge, as well as to turn them into agents capable of changing society through attitudes and practices based on social values.

The teasing strategies adopted in the first focus group enabled a brief analysis of students' experiences and knowledge. The intention was to make the planned activities meaningful to participants' lives so they can use them to support their daily practices. The first focus group made it possible conducting a survey focused on raising thoughts about future actions, which were planned based on the action-research method. Dialogue, critical thinking, practices developed during meetings and reflections should be part of students' daily lives in order to help mitigating alienation cases and / or disseminating agroecological practices capable of contributing to the environment.

4. Discussion: schools seen as places for human and citizenship education focused on helping better understand the environment

The merge of knowledge, experiences and life stories happens in several places; however, schools are human, social, critical and reflexive education environments that encourage the practice of dialogue and the construction of new knowledge. Nowadays, thinking about actions capable of benefiting all life

forms triggers the awareness about environmental preservation and maintenance issues. The construction of spaces where knowledge is plural leads to debates about anthropic actions headed towards the natural environment. Thus, the aim of the current chapter is to address the role played by educational environments in individuals' reflection processes and in qualifying them to develop critical and autonomous actions in socio-environmental and cultural contexts.

Schools are environments focused on promoting the teaching-learning process. Teachers and students driven by curiosity exchange experiences and promote the articulation of different concepts and knowledge. The greater the interaction and the pursuit of knowledge, the stronger the likelihood of becoming critical and reflective individuals.

As students broaden their knowledge, the better they understand the role played by them in society, as well as the interweave values and attitudes they must adopt in social practices. Overall, they learn from each other as they talk and share their experiences. Knowledge transferred from generation to generation becomes plural in educational environments. It comprises customs, dances, songs and practices that merge and (re) create new ways of acting in society. Schools are educational environments focused on encouraging the development of ideas, as well as on forming autonomous individuals and citizens.

Past generations have left many legacies for the contemporary civilization. They comprise beliefs, religions and cultures that remain for decades, but even if they change, there is still some originality in them. Teaching is an example of legacy, because, even after years, one still needs to teach someone so knowledge can spread towards collectivity. Overall, discoveries can be shared in a dialogical, practical and expository manner. New knowledge should be shared among several individuals to enable spreading it as much as possible.

In addition to the educational, citizenship and human education process, schools often articulate knowledge through dialogic and practical activities. Teachers are professionals who exercise both pedagogical and social knowledge. Cooperative activities, such as group works, make classes more dynamic and transcend the pursuit of new knowledge. Educational teams should encourage students to find answers to their questions, as well as to find ways to solve challenges affecting the educational field, in order to enable the teaching-learning process.

Students' participation in teaching, research and extension projects reflects on their personal and professional life, since the amount of experience acquired by them ends up contributing to their identity/moral/citizenship construction process. Schools - as environments focused on implementing theoretical and practical activities - should plan and develop several practical activities to be performed with students. Some examples comprise the elaboration of didactic materials, scavenger hunts, educational school games, the construction of a vegetable garden, as well as cultural and integrative activities along with the community and other institutions. Finally, the school environment should enable the connection between students and society in order to help the formative and educational process of different social groups.

It is essential taking into consideration that the world has been experiencing a liquid modernity. According to Baumam (2001), the anthropological thinking is influenced by economic and political forces that make it difficul reflecting about the current reality. Agricultural practices have persisted since the dawn of civilizations in the anthropocene. Thus, men need the soil to plant, harvest, breed animals, build houses,

among others. The natural environment has changed since man started pursuing new horizons such as socioeconomic development. According to Caporal and Costabeber (2004), in the pursuit of building a new knowledge, agroecology has emerged with a new scientific focus capable of supporting the transition from farming styles to a more sustainable practice.

Places addressing environmental topics, such as educational institutions, enable the construction of new knowledge, as well as encourages changes in social practices by (de) constructing concepts and reformulating ways of thinking. School - as the environment for individuals' ethical, social and citizenship education - contributes to the formation of critical-reflective individuals capable of understanding their role in society and of enabling changes. According to Oliveira, Quintas and Gualda (1991, p. 18), "*environmental education enables individuals to build values necessary to live in society and to contribute to the environmental balance*". Based on Altieri (2000), agroecology refers to the environmental and social perception about agriculture, which has implications in the global context.

Understanding that the environment is not only characterized by trees, rivers and animals remains a challenge for society, since this concept pervades all social groups. Besides new studies, deconstructing and reconstructing the concept of environment requires reflections and an epistemological perspective about this topic. According to Guimarães (2011, p. 13), "*the environment is not only the sum of its component parts, but also the interaction between these parts in interrelation with the whole* [...]". Thus, all living and non-living beings are part of the biophysical environment, because together, they maintain the environmental balance.

The plurality of social knowledge originates from dialogue and research, i.e., the empirical knowledge of one group should be spread to others in order to bring significance to all individuals. Educational environments are an example of places that enable the exchange of traditional and scientific knowledge, since they value knowledge diversity. According to Eloy et al. (2014), most scientific knowledge emerged from local knowledge, also known as traditional knowledge, so knowledge diversity must be respected and valued. Based on Ribeiro (2013, p. 206), "*learning is one of the ways to improve ecological awareness and reduce several forms of alienation*". Thus, one realizes the importance of working on these subjects in schools.

This concept of knowledge is embodied by different cultures and it brings along reflections about the need of exchanging knowledge by using dialogue and sociocultural practices, such as group communication mechanisms. Overall, individuals' knowledge derives from experiences they have in their place of living, as well as from habits and traditions perpetuated by the culture of each group. Yet, this knowledge should not be unique to a single group, because the greater the knowledge, the stonger the likelihood of finding answers to social issues affecting the world population.

The ecology of knowledge proposed by Santos (2010) brings along reflections about social, cultural, economic and environmental aspects, since they are part of society's knowledge, although dominated by a minority. One cannot exclude this knowledge or say which knowledge is the correct one. It is necessary thinking about the knowledge necessary nowadays and about how it should be used.

Students should be aware that natural resources must be used in a conscious and sustainable way. According to Fernández and Garcia (2001, p. 17), it is necessary "*having an evolved human being, whose attitude towards nature lies on coexistence rather than on exploitation"* in order to enable sustainability.

Knowledge exchanges in schools generate significant knowledge that is taken for life. According to Altieri (2012), agroecology enables man's wisdom and knowledge based on human interactions with nature.

Addressing knowledge about the environment under the agroecological perspective in educational spaces allows redefining knowledge and changing the social context. According to Leff (2008, p. 257), "*environmental education brings along a new pedagogy, which arises from the need of guiding education within the social context, as well as in the ecological and cultural reality individuals and actors of the educational process live in*". Environmental education enables individuals to better understand that they are part of the environment and, consequently, that they must preserve it. Based on Almeida and Oliveira (2017), the principle guiding agroecology and its contents (science, technique and practice), lies on the valorization of the life, culture, knowledge and techniques of individuals living in the countryside, as well as their way of living in the agroecosystem. Thus, agroecological contents and practices are of paramount importance in rural schools.

Knowledge exchanges between students and teachers generate an environment where teachers are not the owners of knowledge. According to Freire (1987, p. 9), "*teachers are not only educators; they are also the ones who, while teaching, also learn from the dialogue with their students*". Thus, dialogue allows all parts to expose their knowledge and to build a new knowledge together. Environmental education, with emphasis on agroecological practices, should be disseminated in individuals' identity development process, since the very beginning of their school life. Students start developing their identity through social interactions; thus, encouraging new experiences may result in meaningful learning.

Enabling practical activities about agroecology may result in socio-cultural (trans) formations, since school experiences are overall significant to knowledge acquisition. Based on the exchange of knowledge and experiences, new environmental knowledge can emerge and enable a human, social and citizenship education based on the dialogue between students and teachers.

Building a vegetable garden in the school by giving attention to the handling of soil and cultivars, as well as to their development process, helps individuals better understanding different knowledge types spread throughout different communities. Students should plan and plant a garden with their teachers.

5. Final Considerations

Initial investigations have shown that students overall associate agroecology with plants and animals. Holding debates in the educational environment encourages students to share their experiences and enables teachers to develop didactic-pedagogical strategies to be adopted in the classroom. In addition, topics associated with the environment, such as agroecology and its sociological, philosophical and anthropological background; enable reflecting about the need of forming critical individuals to act in the social environment and to have environmental responsibility.

The sixth-grade students investigated in the current study were very participative in answering the questions, a fact that highlighted the relevance of enabling dialogue in the educational environment in order to enhance the knowledge exchanging process. All students can share their experiences and it is up to the teacher to boost debates in the classroom. The initial dialogue in the present study was used as basis to plan and implement action-research activities.

6. Acknowledgement

The current study was partly financed by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES) – Finance Code 001. The authors are gratefull for the scholarship granted by Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul (FAPERGS).

7. References

ALMEIDA, Rejane C. Medeiros de.; OLIVEIRA, Eduardo Bonfim de. Agroecologia nas escolas do campo no município de Goiás. In: Cadernos de Agroecologia. Anais do VI Congresso Latino-Americano, X Congresso Brasileiro, V Seminário do DF e Entorno. Brasília, DF, Brasil, 2017.

ALTIERI, Miguel. Agroecologia: bases científicas para uma agricultura sustentável. 3 ed. São Paulo - Rio de Janeiro: Expressão Popular – AS-PTA, 2012.

ALTIERI, Miguel. Agroecologia – a dinâmica produtiva da agricultura sustentável. Porto Alegre: Editora Universidade/UFRGS, 2000.

BARDIN, Laurence. Análise de conteúdo. Lisboa: Edições 70, 1977.

BAUMAN, Zygmunt. Modernidade Líquida. Rio de Janeiro: Editora Zahar, 2001.

CAPORAL, Francisco Roberto; COSTABEBER, José Antônio. Agroecologia e extensão rural: contribuições para a promoção do desenvolvimento rural sustentável. Brasília: MDA/SAF/DATER-IICA. 2004.

ELOY, Cristinne, Costa; VIEIRA. Danielle Machado; LUCENA, Camilla Marques de; ANDRADE, Maristela Oliveira de. Apropriação e proteção dos conhecimentos tradicionais no Brasil: a conservação da biodiversidade e os direitos das populações tradicionais. Gaia Scientiae, Edição Especial Populações Tradicionais, 2014.

FACHIN, Odília. Fundamentos de Metodologia. 4ª ed. São Paulo: Saraiva, 2003.

FERNÁNDEZ, Xavier Simón; GARCIA, Xavier Domingues; DOLORES. Desenvolvimento rural sustentável: uma perspectiva agroecológica. Porto Alegre: Revista Agroecologia e Desenvolvimento Rural Sustentável. v.2, n.2 abr./jun. 2001. (pág. 17-26).

FREIRE, Paulo. Pedagogia do oprimido. 17. Ed. Rio de Janeiro: Paz e Terra, 1987.

GIL, Antonio Carlos. Métodos e Técnicas de Pesquisa Social. 6ª ed. São Paulo: Editora Atlas, 2011.

GUIMARÃES, Mauro. Caminhos da educação ambiental: da forma à ação. São Paulo: Papirus, 2011.

LEFF, Enrique. Saber ambiental: Sustentabilidade, Racionalidade, Complexidade, Poder. Petrópolis, Rio de Janeiro: Vozes, 2008.

MARCONI, Marina de Andrade; LAKATOS, Eva Maria. Metodologia Científica. São Paulo: Editora Atlas, 2004.

MOREIRA, Marco Antônio. Organizadores prévios e Aprendizagem Significativa. Revista Chilena de Educación Científica, v. 7, n. 2, pp. 23-30, 2008.

RIBEIRO, Andrés Maurício. Meio Ambiente & Evolução Humana. São Paulo: Editora Senac São Paulo, 2013.

SANTOS, Boaventura de Souza. A gramática do tempo: para uma nova cultura política. 3ª ed. São Paulo: Cortez, 2010.

SEVERINO, Antônio Joaquim. Metodologia do Trabalho Científico. São Paulo: Cortez, 2007.

THIOLLENT, Michel. Metodologia da Pesquisa-ação. 2. ed. São Paulo: Cortez, 1986.

Loading time monitoring via individual control charts

Maria Emilia Camargo
University of Caxias do Sul, Brazil

Walter Priesnitz Filho
Federal University of Santa Maria, Brazil

Suzana Leitão Russo
Federal University of Sergipe, Brazil

Angela Isabel dos Santos Dullius
Federal University of Santa Maria, Brazil

Ademar Galelli
University of Caxias do Sul, Brazil

Marta Elisete Ventura da Motta
University of Caxias do Sul, Brazil

Uiliam Hahn Biegelmeyer
University of Caxias do Sul, Brazil

Abstract

In quality control we find techniques that come from different fields, because the objective is to reduce the variability in quality characteristics, these are control and adjustment of processes. In this work, the individual control charts (Xind and Rm) were used to monitor the loading time of a truck measured during 60 consecutive days of a cargo transport company in Rio Grande do Sul. The results showed that the process is out of control both in average and variability, requiring a systematic monitoring in order for the company to maintain the quality of services provided to its customers.

Keywords: *control charts; variability; loading time;*

1. Introduction

At a time of increasing competitiveness among companies in all sectors, carriers are undergoing a process of modernization that involves adopting measures to monitor their activities, always seeking a better performance of service to their customers (GOMES; RIBEIRO, 2004).

From 1990 on, with the commercial opening since 1993, the Brazilian transport companies started to modernize, meeting the demands of the large industrial and commercial firms (GOMES; RIBEIRO, 2004).

According to NBR ISO 8402/1994, "The services are results generated by activities in the interface between the supplier and the client and, by the internal activities of the supplier, to meet the needs of the client".

The activities and trends in quality in recent decades have undergone major transformations. There is a market-oriented quality revolution and it is now beginning to have an impact on both the industrial and service sectors. In addition to high quality products, consumers expect service excellence.

According to Denton (1990), in order to achieve truly quality services, a cultural and perceptual change within the organizations is necessary. Several statistical tools can be used to monitor the performance of services. In this work, the control charts introduced by Shewhart in 1931, which are simple and effective for monitoring the performance of manufacturing processes and, for this reason, widely used in practice, were used.

According to Montgomery (2000), there are at least five reasons for using control charts: (i) are proven techniques for improving productivity, (ii) are effective in preventing defects, (iii) avoid unnecessary adjustments in processes, (iv) provide reliable information for diagnosing process performance and (v) provide information on process capability, as well as allow assessing whether the behavior of the process, in terms of variation, is predictable.

Variability is an intrinsic feature of any service and, in particular, of the logistics service A process is a set of articulated causes that produce one or more effects (FIGUEIREDO; WANKE, 2000). In this case the process considered is the loading time of a truck.

In any process it is impossible to achieve results without variability. Such impossibility is due to the causes of variation inherent to the processes. Two types of variations can be present in a process, i.e., common causes and/or special causes.

Common (or random) causes of variation are intrinsic to the process (DEMING, 1990) and have a stable distribution. The individual identification of these causes is usually a difficult task. Punctual action attempts on common causes generally reduce little variation, and the significant reduction of these causes requires a re-evaluation of the entire system, entailing high costs for the process maintainer. The special (or identifiable) causes of variation are causes that, acting on the process, cause great variations in it. These causes have an unstable distribution and are generally easy to identify. Actions on special causes, if they exist, should be preferred, because they are low cost and greatly reduce the variation of the process.

This paper aims to present an analysis of the performance of the control charts (X_{ind} and R_m) applied in monitoring the loading time of a truck measured during 60 consecutive days of a small cargo transport company from Rio Grande do Sul.

It can be said that transport means driving or taking from one place to another some good. From a business point of view, transportation is part of the logistics or distribution system of companies operating in the market. Road freight transport is an essential activity for the country's economy. Without transport (whatever the mode), the production of the other economic sectors would not advance at all, since the goods produced would not be able to reach their final consumers. In a certain way, all economic agents depend directly or indirectly on transport to satisfy their needs, which is a link of socioeconomic connection (BASTIDAS; NERY; CARVALHO, 2001).

For Parreiras (1990), the mission of freight transport is "to solve customers' transport problems, making them satisfied and profitable. The cargo transport company sells tranquility".

This article is structured as follows: the second section presents the theoretical foundation, the third section presents the results and the discussion. The article is closed by a section of final considerations.

2. Theoretical Basis

In this item will be presented the theoretical basis for the development of this work.

2.1 Control charts (X_{ind} and R_m)

When only individual measurements are available, the use of X_{ind} and R_m control charts becomes necessary. The X_{ind} chart aims to control the individual process measurements and moving amplitude (R_m) is defined as the difference (in module) between two consecutive individual samples, which serves to control the process variability (BUCHAIM; BARBOSA NETO, 1999; MONTGOMERY, 2000).

According to Montgomery (2000), assuming a process where the quality characteristic of interest X_i to be controlled has a normal distribution with mean μ and standard deviation σ.

If x_1, x_2, x_3,...,x_n are samples resulting from individual observations, that is, samples of size n=1 of distribution with mean μ and standard deviation $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} = \sigma$, because n=1, that is $\bar{X} \sim N\left(\mu, \sigma_{\bar{X}}\right) = N(\mu, \sigma)$

.

According to the properties of the normal distribution, it is concluded that there is a probability equal to ($1-\alpha$) that the average of the process is between $\mu - Z_{\frac{\alpha}{2}}\sigma$ and $\mu + Z_{\frac{\alpha}{2}}\sigma$, i.e.

$$P\left(\mu - Z_{\frac{\alpha}{2}}\sigma < \bar{X} < \mu + Z_{\frac{\alpha}{2}}\sigma\right) = 1-\alpha .$$

Using the system 3σ, which consists of doing $Z_{\frac{\alpha}{2}} = 3$. In this case, when k=3, it indicates that 99.73% of the observations in the control chart are in the interval $\mu \pm 3\sigma$, that is, $P\left(\mu - 3\sigma < \bar{X} < \mu + 3\sigma\right) = 0{,}9973$ that it is the probability of occurrence of the observations within this interval. Through the system 3σ, we can conclude that the probability of the graph emitting a false alarm is equal to ($1-\alpha = 1-0{,}9973 = 0{,}0027$), which is the probability of occurrence of values outside the interval $(\mu - 3\sigma, \mu + 3\sigma)$ considered.

Using $\hat{\mu} = \bar{X}$ and $\hat{\sigma} = \frac{R_m}{d_2}$ as estimators of μ and σ respectively, the mathematical model of the control chart for individual measurements x_i is defined with the following parameters:

Upper Control Limit

$$UCL_x = \bar{x} + \frac{3}{d_2}\bar{R}_m \qquad (1)$$

d_2 = tabulated constant as a function of the moving range

Center line

$$LM_x = \bar{x} \quad (2)$$

that represents the mean value of the quality characteristic under study that corresponds to the state under inspection.

Lower Control Limit

$$LCL_x = \bar{x} - \frac{3}{d_2}\bar{R}_m \quad (3)$$

where:

The process average is: $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ (4)

The range of the process is:

$$\bar{R}_m = \frac{\sum_{i=1}^{n-1} R_{mi}}{n-1}$$

(5)

According to Montgomery (2000), in order to evaluate the performance of a control chart and compare several procedures, we can take into account the values of Type I (risk of a point falling outside the control limits, indicating an out of control condition when no significant cause is present) and Type II (risk of a point falling between the limits) errors, when the process is really out of control) associated with decision making and the resulting economic consequences, i.e., the cost associated with the search for the non-existent problem and the cost associated with poor quality that is obtained in the final product since the change occurs until it is detected.

The performance of a control chart can be evaluated in part in terms of sensitivity to detect deviations in the statistics being monitored. This sensitivity can be measured by the number of samples taken until the graph signals that a deviation has occurred, or by the Mean Quadratic Deviation (MONTGOMERY, 2000).

2.2 Performance Measure

The performance measure used, in order to evaluate the effectiveness of the control charts, is the one recommended by (MONTGOMERY, 2000; RUSSO; CAMARGO; FABRIS, 2012), that is, the Mean Quadratic Deviation (DQM), given by:

$$MQD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - T)^2}{n}} \quad (7)$$

where:

n = number of observations;

T = established default value.

3. Results and Discussion

3.1 Descriptive analysis of the data

The values related to the measurement of loading times of a truck from a transport company in the State of Rio Grande do Sul, obtained during 60 days, are presented in Figure 1.

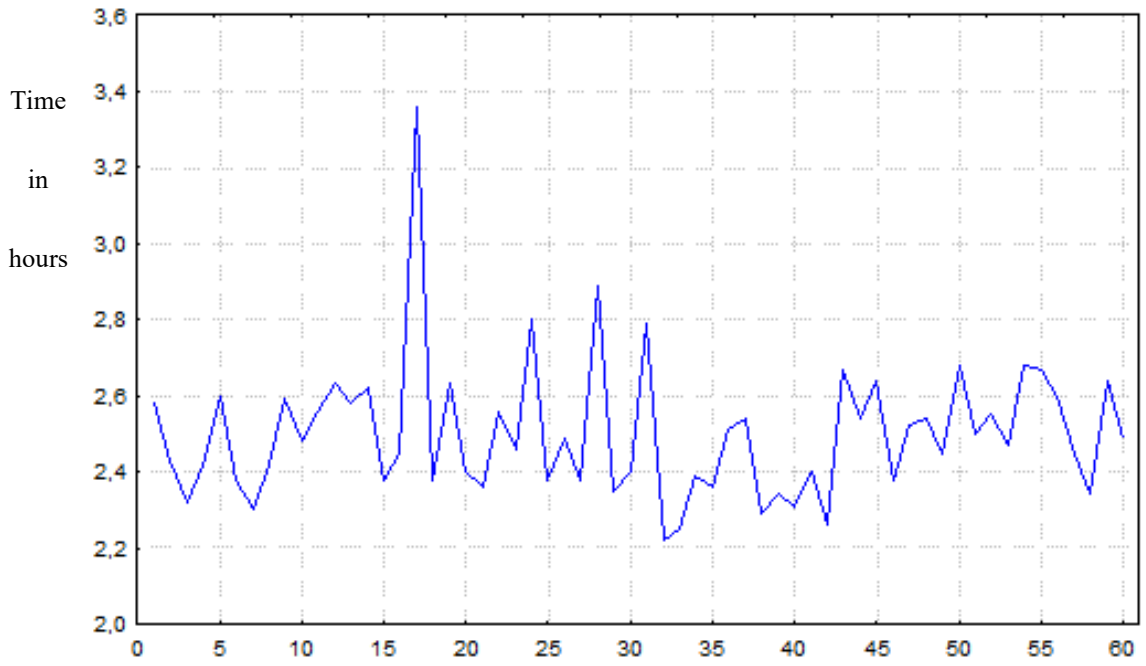


Figure 1 - Representative series of the loading time

It was observed that there was an outlier at observation (t=17), i.e., at observation (t=16) the loading time was 2 hours and 45 minutes, passing to 3 hours and 36 minutes at observation t=17, with an increase of 37.14%. Subsequently in observation 18 there was a reduction of 41.48% to 2 hours and 38 minutes. This variation suggests that a remarkable cause may have occurred, which may mean an abnormality that can be investigated and confirmed through the control charts.

The Kolmogorov-Smirnov test (CONOVER, 1971) was applied to verify the normality of the data, which showed a value of (p-value = 0.27 > 0.05), thus ensuring that the data adjust to a normal distribution, at a significance level of 5%. To test independence, the autocorrelation coefficients presented in Figure 2 were calculated, confirming that the data are independent, since all the autocorrelation function coefficients are within the control limits, i.e., ±2 standard errors.

Thus, the necessary assumptions of normality and independence of the measures are guaranteed and the traditional control charts can be built.

To compare the mean of the measurements (2.50083) with the standard value established by the company, which is 2 hours and fifty minutes, the unilateral student t-test was applied, concluding that the means are equal to the significance level of 5%. Figure 2 shows the autocorrelation coefficients.

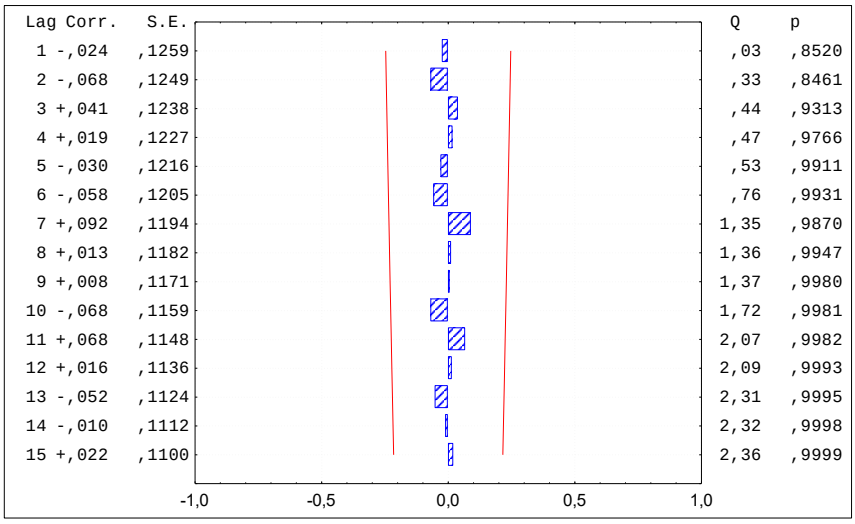


Figure 2 - Autocorrelation coefficients

3.2 Construction of control charts

In Figure 3, it is presented the chart (X_{ind}) to monitor the behavior of the average of the individual values of the loading time.

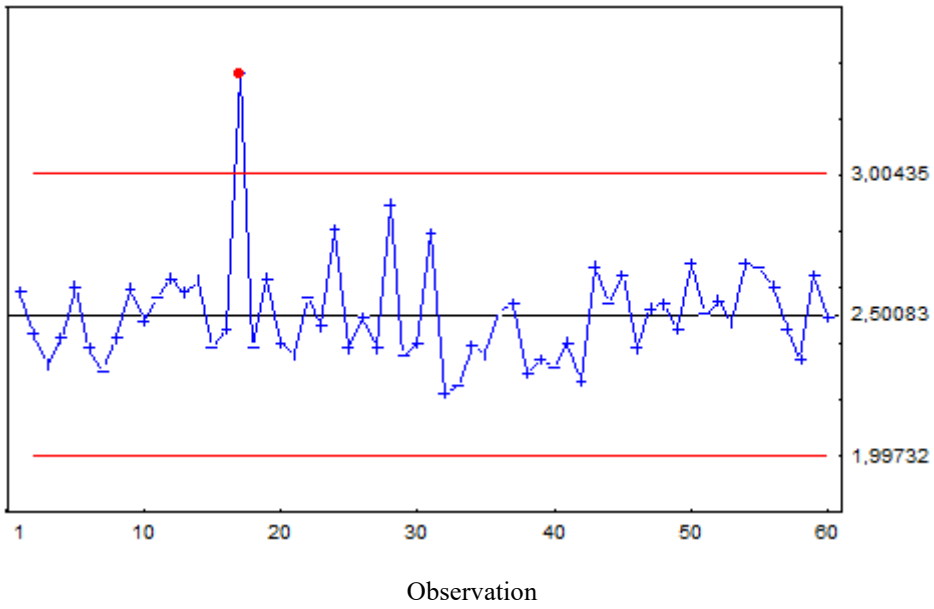


Figure 3 - Control chart for the average loading time

The letter to monitor the dispersion of the process is presented in Figure 4. The X_{ind} chart (individual measurements) presents a special cause. In the observation t=17, as can be seen, there was an increase

in the loading time (3 hours 36 minutes), unbalancing the process. On this day there was a shortage of one employee. In Figure 4, it is shown the graph of the control chart for range of the loading time.

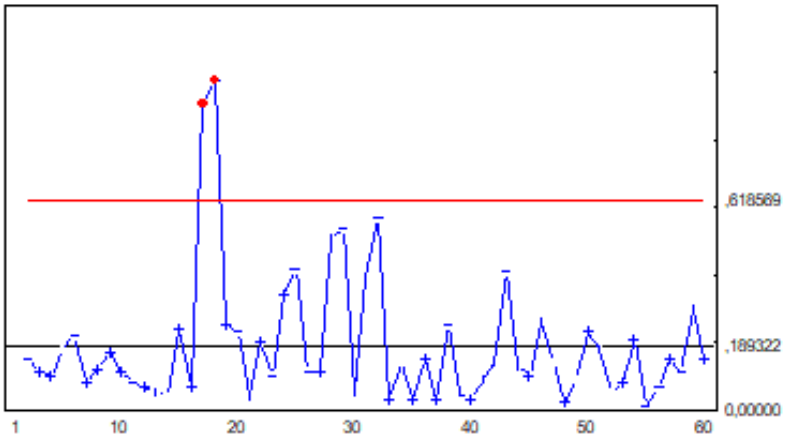


Figure 4 - Control chart for loading time range

In the chart R_m, the presence of special causes acting in the process, that is, in observations 17 and 18. The loading time went from 2 hours and 45 minutes in observation 16 to 3 hours 36 minutes in observation 17, plus 91 minutes. On day 18 when the employee who had been absent on the previous day returned, the time returned to 2 hours 38 minutes in observation t=18, causing a decrease in time of 98 minutes. These variations are shown in Figure 4.

4. Conclusion

The present work found basis in the control chart procedures for individual Shewhart measures (Xind and Rm), used for independent and normally distributed data, which aims to detect changes in the process, both in mean and variability.

In conclusion, it can be said that the control charts are tools that can be used to monitor the behavior of variables in the logistics service, helping professionals in the area to monitor their processes in order to maintain quality services for their customers.

The charts built in this work to monitor the loading time presented satisfactory performance, with a mean square deviation of 0.18 showing that the increase in time on day 17 caused an increase of 29% in process variability.

Thus, the control charts, like any control tool, can help those who control the process and must be used properly. According to Figueiredo; Wanke (2000) "its objective is to show to all who work in the process how it is developing and to inform them quickly the occurrence of some anomaly. This creates in the group an alert consciousness and the interest in solving the problem having it been caused by an equipment failure, a human error or even by some external factor to the system. It also sensitizes the direction of the company to provide all the necessary assistance in order to keep the process under control".

5. REFERENCES

[1] BASTIDAS, G.; NERY, R.; CARVALHO, M.M. *Uso do QFD no Setor de Serviços: Avaliação de uma Transportadora Rodoviária de* Carga. Salvador: Anais do XXI ENEGEP, 2001.

[2] BUCHAIM, J. G.; BARBOSA NETO, P. R. *Controle estatístico do processo fundamental*. São Paulo: QPB .Consultoria e Treinamento, 1994.

[3] CONOVER, W. J. (1971). *Practical nonparametric statistics*. New York: John Wiley.

[4] DEMING, W. E. *Qualidade: a revolução da administração*. Rio de Janeiro: Saraiva, 1990.

[5] DENTON, D. K. Qualidade em Serviços. São Paulo: Mac Graw-Hill, 1990.

[6] FIGUEIREDO, K.; WANKE, P. *Ferramentas da Qualidade Total Aplicadas no Aperfeiçoamento do Serviço Logístico*. Disponível em www.cel.coppead.ufrj.br/fs-public-htm. Acessado em 20/05/04, 2000.

[7] GOMES, C. F. S. & RIBEIRO, P.C.C. *Gestão da Cadeia de Suprimentos Integrada à Tecnologia da Informação*. São Paulo: Thomson, 2004.

[8] MONTGOMERY, D. C. *Introduction to Statistical Quality Control*, 4th ed. New York: John Wiley, 2000.

[9] PARREIRAS, R. *Marketing de Transporte de Cargas*. São Paulo: MacGraw-Hill, 1990.

[10] RUSSO, S. L.; CAMARGO, M.E.; FABRIS, J. P. Applications of Control Charts Arima for Autocorrelated Data. In: InTec. (Org.). Latest Research into Quality Control. (Org.). Applications of Control Charts Arima for Autocorrelated Data. 1ed., 2012, v. 1, p. 1-30. http://dx.doi.org/10.5772/50990.

[11] SHEWART, W. A. *Economic Control of quality of Manufactured product*. New York, D. Van Nostrand Company, INC. 1931.

Post Graduate Courses Stricto Sensu can change profile of Students in the Labor Market?

Sebastião Leão
Universidade de Caxias do Sul, Brazil

Marta Elisete Ventura da Motta
University of Caxias do Sul, Brazil

Maria Emilia Camargo
University of Caxias do Sul, Brazil

Angela Isabel dos Santos Dullius
Federal University of Santa Maria, Brazil

Ademar Galelli
University of Caxias do Sul, Brazil

Abstract

This article aims to verify the importance of the graduate program stricto sensu in Brazil, through a literature search. Through the research it is possible to highlight historical notes on the higher education courses stricto sensu in Brazil, identifying the contribution of CAPES to the higher education courses stricto sensu and the importance of these courses for specialization and training of professionals for the labor market. It can also be observed that the graduate programs stricto sensu contribute to the training of professionals for the scientific and technological development of the country. Therefore, it is suggested longitudinal studies at the international level in order to verify what is the academic development stricto sensu.

Keywords: Program. Higher courses. Professionals. Stricto Sensu;

1. INTRODUCTION

A globalized and highly competitive market, in which quality and productivity have become key elements requiring changes in the organization of work, seeking an adjustment to new trends, and in the face of this new scenario of competitiveness, began to require new professional qualifications in the academic area (PASSOS; GUIA, 2011).

New realities arise at all times, requiring on the part of companies, techniques directed to rapid adaptations, in order to avoid loss of quality and decline in the image of the organization. Just like companies, professionals also need to adapt to new realities, seeking to improve and update their theoretical and

practical knowledge, through courses of higher education stricto sensu so that they can ensure their space in the labor market, and as a way to have a competitive advantage in the face of competition (ARAÚJO, 2006). The organizations are in a permanent state of search for the maintenance of their competitiveness, in the dispute for markets. This search has imposed on organizations the need to rethink their operations and to establish a new definition of business (CASTRO; VALENTE; HUDIK, 2012).
The training of professionals suitable for the labor market has been the main objective of many courses stricto sensu in Brazil. In fact, countries, especially those in development, need qualified professionals in the various areas of knowledge to meet the demands of the market (PEREIRA; MEDEIROS, 2011).

Due to these transformations in today's society, human behavior in organizations required the interaction of new values and professional training. Organizations, when employing, are dealing not only with the abilities of a person, but with different human traits that are part of a system that builds the character of the individual. People see companies as a means to help them achieve their goals, while they need effective and qualified professionals, as well as competent ones to help them achieve organizational goals (PASSOS; GUIA, 2011).

Therefore, there is a need for greater knowledge for economic growth, social development and environmental preservation, as well as the fact that such knowledge is largely being incorporated into organizations and people. Part of this issue is, obviously, the training of individuals in graduate programs and courses in Brazil (MORITZ; MORITZ; MELO, 2011).

It is sought to highlight that the current changes occurred in the educational scenario have been requiring the restructuring of the teaching process - learning in its didactic-pedagogical form, since there is a contemporary dynamic based on new concepts of education, competence, skills and consequently, graduate training (SILVEIRA, 2011).

Since Stricto Sensu courses are still facing major challenges, both in the structures of Brazilian universities and in government policies, in the ongoing internationalization, in the recognition of degrees in foreign universities, especially in Latin America and in the regional differences faced in the country (MORITZ; MORITZ; MELO, 2011).

Therefore, the postgraduate courses stricto sensu, although offered in some cases in the form of extension, take dominantly the forms of improvement and specialization and constitute a kind of extension of the undergraduate degree. In fact, these courses aim at an improvement (improvement) or deepening of professional training, in addition to training in the training of researchers (SAVIANI, 2000).

With this, the question arises: Does the graduate programs stricto sensu in Brazil seek only the improvement of professionals in the area of scientific research and train quality teachers for the country?

Flores (2014) mentions that the norms established for the graduate program stricto sensu were: to constitute

the quality model required for master's and doctoral courses and identify the courses that meet this standard model; to cooperate to advance the efficiency of the programs in meeting the national and regional needs for training high-level human resources to work in the business area.

Therefore, it is justified the need to observe the historical evolution of graduate programs stricto sensu in Brazil, verifying its importance for the teaching staff and the specialization and training of professionals for the labor market.

In addition, this article aims to verify the importance of the graduate program stricto sensu in Brazil, through a literature search. It also highlights the historical notes on the higher education courses stricto sensu in Brazil; identify the contribution of CAPES to the higher education courses stricto sensu and observe the importance of these courses for specialization and training of professionals for the labor market.

2. RESULTS

The university experience in Brazil is recent, since in the colonial period there was no interest from the Portuguese metropolis to create universities in its domains. With the proclamation of political independence, the Constituent Assembly inaugurated in 1823 approved a project to create two universities, one in São Paulo and the other in Olinda, with initial courses in the legal area. In 1920, the University of Rio de Janeiro was created by the mere aggregation of three existing faculties: Law, Medicine and Polytechnic. But only after the Revolution of 1930, that the university regime was instituted in Brazil through the decree 19.851/31, which deals with the Statute of Brazilian Universities, that more courses and universities were developed by the country (SAVIANI, 2000).

According to Rego and Mucci Júnior (2015) the great impulse even occurred for graduate courses in Brazil only occurred in the 1960s, when the Federal Government adopted measures supported by the North American model to formalize the graduate recognizing this as a new level of education, in addition to the baccalaureate. They had initiatives in the creation of master's and doctoral programs in the following universities: Federal University of Rio de Janeiro, master's degree, University of Brasília, Institute of Pure and Applied Mathematics, School of Agriculture of Viçosa and the Federal Rural University of Rio de Janeiro, as well as the aeronautical engineering course at the Technological Institute of Aeronautics in São José dos Campos (MAer/ITA).

The Opinion 977/65, of the Federal Council of Education, authored by Newton Sucupira, had as object the conceptualization of the post-graduation, using the international models as parameter of formation of a proper national model, whose objectives highlighted the growing demand regarding the professional qualification and the necessity of the academic development. This year also saw the beginning of the first Graduate Program in Education in Brazil at the master's level, which was that of the Pontifícia Universidade Católica do Rio de Janeiro (SAVIANI, 2000).

This CFE Nº 977 of 12/03/1965, is one of the main documents that mark the beginning and guides the

Brazilian post-graduation; in it was evident the strong influence of the North American and European models. This explains why the Brazilian post-graduation was developed under international standards, that is, the scientific field was demarcated by the game of competitiveness. This opinion not only discusses the definition, levels and purposes of graduate studies, but mainly endows the university with an even greater symbolic power. The postgraduation started to occupy the dominant position in the structure of the scientific field, legitimized by the mission that had been assigned to it, i.e., the production of specific knowledge (directed) that would result in the scientific and technological development of the country, besides training professionals trained for the labor market (BORATIM, 2014).

However, the regulation of post-graduation occurred only after the university reform in 1968, at the height of the military dictatorship, that the government imposed a reform in higher education, pressured by social and student movements, was strictly regulated specialization, and the master's and doctorate had freedom in its early implementation (BALBACHEVSK, 2005).

According to Verhine (2008), the new emphasis on research and formal degree ended up causing the rapid proliferation of graduate programs in Brazilian universities, coordinated and, after 1980, evaluated by the Ministry of Education, through CAPES. This legislation divided the post-graduation into two categories, "stricto sensu", focused on academic career, and "lato sensu", for those who work in organizations or other professional activities, and establishes the categories of masters and doctorate, without, at the time, the first being necessarily a requirement for the second.

The purpose of CAPES was to ensure the existence of specialized personnel in sufficient quantity and quality to meet the needs of public and private enterprises for the development of the country. Industrialization and the complexity of public administration brought the need for training specialists and researchers in the most diverse branches of activity (SOUZA et al, 2011).

One of the strategies activated by CAPES in view of this objective of consolidating the Post-Graduation in the country, was to induce the creation of National Associations by area of knowledge. As a result of the management then carried out, the National Association of Research and Graduate Studies in Education (ANPEd) emerged in the area of education that held its first Annual Meeting in 1978, in Fortaleza, having as central theme the issue of the master's degree in education, occasion in which was presented a work called "A Conception of Master's Degree in Education" (SAVIANI, 2000).

Meritocracy in the Brazilian post-graduation was evident not only in the characteristics of the evaluation system applied by CAPES, but also in the criteria adopted by the National Council for Scientific and Technological Development (CNPq) in the distribution of resources, which prioritizes the researchers, considered productive, as well as the Postgraduation Programs Stricto sensu with concept 5 or higher. However, it should be noted that this criterion achieved in the academic merit that underpinned the structure of the postgraduate field was agreed by the field's own agents (BORATIM, 2014).

According to Rego and Mucci Júnior (2015) with the institution of graduate programs and its conceptual delimitation according to the international standard according to the advice of opinion No. 977/65 prepared by Professor Newton Sucupira, it was up to the legislator to develop a normative text to formalize the model and make it stiffer in consideration of the claims and national interest. To this end, the Law of guidelines and bases of national education - Law 9.394/1996 was approved, whose objective was to regulate and delimit graduate courses, establishing a dichotomy as to their extension, separating them into broad or restricted research models, general or specific, lato sensu or stricto sensu. According to article 44, item III of Law 9,394/1996, post-graduation courses include "master's and doctoral programs, specialization and improvement courses, and others, open to graduate candidates in undergraduate courses and that meet the requirements of educational institutions" (article 44, paragraph III).

Silva (2010) points out that in the period from 1990 to 2004 there were no national plans that officially guided the development of the sector, a fact that came back to occur, from 2005 on, with the title "V National Plan of Post-Graduation" relative to the five-year period 2005-2010. Quantifying some post-graduation data, between the years 1963 to 2004 the federal government invested R$ 11.1 billion, in updated values, in the granting of master's and doctoral scholarships. About 60% of these scholarships were financed by the Coordination for the Improvement of Higher Education Personnel (CAPES) and another 40% by the National Council for Scientific and Technological Development (CNPq). In February 2010, CAPES, by means of Ordinance No. 04, established the National Commission responsible for preparing the PNPG for the period 2011-2020.

The implementation of the graduate as an organized and mass program has generated a new teaching degree. Regulated, authorized or accredited, it became part of the expectations of complete formation of a Brazilian professional. If the graduation gave the right to professional exercise, the post-graduation deepens the knowledge, skills, increasing the knowledge of the professional's content and/or training him/her for tasks not covered in the graduation, such as the use of more modern and refined techniques and technologies, better qualifying the professional (SILVA FILHO, 2000).

Currently the postgraduate stricto sensu in the area of education has several programs recognized by CAPES. In addition, a reasonable number of institutions with open processes with CAPES aiming at the installation of master's programs in other areas. On the other hand, there is also a significant number of institutions with master's programs functioning independently of the authorization and recognition of CAPES (SAVIANI, 2000).

According to the Ministry of Education and Culture (MEC), postgraduate courses cover master's and doctoral programs, specialization courses that include those designated as MBA - Master Business Administration, improvement and others. And they are intended for graduate candidates in undergraduate courses and who meet the requirements of educational institutions (SANTOS, 2000).

Rego and Mucci Júnior (2015, p. 152) stress that:

> According to Capes (2011), between 2007 and 2010 the Brazilian post-graduation graduated 100 thousand masters, 32 thousand doctors and 8 thousand professional masters, in a total of 140 thousand graduates. In the Northeast, two states had growth greater than or equal to 100% in post-graduation. Sergipe more than doubled its number of courses, jumping from 13 to 27 (107.7% increase). Another state that doubled the number of courses in the last three years was Piauí, which went from 10 to 20 courses. The Northeast region had, in total, a 31.3% growth in post-graduation since the last triennial evaluation in 2007. There are currently 672 master's, doctoral and professional master's degrees in the region. In the Midwest, the Federal District has the largest number of courses. Out of a total of 270 courses evaluated in the region, 135 are from the Federal District. The remaining 135 are distributed among the states of Goiás (71), Mato Grosso (26) and Mato Grosso do Sul (38), Sul (12%), Nordeste (9.6%) and Sudeste (6.3%).

Based on the data presented, it can be seen that the national postgraduate system has been consolidating in recent years and has expanded rapidly.

It should be noted that currently, in private institutions, this practice has been generalizing, including agreements with foreign institutions for the opening of graduate programs, as well as the implementation of master's and doctoral programs, through the mechanism of distance learning.
According to the Federal Council of Administration (CFA), the postgraduation in the strict sense includes the master's programs, which generally last 2 years and as a requirement for approval the defense of a dissertation and the doctoral programs, with duration of 4 years and as a requirement for approval the defense of a thesis. In Brazil there are two types of master's degree: academic master's degree: which aims to train teachers for secondary and higher education and professional master's degree: which aims at professional qualification (SANTOS, 2000).

According to Ikedo, Campomar and Veludo-de-Oliveira (2005) the post-graduation in stricto sensu trains professionals for teaching, researchers and prepares professionals for the labor market. Therefore, it is interesting to highlight that the postgraduate stricto sensu is not limited only in the academic field, which seeks to initiate the student to research, in a gradual process that will enable the independent production of scientific papers, through the submission of articles to specialized journals and annals of congresses, but in professional training.

According to Rego and Mucci Júnior (2015, p. 162) the master's degree or professional doctorate "is the designation that emphasizes studies and techniques directly focused on the performance of professional qualification". It is, therefore, the professional training that enables to explore and technically elevate the processes in the professional field, considering the applied research and the proposal of innovations and technological improvements for the solution of specific problems in a given business field.
Regulated by Normative Ordinance No. 7/2009 of the Ministry of Education, despite its technical

distinction between master's degrees, the professional emphasis does not remove the recognition granted to the academic master in terms of teaching career, constituting objectives of the professional master the training of the student for the exercise of advanced professional practice, meeting specific demands and productive arrangements, the search for solution of problems and generation and application of appropriate innovation processes, besides contributing to aggregate competitiveness in companies, without being removed the essentially scientific objective of research (REGO; MUCCI JÚNIOR, 2015).

Following the evolution of the PNPG, the current national postgraduate plan for the period 2011-2020, provides for some goals similar to those of developed countries in order to contribute more effectively to the development of the country, such as: "increasing the number of doctors/1000 inhabitants, in the age group from 25 to 64 years, from the current 1.4 to 2.8 and annual degrees of 19,000 doctors, 57,000 masters and 6,000 professional masters" (CAPES, 2012, p. 30).

Between the years 1976 to 2009 and between 2004 and 2009, there was a significant increase in master's and doctoral courses, 370.3% and 685.6% respectively. Between 2004 and 2009, there was a growth of 35.9% in the number of academic master's courses, 104.2% in the number of professional master's degrees and 34.4% in the number of doctoral degrees (CAPES, 2012, p. 30).

According to information presented in the National Postgraduate Plan (PNPG), in 2009, the Brazilian postgraduate had 2,719 postgraduate programs, which were responsible for 4,101 courses, of which 2,436 were academic master's courses, 243 professional master's courses and 1,422 doctoral courses (PNPG, 2010). The graduate programs stricto sensu aim to contribute efficiently to the production and dissemination of knowledge and, consequently, to the scientific and technological autonomy of the country (FLORES, 2014).

According to data registered until May 2012 in the National Postgraduate System (SNPG), there are 3,397 programs and 5,080 postgraduate courses disseminated in different major areas, such as: agricultural sciences, biological sciences, health sciences, exact sciences, earth sciences, human sciences, applied social sciences, engineering, linguistics, letters and arts and multidisciplinary. The SNPG integrates academic master's and professional master's degrees, both with an average duration of 24 months and started, normally, after graduation, but with different purposes. The academic master's degree is focused on teaching, and the professional master's degree on the labor market, and finally the doctorate, which has its duration of about 48 months, usually started after the end of the master's degree, with an academic bias for studies that have unprecedented and innovative purposes (FLORES, 2014).

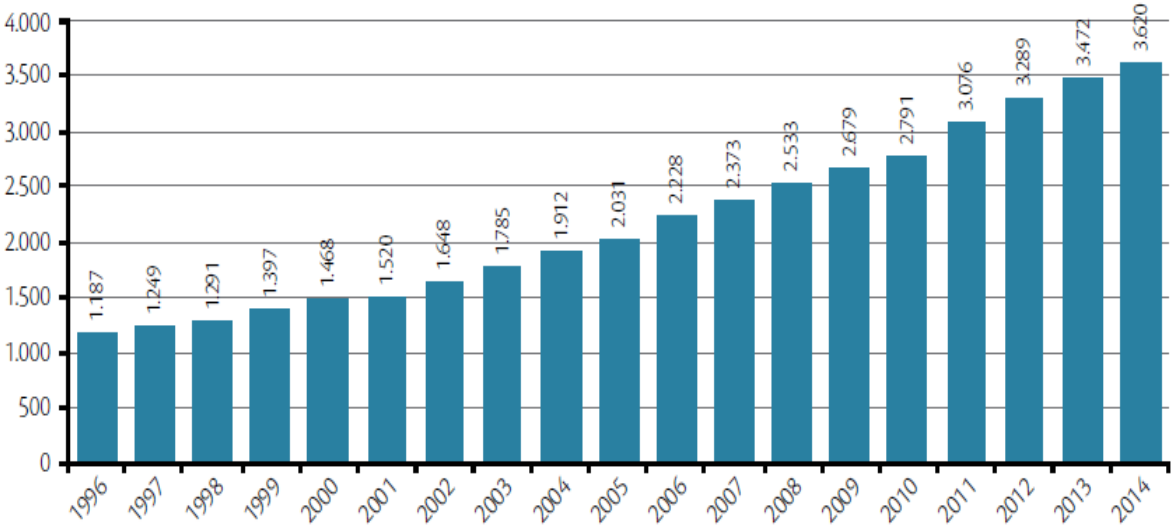
From some data recorded by the CNPq Portal (2014) it is possible to verify this development of science and research in Brazil in 2013, when it counted on a total of 109,799 researchers, PhDs and 78,496 masters in Research and Teaching activities in Brazil.

According to the 2013 Triennial Assessment, 3,337 graduate programs were analyzed, which comprise

5,082 courses, 2,893 of which were master's degrees, 1,792 doctorates and 397 professional master's degrees. The requests for reconsideration of the evaluation results were submitted from 10 December 2013 to 17 January 2014. After the decision of the area commission, the requests were forwarded to the Scientific-Technical Council for Higher Education (CTC-ES), which met at Capes from April 7 to 11, 2014 for final deliberation (CAPES, 2015).

It is also worth noting that the number of master's programs continues to grow at significant rates in Brazil. In 1996, there were 1,187 master's programs in Brazil, while in 2014, the number of these programs was already 3,620, as can be seen in Figure 1. This means that there has been a 205% growth over these 19 years. The annual growth rates varied, always positively, on average, 6.4% in this period. Even though there were decreases over the last three years of the series, the lowest level reached by this growth rate in 2014 was still relatively high (4.3%) (LAPLANE et al, 2016, p. 21).

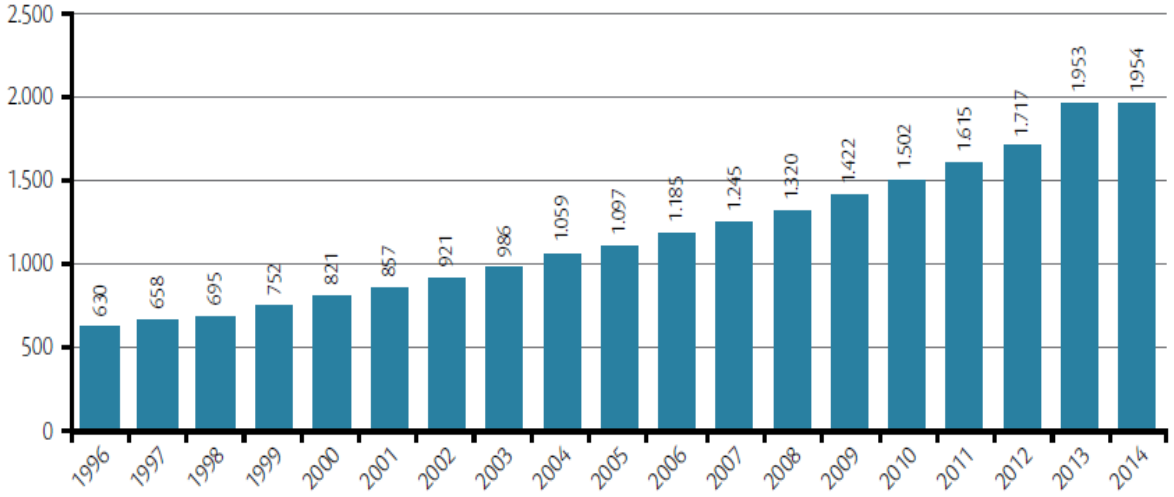
Figure 1: Evolution of the number of graduate programs in Brazil



Source: Laplane et al (2014)

Doctoral courses have also been growing at very significant rates in Brazil, as can be seen in Figure 2. Although annual growth rates have varied greatly over the years, the arithmetic mean of these rates was 6.5% in the period 1996-2014, a value very similar to that of master's programs (6.4%), as seen in the previous section. In the entire period, that is, from 1996 to 2014, the growth in the number of doctoral programs was 210.2%, while that of master's programs was 205.0%.

Figure 2: Evolution of the number of doctoral courses in Brazil



Source: Laplane et al (2014)

Flores (2014, p. 29) found that there is an alignment of the current profile and evolution of postgraduate education stricto sensu in Brazil with some goals of the Draft Law of the National Education Plan (PNE - 2011/2020), among which stand out that in higher education for qualification of the teaching staff 35% (thirty-five percent) of doctors and 40% (forty percent) of masters, highlighting with this, a low index related to other countries, such as Argentina and Chile.

It is also worth mentioning the incentives of the federal government agencies, among which are the edicts of CAPES and the National Council for Scientific and Technological Development for the qualification of postgraduate students abroad. The current situation and future prospects are promising, and are consolidated in the guidelines, objectives and goals established in the PNPG for the period 2011-2020, aligned with the National Education Plan (FLORES, 2014).

3. Final considerations

This article aimed to show the importance of the graduate program in Brazil, through a literature search. For this, it was performed the reading of several works, scientific articles and other materials on line, where one can achieve the objectives of this work.

Through the research one can see the trajectory of the post-graduation, which went through different phases and, certainly, the institutionalization orchestrated by means of public policies centralized in federal government agencies, is the greatest mark of its history. The post-graduation scientific field is a deeply hierarchical structure, with well defined agents, rules of competition and capital, involving on the one hand the Stricto Sensu Postgraduation Programs and its teaching staff, and on the other hand, the administrative-political structure of CAPES, which also gathers researchers recognized from the academic world, responsible in large part for the postgraduation policies.

He also observed the importance of graduate programs and the offer of courses in the strict sense of specialization and improvement, as they highlight the interest in professional training and scientific development. In the same sense, the offer for master's and doctoral programs reveal the national interest in

constituting a teaching base that promotes scientific development, in addition to training students for teaching, considering the need to promote and disseminate knowledge with a view to the national interest. In addition, it was found that in the face of constant economic, social, cultural and environmental changes, higher education stricto sensu has the commitment to contribute to the advancement of scientific, technological and economic knowledge. This is possible, since the stricto sensu graduation is also privileged in the inclusion of innovative disciplines and methodologies, in the sense that a new professional is formed, competent, intuitive, critical and knowledgeable of his social role, more involved with research and with greater vision of decision. Thus, it is suggested longitudinal studies at the international level, in order to verify which is the academic development stricto sensu.

6. References

[1] ARAÚJO, L. C. G. de. **Gestão de pessoas.** São Paulo: Atlas, 2006.

[2] BALBACHEVSKI, E. **A pós-graduação no Brasil:** novos desafios para uma política bem sucedida. In: Brock. C.; Schwartzman, S. *Os desafios da educação no Brasil*. Rio de Janeiro: Nova Fronteira, 2005.

[3] BORATIM, Rogério Júnior. **Avaliação dos Programas de Pós-Graduação *Stricto Sensu* da Universidade Estadual de Londrina (UEL):** um estudo a partir da teoria do campo científico de Pierre Bourdieu. Maringá- PR: Universidade Estadual de Maringá, 2014. Disponível em: http://www.ppp.uem.br/wp-content/uploads/2015/09/ROG%C3%89RIO-J%C3%9ANIOR-BORATIM.pdf. Acesso em dez.2016.

[4] CASTRO, A. C.; VALENTE, G. S. C.; HUDIK, Y. A educação corporativa como vantagem competitiva sustentável para as empresas na atualidade. **Revista Augustus**, 16(32), 2012. Disponível em: http://apl.unisuam.edu.br/revistas/index.php/revistaaugustus/article/view/39. Acesso em dez.2016.

[5] COORDENAÇAO DE APERFEIÇOAMENTO DE PESSOAL DE NÍVEL SUPERIOR. CAPES. **Avaliação da pós-graduação.** 2012. Disponível em: http://www.capes.gov.br/avaliacao/avaliacao-da-pos-graduacao. Acesso em dez.2016.

[6] COORDENAÇAO DE APERFEIÇOAMENTO DE PESSOAL DE NÍVEL SUPERIOR. CAPES. **Avaliação da pós-graduação.** 2015. Disponível em http://www.capes.gov.br/36-noticias/6908-capes-divulga-resultado-final-da-avaliacao-trienal-2013-apos-analise-de-recursos. Acesso em abr.2017.

[7] FLORES, R. D. **Análise dos Indicadores do Sistema de Avaliação da Pós-Graduação *Stricto Sensu* no Brasil:** Um Estudo Multi-Casos nos Programas de Engenharia de Produção. Santa Maria-RS: Universidade Federal de Santa Maria, 2014. Disponível em:http://www.sigmees.com.br/files/Raquel_Dalvit_Flores.pdf**.** Acesso em dez.2016.

[8] GIL, A. C. **Métodos e Técnicas de Pesquisa Social.** São Paulo:Atlas, 1999.

[9] IKEDA, A. A.; CAMPOMAR, M. C.; VELUDO-DE-OLIVEIRA, T. M. A Pós-graduação em Administração no Brasil: definições e esclarecimentos. **Revista Gestão e Planejamento.** Ano 6. Nº 12. Salvador. Jul/ dez. 2005. P. 33-41. Disponível em: http://gvpesquisa.fgv.br/sites/gvpesquisa.fgv.br/files/arquivos/veludo_-_a_pos-graduacao_em_administracao_no_brasil.pdf. Acesso em dez.2016.

[10] LAPLANE. M. F. (Org.). **Mestres e doutores 2015:** Estudos da demografia da base técnico científica brasileira. Brasília- DF: Centro de Gestão e Estudos Estratégicos, 2016. Disponível em:https://www.cgee.org.br/documents/10182/734063/Mestres_Doutores_2015_Vs3.pdf. Acesso em abr.2017.

[11] MORITZ, G. O.; MORITZ, M. O.; MELO, P. A. de. **A Pós-Graduação brasileira:** evolução e principais desafios no ambiente de cenários prospectivos. XI Colóquio Internacional sobre Gestão Universitária na América do Sul. II Congresso Internacional IGLU. Gestão Universitária, Cooperação Internacional e Compromisso Social. Florianópolis, 7 a 9 de dezembro de 2011. Disponível em: https://repositorio.ufsc.br/bitstream/handle/123456789/26136/5.30.pdf?sequence=1 Acesso em dez.2016.

[12] PEREIRA, E. F.; MEDEIROS, C. C. C. de. Metodologia do ensino superior nos programas de pós-graduação *Stricto Sensu* em Educação Física no Brasil: a formação docente em questão. **Movimento.** Porto Alegre, v. 17, n. 04, p. 165-183, out/dez de 2011. Disponível em:seer.ufrgs.br/Movimento/article/download/17806/14887. Acesso em dez.2016.

[13] PORTAL CNPq. **Distribuição geográfica.** 2014. Disponível em:http://estatico.cnpq.br/painelLattes/mapa/. Acesso em dez.2016.

[14] REGO, I. J.; MUCCI JÚNIOR, L. C. Pós-graduação *lato senso* e *stricto senso*: direito fundamental à educação capaz de conduzir a um relevante e renovado inovador Brasil do futuro. **Revista Direitos Sociais e Políticas Públicas (UNIFAFIBE**). v. 3, n. 1, 2015. Disponível em:www.unifafibe.com.br/revista/index.php/direitos-sociais-politicas-pub/.../pdf_37. Acesso em dez.2016.

[15] SANTOS, A. C. P. dos. Análise setorial: ensino superior. **Gazeta mercantil**, v. 2. p. 238 – 239. 2000.

[16] SAVIANI, D. A pós-graduação em educação no Brasil: trajetória, situação atual e perspectivas**.** **Revista Diálogo Educacional**. v. 1 - n.1 - p.1-95 - jan./jun. 2000. Disponível em: www2.pucpr.br/reol/index.php/DIALOGO?dd1=703&dd99=pdf. Acesso em dez.2016.

[17] SILVA FILHO, R. L. L. A Pós-Graduação *Stricto Sensu.* Artigo publicado em 2000. **Lobo & Associados Consultoria.** Uma Referência Nacional de Consultoria em Educação. Disponível em:

http://www.institutolobo.org.br/imagens/pdf/artigos/art_015.pdf. Acesso em dez.2016.

[18] SILVA, R. H. R. **A Educação especial no âmbito da pós-graduação em educação no Brasil**. UFG e UNICAMP – 2010. Disponível em: http://www.anped.org.br/33encontro/app/webroot/files/file/P%C3%B4steres%20em%20PDF/GT15-6140--Int.pdf. Florianópolis, Santa Catarina, Brasil. Acessado em dez. de 2016.

[19] SOUZA, M. T. S. de; MACHADO JÚNIOR, C.; PARISOTTO, I. R. S.; SILVA, H. E. M. da. **A pós-graduação *stricto sensu* em administração como elemento de formação de pesquisadores na área ambiental.** XXXV Encontro da ANPAD. Rio de Janeiro, 4 a 7 de setembro de 2011. Disponível em:http://www.anpad.org.br/admin/pdf/EPQ3156.pdf. Acesso em dez. 2016.

[20] Souza, M. A. de. **Avaliação de egressos de cursos de pós-graduação *stricto sensu* em administração da Universidade Federal da Bahia.** Salvador – BA: Universidade Federal da Bahia, 2014. Disponível em: https://repositorio.ufba.br/ri/bitstream/ri/17678/1/Souza,%20M%C3%A1rcio%20Arcanjo%20de.pdf. Acesso em abr.2017.

A Proposal for Computer use in Mathematics Classes: Algebra Teaching in College

Carlos Henrique Delmiro de Araújo
Secretaria da Educação de Canindé, Escola Municipal José Ivan Magalhães Monteiro, Canindé, CE, Brasil.
delmiro@multimeios.ufc.br

Milínia Stephanie Nogueira Barbosa Felício
Faculdade de Educação, Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil.
milinia@multimeios.ufc.br

José Airton de Oliveira Faustino
Faculdade de Educação, Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil.
airton@multimeios.ufc.br

André Santos Silva
Faculdade de Educação, Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil.
andre@multimeios.ufc.br

Daniel Brandão Menezes
Centro de Ciências Exatas e Tecnologia (CCET), Universidade Estadual Vale do Acaraú (UVA), Sobral, CE, Brasil.
danielbrandao@multimeios.ufc.br

Hermínio Borges Neto
Departamento de Estudos Especializados, Universidade Federal do Ceará (UFC), Fortaleza, CE, Brasil.
herminio@multimeios.ufc.br

Abstract

The present work is based on mathematical teaching, especially in the teaching of Algebra in math courses of the college. The theme mentioned is from the Algebraic Structure Group, there are researchers in Brazil who highlight the students' difficulty in understanding the topic. From this, students find it difficult to associate Algebra teaching with Dynamic Geometry software, in particular "GeoGebra". It is proposed a didactic session planning, in which the teacher takes hold of the "GeoGebra" for teaching the Group Algebraic Structure. To accomplish this teaching proposal, the Sequence Fedathi is used. The use of "GeoGebra" in Algebra classes is suggested. With the Fedathi Sequence is possible to use the software on the geometric visualization of Algebraic Structures.

Keywords: *Algebraic Structure Group; Fedathi Sequence; GeoGebra; Math teaching.*

1. Introduction

From 2010 there was an acceptance of technologies in the classroom. Private or public educational institutions use digital resources to complement the teaching process. Could be computer, notebook, tablet and smartphone.

With these devices, the teacher can use many software to help him. If the teacher is trained at a distance, you can use *Moodle*, *Solar* or *TeleMeios*. In classroom teaching, *GeoGebra*, *WolframAlpha*, *CabriGéomètre* or PDF files.

This work is delimited in the Mathematics Education, at undergraduate level, with a focus on bachelor and bachelor degree, because the theme is recurrent in these courses. We use the help of *GeoGebra* software to carry out this teaching approach.

The authors Franco and Soares (2013) talk about the difficulty of using visualization resources for teaching Algebra. In fact, the concept of the group algebraic structure does not have geometric visualization, but it is possible to give examples that collaborate in this aspect.

Elias and Saviolli (2013) say that the difficulty in teaching algebra happens because it is a content that requires students to know interwoven sets, functions and axioms. And when they are questioned, the absence of answers is commonplace.

Franco and Soares (2013) state that content demands from the student a high capacity for abstraction, this can be a difficulty in teaching the content or in understanding the concepts by students.

The authors Nogueira and Pavanello (2008) report that as a way of circumventing this high abstraction, it is possible to teach algebra through memorization, which also leads to the difficulty of understanding the concepts by students.

Alves and Araujo (2013) bring Maple software to assist in the teaching of symmetrical groups, but they do not use a teaching methodology to plan a didactic class with the theme.

Given this, this work is based on the teaching of Algebra with the help of *GeoGebra*, with the help of the Fedathi Sequence. With this, we seek to present the teaching of Algebra linked to a software of Dynamic Geometry, as well as with the support of a teaching methodology.

For this work, we have the question: Is it possible to connect the Dynamic Geometry software, especially *GeoGebra*, in the teaching of Algebra, in particular the Group Algebraic Structure?

We propose a didactic session plan for the teaching of Algebra using the Dynamic Geometry *software GeoGebra* with complementary character under the support of Fedathi Sequence.

The Fedathi Sequence is a teaching methodology that suggests a teacher's stance in the classroom, and as a consequence of this stance, the student takes on an investigative role that mimics a mathematician's steps in problem solving. This methodology has steps that are performed in the didactic session and fundamentals that the teacher must use to achieve the objectives of the class.

The writing of the work is developed in the Group Algebraic Structure, the mathematical content that delimits the study, plan of a didactic session where the Fedathi Sequence is presented and shows how to use it in the teaching of the Group linked to *GeoGebra* and in the Final Considerations we show the existing

limitations and suggestions for future research.

2. Algebraic Structure Group: definition and teaching

The Group Algebraic Structure is defined in Gonçalves (2013, p. 119) as follows:

> Let G be a nonempty set where an operation between pairs of G is defined, denoted by, (*: G x G → G) | ((x, y) → x * y). We say that the pair G, * is a group that the following properties are valid:
>
> G1) a * (b * c) = (a * b) * c a, b, c, G
>
> G2) ∃e ∈G such that a * e = e * a, ∀ a ∈G
>
> G3) ∀a∈G, ∃b∈G such that a * b = b * a = e.

Property G1 is the associativity, where we can associate the elements of the set as desired and the result of the operation will be equal. The G2 property is called the neutral element of the operation, that is, any element operated with the neutral element will result in the chosen element. And the property G3 is based on the inverse of an element by the given operation, that is, every element of the set has an inverse element, which when operated results in the neutral element. When a set with a given binary operation has these three axioms, we call the set with the group operation.

The definition of this mathematical object is abstract, with no geometric visualization in its definition. Franco and Soares (2013) found in their research that students have difficulties understanding algebraic concepts due to the geometric limitation characteristic of the mathematical object.

But if it is difficult to see this mathematical content, why not remove it from the Higher Education curriculum? Franco and Soares (2013, p. 161) state: "[...] the study of algebraic structures can be seen as a basic foundation for the exercise of mathematics teaching, regardless of the segment that the future teacher may act in." In fact, the mathematics teacher in the final grades of elementary school will come across the process of teaching the game of signs, regarding the multiplication and division between integers, which is later seen in the set of real numbers. In fact, for example, the number -2 times -2 results in 4, and the product between -2 and 2 is -4, and this is based on the Group Algebraic Structure, which can be transposed to the Ring Algebraic Structure. So the subject in higher education is necessary for the teacher to understand why such multiplication between numbers is negative or positive.

Kluth (2007, p. 109) says: "[...] Algebra structures become a theme of Education and Mathematics Education, because they are interconnected with the teaching and learning objectives that have as support material the mathematical content. "It is observed in the course of Mathematics, disciplines such as Differential and Integral Calculus, Linear Algebra, Real Analysis, Complex Variable Calculation and Numerical Calculus, for example, that use the Algebraic Structures, namely Groups, Rings, Bodies or Domain of Integrity.

Regarding teaching, Nogueira and Pavanello (2009) state that "[...] in mathematics classes, the predominance of activities that emphasize the memorization of definitions, formulas and rules, intensive training in algorithmic procedures, to the detriment of knowledge building [...]". That is, the teaching is characterized by "mechanized", where the student only replicates the visa in class, whether in studies or in the resolution of activities. The incorporation of creativity and a conception of valuing error in favor of

learning are set aside.

Thus, there is the Fedathi Sequence methodology, which minimizes this teaching through the mechanism and provides an environment for students to use their previous knowledge to find a solution to the question that is proposed. However, this activity should be widespread so that the student does not see only particular cases, which makes teaching confusing and extensive. The Fedathi Sequence provides this creative environment for the student, becomes a research environment, and Sousa (2015, p. 15) points out: "[...] it is a challenge to make the classroom a research environment that takes students' hypotheses and strategies, followed by verification of the results found." The teacher who uses the Fedathi Sequence in the classroom has to consider the strategies students use to solve the activity, and these strategies are generalized and synthesized with the formal mathematical language, by the teacher, and therefore the importance of the activity being generalizable.

According to Sousa (2015, p. 17), "[...] the essence of the Fedathi Sequence is the teacher's posture as a mediator in the classroom." There is a change in the teacher's posture in making the classroom an environment of research, where all answers are valid, whether right or wrong, but the teacher must mediate these errors to become part of the learning process. This change proposed by the Fedathi Sequence is also based on its foundations, where they are positions in which the teacher must assume in the classroom, using Fedathi Sequence as a teaching methodology (BORGES NETO, 2018).

3. Plan for a Didactic Session

The Fedathi Sequence is a methodological proposal that has the characteristic of transposing the scientific method for teaching (BORGES NETO, 2016). It is characterized by having four steps which are called Position Making, Maturation, Solution and Proof, and your fundamentals called Hand in Pocket Posture, Adidatic Situation, Mediation, Didactic Agreement, Counterexample, The Question and the Conception of Error (BORGES NETO, 2018).

Before entering the stages of Fedathi Sequence, the teacher must use the Didactic Agreement foundation, it says the rules that will be part of the didactic session, and the *plateau*, where are reminded the previous knowledge that students must have to continue the activity proposed in the Position taking. It is suggested that the teacher make, in the Didactic Agreement, the call for the use of *GeoGebra*, on the computer or cell phone, without giving up paper and pen (SANTANA, 2002). With the *plateau*, it is feasible for the teacher to recall the pertinent concepts in Sets, Functions and Equivalence Relationships, which are prior knowledge to construct the Group concept.

The first step in the Fedhati Sequence is Position Taking, in which the teacher presents an activity in which it may be a game, a book issue, a list of exercises, a problem situation, or a generalized exercise. that is, the algorithm, the idea, to solve the activity serves to other problems of the same general character. For example, the teacher may ask the student to solve the quadratic equation $x^2 - 5x + 6 = 0$ without the aid of Bhaskara's formula, and the way he solves it may apply to any quadratic equation resolution. This is different if the activity is the resolution of the quadratic equation $x^2 - 9 = 0$, because the way to solve it is not characterized in all quadratic equations, which means that it is not a generalizable activity.

The Algebra Position Taking is presented, which is to verify that G, a set with the elements $f(x) = 2x + 4$,

g (x) = 3x + 2 and h (x) = x + 1, with the operation ∘, which is the composition of functions, is group.

In Maturation, after the Position Taking, the teacher stimulates the student's autonomy, in which she seeks the solution to the activity. If the student has any obstacles and requests the teacher's assistance, some Sequence Fedathi fundamentals should be used to address the student's doubt. As soon as the student asks a question, the teacher should not immediately respond or resolve it by the student, but instead use the question foundation to prompt the student to reflect on the subject. As the teacher will not answer the student how to do it, this is characterized by the Hand in Pocket Posture. If the student reflects after the teacher inquires and contains mathematical errors in the student's reasoning, the teacher must have the Conception of Error as something that can leverage learning, not just point out the error, and so we have to use another Fedathi Sequence plea. If the student still has errors, the teacher may suggest a counterexample for the student to realize that his idea, or reasoning, has misconceptions, and thus uses another foundation of Fedathi Sequence.

Still in Maturation, the student will look for ways to, with the elements of the set G, with the function composition operation, verify the three group properties, which are: associative, neutral element and inverse in relation to the function composition operation. As possible errors, the student uses the multiplication operation instead of function composition, both in paper and in *GeoGebra*, and generates the wrong result in relation to function composition, although the solution characteristic is approximate to the one proposed here. The student may also perform the composition of functions erroneously, and thus not proceed in *GeoGebra*, or paper, the verification that (G, ∘) is group. As well as the student may make mistakes with the software for lack of experience in its use.

An important motto to consider is the use of technology only if what is done is better than without it, the use should be restricted to situations where knowledge could be better aggregated. Concerning the development of logical reasoning, Borges Neto and Capelo Borges (2007) point out that software helps the development of cognitive skills that need special attention by teachers so that they can identify and use them with their students in the classroom. it calls: random, trial and error, trial and error, and finally deduction.

When the student gives a random answer, he or she has not processed any reasoning to come up with an answer, disregarding any clues or clues that foster choice. Trial and error is very common among students who randomly test variables in order to find satisfactory possibilities, not necessarily having to formulate hypotheses. The trial and error is a controlled experiment with the testing of a predetermined hypothesis with the studied intention of finding an expected result. Deduction is the experimental process performed after the inference or analysis of attempts made from tests on other events or even this one.

The use of software as a didactic-pedagogical activity in the study group to solve problems related to the content of Related Fees has the purpose to analyze if the students were stimulated to develop answers directed to the cognitive skills of the essay and error and deduction, therefore, if the teacher does not have controlled mediation on the path taken by the student, it may focus on their solutions to chance and trial and error, thus not having generated a reflection on the experience of maturation.

Such mediation in the course of the meetings is not a fixed model, but the experience of a teacher who planned the didactic session according to the Sequence Fedathi teaching methodology. Students already had some degree of intimacy with the software and this helped to conduct the session. All the behavior of

the teacher was guided by the principles of Sequence Fedathi, thus guiding the student work.

The third step provided by Sequence Fedathi is the Solution. Here the student presents to his classmates and the teacher how he solved the activity. If the student has an error, the teacher uses the fundamentals of Conception of Error, Posture Hand in Pocket, Question and Counterexample, so the student can reach the correct solution for the activity.

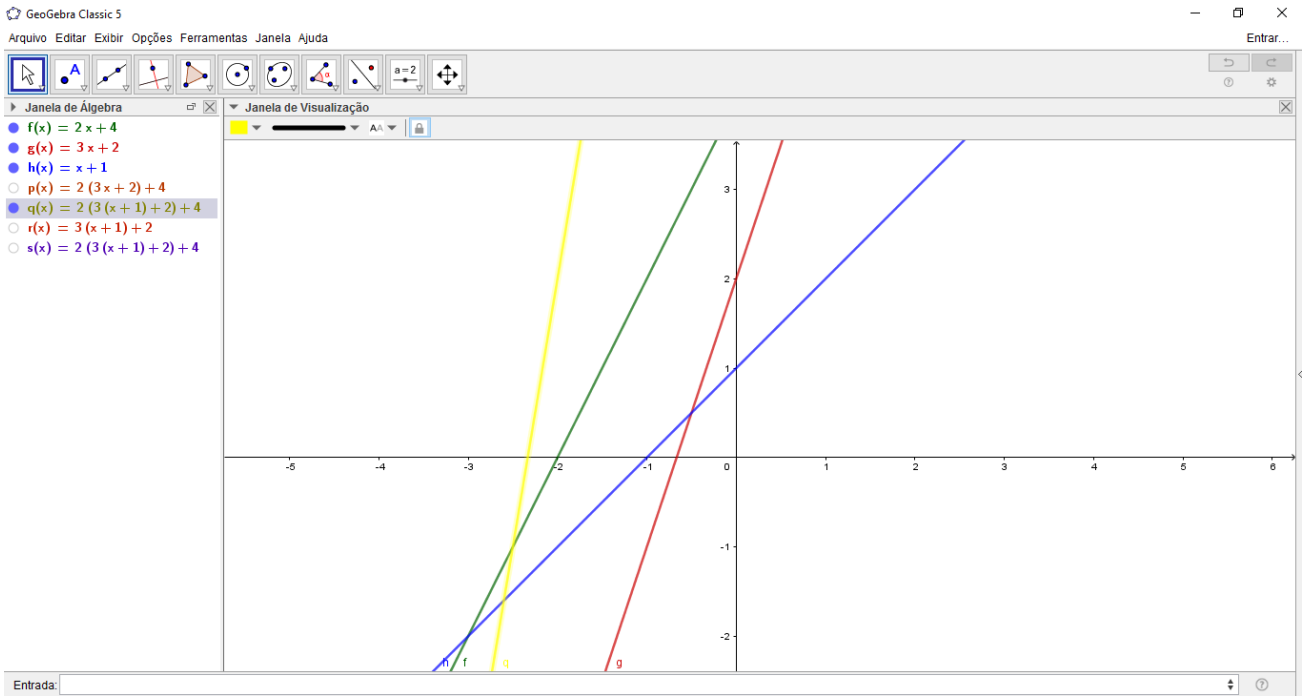
The solution the student may provide in *GeoGebra* is shown in figure 01.

Figure 01 - Composition of Functions (f ∘ g) ∘ h

Source: Prepared by the authors.

The green line is configured by the f function, the red line by the g function and the blue line by the h function. The purple line is characterized by the composition of functions (f∘ g) ∘ h. Figure 02 shows the composition of functions f ∘ (g ∘ h).

Figure 02 - Composition of Functions f ∘ (g∘ h)

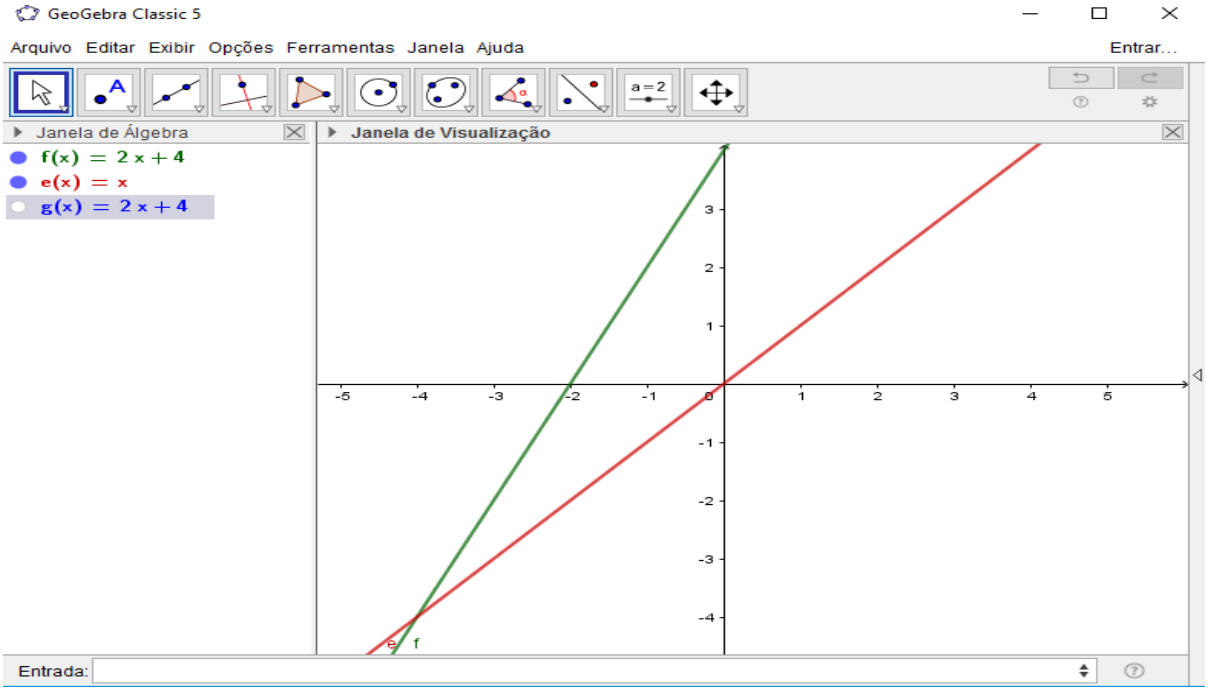


Source: Prepared by the authors.

The yellow and purple lines have the same geometric place, which characterizes that the associative holds true for this set with the function composition operation.

Note, in Figure 03, the verification of property G2 where the neutral element between the composition of functions is the function e (x) = x.

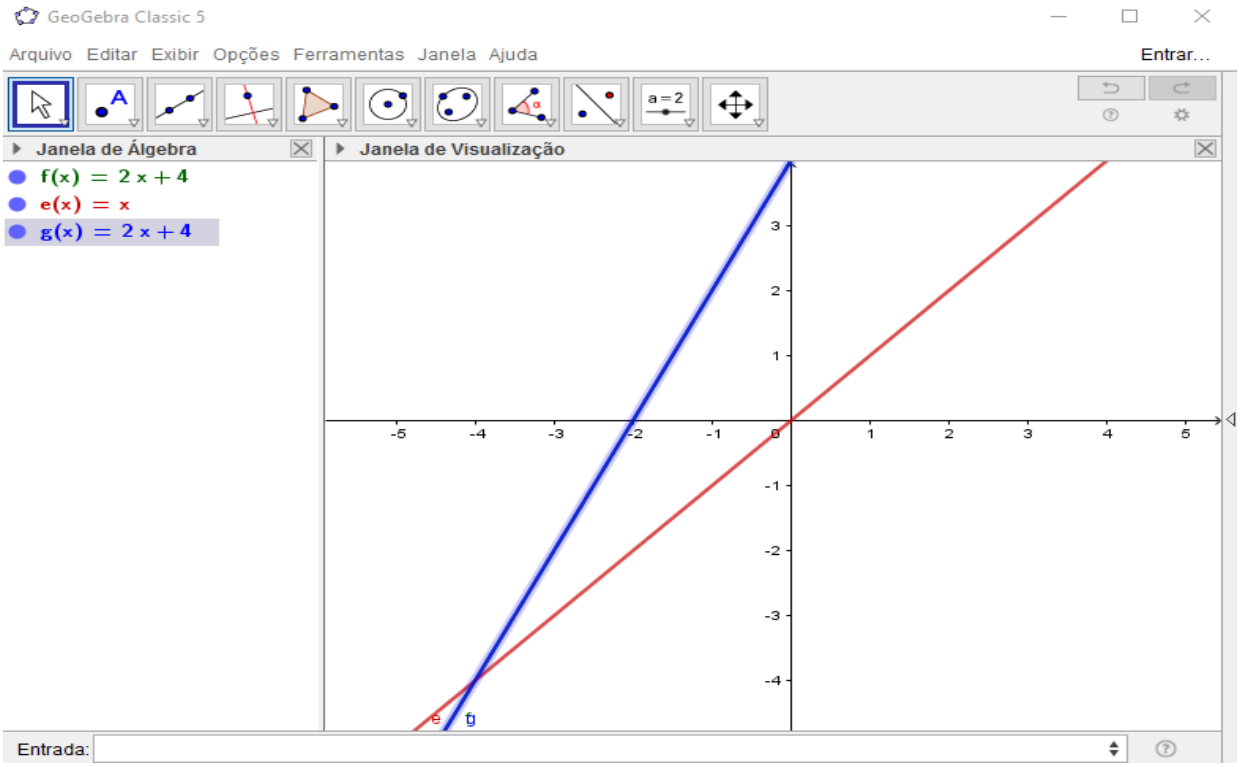
Figure 03 - Visualization of functions f(x) e e(x).



Source: Prepared by the authors.

When composing f (e (x)) in *GeoGebra*, figure 4 is compiled.

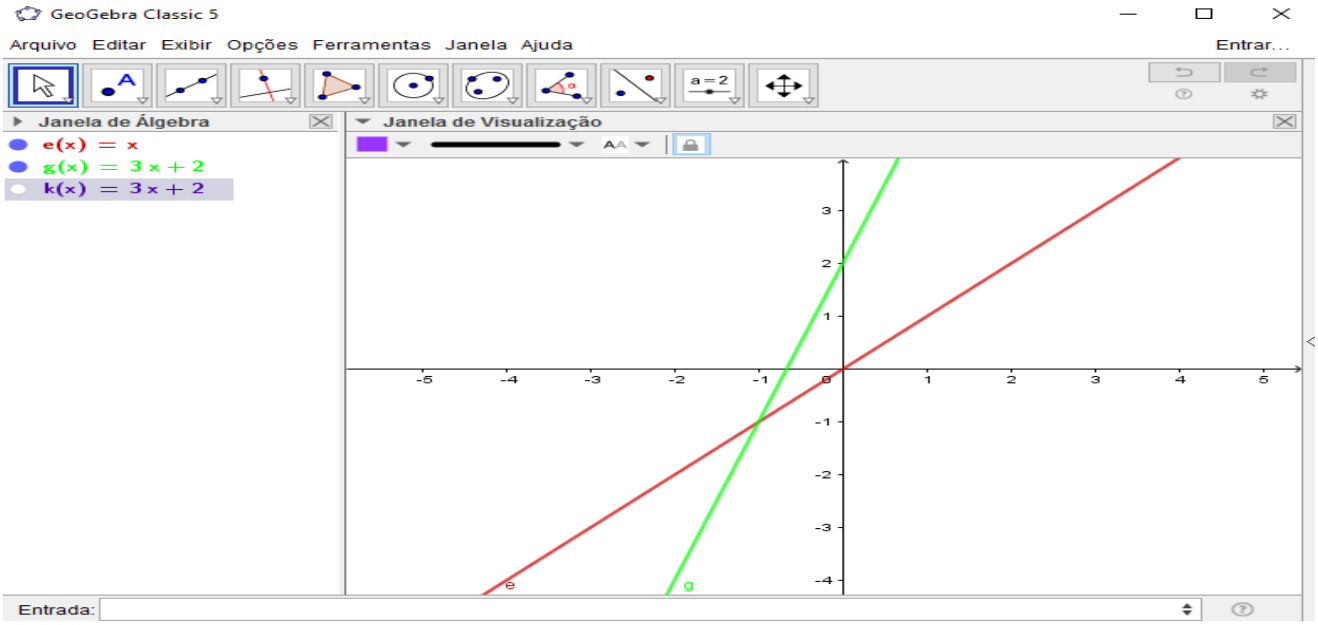
Figure 04 – composition of functions between f (x) and (x).



Source: Prepared by the authors.

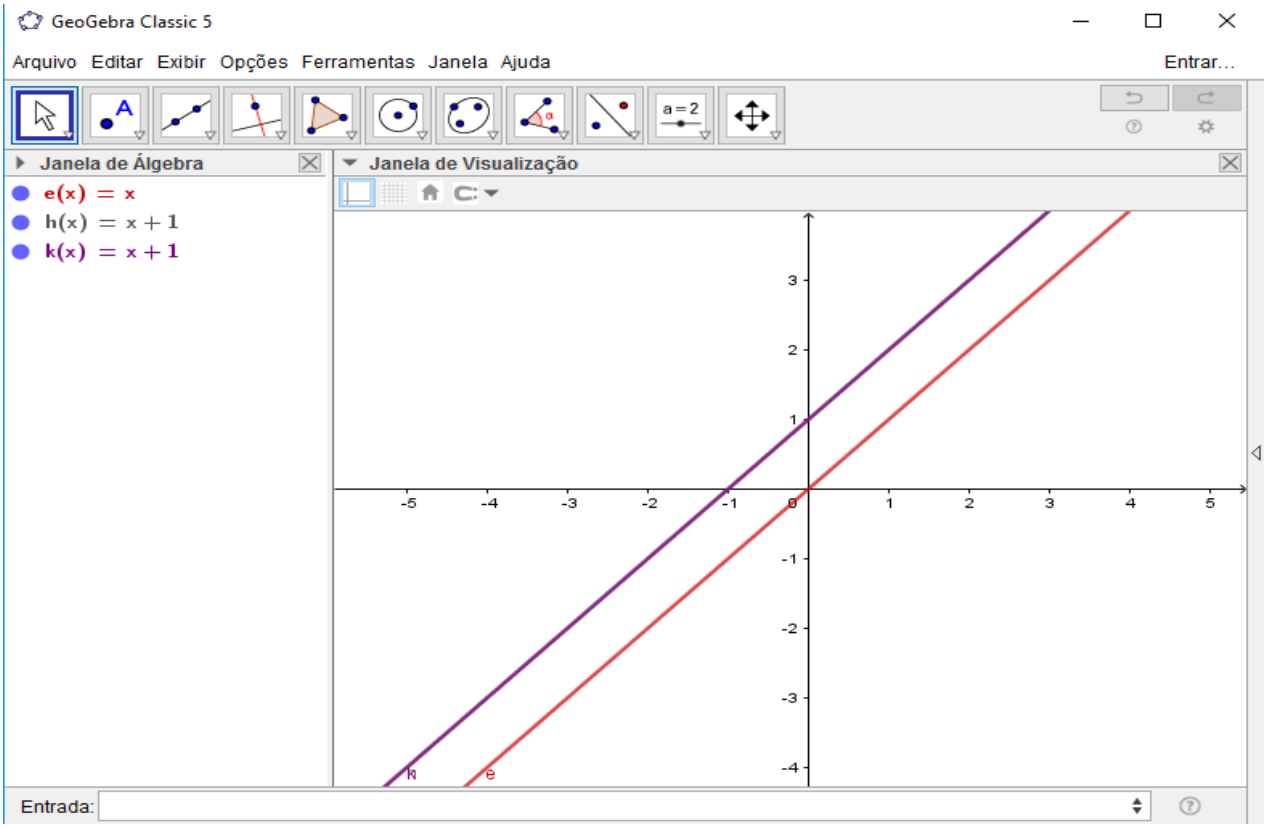
The line of function e (x) overlapped over the line of function f (x). Thus, we characterize e (x) the neutral element of G. We can see in figures 05 and 06 the composition of the function e (x) with g (x) and h (x).

Figure 05: Visualization of functions g(x) and e(x).



Source: Prepared by the authors.

Figure 06: composition between the functions h (x) and (x).



Source: Prepared by the authors.

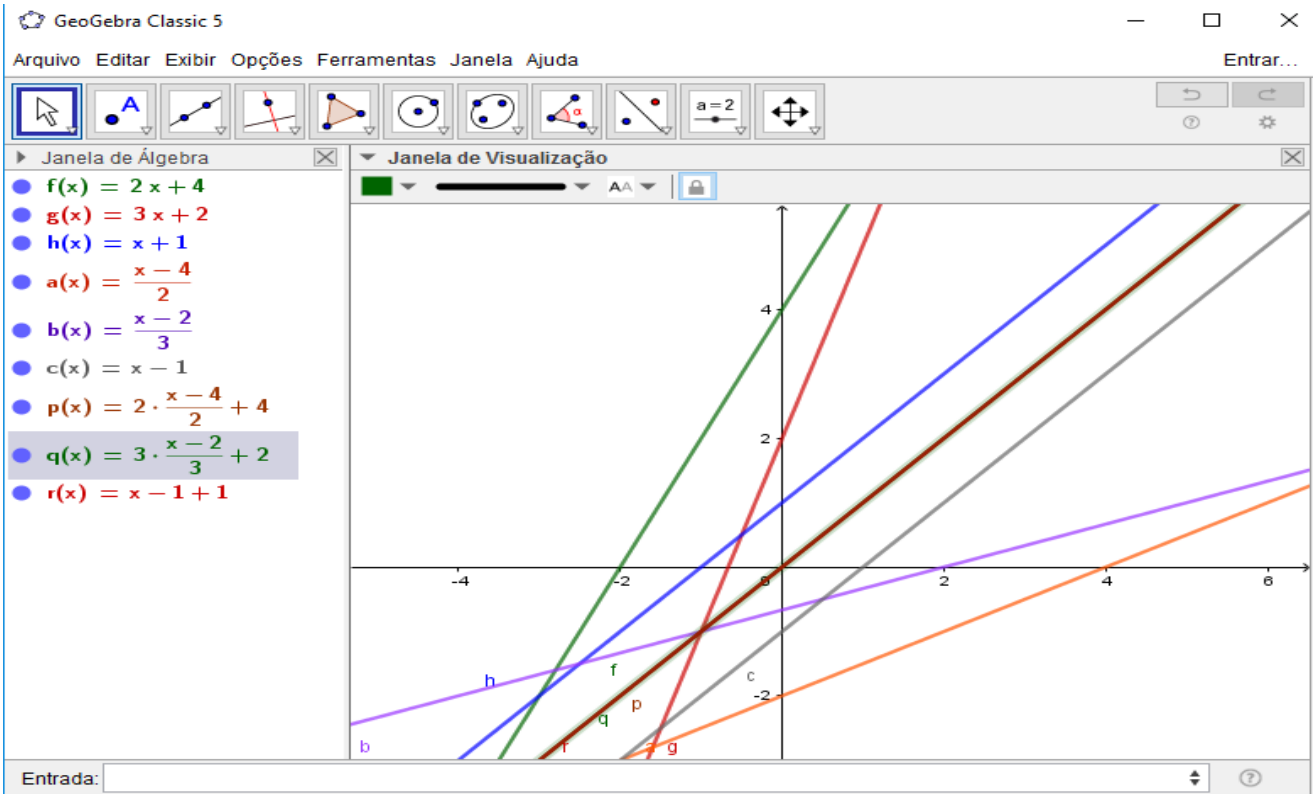
Then e (x) is the neutral element of set G with the function composition operation. Note that the line that expresses geometrically the composition of one of the functions, f (x), g (x) or h (x), with e (x), overlaps the original function, whether f (x), g (x), or h (x), this characterizes the visualization of the operation of functions, being the Position Taking used here.

And finally, a solution that the student may provide in class about the inverse element is followed by figure 07.

The functions a (x), b (x) and c (x) are adopted as the inverse functions of f (x), g (x) and h (x), respectively. Note that the functions p (x), q (x) and r (x) in the Algebra Window of figure 07 configure the identity function, that is, the neutral element in the composition of functions, and (x). Therefore, operating each function with its inverse compiles the identity function. And with that, we have the verification that the set G with the function composition operation is group.

One mistake that the student may have in solving the inverse element of this activity is to be mistaken in the inverse function of each function of the set G, and thus generate another result that does not corroborate those described in the Algebra Window of figure 07.

Figure 07 - inverse functions of f (x), g (x) and h (x).



Source: Prepared by the authors.

In the last phase provided by Sequence Fedathi, the Exam, the teacher takes the students' solutions and synthesizes the content worked. Here, too, one must generalize the problem. The generalization of the suggested Position Taking refers to Example 4, in Gonçalves (2013, p. 121), where given G the set of lines in the Cartesian plane with ≠ 0, that is, G = {f: R → R: f (x) = ax + b, 0 a, b R. As it is not possible to perform mathematical demonstration in *GeoGebra*, the teacher can use the blackboard, with brush and eraser, to demonstrate that this set G, with the operation composition of functions, is group. Such a demonstration may be used for any activity requiring the demonstration of a set with a given operation is group. The obtaining of the neutral element is given first by the assumption that this neutral element exists, and then a value is assigned to be the neutral element, after which it must be proved that given the element x of the set, operated with the neutral element, is the same as element x. Finally, the inverse element assumes that the inverse element exists in the operation and then verifies whether given element x operated with x-1 results in the neutral element.

Another point to highlight from generalization is the fact that to demonstrate if given a set with a binary operation is Group, it is enough to verify the three Group axioms. The verification of associativity occurs in manipulating with the operation to verify the veracity of equality. In the neutral element, we search for the element.

During the didactic session, the teacher uses the Mediation foundation, where is the way that the teacher becomes a mediator of knowledge for the student, not the content player. The student can also provide a solution in which the teacher has not thought about their planning, and this is characterized as a foundation of Sequence Fedathi called adidatic situation.

4. Final Considerations

It is noted that it is possible to develop didactic sessions in the teaching of Algebra under the aegis of a Dynamic Geometry software, although the content limits the use of the tool in only examples unlike the Differential and Integral Calculus that can have the geometric character even in the concepts and not only boiled down to exemplification.

The use of *GeoGebra* software for the teaching of Algebra is a possibility even with these difficulties in inserting a geometric relationship to the content. And so, one can have a lesson plan oriented to teaching the Algebraic Structure Group, which links the *GeoGebra* software.

The research was directed to the use of the computational tool in the teaching of Algebra, but it is noteworthy that the course of the activity is idealized by the Sequence Fedathi teaching methodology, as it provides the teacher with a guide on how to proceed and what posture should take in the classroom.

Thus, there is a contribution to the use of *GeoGebra* in Algebra teaching as well as Mathematics Education in higher education. We use here only an Algebra clipping for the applicability of *GeoGebra*, which causes a limitation of the work. However, it is suggested to use this tool to teach the concept of other Algebraic Structures, such as Rings, Integrity Domain and Bodies.

7. References

[1] ALVES, Francisco Régis Vieira; ARAUJO, Ana Gleiceane Dias de. Ensino de Álgebra Abstratacom Auxíliodo Software Maple: grupos simétricos Sn. **Conexões**: Ciência e Tecnologia, Fortaleza, v. 7, n. 3, p.25-35, nov. 2013.

[2] BORGES NETO, Hermínio. Uma proposta lógico-construtiva-dedutiva para o ensino de Matemática. 2016. 28f. Tese (Ascenção a Professor Titular) – Faculdade de Educação, Universidade Federal do Ceará, Fortaleza, 2016.

[3] BORGES NETO, Hermínio; CAPELO BORGES, Suzana. As Tecnologias Digitais no Desenvolvimento do Raciocínio Lógico. **Linhas Críticas**, v. 13, n. 24, p. 77-87, 2007.

[4] BORGES NETO, Hermínio. **Sequência Fedathi:** fundamentos. Curitiba: Crv, 2018. 136 p.

[5] ELIAS, Henrique Rizek; SAVIOLI, Angela Marta Pereira das Dores. Dificuldades de graduandos em Matemática na compreensão de conceitos que envolvem o estudo da estrutura algébrica grupo. **Educação Matemática Pesquisa**, São Paulo, v. 15, n. 1, p.51-82, 2013. Disponível em: <https://revistas.pucsp.br/emp/article/view/10353/pdf>. Acesso em: 05 out. 2019.

[6] FRANCO, Hernando José Rocha; SOARES, Carlos Alberto Santana. Conflitos de Aprendizagem na Disciplina de Álgebra Abstrata. **Revista Paranaense de Educação Matemática**, Campo Mourão, v. 2, n. 2, p.160-178, jan./jun. 2013. Disponível em: <http://www.fecilcam.br/revista/index.php/rpem/article/view/888>. Acesso em: 05 out. 2019.

[7] GONÇALVES, Adilson. **Introdução à Álgebra.** 5. ed. Rio de Janeiro: Impa, 2013. 194 p.

[8] KLUTH, VerildaSperidião. O Movimento da Construção das Estruturas da Álgebra: uma visada fenomenológica. **Bolema**: Boletim de Educação Matemática, Rio Claro, v. 20, n. 28, p.95-112, 20 ago. 2008. Disponível em: <https://www.periodicos.rc.biblioteca.unesp.br/index.php/bolema/article/view/1533>. Acesso em: 06 out.

2019.

[9] NOGUEIRA, Clélia Maria Ignatius; PAVANELLO, Regina Maria. A Abstração Reflexionante e a Produção do Conhecimento Matemático. **Bolema**: Boletim de Educação Matemática, Rio Claro, v. 21, n. 30, p.111-130, 06 out. 2008. Disponível em: <http://www.periodicos.rc.biblioteca.unesp.br/index.php/bolema/article/view/1784>. Acesso em: 05 out. 2019.

[10] SANTANA, José Rogério. **Do Novo PC ao Velho PC:** a prova no ensino de matemática a partir do uso de recursos computacionais. 2002. 171 f. Dissertação (Mestrado) - Curso de Programa de Pós-graduação em Educação, Faculdade de Educação, Universidade Federal do Ceará, Fortaleza, 2002.

Strategic feeding supplementation: An alternative for sustainability of beef production in native pastures

Lucas Carvalho Siqueira, Bruno Pagliarin Oliveira, Daniele Furian Araldi, Juliana Medianeira Machado, Claudia Prudencio Mera, Guilherme Konradt, Patricia Wolkmer

Abstract

The present study aimed to evaluate the effects of a strategic feeding supplementation protocol on reproductive and economic results of exclusively fixed timed artificial inseminated (FTAI) beef cows from a southern Brazilian herd. The experiment was carried out over 2 consecutive breeding seasons (2016 and 2017, from October to January). Two-hundred, 3 and 4 years old, non-suckled, Angus cows (n=100/year), were divided into two homogeneous groups (by weight and body condition score) 25 days before the first FTAI of the breeding season (First FTAI=Day 0). As a representation of traditional management of herds grazing on natural pastures from Rio Grande do Sul Province, Brazil, cows from control group (CG; n=100; 50 cows in each year) received basic mineral supplementation (without protein an energy) ad libitum during the entire experimental period. As an alternative feeding protocol, supplemented group (SG; n=100; 50 in each year) received a mineral supplementation enriched with protein (23%), energy (44% NDT) and sodium monensin (0.25%) ad libitum from days: –25 to 80 of breeding season. Cows were maintained in 2 separated paddocks of native pasture with similar forage composition and availability. All cows were submitted to a progesterone/estradiol-based estrus synchronization protocol on day -10, and cows not pregnant at diagnosis were resynchronized on days 28 and 76 using the same hormonal treatment. There was no year effect (P>0.1) on weight gain and reproductive results, data from both breeding seasons were polled together for further analyzes. Cows from SG presented higher average daily weight gain and gained more weight than cows from CG (p<0.001). Conception rate was higher for SG than CG at the first FTAI cycle (p<0.05). No differences between groups were detected on final pregnancy rates (CG=80% and SG=88%; p>0.1). Cows from SG became pregnant earlier (p<0.01) during the breeding seasons. Also, the feeding supplementation provided an opportunity to increase gross margin. In conclusion, strategic feeding supplementation of beef cows grazing in natural pasture and submitted exclusively to fixed timed artificial insemination increases cows' weight gain, anticipates pregnancies during the breeding season and can increase profit margin when compared to traditional management adopted in southern Brazil.

Introduction

Traditional beef cattle production in southern Brazil, especially in Rio Grande do Sul state, utilizes native pastures as the main feeding resource (Lobato et al., 2014). In this pastoral system, animals can continuously graze year-round on the natural pasture with little or no feed supplementation. Pampa is one of the six officially recognized biomes in Brazil and the largest natural grassland biogeographic unit in South America (Carvalho et al., 2008; 2009). Beef production on natural grasslands is an alternative for sustainable environment preservation. However, historically, cattle farmers have managed the natural

grasslands using practices that result in overgrazing, low productivity and low farm income. This scenario stimulates the region's conversion of natural pampas to more profitable activities, such as high technology agriculture, which puts regional cattle production and Pampa biome sustainability at risk (Carvalho, 2011).

Ruviaro et al. (2016), using scenario simulations, concluded that system profitability, based on animal grazing on native grasslands and protein-energetic supplementation, would achieve the best results. The supplementation would allow a higher calf weaning weight and fertility rates at reasonable investment costs. In tropical countries like Brazil, breeding season occurs during the spring and summer (September to March) when there is a greater supply of natural pastures (Ruviaro et al., 2014). Forage production is strongly affected by climatic variations, affecting overall performance, especially reproductive indexes. The minimum use of technology and human interference leads to very low productivity indexes. In 2013, Rio Grande do Sul state registered only 21% average cattle offtake, presenting a calf/cow ratio of 0.56 (SEAPA, 2013). Nevertheless, in Brazil as a whole, little research has been conducted on natural pasture systems to improve the current reproductive indexes.

High reproductive performance is an essential requirement to ensure maximum livestock production and satisfactory economic return (Baruselli et al., 2012). In this context, the incorporation of reproductive programs can optimize reproductive outcomes and profitability. Artificial insemination (AI) promotes genetic and economic gains through the use of superior genetic bulls. Currently, FTAI programs are applied routinely in Brazilian beef herds, providing a systematic approach to the use of AI (Baruselli et al., 2017). For pasture-based systems, high pregnancy rates in the beginning of the breeding season are critical for herd profitability. Cows that become pregnant earlier in the breeding season will calf earlier in the next calving season, and, consequently, will have additional time to recover before the next breeding season.

Reproductive management using exclusively FTAI have been developed using resynchronization programs (Colazo et al., 2007; Pessoa et al., 2018). Recent studies have shown that is possible to obtain better results than natural breeding and estrus detection-based AI (Bo & Baruselli, 2014; Campos et al., 2013). However, studies using only FTAI under natural pasture are limited.

Taking this information into account, the present study aimed to evaluate the effects of a strategic feeding supplementation protocol on reproductive and economic results of exclusively fixed timed artificial inseminated (FTAI) beef cows from a southern Brazilian herd. The primary objective was to determine if the strategic supplementation would allow cows to gain more weight and became pregnant earlier during the breeding season than cows submitted to the traditional feeding system. The secondary objective was to verify if the difference in weight gain would be enough to cover supplementation costs.

Material and Methods

The study was conducted in a commercial beef farm, localized at northwest region (28°35'21.6"S; 55°08'09.1"W) of Rio Grande do Sul state, Brazil. The prevailing climate of the region is humid subtropical according to Köppen's classification. The mean annual temperature varies from 14.3 to 25.2 ºC, with a minimum of 9.7 ºC in August and maximum of 39.9 ºC in January. The mean annual relative air humidity is 73%, and precipitation is 1950.9 mm. All animal handling procedures in these experiments followed general guidelines for animal welfare.

The experiment was carried out over two consecutive breeding seasons (2016 and 2017, from October to January). Two hundred, 3 and 4 years old, non-suckled, Angus cows (n=100/year), were divided into two homogeneous groups (by weight and body condition score) 25 days before the first FTAI of the breeding season (First FTAI=Day 0). Only clinically heathy cows (general and gynecological exam) with body condition score (BCS) of at least 2.5 (1- emaciated; 5- obese) were enrolled in the study. Cows were weighed on days -25, 0, 28 and 76. All cows received the same sanitary protocol for vaccinations and control of endo- and ectoparasites.

Groups of cows were maintained in two separated paddocks (57 hectares each) of native pasture with similar forage composition and availability and submitted to continuous grazing (Table 1). The forage mass was determined by the direct visual estimation method with double sampling (Gardner, 1986). During spring and summer season, samples of grazing simulation were collected, and analyzed for dry matter (DM), mineral matter (MM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) (Van Soest et al., 2018) and extract ether (EE) (Silva & Queiroz, 2002). Analysis of the digestibility of organic matter (OM) was conducted according to Tilley and Terry (1963).

Table 1 – Mean forage mass during spring and summer of the second Year of the study.

Samples	DM (%)	% DM					
		MM	CP	NDF	ADF	EE	OM
Spring (Day = -25)	85,83	10,48	15,81	63,87	30,31	4,86	56,72
Summer (Day = 80)	86,17	7,42	12,17	66,04	33,88	4,29	52,16

Experimental design

As a representation of traditional management of herds grazing on natural pastures from Rio Grande do Sul state, Brazil, cows from control group (CG; n=100; 50 cows in each year) received basic mineral supplement (Table 2) ad libitum during the entire experimental period. As an alternative feeding protocol, supplemented group (SG; n=100; 50 in each year) received a mineral supplementation enriched with protein (23%), energy (44% NDT) and sodium monensin (0.25%) ad libitum from days: –25 to 80 of breeding season. Treatments were available in covered mineral feeders at all times during the experimental feeding period.

Table 2 – Mineral supplements composition used for control (CG) and supplemented groups (SG).

Element	CG	SG
Calcium (min-max)	55-68 g	54-65g
Cobalt (min)	38.9mg	10mg
Copper (min)	---	121mg
Crude Protein (min)	---	230g
Fluor (max)	---	100mg
Iodine (min)	50mg	50mg

Magnesium (min)	2.3mg	4.2g
Manganese (min)	---	180mg
Sodium Monensin (min)	---	250mg
NDT (min)	---	440g
NNP equivalent (min)	---	150g
Phosphorus (min)	45g	10g
Selenium (min)	9mg	5mg
Sodium (min)	152g	55g
Sulfur (min)	---	6g
Zinc (min)	2,520mg	500mg

Total individual consumption was estimated by dividing the total amount (kg) of supplement offered for each group by the number of cows per group. Daily individual consumption was estimated by dividing total individual consumption by the period of supplementation.

Reproductive Management

On day -10, all cows received an intravaginal device containing 1.0 g of progesterone, plus 2.0 mg of estradiol benzoate IM. Eight days later, the device was removed, and cows were given 0.25 mg of cloprostenol sodium IM and 300 IU of equine chorionic gonadotropin IM. At intravaginal device removal, cows received 1 mg of estradiol cypionate IM. Cows were inseminated 48 to 52 h after the progesterone device was removed. Inseminations were performed by one technician, using frozen-thawed semen from one bull each season, previously approved for use in accordance with the Brazilian College of Animal Reproduction (2016).

Twenty-eight days (day=28) after every FTAI, pregnancy diagnosis was performed using transrectal ultrasonography (8 MHZ probe). Detection of an embryonic vesicle with viable embryo (presence of heartbeat) was used as indicator of pregnancy. The conception rate for each FTAI was calculated as the proportion of cows pregnant 28 d after FTAI, divided by the total number of cows inseminated per group. Pregnancy rate was calculated as the proportion of cows pregnant 38 d after the last FTAI of the breeding season, divided by the total number of cows per group.

Data analysis

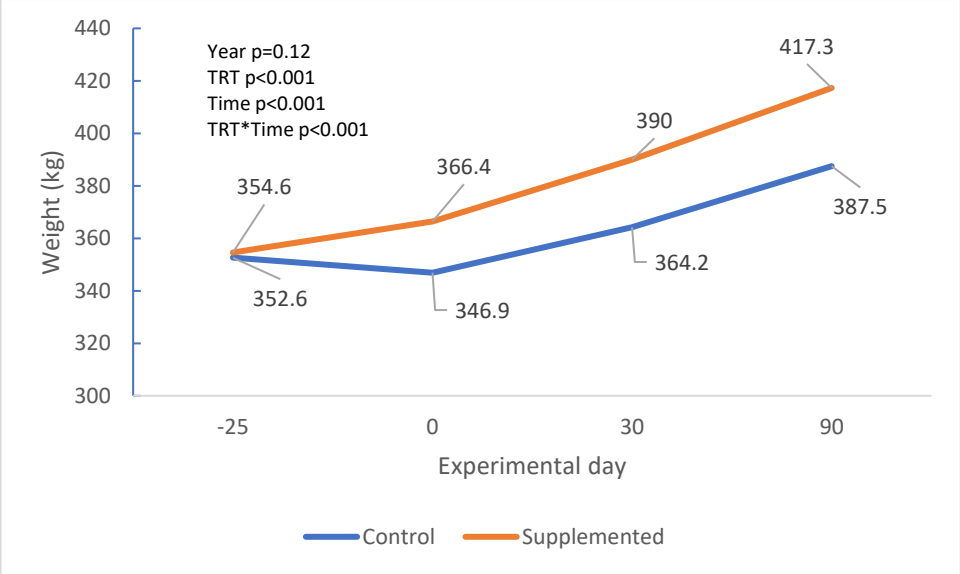
Total weight gain was compared by standard least square including (year nested within treatment). Data are reported as least squares means ± standard error of the mean. Survival analysis using the Kaplan-Meier estimator was performed to calculate cumulative conception rates during the breeding season. Final pregnancy rates were compared by chi-square test. Repeated measures multivariate analysis of variance (MANOVA) was used to examine effects and interactions of treatment and year on changes in weight during experimental period. All analyses were performed using the software JMP Pro14 (SAS Institute Inc., Cary, NC, USA).

For estimation of herd-level economic analysis, all financial values are presented in US dollars (U$), and the following parameters were considered: treatment cost (U$/per kg); total consumption (kg); total weight gain (kg), and regional marked value of replacement heifers (U$/per kg). Marked value gain was estimated as a result of total weight gain multiplied by marked value per kg. Treatment gross margin was estimated as the result of the subtraction of treatment cost from marked value gain according to each group (U$/cow). Treatment costs and replacement heifers value (https://www.scotconsultoria.com.br/cotacoes) were updated on June 10, 2019.

Results

Beef production based on regional native pasture biomes requires cost-effective strategies for its sustainability. The present work compared the effects of a strategic feeding supplementation protocol on reproductive and economic results of exclusively FTAI beef cows from a southern Brazilian herd. Since there was no year effect (P>0.1) on weight gain and reproductive results, data from both breeding seasons were polled together for further analyses. Confirming the experimental hypothesis, there was a significant effect of treatments on individual weight over time (p<0.01), independent of year (p>0.1). During experimental period, cows from SG presented greater total weight gain compared to CG (p>0.01; 62.7±1.1 and 34.9±1.1, respectively; Figure 2).

Figure 2 - Effect of treatments on weight gain during two breeding seasons of fixed timed artificial inseminated (FTAI) beef cows from a southern Brazilian herd.



Conception rate was higher for SG than CG at the first FTAI cycle (p<0.05; Table 3). No differences between groups were detected on final pregnancy rates (CG=80% and SG=88%; p>0.1). Cows from SG became pregnant earlier (p<0.01) during the breeding seasons than CG (Figure 3). Cows from SG consumed approximately 7.4 x more supplement and the total investment required for the strategic feeding supplementation was 12.6x higher than CG (Table 4). Considering only the weight gain variable as an

economical return indicator, the strategic feeding protocol resulted in 41.0% increase on gross margin per animal, since cows from SG gained 79.6% more weight than CG cows (Table 4).

Table 3 – Effects of treatments on conception rates per IATF cycle and final pregnancy rates of the two breeding seasons of fixed timed artificial inseminated (FTAI) beef cows from a southern Brazilian herd.

Group	IATF			Pregnancy rate
	1st	2nd	3rd	
Control - % (Preg/IA)	29.0[a] (29/100)	42.3 (30/71)	51.2 (21/41)	80.0 (80/100)
Supplemented - % (Preg/IA)	44.0[b] (44/100)	53.6 (30/56)	53.8 (14/26)	88.0 (88/100)

[a,b]different letters in the same column indicate statically difference ($p<0.05$).

Figure 3: Effects of treatments on survival curves ($p=0.01$) for proportion of non-pregnant cows submitted exclusively to FTAI, performed at days 0, 38 and 76 of two breeding seasons.

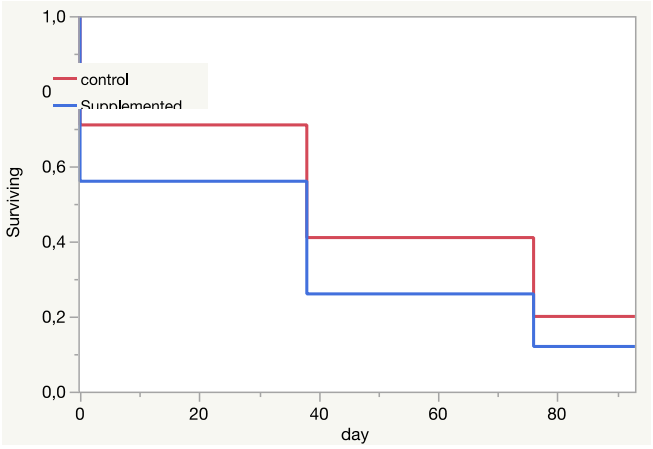


Table 4 – Economic analysis of strategic feeding supplementation of fixed timed artificial inseminated (FTAI) beef cows from a southern Brazilian herd.

	Control	Supplemented
Treatment cost (U$/kg)	0.22	0.38
Total consumption (kg/cow)	7.07	52.02
Average weight gain (kg/cow)	34.9	62.7
investment (U$/cow)	1.55	19.77
Marked value per kg (U$/cow)	1.3	1.3
Marked value gain (U$/cow)	45.37	81.51
Gross Margin (U$/cow)	43.82	61.74

Discussion

In view of the cattle ranching tradition of the state of Rio Grande do Sul, one expects greater productive, reproductive and economic efficiency of this activity. However, present median weaning rate is 62.4% (Lobato et al., 2014; SEAPA, 2019), and 160 cows are needed to produce 100 calves per year. Undernutrition plays a main role in decreasing beef productivity, especially under natural pasture. Energy and protein supplementation can be an auxiliary tool to improve individual animal performance, increase pasture stocking rate, increase total meat production per unit area and improve reproductive efficiency (Mulligan et al., 2001; Lobato et al., 2014). Lack of information about the feasibility and nutritional basis involved in the response to supplementation at different stages of life of animals has hindered adoption of the practice of supplementation on production systems (Hawkins et al., 2000). The present work shows, after two breeding seasons, that cows from SG had enhanced productive, reproductive and economic performance than CG cows.

In general, the genetic potential of animals is not maximized under tropical pasture regime, mainly due to the restriction in energy and protein intake (Fieser et al., 2007; Forero et al., 2019). Here, the SG cows had higher weight gain than the CG ($P < 0.1$). Mulligan et al. (2001) mention that during the hot seasons (spring-summer), it may be convenient to supplement with protein sources of lower ruminal degradability, even for animals grazing fodder with high protein levels. An important discussion related to the energetic-protein-mineral supplementation, emphasizes that it could improve the utilization of the pasture protein. This fact may justify results observed during the present study.

Besides protein and energy, the supplement used in SG during the present study contained sodium monensin. These ionophores have been associated with positive results on beef production for a long time (Rouquette et al., 1980). Monensin fed through a mineral supplement can improve weight gain on pasture-based systems. Also, there is evidence that mineral deficiency correction may interact with monensin in increasing weight gain (Fieser et al., 2007; Forero et al., 2019). The effect of an energy supplement with monensin on CH4 emissions and performance of stocker calves grazing has recently been suggested (Thompson et al., 2019). The inclusion of ionophores in cattle diets, such as sodium monensin, causes changes in the microbial population and alters the final proportions of volatile fatty acids. In a meta-analysis study, a linear effect of ionophore was observed to improve feed efficiency, reduce dry matter intake and increase daily average gain (Duffield et al., 2012).

The higher conception rates observed here at first FTAI had a positive effect that lasted throughout the entire breeding seasons (Figure 5). The precocious pregnancy will result in early parturitions in the following calving season (Baruselli et al., 2018; 2019). This could lead to remarkable outcomes, since cows and heifers that calve earlier have greater chance to conceive in the following breeding season. It also seems important to highlight that calves born in the beginning of the season are heavier at weaning. These events can positively affect the entire beef production chain (Rodgers et al., 2012; Funston et al., 2012).

Reproductive managements using FTAI and resynchronization programs have the potential to accelerate genetic gain and improve overall productive efficiency (Rodgers et al., 2012). The estimated cost to obtain a pregnancy in managements using FTAI followed by resynchronizations is lower when compared to FTAI followed by natural service (Baruselli et al., 2017). Here, as a management proposal,

we used exclusively FTAI for two consecutive breeding seasons and obtained pregnancy rate over 80%. This is a cutting-edge biotechnology tool for beef farms that could, if adequately implemented, help reverse the low reproductive indexes currently observed in the field (Oosthuizen, 2018).

The causes threatening natural grasslands in southern Brazil are very similar for all countries facing the classical global production versus conservation dilemma (Carvalho et al. (2008). Expansion of the agricultural border and overgrazing are frequently cited as the basis of the phenomena. Regarding agricultural expansion, soybean and forestry are the main recent agricultural initiatives threatening natural grasslands. Discussions on the sustainability of different human activities have been highlighted (Robèrt, 2000;), especially with regard to beef cattle production and the impact of this activity on plant-animal dynamics (Dick et al., 2015).

The Pampa biome consists of very old grasslands, covering an area of 178,243 km2 and encompassing the entire country of Uruguay, part of Argentina and about two-thirds of Rio Grande do Sul state in southern Brazil (Overbeck et al., 2007). Cattle grazing native pasture has been suggested as the main conservation tool, as it maintains Pampa biome flora and fauna diversity (Bustamante et al., 2012; Modernel et al., 2013). Historically and presently, from the socioeconomic point of view, low livestock productivity results in minimal returns for local economy, lower population density and regional development (Santos & Trevisan, 2009). A proposed alternative would be considering those farmers as environmental protectors and reward their efforts through monetary compensation (Overbeck et al., 2009). Veysset et al. (2010) point out that French cattle culture calf stage focuses on low fertility mountainous pasture areas, thus being a fundamental activity for regional development, maintaining the landscape and biodiversity level of some of the systems.

Meanwhile, the strategies for increasing production must be economically justified to be adopted by producers. Based on the present data, strategic feeding supplementation provides an opportunity to increase gross margin. First, the difference in weight gain between groups was enough to cover supplementation costs. Although to obtain these results would require an investment almost 13x more (U$1.55 vs U$19.77; Table 4) than for the traditional feeding system, the 41% increase on gross margin per animal (U$43.82 vs U$61.74; Table 4) can justify the adoption of this management during breeding season. Also, the already discussed benefits for anticipation of pregnancy during breeding season further support this notion.

In conclusion, strategic feeding supplementation of beef cows grazing in natural pasture and submitted exclusively to fixed timed artificial insemination increases cows' weight gain, anticipates pregnancies during the breeding season and can increase profit margin when compared to traditional management adopted in southern Brazil. The adoption of this nutritional management option must be conditioned by farmer's productive purposes and linked to the cost-benefit of his practice. It seems important to highlight that more studies aiming to evaluate technologies to optimize the use of available natural resources, increase profit and key production indicators are required to assure production and environmental sustainability.

REFERENCES

Baruselli, P. S., Sales, J. N. S., Sala, R. V., Vieira, L. M., & Sá Filho, M. F. (2018). History, evolution and perspectives of timed artificial insemination programs in Brazil. *Animal Reproduction (AR)*, *9*(3), 139-152.

Baruselli, P. S., Ferreira, R. M., Colli, M. H. A., Elliff, F. M., Sá Filho, M. F., Vieira, L., & de Freitas, B. G. (2018). Timed artificial insemination: current challenges and recent advances in reproductive efficiency in beef and dairy herds in Brazil. *Animal Reproduction (AR)*, *14*(3), 558-571.

Baruselli, P. S., Ferreira, R. M., Sá Filho, M. F., & Bó, G. A. (2018). Using artificial insemination v. natural

Carvalho, N. A. T., Soares, J. G., & Baruselli, P. S. (2018). Evolution and perspectives of timed artificial insemination (TAI) programs in Brazil-A review. *The Indian Journal of Animal Reproduction*, *39*(2), 1-8.

Bó, G. A., & Baruselli, P. S. (2014). Synchronization of ovulation and fixed-time artificial insemination in beef cattle. *Animal*, *8*(s1), 144-150.

Bustamante, M. M., Nobre, C. A., Smeraldi, R., Aguiar, A. P., Barioni, L. G., Ferreira, L. G., ... & Ometto, J. P. (2012). Estimating greenhouse gas emissions from cattle raising in Brazil. *Climatic change*, *115*(3-4), 559-577.

de CARVALHO, P. C. F., da Silva, S. C., Nabinger, C., Moraes, A. D., & Genro, T. C. (2008). Managing natural grasslands in a changing world: grazing ecology insights to accomplish re-oriented management expectations. In *Embrapa Pecuária Sul-Artigo em anais de congresso (ALICE)*. In: INTERNATIONAL GRASSLAND CONGRESS, 21.; INTERNATIONAL RANGELAND CONGRESS, 7., 2008, Hohhot. Multifunctional grasslands in a changing world: proceedings. Guangzhou: Guangzhou People's Publishing House, 2008..

Carvalho, P. C. F, & Batello, C. (2009). Access to land, livestock production and ecosystem conservation in the Brazilian Campos biome: the natural grasslands dilemma. *Livestock Science*, *120*(1-2), 158-162.

Carvalho, P. C. F., Nabinger, C., Lemaire, G., & Genro, T. C. M. (2011). Challenges and opportunities for livestock production in natural pastures: the case of Brazilian Pampa Biome. In *Embrapa Pecuária Sul-Artigo em anais de congresso (ALICE)*. In: INTERNATIONAL RANGELAND CONGRESS, 9., 2011, Rosario, Argentina. Diverse rangelands for a sustainable society:[plenary...]. Rosario: Instituto Nacional de Tecnología Agrpecuaria; Asociación Argentina para el Manejo de Pastizales Naturales, 2011. p. IX-XV..

Campos, J. T., Marinho, L. S. R., Lunardelli, P. A., Morotti, F., & Seneda, M. M. (2013). Resynchronization of estrous cycle with eCG and temporary calf removal in lactating Bos indicus cows. *Theriogenology*, *80*(6), 619-623.

Brazilian College of Animal Reproduction CBRA - Manual para exame andrológico e avaliação de sêmen animal (third ed.), Colégio Brasileiro de Reprodução Animal, Belo Horizonte- MG (2016).

Colazo, M. G., Kastelic, J. P., Small, J. A., Wilde, R. E., Ward, D. R., & Mapletoft, R. J. (2007). Resynchronization of estrus in beef cattle: Ovarian function, estrus and fertility following progestin treatment and treatments to synchronize ovarian follicular development and estrus. *The Canadian Veterinary Journal*, *48*(1), 49.

Dick, M., da Silva, M. A., & Dewes, H. (2015). Life cycle assessment of beef cattle production in two typical grassland systems of southern Brazil. *Journal of Cleaner Production*, *96*, 426-434.

Duffield, T. F., Merrill, J. K., & Bagg, R. N. (2012). Meta-analysis of the effects of monensin in beef cattle on feed efficiency, body weight gain, and dry matter intake. *Journal of Animal Science*, *90*(12), 4583-4592.

Fieser, B. G., Horn, G. W., & Edwards, J. T. (2007). Effects of energy, mineral supplementation, or both, in combination with monensin on performance of steers grazing winter wheat pasture. *Journal of animal science*, *85*(12), 3470-3480.

Forero, L. C., Davy, J. S., McMurry, B. E., & Oltjen, J. W. (2019). Monensin and mineral supplementation economically increase yearling cattle weight gain on California annual rangeland. *Translational Animal Science*, *3*(2), 737-741.

Funston, R. N., Musgrave, J. A., Meyer, T. L., & Larson, D. M. (2012). Effect of calving distribution on beef cattle progeny performance. *Journal of animal science*, *90*(13), 5118-5121.

Hawkins, D. E., Petersen, M. K., Thomas, M. G., Sawyer, J. E., & Waterman, R. C. (2000). Can beef heifers and young postpartum cows be physiologically and nutritionally. *J Anim Sci*, *77*, 1-10.

Lobato, J. F. P., Freitas, A., Devincenzi, T., Cardoso, L. L., Tarouco, J. U., Vieira, R. M., ... & Castro, I. (2014). Brazilian beef produced on pastures: sustainable and healthy. *Meat science*, *98*(3), 336-345.

Modernel, P., Astigarraga, L., & Picasso, V. (2013). Global versus local environmental impacts of grazing and confined beef production systems. *Environmental Research Letters*, *8*(3), 035052.

Mulligan, F. J., Caffrey, P. J., Rath, M., Kenny, M. J., & O'mara, F. P. (2001). The effect of dietary protein content and hay intake level on the true and apparent digestibility of hay. *Livestock Production Science*, *68*(1), 41-52.

Oosthuizen, N., Fontes, P. L. P., Sanford, C. D., Ciriaco, F. M., Henry, D. D., Canal, L. B., ... & Lamb, G. C. (2018). Estrus synchronization and fixed-time artificial insemination alter calving distribution in Bos indicus influenced beef heifers. *Theriogenology*, *106*, 210-213.

Pessoa, G. A., Martini, A. P., Sá Filho, M. F., & Rubin, M. I. B. (2018). Resynchronization improves reproductive efficiency of suckled Bos taurus beef cows subjected to spring-summer or autumn-winter breeding season in South Brazil. *Theriogenology*, *122*, 14-22.

Rouquette Jr, F. M., Griffin, J. L., Randel, R. D., & Carroll, L. H. (1980). Effect of monensin on gain and forage utilization by calves grazing bermudagrass. *Journal of animal science*, *51*(3), 521-525.

Gardner, A. L. (1986). *Técnicas de pesquisa em pastagens e aplicabilidade de resultados em sistemas de produção* (No. 634). IICA Biblioteca Venezuela.

Rodgers, J. C., Bird, S. L., Larson, J. E., DiLorenzo, N., Dahlen, C. R., DiCostanzo, A., & Lamb, G. C. (2012). An economic evaluation of estrous synchronization and timed artificial insemination in suckled beef cows. *Journal of animal science*, *90*(11), 4055-4062.

Ruviaro, C. F., de Léis, C. M., Lampert, V. D. N., Barcellos, J. O. J., & Dewes, H. (2015). Carbon footprint in different beef production systems on a southern Brazilian farm: a case study. *Journal of Cleaner Production*, *96*, 435-443.

Ruviaro, C. F., da Costa, J. S., Florindo, T. J., Rodrigues, W., de Medeiros, G. I. B., & Vasconcelos, P. S. (2016). Economic and environmental feasibility of beef production in different feed management systems in the Pampa biome, southern Brazil. *Ecological indicators*, *60*, 930-939.

Santos, T., & Trevisan, R. (2009). Eucaliptos versus Bioma Pampa: compreendendo as diferenças entre lavouras de arbóreas e o campo nativo. *Lavouras de Destruição: a (im) posição do consenso*, 299-332.

SILVA, D.J.; QUEIROZ, A.C. Análise de alimentos (métodos químicos e biológicos). 3.ed. Viçosa, MG: Editora UFV, 2002. 235p.

SEAPA - Secretaria da Agricultura, Pecuária e Agronegócio do Rio Grande do Sul, Dados estatísticos. http://www.agricultura.rs.gov.br (2019)

Thompson, L. R., Beck, M. R., Gunter, S. A., Williams, G. D., Place, S. E., & Reuter, R. R. (2019). An energy and monensin supplement reduces methane emission intensity of stocker cattle grazing winter wheat. *Applied Animal Science*, *35*(4), 433-440.

Tilley, J. M. A., & Terry, R. A. (1963). A two-stage technique for the in vitro digestion of forage crops. *Grass and forage science*, *18*(2), 104-111.

Van Soest, P. J. (2018). *Nutritional ecology of the ruminant*. Cornell university press.

Veysset, P., Lherm, M., & Bébin, D. (2010). Energy consumption, greenhouse gas emissions and economic performance assessments in French Charolais suckler cattle farms: Model-based analysis and forecasts. *Agricultural Systems*, *103*(1), 41-50.

Structural Performance of Modular Wood Panel of Planted Forest and Particleboards Based on Sugarcane Bagasse

Diogo de Lucca Sartori [a, *], Julio Cesar Machado Cravo [b], Erika Yukari Nakanishi [b], Cleber Alexandre de Amorim [a], Márcio Eduardo Silveira [c], Andre Luis Christoforo [d], Juliano Fiorelli [b]

[a] School of Sciences and Engineering, São Paulo State University, Domingos da Costa Lopes Street,780, Tupã, SP, 17602-496, Brazil.
[b] Research Nucleus on Materials for Biosystems, Department of Biosystems Engineering, University of São Paulo, Duque de Caxias Norte Street, 225, Pirassununga, SP, 13630-000, Brazil.
[c] Federal University of São João Del Rei, Frei Orlando Square, 170, São João Del Rei, MG, 36307-352, Brazil.
[d] Department of Civil Engineering, Federal University of São Carlos, Washington Luís Road (SP-310), km 235, São Carlos, SP, 13565-905, Brazil.

ABSTRACT

The production and study of alternative material produced with lignocellulosic waste to application in livestock production installation is not common in Brazil, however, is a great sustainable alternative as substitutes of conventional materials, therefore, the present study aimed to evaluate the structural performance of modular panel of homogeneous sugarcane bagasse particleboards and reforestation wood, by numerical and experimental analysis, with application prospect as lateral closure in cattle handling facilities. The evaluation of the modular panel performance was conducted by a numerical simulation by way of finite elements, in laboratory by soft body impact test, in situ, applied to a crowding pen of corral for cattle management. The results indicated good correlation among experimental and theoretical values and the modular panels met satisfactorily the proposed use as a lateral closure for cattle handling facilities.

KEYWORDS: numerical modeling; soft body impact; handling facilities; rural constructions

1. INTRODUCTION

The birth, growth, and development of plants and animals in agricultural production systems depend on specific buildings that provide adequate conditions to these situations, requiring specific architectural designs. In agriculture, buildings must produce optimal environmental conditions for plants and animals and ensure hygiene and health for the workers involved in the day-to-day care of these living organisms at different stages of their development (FUENTES et al., 2010; PICUNO et al., 2015; PICUNO, 2016).

Regarding the facilities for beef cattle, Carneiro (1979) states they are always more rustic and simpler when compared to those of dairy cattle, basically consisting of corrals, fences, and scales. In agreement

with these statements, Fiorelli and Medeiros (2008) mention that rural facilities for beef cattle are most often performed with projects and old technologies, not focusing on animal welfare and worker safety.

Management activities in the pasture or confined cattle production system require adequate facilities for the management of the animals. Euclides Filho et al. (2002) claim that improper installation and endanger the animals and the staff responsible for its management, contribute reducing competitiveness and commitment quality of meat and leather. Thus, a well-designed bovine handling facility has as main benefits the bruises reduction in the animal carcasses and injuries in the people, having a significant impact on the ease of handling and movement of the animals, as well as on the well-being of these (GRANDIN, 1983; PETHERICK, 2005).

A corral for bovines comprises a group of structures necessary to manage the animals, as holding pens and gates, access/sorting alley, crowding pen and gate, working chute, headgate and holding chute/squeeze, scale and loading chute. It is used to safely and efficiently confine cattle for observation, routine sanitary management and handling procedures (BICUDO et al., 2002).

The internal walls of the crowding pen, working chute and loading chute access ramps should be smooth and free of protrusions, such as nail tips, screws, or hardware that could damage the animal. Paranhos da Costa et al. (2002) cites the efficiency between handling and the material which is made surrounded the corral and other areas of work with animals, especially regarding the sealing of the side walls of the premises. Which prevent the cattle get distracted or frightened by external events, causing stop, retreat and even animal jump, delaying the completion of the work.

Several papers relating the production of particleboards based on agroindustrial residues, as substitutes for conventional materials, have been found in the literature. As shown by Maduwar et al. (2013), with the aim of developing sustainable materials that promote the natural resources use reduction.

Among all the lignocellulosic residues, the sugarcane bagasse has been highlighted, being used and studied by several researchers. These have been testing the potential of their use as the main raw material or as part of the composition and production of particleboards (FIORELLI et al., 2013; JONOOBI et al., 2016; SANTOS et al., 2014; TABARSA et al., 2011; MENDES et al. 2010; MESQUITA et al. 2018; ZHANG et al., 2018). This is due to its lignocellulosic structure one name of hardwoods, which contains less lignin content and higher pentosan content (SOUSA et al., 1986).

Sugarcane bagasse is classified as a solid residue and can be considered a by-product, resulting from sugarcane crushing in the sugar-alcohol plants. The proportion of production depends on the amount of fiber present in the sugarcane cultivars, estimated in Brazil at 270-290 kg of bagasse for each ton of processed cane (BRAZIL, 2011).

Development and application of new technologies application in facilities intended for agricultural production are not common in Brazil. Thus, it creates a shortage and dependence as the parameters, recommendations and technologies developed abroad, these being appropriate the specific needs of their realities. Therefore, this paper proposes the material production for improving the production system, based on a lignocellulosic waste and evaluation of performance when applied in facilities for livestock production.

The present work had as objective to produce and evaluate the structural performance of modular panel of reforestation wood and homogeneous sugarcane bagasse particleboards. The structural analysis

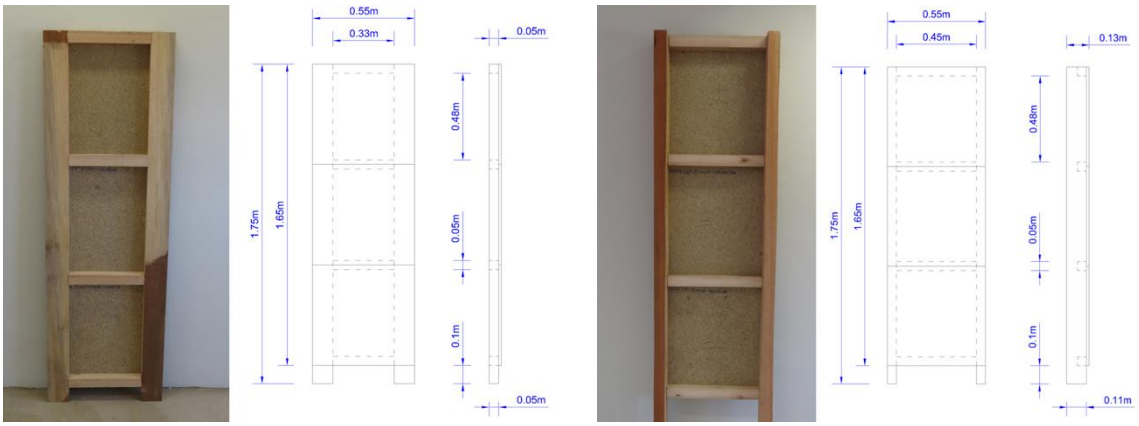
will be performed through numerical simulation and experimental measurement. The outstanding result enables the panels to be applied as a lateral installation closure for cattle.

2. MATERIAL AND METHODS

For manufacturing the modular panels, beams and rafters of sawn timber of the genus *Eucalyptus spp*. from planted forests. The homogeneous sugarcane bagasse particleboards were produced following the guidelines established by Sartori et al. (2012).

2.1. Assembly of modular panels

The assembly of the modular panels followed two models that differed by position of the wood beams making up the panel structure: Closing Panel (CP) and Structural Panel (SP) (Fig. 1). To prepare the modular panels were used beams (0.05 × 0.11 m) and rafters (0.05 × 0.05 m) of wood, and three homogeneous particleboards of sugarcane bagasse agglutinated with two-component polyurethane resin based on castor oil (PU-castor oil). The structure was made by fitting the wood and the screws fixed the particles.

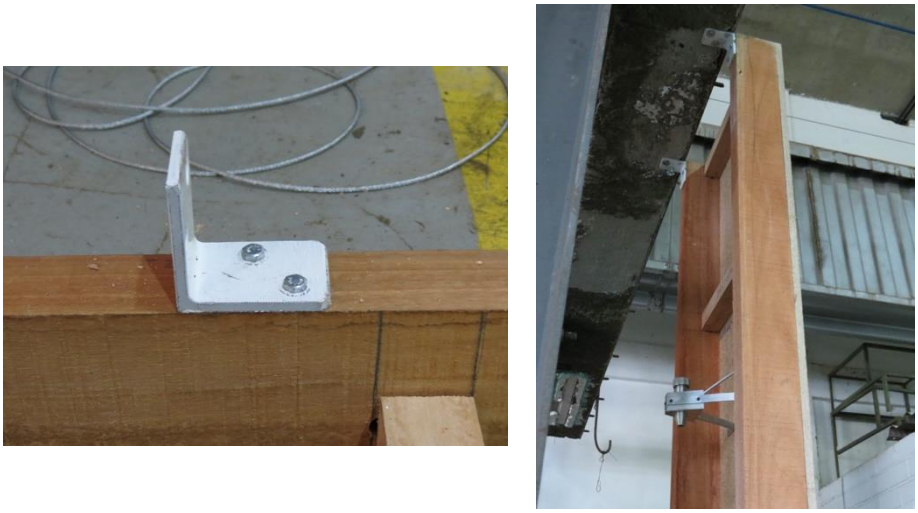


(a) (b)

Fig. 1. Type of modular panels and their dimensions: (a) Closing Panel. (b) Structural Panel.

2.2. Soft Body Impact Test

Soft body impact test was carried out following the precepts of the ABNT standard MB-3256: 1990 - Modular internal light partitions - Impact resistance verification. Through this test it was possible to verify the behavior of the modular panel when subjected to impacts applied to the structure, simulating an impact caused by an adult bovine. To perform the test, it was placed modular panels in a gantry with beams adjustable to their structure, composed of steel and concrete. The fixation of the modular panel was performed using metal parts, made for such use (Fig. 2).



(a) (b)

Fig. 2. Fixing the modular panel. (a) Metal part for fixing. (b) Fixing the modular panel to the gantry.

The span between the gantry beams was 1.75 m (Fig. 3a). As a soft body, a synthetic leather bag of 0.35 m in diameter and 0.90 m in height was used, filled with a mixture of wood shavings and sand in a ratio that would complete its volume and reach the mass of 40 kg (Fig. 3b). It fixed the device for registering the transverse displacements in the center of the modular panel, corresponding to the impact location of the soft body and it recorded the displacement on a sheet of graph paper (Fig. 3c).

(a) (b) (c)

Fig. 3. Soft body impact test: (a) Modular panel positioned and fixed to gantry. (b) Leather bag used as a soft body. (c) Device for recording displacement at impact.

For performing the soft body impact test was released from various heights corresponding to different energy intensities. Table 1 shows the heights and respective impact energies, considering the 40 kg mass of the leather bag. The highest energy used in the tests was 600 J, which corresponds to an impact of an adult cattle, all measurements were performed in duplicate.

Table 1. Impact energies corresponding to the soft body abandonment height.

h (m)	E (J)
0.15	60
0.30	180
0.45	240
0.90	360
1.20	480
1.50	600

After each test, it was measured the residual and instantaneous transverse displacements. A visual inspection throughout the modular panel was carried out to identify ruptures and cracks in the wood structure, particleboards and the connecting elements (fitting and screws).

2.3. Numerical simulation

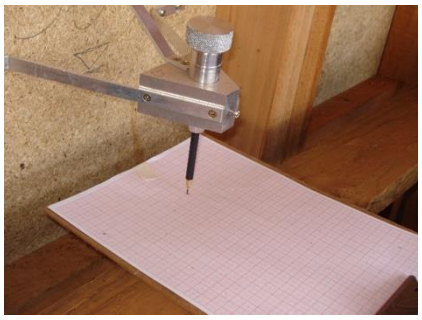
It was performed the dynamic nonlinear numerical simulation of modular panels structural behavior (geometric and contact) in Radioss V120 software, with explicit integration in time. The simulations were done under the same conditions set forth in the soft body impact test as described above. The values of the mechanical properties of the constituent materials of the modular panels (homogeneous sugarcane bagasse particleboards and *Eucalyptus* spp. Wood) were used. It was considered the elastic-linear behavior for materials. The simulations were done on a computer with a 4-core I3 processor, the time of each simulation was 3 h.

Modular CP and SP panels were evaluated at 6 soft-body drop height levels, similar to the experimental procedure of the soft-body impact test (Table 1). For the theoretical modeling, solid elements were considered hexahedral for the wood and for the sandbag, shell elements for the homogeneous sugarcane bagasse particleboards and bar elements for the steel cable. For the boundary conditions, the modular panels were fixed (all degrees of freedom) at the ends, as performed in the soft body impact test. The steel cable was fixed (displacement only) at its upper end. It was attributed a vertical acceleration of 9.81 m/s^2 corresponding to gravity. The contact restrictions were established between the sandbag and the modular panel.

2.4. Structural performance evaluation of modular panels applied to management corral

Modular panels were applied in a cattle management corral at the University of São Paulo (USP), Faculty of Animal Science and Food Engineering (FZEA), Campus of Pirassununga-SP. It was attached to the crowding pen sides (Fig. 4a). All CP were supported and fixed on the existing crowding pen side wall, since ones were only fixed at their ends on the floor and at the top, having their length free. It measured the horizontal displacements in four modular panels of SP types, with the same device used in the soft body impact test (Fig. 4b), it installed in the geometric center of each SP. The SP modular panel was evaluated under two different management system: i) experimental management (with the amount of controlled animals) and ii) conventional management (without controlling the amount of animals).

(a)



(b)

Fig. 4. Bovine management center: (a) Crowding pen internal view. (b) Device to measure horizontal displacement.

3. RESULTS AND DISCUSSION

3.1. Soft body impact test

Table 2 shows instantaneous transverse displacements and residual values to CP and SP samples got for each impact point, and the observation of occurrences after each impact applied to modular panels.

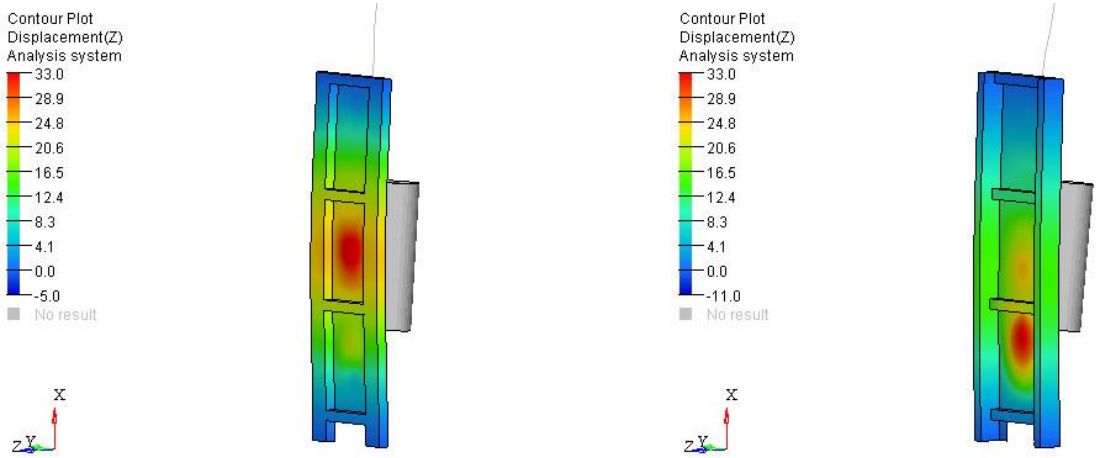
Table 2. Transversal displacement of the soft body impact test in SP and CP for different energy levels.

Heigh (m)	Impact numbers	Energy (J)	Transversal displacement (mm)				Occurrence
			Instantaneous		**Residual**		
			SP	**CP**	**SP**	**CP**	
0.15	**1**	**60**	3	8	0	0	No Occurrence
	2		3	8	0	0	No Occurrence
0.30	**1**	**120**	6	11	1	1	No Occurrence
	2		6	13	1	1	No Occurrence
0.45	**1**	**180**	9	18	1	2	No Occurrence
	2		7	20	1	2	No Occurrence
0.60	**1**	**240**	10	24	2	2	No Occurrence
	2		11	25	2	1	No Occurrence
0.90	**1**	**360**	15	30	2	5	No Occurrence
	2		20	23	5	1	No Occurrence
1.20	**1**	**480**	23	28	5	5	No Occurrence
	2		19	31	2	3	No Occurrence
1.50	**1**	**600**	27	37	5	6	No Occurrence
	2		28	36	4	6	No Occurrence

The SP and CP modular panels present average value for instantaneous transverse displacements of 22 mm and 13 mm, respectively. The results show that the SP presented a better efficiency in resisting the applied impact. This is due to the structural configuration of its construction with the wooden beams in the largest moment of inertia position. It was also observed that after the soft body impact test there was no occurrence of cracking, fissures and other types of damages in the components and structure of CP and SP.

3.2. Numerical simulation

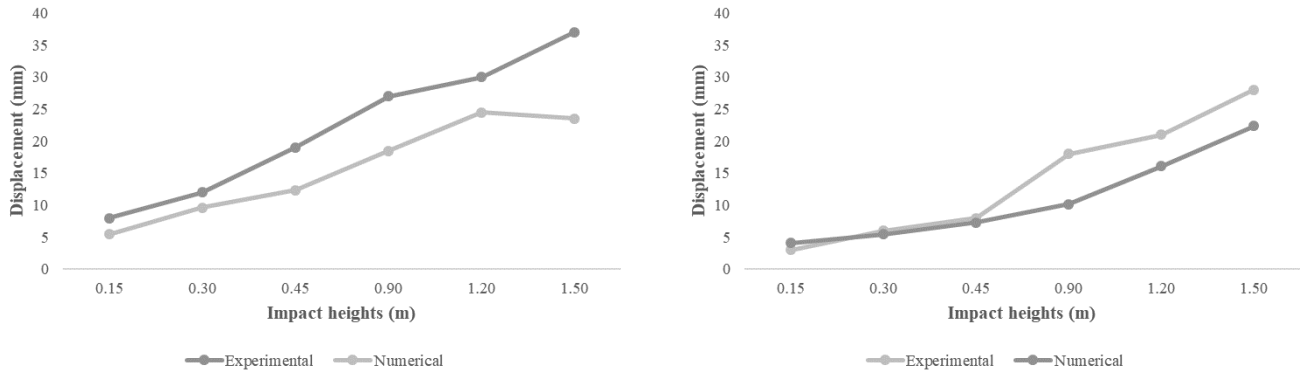
Fig. 5 shows the maximum transverse displacements of the SP and CP samples got through numerical simulations. Fig. 5a presents the results for the CP modular panels, and Fig. 5b for the SP, the impact height was 1.5 m.



(a) (b)

Fig. 5. The figure shows the horizontal displacement distribution, by numerical simulation, for the height of 1.5 m for the samples of (a) CP and (b) SP.

Theoretical maximum transverse displacements values obtained by performing the numerical simulation, and the experimental results of the soft-body impact test, for the six different levels of impact height tested, are presented in Fig 6.



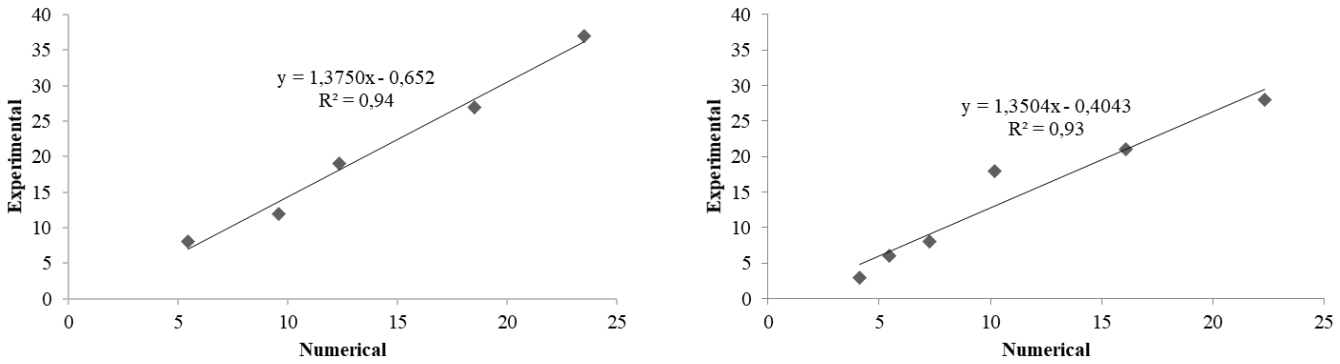
(a) (b)

Fig. 6. Data obtained experimentally and by numerical simulation of transverse displacements for samples (a) CP and (b) SP.

The numerical simulation showed lower transverse displacement values than those obtained in the soft body impact test. This is due to the numerical form of structural system linkage (end fitting), which made the system more rigid than the real one. Only for the SP sample at a clearance height of 0.15 m the numerical value was higher than the value in the assay.

For the impact heights corresponding to the energies of 60, 120 and 180 J (see table 2), a correlation between the numerical and experimental values was observed. For heights over 0.90 M and J = 360, the values began to diverge. This effect can be explained by the occurrence of an inlay in the connections between the homogeneous sugarcane bagasse particleboards to the modular panel wood structure, a condition that was not considered in the numerical model. The SP samples presented lower values for transverse displacements for all the impact heights when compared to the CP samples, i.e., a panel with a more rigid structure.

In order to verify a correlation between the variables studied, a linear regression analysis was performed between the results of experimental and numerical simulation transversal displacement. These are shown in Figs. 7a and 7b, for the CP and SP samples, respectively. The analysis showed a linear relationship between the parameters studied, with a reliability of over 93% for both samples.



(a) (b)

Fig. 7. Scatter diagram of experimental and numerical samples transverse displacements (a) CP and (b) SP, respectively.

3.3. Modular panel applied in crowding pen of corral for cattle management

Table 3 shows the average values of the maximum horizontal displacements of SP modular panels measured during the experimental managements (with the amount of controlled animals) and conventional (without controlling the amount of animals).

Table 3. Average values of maximum instantaneous transversal displacements of SP modular panels.

Kind of management	Day	Maximum instantaneous transversal displacements (mm)	General Average (mm)
Experimental	1	0.25	1.50 ± 1.95
	2	3.75	
	3	0.50	
Conventional	1	4.25	4.25 ± 0.75
	2	5.00	
	3	3.50	

When analyzing the maximum instantaneous transverse displacement, for the three days of management tested for each treatment in both conditions, a maximum value of 3.75 mm was observed for the experimental management and of 5.00 mm for the conventional one. The trend of greater displacements in the SP modular panels in the conventional management days was clearer when observing the general average of the treatments, getting a value of 4.25 mm for the conventional and 1.50 mm for the experimental one.

The value difference of SP modular panel displacement between the conventional and experimental management was 2.75 mm, i.e., SP modular panel presented the 65% transverse displacement higher when conventional management was applied. This variation can be explained by three main factors, being the first one related to the animal category, since for the Conventional treatment, young animals of the Nellore breed, with an approximate age of 14 months, presented a more agitated and reactive temperament to the handling, thus leading to a greater movement in the moment of agglomeration in the crowding pen and greater and more intense contact with the lateral walls of the installation. The other two factors that may have contributed to explain the greater displacement observed in the SP are related to: a) way of conducting the management, being a more dynamic management and representing the employee routinely in rural properties; b) failure to respect the crowding pen stocking rate, with the allocation of a larger number of animals at the filling stage of the crowding pen stocking rate.

The results of the maximum horizontal displacements of SP modular panels for the experimental and conventional managements compared with those obtained on the soft impact test and numerical simulation have demonstrated the efficiency of SP on the application proposed. The average value of the maximum instantaneous transverse displacement was 5 mm, much lower than the 28 and 22 mm obtained in the soft body impact test and numerical simulation, respectively.

4. CONCLUSIONS

Based on the results of this study, the following concluding remarks can be mentioned:

Theoretical and experimental transversal displacement values of the modular panels of homogeneous sugarcane bagasse particleboards and reforestation wood (CP and SP) showed a relationship between the data, validating the proposed numerical model.

SP presented better structural performance when compared to the CP closure panels, when subjected to the tests of soft body impact and numerical simulation.

SP, when applied as a lateral closure in a crowding pen of corral for cattle management, presented a transverse displacement lower than the values obtained in the soft body impact test and in the numerical simulation, confirming the technical feasibility of this constructive component.

The production of modular panels of homogeneous sugarcane bagasse particleboards and reforestation wood for use as a lateral closure in a crowding pen of corral for cattle management may be recommended.

ACKNOWLEDGMENTS

The authors would like to thank FAPESP for supporting the research (proc. 2012/13881-2; proc. 2013/19895-8; 2012/51467-3).

REFERENCES

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS - ABNT. MB-3256: Divisórias leves internas moduladas. Rio de Janeiro, 1990.

BICUDO, J. R. et al. Cattle handling facilities: planning, components and layouts. Lexington, KY: University of Kentucky Cooperative Extension Service AEN-82, 2002.

BRASIL. Companhia Nacional de Abastecimento. A geração termoelétrica com a queima do bagaço de cana-de-açúcar no brasil, análise do desempenho da safra 2009-2010. Brasília: Conab, 2011.

CARNEIRO, O. Construções rurais. 8. ed. São Paulo: Nobel, 1979.

EUCLIDES FILHO, K.; EUCLIDES, V. P. B.; CORRÊA, E. S. Boas práticas na produção de bovinos de corte. Campo Grande, MS: Embrapa Gado de Corte, 2002. 25 p. (Embrapa Gado de Corte. Documentos, 129).

FIORELLI, J.; MEDEIROS, S. F. Curral de manejo para gado de corte em madeira: projeto, construção e análise de custos. In: ENCONTRO BRASILEIRO EM MADEIRAS E EM ESTRUTURAS DE MADEIRA -EBRAMEM, 11., 2008, Londrina - PR. Anais… Londrina: EBRAMEM, 2008.

FIORELLI, J.; SARTORI, D. L.; CRAVO, J. C. M.; SAVASTANO JUNIOR, H.; ROSSIGNOLO, J. A.; NASCIMENTO, M. F.; LAHR, F. A. R. Sugarcane bagasse and castor oil polyurethane adhesive-based particulate composite. Materials Research, v. 16, n. 2, p. 439–446, abr. 2013.

FUENTES, J. M.; GALLEGO, E.; GARCÍA, A. I.; AYUGA, F. New uses for old traditional farm buildings: the case of the underground wine cellars in Spain. Land Use Policy 27, p. 738–748, 2010.

GRANDIN, T. Handling and processing feedlot cattle. In: Thompson, G. B.; O'Mary, C. C. (Eds.). The feedlot. Philadelphia: Lea and Febiger, 1983. p. 213-235.

RICARDO GABRIEL DE ALMEIDA MESQUITA; LOURIVAL MARIN MENDES; ANAND RAMESH SANADI; ALFREDO RODRIGUES DE SENA NETO; PEDRO IVO CUNHA CLARO;

ANA CAROLINA CORRÊA; JOSÉ MANOEL MARCONCINI. Urea Formaldehyde and Cellulose Nanocrystals Adhesive: Studies Applied to Sugarcane Bagasse Particleboards. Journal of Polymers and the Environment, 2018.

PARANHOS DA COSTA, M. J. R. et al. Contribuição dos estudos de comportamento de bovinos para implementação de programas de qualidade de carne. In: ENCONTRO ANUAL DE ETOLOGIA, 20., 2002, Natal-RN. Anais... Natal: Sociedade Brasileira de Etologia, 2002. p.71-89.

PICUNO, P.; STANOVCIC, T.; MORIC, I.; DIMITRIJEVIC, A.; SICA, C., 2015. The valorisation of vernacular farm buildings for an innovative rural tourism. In: Proceedings of the 43rd Symposium on: Actual Tasks on Agricultural Engineering – ATAE 2105, 24–27 February 2015, Opatija (Croatia), pp. 807–817, UDC 721:631.2.

PICUNO, P. Use of traditional material in farm buildings for a sustainable rural environment. International Journal of Sustainable Built Environment, 2016.

PETHERICK, J. C. Animal welfare issues associated with extensive livestock production: The northern Australian beef cattle industry. Applied Animal Behaviour Science, v. 92, 2005.

SARTORI, D. L. et al. Painel em madeira de reflorestamento e chapas de partículas para instalações rurais. Floresta e Ambiente, Rio de Janeiro, v. 19, n. 2, p. 171-178, 2012.

SANTOS, M. F. N.; BATTISTELLE, R. A. G.; BEZERRA, B. S.; VARUM, H. S.A. Comparative study of the life cycle assessment of particleboards made of residues from sugarcane bagasse (Saccharum spp.) and pine wood shavings (Pinus elliottii) Journal of Cleaner Production, v. 64, 2014.

M. JONOOBI, M. GRAMI, A. ASHORI, G. EBRAHIMI. Effect of ozone pretreatment on the physical and mechanical properties of particleboard panels made from bagasse, Measurement (2016), doi: http://dx.doi.org/10.1016/j.measurement.2016.08.019

M. V. MADURWARA; R. V. RALEGAONKAR; S. A. MANDAVGANE. Application of agro-waste for sustainable construction materials: A review. Construction and Building Materials 38 (2013)

HAI ZHANG; STEFANO SFARRA; FABRIZIO SARASINI; JULIANO FIORELLI; JEROEN PEETERS; NICOLAS P. AVDELIDIS; DIOGO DE LUCCA SARTORI; CLEMENTE IBARRA-CASTANEDO; STEFANO PERILLI; YACINE MOKHTARI; JACOPO TIRILLÒ; XAVIER P. V. MALDAGUE. Impact Modelling and A Posteriori Non-destructive Evaluation of Homogeneous Particleboards of Sugarcane Bagasse. Journal of Nondestructive Evaluation, v. 37, 2018. https://doi.org/10.1007/s10921-018-0461-9

SOUSA, M. F. B.; SCHUCHARDT, U.; RODRIGUES, J. A. R. Separação e identificação dos constituintes do bagaço de cana-de-açúcar pelo processo “Organosolv”. Ciência e Cultura, São Paulo, v. 38, n. 1, p. 181-188, 1986.

MENDES, R. F. et al. Painéis aglomerados produzidos com bagaço de cana em associação com madeira de eucalipto. Scientia Forestalis, Piracicaba, v. 38, n. 86, p. 285-295, jun. 2010.

TAGHI TABARSA; ALIREZA ASHORI; MARIA GHOLAMZADEH. Evaluation of surface roughness and mechanical properties of particleboard panels made from bagasse. Composites: Part B, v. 42, 2011.

Exponential Organizations and Digital Transformation: Two Sides of The Same Coin

Fonttamara Lima, Giuliano Carlo Rainatto, Norberto de Almeida Andrade, Fernando Rodrigues da silva

ABSTRACT

The objective of this paper is to verify if there is a link between start-ups that have characteristics of exponential organizations and if this growth has a connection with the digital transformation. It is a bibliographic research with a field research based on the theoretical framework in order to understand the influence of digital transformations on ExOs. A semi-structured questionnaire was used to investigate the relationship between ExOs and digital transformation, will be applied to founders and co-founders of six start ups of different segments and sizes, their answers analyzed qualitatively, based on the theories of exponential organizations, would have singularity and abundance. After the analysis it is concluded that of the companies studied, which have strong characteristics of exponential organizations, 100% of them use digital business models (software or platforms) and operate with the strong use of digital tools and agile methods.

Keywords: Exponential Organizations, Digital Transformation, Startups, Network Effect

INTRODUCTION

Over the past 30 years, the desire for economies of scale has resulted in an explosion of large globalized corporations, pressure for ever-increasing margins and cost reductions, increased revenues and better financial results. (ISMAIL et al., 2015) However, according to the authors, these changes bring a high cost, since large organizational structures are inversely proportional to the much needed flexibility. Thus, large companies with thousands of employees and large facilities face the great challenge of operating quickly.

According to ulman et al (2015), from the 2010s onwards, there is the emergence of a new organization model, whose agility and impact differs from existing models, called Exponential Organizations.

Exponential Organization (ExO) is one whose impact (or outcome) is disproportionately large - at least ten times greater over 4-5 years - compared to peers due to the use of new organizational technologies that leverage accelerated technologies. (ISMAIL et al., 2015).

According to Diamandis (2015) these organizations follow the concept of the 6Ds of disruption: digitized, disguised, disruptive, dematerialized, demonetized and democratized. According to the author, any technology that becomes digitized enters a period of growth in disguise. This rapid increase causes disruption and, as technology becomes disruptive, it dematerializes, de-demonetizing and democratizing the product or service.

ExOs use fewer physical facilities and fewer employees than traditional organizations, as they are grounded in information technology, dematerializing physical structures and transferring them to the digital universe on demand. They learned to organize around an information-based world. (ISMAIL et al., 2015)

According to Hagel (2012) when comparing the model with linear organizations, it is observed that they are prepared to support these changes only from the outside, rather than deploying them internally ie linear organizations will rarely disrupt their products or services. because they do not have the tools, attitudes or perspectives to do so. In this way, linear organizations will continue to grow and benefit from the so-called "economies of scale", also called "scalable efficiency, a paradigm that guides most linear corporate strategies" (Brown, J .; 2012).

Mentioning the exponential disruption, (Diamandis, P .; 2015), we observe the imminent obsolescence of current models, so there is a pressing need for constant updating on new technologies and organizational capabilities. For Hagel (2012), rapid or disruptive change is a subject of extreme difficulty for large matrix organizations, which tend to react to change as if they were attacks.

Digital Transformation

In 1911 Frederick Taylor launches an important book: Principles of Scientific Management, the product of his observation in the steel industry where he worked. For him, it was not up to the worker to make decisions about his work, but to produce more and better to meet the organization's objectives within the established time

Around 1915 Henry Ford developed and refined the concept of assembly line work by manufacturing his first model: the large-scale, low-cost black Ford Mustache. Ford's work was groundbreaking at the time, within the principles of Scientific Management, organizing tasks in such a way as to require as little willpower and intellectual effort as possible from the workers. In 1916, Henri Fayol's book General and Industrial Administration is published. He later became the founder of the Classical Management Theory. The famous division of the functions of the administrator is his own: planning, organizing, coordinating, commanding and controlling. (FAYOL, H, 1916)

In the United States, in 1943, Peter Drucker, who would later be considered the father of modern management, launches an important book: The Future of Industrial Man, which invites him to undertake a scientific analysis at a large company: General Motors. As a product of this work, studies in business have gained another major publication: Concept of the Corporation, launched in 1946, laying the groundwork for management to become a scientific discipline. Drucker and his studies have made major contributions to management by integrating strategic planning, marketing, and finance for the first time. It also re-signified the figure of the worker, coining the well-known term 'knowledge worker' in the late 1950s. His vision revolutionized managerial thinking that originated in post-war Japan

The great symbol of the devastated Japanese recovery was the auto industry. The main feature of the Japanese administration was the creation of a formal model, comprising techniques and doctrines, with the purpose of managing production processes and, subsequently, the entire company. Toyotismo, a production system developed by Toyota between 1947 and 1975, aimed at increasing efficiency and productivity,

avoiding waste without creating stock, such as waiting time, overproduction, transport bottlenecks, unnecessary inventory, among others. (Magaldi, S., Neto, Jose S., 2018)

Earlier in the 1970s, Intel founder Gordon Moore developed the microprocessor, bringing technology into the business world. From now on, technology gained speed, accelerating growth at a pace never seen before. This invention only began to impact technology, in fact, in the 1980s, in a thesis known as Moore's Law. This theory predicted that the price / performance ratio of computing would double every 18 months (ISMAIL et al, 2015).

Parallel to the technological advances, the technology giants emerged: Microsoft, Oracle, SAP, Apple, spreading and popularizing the use of technology, bringing more information to the world and, consequently, to consumers who were strongly empowered over time.

In the 1990s, the term innovation gains space and strength never seen before. In a constantly changing world, the level of complexity of social change is growing, forcing organizations to constantly innovate in their markets to remain competitive. The concepts described by economist Joseph Schumpeter in 1942 about creative destruction now gain even more space in the present scenario. The author, in his book Capitalism, Socialism and Democracy, describes the process of innovation, where new products destroy companies and old business models and, for him, is the main driving force of sustained long-term economic growth. According to Schumpeter (1942), the process of creative destruction is the essential fact of capitalism, the innovative entrepreneur being its major protagonist (Schumpeter, J., 1942).

From Schumpeter's studies on creative destruction, in 1995 professors Clayton M. Christensen and Joseph L. Bower published the article Disruptive technologies: catching the wave in Harvard Business Review, introducing the concept of disruptive innovation to the technology universe. . It was the beginning of the Digital Age, which we live today.

With the internet, whole businesses could be reinvented, new products and services more widely spread, and new business models emerged. One in particular stands out in this new environment: startups. Through them it was possible to innovate with high scalability. Due to their leaner structure, final product costs could be reduced and experimentation gained momentum in order to satisfy consumers and bring important differentials in order to gain new customers and new markets. (MAGALDI, S., NETO, Jose S., 2018)

In 2006, another important milestone for enterprise management: Amazon, from Jeff Bezos, launches its cloud storage solution, Amazon Web Services (AWS). At this time affordable cloud services have been created for small and midsize businesses. This has led to a significant reduction in data maintenance costs, garnering numerous startups as customers, who now enjoy cloud storage services and can expand their technology and better store their information. (ISMAIL et al, 2015).

In this moment of disruption, many market leaders were extinguished because they did not understand the new scenario that was emerging in that context. A famous case was Eastman Kodak, which did not invest in the digital market (although he invented the digital camera). While bankrupt, Instagram, with only three years in the market and just over ten employees, was bought by Facebook for $ 1 billion.

The table 1 Show the organization market value

Table 1 –Actual size of the organization market

Company	Family	Market Value (in billion USD)
Github	Technology	7.5
Airbnb	Lodging	25.5
Google	Technology	403.07
Netflix	Streaming	41.6

Source: EXPONENTIAL ORGANIZATIONS (2017).

According to Ismail (2015) "What we are seeing today is a new generation of companies expanding and generating value at a pace never seen before in the business world."

In 2016, the book The Fourth Industrial Revolution by Klaus Schwab, founder of the World Economic Forum, is published. In the work, the author states that “the changes are so profound that, from the perspective of the history of humanity, there has never been such a potentially promising or dangerous moment” (SCHWAB, 2016).

Overall, organizations have evolved through the paradigm of a strategy that focuses on gaining high growth at low costs. Naturally, traditional organizations have adopted a method of wealth generation that includes complete mastery of the entire production chain, from sourcing (for example, control during tobacco planting and harvesting to final cigarette production by the tobacco industry). tobacco). All process steps calculated by the organization.

However, with the arrival of the Digital Age, an important break in this model happens: for the supplier, there is the gain of scale through the growth of existing demand. The “network effect” starts to occur as more and more markets can be accessed, enhancing business reach, generating more connections and, consequently, business opportunities. That is, the gain of scale occurs in a new perspective: that of orienting to demand (MAGALDI, 2018)

The aforementioned effect is made possible by social networks, apps, smartphones, wearable technologies, high scalability applications running in the cloud. All of this working together with potential never before seen.

The collaborative system, which is the act of co-creation and participation to form interactive networks, has also become the essence of giant business in many different sectors: another new business model. Airbnb and Waze use collaborative networks. to make your business happen. The former has built an important network of followers (buyers and sellers) generating a valuable universe of data from sharing. As such, it has hosted over 150 million people, with more than 3 million accommodations in 65,000 cities in over 190 countries. And it achieved a market value of $ 30 billion in 2018. (ISMAIL et al, 2015)

Waze follows the same logic. When it was acquired by Google in June 2013 for $ 1.1 billion, it had no infrastructure, no hardware, and fewer than 100 employees. However, it had 50 million users, that is, 50 million informants collaboratively producing and sending traffic information. Another paradigm breakthrough generating a new business model: Instead of investing huge capital in hardware (traffic sensors), its founders opted for the collaborative network generated by the application to capture traffic information, based on the GPS of users' smartphones. (ISMAIL et al, 2015)

These two examples illustrate well two new models, managed from strategically sharing information, substantially increasing the connection with their users (clients), turning them into loyal users of their platforms. The platform model stands out as a strong strategic option for business management, efficiently uniting technology, communication and sharing. (PARKER, G., 2018)

> The value in a platform is not only generated by the monetary exchange between participant and environment owner company. In some situations, the exchange unit may be the consumption of certain content, in others the sharing of some information and so on. The platform's value lies in encouraging interactions, and through it the ecosystem holder will generate monetary value (MAGALDI, 2018, p. 96).

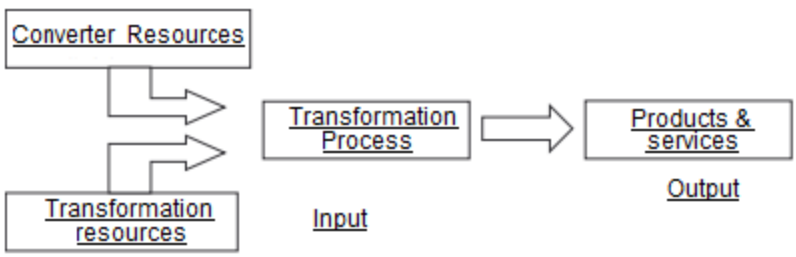
Managers today need to reflect on their business models. Is it focused on cost control or developing demand generation? Do your competitors adopt other models? What would it look like if model developed on a business platform? Is it possible to use the "network effect" to boost your business? Questions of this nature help align the business with new trends and new management models made possible by the advent of technology.

> In the face of all this, one sees how digital technologies are reshaping five key domains of strategy: customers, competition, data, innovation, and value. These five domains describe the digital transformation landscape for today's business. Across these five domains, digital technologies are redefining much of the basics of strategy and changing the rules of how companies must operate in the marketplace to be successful. (RODGERS, David L. (2018). P.20)

Organization Process

According to Peinado and Graeml (2007), the activities in a company result from a succession of events, requirements of the environment in which the company is inserted or resulting from actions of the members of the organization itself. During this succession of events, inputs are received, processed and returned to society in the form of products or services.

For Keen (1997), we can also define organizational process as any recurring work that somehow impacts the organization's capacity point and can be done in different ways with different results and contributions.Figura 1: Modelo genérico de processo organizacional



Source: Peinado e Graeml 2007.p.143

Customer Experience

According to Andrade (2018), customer experience implies their involvement at different levels. According to the author, this experience can be defined as the internal and personal responses of customers to the organization and is created by the contribution not only of customer values but also by the contribution of the company providing the experience, events being experienced by customers prior to purchase and during aftermarket part of this experience.

According to Rodgers (2018), in the Digital Age, we leave a model characterized by mass markets to a customer network model, brought about by the network effect.

But can these strategies used in the largest organizations in the world apply to the management of companies of all sizes? Some Brazilian retail chains have also created new models.

Business Models

According to Rodgers (2018) for organizations to dominate competition in the digital age, business models need to evolve, facing challenges never before encountered that bring new paradigms. And we also need to be clear about the growing importance of strategies for building platforms, not just products.

A traditional and important example of platform business is Uber, which runs a pairing service, which helps passengers find drivers and vice versa. As in the case of Uber, positive network effects are the main source of value generation and hence competitive advantage in a business platform.

The network effect represents a new economic paradigm, totally driven by the technological revolution. Economies of scale in the digital age draw on advances in technology that affect demand (Parker, G. et al., 2018). Social networks, application development, and other actions that use technology to create more value for users are factors that leverage economies of scale from a demand standpoint. These factors have the power to provide the leading company in a network platform marketplace that is important and difficult for competitors to achieve.

Digital transformations Agents

Social Networks

According to Andrade (2018) social media are technologies that aim to facilitate the creation and sharing of information through communities and virtual networks where user profiles are all connected and user generated content is the lifeblood.

According to the author, by interacting with these networks, users can create highly interactive platforms through which individuals, communities and organizations can share, co-create and debate content generated and published by other users, significantly changing the way individuals and large organizations. communicate.

According to Andrade (2018), the corporate social network involves the informal bonds and the bonds of corporate / organizational staff with other people in their field or sector, clients other members of the public, who form through social networks. Corporate social networking can increase operational performance capabilities in a number of ways by enabling sales staff to find new customers; help the marketing team learn about customer needs and demands and teach management about the public perceptions of their strategy or approach.

Cloud Computing

According to Rodgers (2018), cloud computing enables businesses of any size to grow their platform very quickly to bring in more customers. From physical services such as transportation or hosting, and adapting to cloud platform business models, giants like Uber and Airbnb expand exponentially, virtually limitless for growth.

Even if an organization's business model is platform-based, it will reach a very concrete limit to its growth. However, when hosted on the cloud, the platform gains unlimited scalability.

One of the leading exponents of cloud computing, Amazon with its Amazon Web Services (AWS) service, was launched in July 2002, revolutionizing the business world. Ismail et al (2015) states that while there is no official milestone on the emergence of ExOs, it is estimated that the impact of AWS creation may have been an important time. Because affordable cloud services have been created for businesses, which has led to a significant reduction in data maintenance costs, enabling countless start-ups around the world to enjoy cloud storage services that can expand their technology and better store. your information. (Ismail, et al. 2015).

Cognitive Computation (Artificial Intelligence)

According to Andrade (2018), Artificial Intelligence (AI) is a field of study that explains and "imitates" intelligent behavior through computational processes, performing decision-making, problem solving, and learning tasks. According to the author, AI is concerned with understanding and building intelligent entities and has the ability to automate equally intelligent processes.

The concept of artificial neural networks (RNA) is crucial for AI, it is computational models based on the central nervous system of animals, which have the ability to learn and recognize patterns. RNAs generally present themselves as interconnected neuron systems that can receive input values (imputs), emulating the behavior of animal neural networks.

Systems capable of learning from data, RNAs have been used to solve highly complex tasks from common rule-based programming, speech recognition and computer vision - a science that develops technology for building artificial systems that get information from images or any other multi-dimensional data.

Another widely used concept in AI is fuzzy logic, which is the form of logic in which the logical values of variables can represent any real number between 0, corresponding to the false value, and 1, corresponding to the true value. The concept has been extended to deal with the concept of partial truth, where the truth value can comprehend between completely true and completely false. Also, when linguistic variables are used, these degrees can be manipulated by specific functions. (Ahlawat, N. et al, 2014, p.630)

Big Data

Founded in the 1990s, and attributed to John Mashey (computer scientist, director and entrepreneur in the US), Big Data tends to include data sets that are sized beyond the ability of commonly used software tools to capture, organize, manage. and process data within a tolerable elapsed time. (ANDRADE, No. 2018, p.360)

For Dans (2011) Big Data is about "handling and analyzing huge data repositories, so disproportionately large that it is impossible to handle them with conventional database and analytical tools."

According to Hopkins (2011), Big Data addresses three fundamental aspects:

1) Techniques and technology: The company has people, who have great representativeness and data analysis to generate information with high added value.

2) Large scale of data that exceeds current technology due to its volume, speed and variety.

3) The economic value by making solutions affordable and helping with the company's investment.

"According to Andrade (2018), besides the concepts of the three Vs (volume, variety and velocity), commonly brought by the literature on the subject, other concepts have been expanded to other complementary characteristics of big data:

• Machine Learning: Big data tends not to question, it simply detects patterns.

• Digital footprint: Big data often presents itself as a cost-free byproduct of digital interaction. ”

Unlike Business Intelligence (BI), which uses descriptive statistics with high-density data for measurement and trend detection, big data uses inductive statistics and concepts to identify nonlinear systems to infer laws (regressions, unrelated relationships). linear and causal effects) of large data sets with low information density to reveal relationships and dependencies, or to make predictions of outcomes and behaviors. (ANDRADE, N., 2018. p.361)

Digital Transformation activators

Organizations have been using digital tools that can speed up processes and, as a result, provide a better customer experience and create new and innovative business models. Are they:

Agile Methodology

According to Tomas (2009) The market has been acting faster and faster, demanding high quality results in the short term. Agile methods aim to increase both the quality and speed of deliveries in order to achieve early project entry into the market. They usually promote adaptive planning over rigid and highly detailed planning, self-organized and multidisciplinary teams, continuous improvement and evolutionary development.

In agile methods customer opinion is highly regarded, even as part of the team. The product goes to the market even if it is not its final version, in this case being called PMV - Minimum viable product, launched to the market to be improved through insights brought by the market and users (customers), the so-called evolutionary development. In this way, the end product meets the real business needs. These methods follow an iterative process of development and recurring customer deliveries, which is testing and evaluating this evolution and defining the new features to add, in constant improvement movements that make the process agile and adaptable. (TOMAS, M, 2009)

There are currently different types of agile methodologies, including:

1. Scrum:

Created by Ken Schwaber and Jeff Sutherland, it defines some of the roles, artifacts, and events that make up the method, acting as a framework for product development and support. In this methodology, a software project is divided into Sprints - cycles of 1 to 4 weeks where, each sprint, a product evolution is obtained, which the customer can already use. (Sutherland, 2014)

2. Kanban:

This agile method is part of the famous Toyota production system, and is related to the concept of just in time delivery, programming and controlling and improving productivity through methods and practices that identify areas with potential problems.

It is a visual symbology used in the industry to record actions widely used in Brazil since the 1980s, where it is also called visual management.

3. Feature Driven Development (FDD)

According to Tomás (2009), this methodology brings an object-oriented process applicable to more complex software engineering projects. Created in Singapore between the years 1997 and 1999 by Jeff de Luca, it works very well in conjunction with Scrum as it works in project management and FDD acts in the development process.

FDD has five basic processes.

• Comprehensive model development (Object Oriented Analysis);
• Feature List Building
• Plan by functionality (Incremental planning);
• Detail by functionality
• Build by functionality

Application Programming Interface - Management

Today, the vast majority of developed applications work exclusively over the Internet, being consumed on desktops, smartphone notebooks or tablets, that is, regardless of platform. At the same time, organizations are constantly feeding their management software (management information, ERPs). Faced with these two scenarios - the need for enterprises and applications accessed by the network - a solution was needed to bridge this gap, so that two different systems share data and functions. Thus, an API is a set of standards, guidelines, and practices involving programming codes that allow software to access the functionality of an application. (MASSÉ, M. 2012, p.5)

Geris APIs can imply simplifying system scaling and speeding implementation of features, so managing APIs becomes highly strategic. These currently follow the standards of Representational State Transfer (REST), which consists of a web services architecture (MASSÉ, M. 2012, p.6)

DevOps

Term from the combination of the terms - and practices - of "development" and "operations", is a software engineering practice that aims to unify software development and operation.

DevOps practices symbolize a convergence between many managerial and philosophical movements and are therefore the result of applying the most reliable principles of physical manufacturing and leadership in the IT value stream. It encompasses Lean values, resilience engineering, Toyota Production system, learning organizations, human factors, safety culture, constraint theory. Relevant contexts such as high trust management cultures, organizational change management, and server leadership are also included. As an end product, organizations achieve quality, high reliability of end products and processes, stability and security at ever-lower costs. (KIM et al, 2018.p.4)

Information Management

According to Fontes (2006), information security is the term that designates the set of guidelines, rules, policies and procedures that aims to protect the information resource enabling the execution of the organizational strategy, existing to minimize business baits.

According to Lyra (2015), there are three pillars that act as the basic principles of information security. Are they:

- Confidentiality: This is the guarantee that access to information will only be made by certain users, also called legitimate users.
- Integrity: Affirms that the information must be preserved and kept under the same conditions as the information provided by the owner. The purpose is to protect it against unintentional or unintended changes.
- Availability: States that, whatever the purpose for which the information is intended, should be available.

The object of this protection is any data and / or information of any value to the organization, such as contracts and agreements, system documentation, databases, user manuals, systems, applications, removable media, computer equipment, among other elements, called “information assets”. (LYRA, Maurício M., 2015. p.11).

Exponential Organizations

ExOs are built on Information Technology (IT), which dematerialize what is physical in nature and transfer it to the digital world on demand. Thus, they do not use large physical structures or large numbers of employees. (ISMAIL et al; 2015)

To be considered an ExO, the organization must have a Massive Transformer Purpose (PTM) in addition to ten other attributes that reflect internal and external mechanisms that are continually being leveraged to achieve exponential growth. , we use the acronym SCALE (Staff on Demand, Community and Crowd, Leverage Assets, Algorithms and Engagement) and for external attributes we use the acronym IDEAS (Interfaces, Dashboards, Experimentation, Autonomy and Social Technologies). Not all ExOs have the ten attributes, however, there are a minimum of four attributes to be considered as ExO and the more attributes the more expandable they tend to be (ISMAIL et al; 2015. p.50

Below, in Table 5, we can see examples of some Exos known in the market where they operate and their SCALE attributes:

ExO	Atribute SCALE
Uber	Algorithm
TED	engagement
Waze	Leverage actives
Google	Comunity algorithms
Github	Comunity

Source: Ismail *et al*, 2015

In today's information age, the process of digital transformation is broad. In 2012, 93% of US business transactions were already digital; Sophisticated digital cameras, like Nikon's, no longer exist: they have been surpassed by cameras attached to smartphones; maps and atlases replaced by GPS, already surpassed also by applications in mobile phones; libraries, music and book readers as well. Retail stores being replaced by e-commerce icon AliExpress and Tesla launching more sophisticated electronic cars than personal computers.

The ExO paradigm was first identified in 2009 and, after years of observation and research, Ismail et al (2015), note that this paradigm applies to other major markets as well:

> There is a growing recognition that the pace of change seen in computing is occurring in other technologies and to the same effect. For example, the first human genome was sequenced in 2000 at a cost of $ 2.7 billion. Due to the underlying accelerations in computing, sensors, and new measurement techniques, the cost of DNA sequencing has decreased at a rate five times higher than Moore's law. In 2011, Dr Moore had his own genome sequenced for $ 100,000. Today, this same sequencing costs about $ 1,000. (Ismail et al; 2015)

According to Ismail et al (2015), ten years ago there were 500 million devices connected to the internet. There are currently about 8 billion. The projection for 2020 is 50 billion and, by 2030, one trillion connected devices.

Applying Moore's Law or LOAR in this scenario, we observe that we have only traveled 1% of this path, ie according to Moore and Kurzweil apud Ismail et al (2015), all growth is still ahead of us. Such disruption was initiated with some products and services such as books (Amazon), hosting (Airbnb), travel (Booking.com), auction (eBay). In some industries, entire industries have been destabilized such as the music industry by Apple iTunes or the major rental networks by Netflix.

As we resume, the concept of ExOs: An Exponential Organization (ExO) is one whose impact (or outcome) is disproportionately large - at least ten times greater - than that of its peers, due to the use of new organizational techniques that leverage accelerated technologies. (ISMAIL et al. 2015. p. 19). We can list the ten most relevant ExOs in your industry (in alphabetical order):

Quadro 8: As cinco ExOs mais relevantes em seu setor

ExO	Field	Market value (in billion USD)	Exponential Quo/ 84 pontos
Github	Technology	7.5	76
Airbnb	Lodging	25.5	84
Uber	Mobility	51	73
Indiegogo	Crowdfunding	60.5	73
Google	Internet	143	73

Source : Author ellaboration

In order to achieve scalability, ExOs have brought a new and disruptive pattern. Instead of owning assets or a large fixed staff, they leverage external resources to achieve their goals. It maintains a small core of employees and facilities, allowing for much flexibility as they focus on exponentially increasing their profit margins. They recruit their customers and foster online and offline communities to design and develop products. As a result, they grow to important levels in a short time. (Ismail, et al; 2015)

The most relevant result of a well-designed PTM is that it will generate a cultural movement that ensures strong attractiveness, inspiring people to the point of generating a community around ExO (Ismail *et al*, 2015)

The Theory of Exponential Organizations is based on three important theories: Theory of Abundance, Theory of Disruptive Innovation and Theory of Singularity, which will be described below.

Abundancy theory

Diamandis and Kotler (2012), authors of Theory, state that, with progress in the areas of artificial intelligence, robotics, digital manufacturing, nanomaterials, synthetic biology and many other exponential growth technologies, we will achieve greater gains over the next two decades than in the past. of the last two centuries.

According to Ismail et al (2015), to make this possible, there are four emerging forces: exponential technologies, innovators who follow the do-it-yourself philosophy, technophilanthropists and the rising billion (the group of the poorest individuals in the world who The next ten years will become one of the most important forces.) that conspire to solve humanity's greatest problems because, thanks to exponential technologies, small groups of people can solve big problems.

Diamandis and Kotler (2012) state that abundance theory has been happening for the past two decades, with the advent of the internet and wireless technologies spreading across the globe, accessible to most of the planet's population. According to the authors, we are already experiencing this world of abundance in communications and access to information. (DIAMANDIS; KOTLER, 2012)

> What is important here is the unbelievable spread of exponentially growing technologies and the impressive potential of these technologies to improve global living standards. A distant future where we have artificial intelligence in our brains sounds auspicious (at least to me), but how about a near future where artificial intelligences could be used to diagnose

illness, help educate our children or supervise an intelligent energy grid? The possibilities are immense (DIAMANDIS; KOTLER, 2012, p 77).

Disruptive innovation theory

In 1942 economist Joseph Schumpeter publishes his book Capitalism, Socialism, and Democracy, which is rapidly gaining momentum in a rising moment of neoliberalism and neoconservatism. In the book, the author describes the process of innovation, where new products destroy companies and old business models and, for him, are the main driving force of long-term sustained economic growth (MAGALDI, S; NETO, JOSÉ S. , 2018).

According to Schumpeter apud Magaldi, S; Neto, José S., 2018, the process of creative destruction is the essential fact of capitalism, the innovative entrepreneur being its protagonist.

Johnson, B e Christensen, C. (2012) states that large companies, even taking wise actions such as listening to their customers, staying competitive and investing heavily in high technology, lose their leadership in the market where they are faced with competitors offering simpler, disruptive solutions. and less costly. For the author, it is disruptive innovation that creates new markets, combats non-consumption and promotes job growth and is thus a multiplier economic effect on the chain.

Schumpeter (1988) argues that innovation is the great focus of organizations to remain competitive over time with their competitors. According to the author, innovation is the product of new combinations, characterized by the insertion of a new product, process or market or the discovery of new raw materials.

For Peter Drucker (1962) innovation translates into value creation, either by creating a new product or service, or by repositioning existing products, bringing you new functionality. For the author, entrepreneurs use it to create new business opportunities. Schumpeter (1939) creates the concept of creative destruction, based on the observation of the difficulties found by organizations already consolidated in their markets to innovate. For him, innovation is the transforming impulse for reinvention, an important characteristic of capitalism. And it claims that reinvention alone is not enough, and includes the destruction and replacement of certain production methods and markets as part of this process.

Singularity University

The term "uniqueness" coined by John Von Neuman brings reflections on technological progress being associated with accelerated change: "The acceleration of technological progress and changes in the human way of life give a appearance of essential uniqueness in the history of race beyond which human affairs, as we know them, cannot continue. "(Neuman, J.V .; 1950)

Ray Solomonoff´s, American Researcher in the field of Artificial Intelligence, Inspired by Moore's Law (1965), previously seen in Theory of Exponential Organizations, the author gave his contribution to Theory by mathematically presenting a progression of intelligence self-improvement capabilities. over time, in his article The Time Scale of Artificial Intelligence, 1985

Research and Methodology

This study brings a new theme, with little theoretical foundation. Therefore, an exploratory qualitative research will be applied in a semi-structured questionnaire. This method was chosen because there was a need to fill in some of the gaps that appear in the study, because it is a new theme. Therefore, the objective of the research is to gather information and not to obtain statistical conclusions.

The research will be carried out in three stages, as follows:

In the first stage, organizations with characteristics of ExOs will be listed for the application of the research. To be selected, companies must meet the minimum requirements that characterize them as exponential organizations. For this we will use the two acronyms SCALE for external aspect analysis and IDEAS for internal aspect analysis. In addition, they must have a highly inspiring Massive Transformer purpose (PTM), it forms a community around the organization, and is so comprehensive that there is no place for competition other than below it.

In the second stage, a field research will be conducted based on the theoretical framework in order to understand the influence of digital transformations on ExOs. to verify whether or not the foundations, technologies, and tools used by exponential organizations are related to digital transformation. The questionnaire will be divided into three parts:

a) The first part will contain questions regarding the pillars of digital transformation (processes, customer experience and business models)

b) The second part will contain questions about the tools that materialize ExOs (social media, big data, cloud computing, IoT)

c) The third part will contain questions that involve the use of transformation enabling elements in ExOs (Agile Methodologies, API Management, DevOps and Security)

For this research, six organizations were chosen, they are:

1.Taqe: Developed an application that matches operational level professionals and available job openings.

2.Pag Seguros: pioneer and leader in the Brazilian online payment market.

3.UpLexis: a company specialized in technologies for searching and structuring information from big data extracted from the internet and other knowledge bases.

4. Organic Gourmet: High-end food selling platform

5. eGuincho: Technology company focused on the automotive 24/7 assistance market, bringing agility and efficiency.

6. Bynd: is a corporate mobility solution that uses technology to fill empty seats in cars through the ride.

For the third stage of the research, the results obtained with the questionnaire will be compiled to answer the research question: are digital transformation and exponential organizations both sides of the same coin?

A qualitative analysis will be performed on the answers to the questionnaire, which will be applied in an interview with two or three managers of each company, from different areas, in person, or with the

founders / co-founders. Based on the results obtained, we will make the analysis based on the theories already explained in the theoretical framework. The main objective is to bring real situations of ExOs to demonstrate if they make use of most of the resources presented here in the theoretical framework.

The analysis will be performed based on the data collected through the application of the semi-structured questionnaire whose objective was to verify if the bases on which exponential organizations are based are in sync with the pillars of digital transformation; if the technologies used by exponential organizations can be classified according to the agents of digital transformation and if the tools used by the organizations studied represent the majority of activators of digital transformation

We found that 66.7% of respondent companies report heavily using business processes in their organizations, while 80% report using organizational processes and all 100% make use of management processes for benchmarking, controls and possible adjustments needed. the operation.

Company	Business Process	Organizational Process	Management Process
Bynd	X	x	x
Orgânico Gourmet	X	x	x
Taqe	X	x	x
UpLexis	X	x	x
eGuincho	X		x
PagSeguro		x	x

Regarding the Customer Experience, there is great concern on the part of the organizations analyzed to constantly observe and improve it.

According to Rodgers (2018), in the Digital Age, we leave a model characterized by mass markets to a customer network model, brought about by the network effect.

According to the survey, for 100% of respondent companies, the user experience is an important focal point, noting the use of different tools, some common. Another important point analyzed was the business models where, once again, the full influence of digital transformation can be observed. (Graphic 1)

According to Rodgers (2018), for organizations to dominate competition in the digital age, business models must evolve. And we also need to be clear about the growing importance of strategies for building platforms, not just products.

Platform-based business models feature an innovative and powerful new paradigm, the network effect. This represents a new economic paradigm, totally driven by the technological revolution. Economies of scale in the digital age draw on advances in technology that affect demand (Parker, G. et al., 2018). Social networks, application development, and other actions that use technology to create more value for users are factors that leverage economies of scale from a demand standpoint. These factors have the power to provide the leading company in a network platform marketplace that is important and difficult for competitors to achieve.

Considering how value has been created and transferred in most markets, we note the pipeline system, a type of business that follows a step-by-step approach to creating and transferring value. As a first step, the company designs the product / service, then it is manufactured and put up for sale, and in the end, the

commercial area looks for a customer to buy it. This model can be considered a linear value chain because it is a one-way model (Parker et al.; 2018).

When analyzing the new platform business model, it is observed that this is a more complex system, where all involved (producers, consumers and the platform itself) establish a set of relationships. These different actors interact in connection, using the resources provided by the platform and creating, in various ways, the value proposition for the business.

In the business model analysis of the respondent companies, 66.7% use business models in digital platforms / marketplaces, while the other 33.3% preferred to establish their business in software as a service (SaaS) models. In both formats we could clearly see the digital model, which allows for an important reach in visibility for the target audience, easier to segment and achieved through digital means, as well as high scalability in a short time.

Analyzing the activators of digital transformation in organizations, according to the verified pillar, we started to collect data about the use of corporate digital media in these organizations.

According to Andrade (2018), corporate social networking can increase operational performance capabilities in a variety of ways by allowing salespeople to find new customers; help the marketing team learn about customer needs and demands and teach management about the public perceptions of their strategy or approach.

In the organizations studied, there is a strong use of digital media for customer segmentation and capture, communication with the target audience, prospecting and commercial approach, brand building and positioning. There is a strong presence of corporate social media in 100% of the analyzed companies.

The second tool whose presence was analyzed in each of the organizations was Cloud Computing.

According to Brandt (2012), the phenomenon of cloud computing consists of using a program installed on a web server that is elsewhere, rather than installing it on the desktop itself.

Once again it is possible to notice the resource utilization in all analyzed companies, that is, 100% of the respondent companies have their cloud hosted business models, either in the platform model (67%) or in the SaaS model (33%).

Concerning the third activator of Digital Transformation, Artificial Intelligence (AI) was also checked to understand if AI resources are present in the verified organizations.

According to Andrade (2018), Artificial Intelligence (AI) is a field of study that explains and “imitates” intelligent behavior through computational processes, performing decision-making, problem solving, and learning tasks. According to the author, AI is concerned with understanding and building intelligent entities and has the ability to automate equally intelligent processes.

After the application of a semi-structured questionnaire, there was no presence of tools that brought their use in daily life. Based on all the collected data, it is observed that AI is not yet a feature present in the daily life of these organizations, and its use is not evidenced in any of the tools present.

Regarding the third tool, Big Data, another scenario is presented to us.

> The big data philosophy encompasses unstructured, semi-structured and structured data, however the main focus is on unstructured data. Big Data's “size” is a constantly moving goal of 2012 ranging from a few dozen terabytes

> to many hexabytes of data. Big data requires a set of techniques and technologies with new forms of integration to unlock insights into data sets that are diverse, complex, and large in scale. (ANDRADE, No. 2018, p.361)

For all organizations studied, reports using big data tools are very recurring for a variety of purposes. Decision making, designing products, stratifying and grouping types of customers, financial results, management and monitoring of services provided, inventory checking were the most cited by these companies, who use this type of tool daily to gain insight. business through different aspects of the business.

In the third stage of the questionnaire, questions were asked to verify the presence of activators of digital transformation in these organizations.

The first activator verified was the use of agile methodologies, being Scrum the most used method, including in previous organizations, where the interviewed founders / co-founders came from. According to the collected data, the use of agile methodologies provides a strong increase of efficiency and agility in the process delivery.

Information technology encounters scenarios that are increasingly connected and integrated with other services. Thus, another verified activator is the APIs. For these business models, their management becomes highly strategic. It was observed the use of APIs in all organizations verified, for different purposes, that facilitate or allow the execution of the service provided, and that demands intelligence and data consumption.

These organizations also saw the use of a fourth Digital Transformation activator; the DevOps method.

The term comes from the junction of the terms - and practices - of "development" and "operations", is a software engineering practice that aims to unify software development and operation.

According to KIM et al, (2018 p.4) DevOps practices symbolize a convergence between many managerial and philosophical movements and are therefore the result of applying the most reliable principles of physical manufacturing and value stream leadership. from you.

This activator was not unanimous in the organizations studied, due to different factors. For some organizations, there is no clarity about what benefits could be brought with the implementation of the method, others, using business models in SaaS, do not have local team of developers and others still use in their squads, however Its founders are also unclear about which benefits are generated for the business due to their use.

Finally, there was a fifth activator: data security methods. More familiar and with noticeable benefits, all organizations interviewed have a strong concern and focus on the topic because they deal with sensitive data from their consumers. According to some founders, exposing data from their customers can lead to serious brand losses. (Gráfico 5)

Conclusion

The article pointed as a research problem the following question: Is there a link between digital transformation and the emergence of Exponential Organizations?

The contribution proposed by this study concerns the raising of questions about Exponential Organizations and does not aim to clarify points about them.

The present work aims to demonstrate that digital transformation, through its pillars, agents and activators, is fundamental for the emergence and development of more agile and dynamic organizations, with exponential characteristics. In order to achieve the general objective the following specific objectives were defined:

(i) verify that the foundations on which exponential organizations are based are in sync with the pillars of digital transformation;

ii) Verify that the technologies used by exponential organizations can be classified according to the agents of digital transformation;

iii) Verify that the tools used by exponential organizations represent the majority of activators of digital transformation.

In order to conceptualize and understand how exponential organizations are constituted, four theories were studied, presented in the theoretical framework of this work, namely: the Singularity Theory, the Abundance Theory and, finally, the Exponential Organizations Theory.

The three specific objectives were partially met, based on the research problem: "Is there a link between digital transformation and the emergence of Exponential Organizations?" To obtain this answer, it was assumed that the questionnaire would provide the answers. necessary for a broader understanding of the business model, based on digital software or platforms, of the transformation activators present in organizations through agile methodologies - used by all respondent companies and digital tools, also present in 100% of the companies surveyed. . Unstructured interviews were conducted with six founders / co-founders of start ups whose business model is SaaS software or digital platforms, and which operate heavily using digital tools. Companies that attribute their scalability to digital tools were also noted, understanding that without them, the scope they already have or project for their business in the short term would not be possible. Among the companies studied, there are also reports of elimination of intermediaries, reducing costs for themselves and the end consumer, another aspect that is only possible in the adopted business model.

Some limitations found concern the classification of these companies as exponentials. Note that it is not possible to say with 100% certainty that these are organizations that grow exponentially. There are reports of founders who, facing the current economic scenario, turn their attention to the acquisition of customers, their loyalty to the generation of recurring revenue, showing to be in a slower but solid growth moment, not yet identified with a model of exponential growth.

ExOs have their own characteristics, among them, to use the so-called network effect with great property, in order to obtain high scalability and, consequently, to grow exponentially. Through the Theory of Exponential Organizations it is possible to understand these characteristics and how they impact not only companies but also create and transform markets, and how digital transformation has supported and provided high scalability and, as a consequence, exponential growth.

. Through the application of the questionnaire and interviews, it was possible to verify that the 6 companies analyzed are in compliance with the three pillars of digital transformation, with business models based on software or platforms and whose operation is based on digital tools. While we cannot say that these are exponential, we can say that digital transformation has provided a strong basis for their creation and development.

The study was exploratory in nature, since it is a new theme, a field research was conducted to assess the characteristics of these organizations, if they can be considered exponential, and if there are indications of the presence of the pillars of digital transformation. However, as far as it was possible to measure, it was not possible to verify if they are in fact exponential, but it was possible to verify that if there were no digital transformation, they would not get enough speed to deal with this universe.

Another aspect observed based on the data collected is that innovation alone is not enough, there are several other factors that positively or negatively impact the growth of these organizations such as capital investment, political-economic scenario, cultural aspects, consumer openness to paradigm shifts, among others.

The same is true of the exponential growth provided by digital transformation, the relationship of which we have observed. These organizations do not perceive a focus on this level of growth, but rather the search for a scalable, promising and competitive business in the long term, which leads us to believe, based on the answers provided, that this long-term competitiveness will occur. through successive and constant innovations.

7. REFERÊNCIAS

Alberto Bastos & Rosângela Caubit Ano: 2009. Edição: 1ª. Editora: Ver Curiosidades

Ahlawat, Nishant, Ashu Gautam, and Nidhi Sharma (International Research Publications House 2014) "Use of Logic Gates to Make Edge Avoider Robot." *International Journal of Information & Computation Technology* (Volume 4, Issue 6; page 630) ISSN 0974- 2239 (Retrieved 27 April 2014)

Andrade, Norberto , Principal P do Marketing: Pessoas – São Paulo: Ed Book Express, 2018

Brandt, Tobias; Tian, Ye; Hedwig, Markus; and Neumann, Dirk, "AUTONOMIC MANAGEMENT OF SOFTWARE AS A SERVICE SYSTEMS WITH MULTIPLE QUALITY OF SERVICE CLASSES" (2012). ECIS 2012 Proceedings. Paper 158.

Camargo-Vega, J., Camargo-Ortega, J., & Joyanes-Aguilar, L. (2015). Conociendo big Data/Knowing the big Data/Conhecendo big data. *Revista Facultad De Ingenieria, 24*(38), 63-77. Disponível em: https://search.proquest.com/docview/1865436958?accountid=34749

Drucker, P., *The Practice of Management,* New York, Harper and Row. 1962.

E. Dans. Disponível em: en:http://www.enriquedans.com/2011/10/big-data-una-pequenaintroduccion.html, 2011

Fadel A. C. e Silveira, H. da M. (2010) Metodologias ágeis no contexto de desenvolvimento de software: XP, Scrum e Lean. 26 f. Monografia (Especialização) - Curso de Faculdade de Tecnologia, Unicamp – Universidade Estadual de Campinas, Limeira

Fayol, H. (1916) General and Industrial Management. Institute of Electrical and Electronics Engineering, Paris.

FONTES, Edison. Vivendo a segurança da informação: orientações práticas para pessoas e organizações. São Paulo: Sicurezza, 2006.

Gonçalves, J.E.L Revista de Administração de Empresas • Jan./Mar. 2000 – São Paulo V40 N1 p 6-19

HAMEL, G.; PRAHALAD, C. K. Competindo pelo Futuro: estratégias inovadoras para obter o controle do seu setor e criar os mercados de amanhã. Rio de Janeiro: Campus: 1995.

Hagel III, J.; Brown John S.; Davidson L; 2010 *apud* ISMAIL Salim, MALONE, Michel S., GEEST, Yuri Van. Organizações Exponenciais. Por que elas são 10 vezes melhores, mais rápidas e mais baratas que a sua (e o que fazer a respeito). Edição digital. HSM do Brasil, 2015.

ISMAIL Salim, MALONE, Michel S., GEEST, Yuri Van. Organizações Exponenciais. Por que elas são 10 vezes melhores, mais rápidas e mais baratas que a sua (e o que fazer a respeito). Edição digital. HSM do Brasil, 2015.

Johnson, B., & Christensen, L. (2012). Educational Research (4th ed.). Los Angeles, CA: Sage

KEEN, Peter G. The process edge. Cambridge: Harvard Business School Press, 1997.

Administração da produção: operações industriais e de serviços / Jurandir Peinado e Alexandre Reis Graeml Curitiba : UnicenP, 2007.

Kim *et al.* DevOps: como obter agilidade, confiabilidade e segurança em organizações tecnológicas. Rio de janeiro: Atlas Books, 2018

Kim, Gene et al , Manual de DevOps – São Paulo: Alta Books, 2018

Kurzweil, R., The Singularity is Near: When Humans Transcend Biology – Ed Penguin,2006

Kurzweil, R., A Era das Máquinas Espirituais – São Paulo: Editora Aleph, 2007

Lyra, Mauricio Rocha Governança da Segurança da Informação/ Edição do Autor – Brasília, 2015

Magaldi, S., Neto, José S, Gestão do Amanhã – São Paulo: Ed Gente, 2018

Massé, M., REST API Design Rulebook, in Designing Consistent RESTful Web Services Interfaces, S.S. Laurent, Editor 2012, O'Reilly Media, Inc

Morris, Daniel, Brandon, Joel. Reengenharia: reestruturando sua empresa. São Paulo: Makron, 1994

Neuman, J.V apud *The Technological Singularity* by Murray Shanahan, (MIT Press, 2015), page 233

Parker, Geoffrey et al, Plataforma: A Revolução da Estratégia – São Paulo: HSM, 2016

Peinado, J e Reis, A., Administração da produção: operações industriais e de serviços / Graeml Curitiba : UnicenP, 2007

Rodgers, David L, Transformação Digital – São Paulo: Autêntica Business, 2018

Salomonoff, R.J, The Time Scale of Artificial Intelligence, Oxbridge Research, 1985

Schumpeter, J. A. Teoria do desenvolvimento econômico: uma investigação sobre lucros, capital, crédito, juro e o ciclo econômico. 3 ed. São Paulo: Nova Cultural, 1988.0

Schwab, K., The Fourth Industrial Revolution – World Economics Forum – Ed Edipro, 2016

Tomás, Mario R S, Métodos ágeis: características, pontos fortes e fracos e possibilidades de aplicação; Centro de Investigação em Inovação Empresarial e do Trabalho Faculdade de Ciências e Tecnologia Universidade Nova de Lisboa, 2009

Taylor, F.W, Principles of Scientific Management, New York, London, Harper & Brothers, 1911.

Reflection on the Evaluative Practices in the Teaching of Administration in Educational Institutions

Marta Elisete Ventura da Motta
University of Caxias do Sul, Brazil

Rudiclér Silveira Belem
University of Caxias do Sul, Brazil

Maria Emilia Camargo
University of Caxias do Sul, Brazil

Angela Isabel dos Santos Dullius
Federal University of Santa Maria, Brazil

Ademar Galelli
University of Caxias do Sul, Brazil

Abstract

This study seeks to analyze the evaluative methods adopted by teachers, carried out by students of undergraduate courses in Business Administration in an Institutions of Higher Education located in the mountains of Rio Grande do Sul, Brazil. The methodology in this research has a descriptive character of the type survey and the instrument for data collection was a questionnaire composed of 18 (eighteen) closed questions, applied to 18 teachers of Administration courses during the year 2018, using the quantitative approach for data analysis with the help of descriptive statistics. The results allow us to conclude that there is a sign of change in the evaluation methods applied, where teachers demonstrate the use of other evaluation tools, besides the traditional test, and migrating to more modern and efficient methods.

Keywords: Teacher Assessment; Teaching Administration; Higher Education Institution; Higher Education.

1. INTRODUCTION

This article seeks to know the conceptions and practices of evaluation of the learning of the course of administration in the state of Rio Grande do Sul, located in Serra Gaúcha and compare with the existing literature on the subject.

For Pimenta (2002), education today is the portrait and reproduction of society and, at the same time, the desired society is projected. Higher education sees the importance and urgency of seeking updating, of looking at academics as future professionals working in society. Thus, it is observed the importance of teaching practices in this challenge of education, since the progress in the teaching process depends on the performance of the teacher.

According to INEP data, through CENSUP 2013 (Census of Higher Education), the percentage of people attending higher education represents almost 30% of the Brazilian population in the age group of 18 to 24 years. The state of Rio Grande do Sul registered an increase of 150% in HEIs (Higher Education Institutions) totaling 120 HEIs in 2013, against 47 in the year 2000, according to data from the 2015 Higher Education Map (SEMESP). Also in this report, the Administration course was the second most sought after by students in private HEIs in the state with 45,200 enrollments, losing only to the Law course. In the distance learning modality (DL), the Administration course led the search with 15.6 thousand registered enrollments.

The transformations that have occurred in higher education cannot be separated from the changes in ideas and practices that develop it, as well as from the actors that are the characters of this practice. In addition, these transformations are in accordance with the teaching plan, and it is important to consider the actions aimed at teaching experiences as they are applied, developed and evaluated. Thus, it is essential to rethink the educational practices that serve as a basis for the curricula of courses at the university and the various pedagogical practices exercised by teachers, including assessment.

The objective of this research is to discuss the evaluative practices of teachers in Administration, through methodologies in force, which follows the technological evolution with the objective of offering education and learning of quality in the field of higher education, and which meets the professional demands of the area and society, reinforcing the role of the university in this context.

Thus, this work is divided into two parts. The first part deals with the theoretical framework, which had as its main theme the evaluation of learning, seeking to clarify its process, its methodologies and purposes, focusing on higher education. The second part brings the reality researched, through the result and analysis of the research, where the data obtained with the tabulation of the questionnaire are analyzed, confronting with the theory, to demonstrate the results obtained, after the second part were presented the conclusions.

2 EVALUATION AND THE TEACHING AND LEARNING PROCESS

Evaluation methods should be dynamic and use various tools so that the educational process demonstrates and is effective for the purposes of its objectives. It is ideal that this process is systematic, to achieve progress and be possible to carry out a reflection in practice, to promote improvements from difficulties, new methods or difficulties.

Among the teaching activities, it is evident that the evaluation is one of the fundamental components, because this process is responsible for the formulation of the objectives of the educational methods, in the definition of the contents to be worked on and in the identification of new practices that achieve the proposed objective.

In this way, the evaluation is able, in the pedagogical sense, to build an orientation in the teaching process, throughout the development of practices in the pursuit of the objectives planned by the teacher in the teaching plan.
Then it is noticed that the evaluation does not only mean the attribution of a grade, or quantification, but also the attempt to identify how effective the practices used by teachers were and also to create a pattern of interaction between the teacher and student in the search for reassessing the entire teaching process to meet its purpose.

Vasconcelos (2000) defines the evaluation of teaching-learning as a "process", because according to the author the teacher will follow the construction of the student's knowledge, instead of simply judging him in a certain situation.
The evaluative practice is one of the most efficient tools to act or control behaviors, attitudes and beliefs among students, and in many moments being positive or negative in their development possibilities, by the way it is applied and perceived importance has as a function the social inclusion or exclusion, through the bureaucratic and legal issues impregnated in its use.

In many cases, what makes the process of alternative assessments more difficult is management by the educational institution with a high level of authoritarianism and bureaucracy. Normally, the evaluation process is labeled as a process of extreme sacrifice, both for the evaluated and for the evaluators. In some educational institutions, the amount of mandatory content is pre-determined, with the definition of an expected date for the application of the test. This situation promotes an exhaustive situation of automatic correction of a high number of tests and quantification, through the grade, mainly in teachers with several subjects.

The assessment process should not be closed with the assignment of a grade, to determine the level of knowledge absorbed in the teaching and learning process. The purpose of the assessment is to make an analysis of the information, to which it is continuously being aggregated throughout the development of the teaching and learning process, which can be used to develop a critique of the teaching method applied.

According to Luckesi (1995), the evaluation directs the object in a dynamic path while the verification "freezes" it. Thus, in order to develop the evaluation process, we necessarily have to verify, but later we need to take an attitude in order to change the situation verified, then we will be evaluating.

According to Benjamin Bloom, an important researcher in the field of learning, especially in the evaluation of learning, the evaluation can be classified into three categories: somative, diagnostic and formative (BLOOM; HASTINGS; MADAUS, 1983, p. 8).

The Somative evaluation is a very general evaluation, which serves as a support point to assign grades, classify the student and transmit the results in quantitative terms, done at the end of a period (BLOOM; HASTINGS; MADAUS, 1983, p. 100).

The denomination somative evaluation is questioned by Luckesi (2005, p. 1), who argues that, instead of somative evaluation, we should use the expression final results, considering that "these results will always be positive if they were effectively constructed as the desired results". Thus, he suggests that it is

designating the somative assessment, we refer to practices in which the end of the educational process becomes more important than the process itself.

The Diagnostic Assessment is based on the student's knowledge, strategies and personal experiences to detect their needs and difficulties, allowing the teacher a more detailed analysis of the learning process.

Machado (1995, p. 33) observes that "The diagnostic evaluation enables the educator and student to detect, throughout the learning process, their failures, deviations, their difficulties, in time to redirect the means, resources, strategies and procedures in the desired direction" (MACHADO, 1995, p. 33).

Formative assessment is the provision of data that will be used to improve the training and performance of the student throughout the learning process. Summative assessment refers to the information at the end of this process.

Thus, through the formative assessment it is possible to verify whether the established objectives were achieved by the students, as well as collect data so that the teacher can perform a recovery work and improve their procedures (HAYDT, 2008).

It is perceived then that the act of evaluating should not only be a mechanism to be applied at the end of a learning, but should be a continuous process, where it can have a monitoring and guidance to really ensure the effectiveness in the process of teaching and learning.

3. ASSESSMENT INSTRUMENTS IN HIGHER EDUCATION

With the same level of importance as the learning method, but much less addressed in themes in teaching, the form of evaluation of the teaching and learning process, represented by the evaluative instruments, represent how important the effectiveness of the content taught is. These methods or instruments should not be considered as a neutral or merely technical activity, but rather dimensioned by a theoretical model of teaching, science and education, reflected in pedagogical practice.

The practice of evaluating teaching and learning processes should occur through the pedagogical relationship that involves the proposed objectives and in behaviors, attitudes and skills of teachers and students. As an evaluator of this process, the teacher interprets and assigns meanings and meanings to the evaluation, producing knowledge and representations about the evaluation and about his role as evaluator, based on his own conceptions, experiences and knowledge (SORDI, 2001; CHUEIRI, 2008).
Through research, conducting a search for the history of education systems and evaluation practices, it is essential to observe that from the sixteenth century to the nineteenth century the practice of evaluation occurred as a way for the student to account for the content learned through repetition (SOUSA; ALAVARSE, 2003). In Brazil, during the nineteenth century the educational process was still developed in traditional methods: "a teacher who transmits knowledge accumulated by humanity and systematized logically, it is up to the student to decorate the lessons and repeat them, disciplined, in the exercises" (SOUZA, 2012, p. 241- 2).

The education practices remained for a long time without updating, and all their methods were performed in the same way. The content passed in an expository way to the student, who in turn memorized what had

been received information and later was submitted to an accountability with the teacher. Pimenta and Anastasiou (2002) state the existence of the habitus, when they analyze the permanence of the traditional model of teaching, which still marks the teaching practice in higher education. For these authors, the concept of habitus is equivalent to repeated practices without reflection for many generations and, therefore, they were institutionalized, that is, became official, being seen as the only way to develop teaching and learning. For Vasconcellos (2003), such practices have been used by teachers for so long that they are accepted as if they were natural.

Thus, the assessment practices carried out within the classrooms, when they prioritize tests that apparently only aim to measure, quantify, verify and even classify the students' learning, reinforce a complex and sensitive ideology of control and serves as parameters of social behavior.

The importance of evaluation instruments, despite their usefulness in certain situations, seems to be overestimated (LACUEVA, 1997). In a way, the overvaluation of the instrument would be reinforcing the traditional form of evaluation, although for this study it is more important why and for what it is evaluated, than the how.
According to Ludke (1995), unfortunately what is frequently seen is a reductive identification of the term evaluation to the concept of proof. The test is preferred in higher education courses among the various instruments used in the assessment. Some educators are concerned with finding a certain form of assessment, usually related to the construction of efficient tests, associating assessment with tests or exams.

Since evaluation is the central process of effective teaching, it is through it that we can find out whether the planning of proposed teaching activities resulted in the proposed learning objective. An assessment in an ideal model is necessary to interpret, in an efficient way, what the evaluated know and what they are able to do with regard to the proposed content.

According to Masetto (2003), the higher education teacher is no longer a transmitter of knowledge, but rather a mediator in the learning process of the student, because in this segment of education there is a new perspective in the relationship between teacher and student.
In recent years, there has been a high increase in the number of HEIs, consequently increasing the number of teachers. The demand for teachers was not sufficiently met to meet the needs of the market, with an excess of students by subjects, dissatisfaction and wear and tear on the part of teachers (MARTINS, 2008). Still for this author, there is a disqualification of teachers who, associated with the flexibility and precariousness of employee and work relationships, further aggravate this evaluation process (MARTINS, 2008).

In this sense, it is necessary that the teacher evaluator uses evaluative instruments that will contribute both to teaching and learning. Various assessment instruments or techniques can be used to assess the student's progress. "As assessment is a learning-driven process, it can be deduced that the learning objectives are the ones that will define assessment techniques" (MASETTO, 2003, p. 159).
Many of the theoretical references present in the assessment practices normally used are related to the association with the requirements of the planned contents, analyzing, through exams, the achievement of these objectives by the students; the assessment is seen as separate from the learning process, summarizing its application and its result. Thus, the tendency is to think of evaluation as a judgment of performance in function of the achievement of the proposed educational objectives (SOUZA, 1991).

In addition to the proof, Masetto (2010) shows other instruments or assessment tools that can be practiced in higher education by teachers, such as: the case study, and that "this technique aims to assess the knowledge and its application to a particular problem situation [...]" (MASETTO, 2010, p. 168). The case study also serves to assess skills and attitudes, according to the objectives that are proposed).

3.1 METHODOLOGICAL PROCEDURES

Aiming to understand the current methodology used in higher education evaluations, in Business Administration courses, this study is characterized as being of an applied nature, with a quantitative approach and descriptive purpose. Applied research increases the possibility of understanding and solving organizational problems (HAIR JR. et al., 2005). The research with descriptive purpose consists of a type of conclusive research that seeks to describe, in general, characteristics or functions of the market, and is commonly performed to estimate the percentage of the population that exhibits a certain behavior and perform specific forecasts (MALHOTRA, 2006). Regarding the procedures, a survey was conducted in November 2018, between 20 and 23 days, aiming to gather information provided by a group of interest about the data that is intended to be obtained (HAIR Jr. et al., 2009).

4 ANALYSIS AND INTERPRETATION OF RESULTS

4.1 CHARACTERISATION OF RESPONDENTS

The block of questions called "Profile" has 4 closed questions, which seek to verify the main characteristics of the respondents. It is possible to observe that 77.8% of the interviewees are male, with ages between 36 and 45 years (44.4%) and teaching time from 3 to 5 years (33.3%). Referring to the Discipline Taught in the area of Human Resources (27.7%). Table 1 shows the respective percentages and absolute numbers.

Table 1 - Sociodemographic characteristics of respondents

Demographic Characteristics	Cases (n = 18)	Percentage (%)
Genre		
Male	14	77.8
Female	4	22.2
Age range		
18-25 years	0	0.0
26-35 years	6	33.4
36-45 years	8	44.4
46-55 years	4	22.2
56-65 years	0	0.0
Teaching Time		
up to 1 year	1	5.6
from 1 to 3 years	5	27.7
from 3 to 5 years	6	33.4
from 5 to 10 years	4	22.2
over 10 years	2	11.1

Ministered Discipline		
TGA	1	5.5
Operations (production)	2	11.2
Finance	4	22.2
Human Resources	5	27.7
Marketing	2	11.2
Quality	0	0.0
Other	4	22.2

Below are the statistical analyses carried out in order to evaluate the evaluation methodologies currently applied.

4.2 DATA ANALYSIS

The descriptive analysis allows the understanding of data behavior through tables and by identifying trends and variabilities (FÁVERO et al., 2009). To enable the descriptive analysis, the mean, standard deviation and variance by issue were calculated, as shown in Table 2.

Table 2 - Descriptive Analysis by Question

	Question	μ	s	s^2
Q1	I always try to make use of different evaluation methods and instruments	**5.889**	1.410	1.987
Q2	Generally, my evaluations are tests, with content seen in class, without consultation.	4.222	1.865	3.477
Q3	Generally, my evaluations are tests, with content seen in class, with consultation.	4.056	1.514	2.291
Q4	My evaluations in general are in groups.	2.778	1.437	2.065
Q5	My evaluations in general are in pairs.	3.000	1.495	2.235
Q6	My evaluations in general are carried out through autonomous work.	4.944	1.765	3.114
Q7	I carry out evaluations by reading and interpreting texts.	4.278	1.602	2.565
Q8	I carry out evaluations through discussion and debate of topics and/or problems.	**5.167**	1.465	2.147
Q9	I carry out evaluations through research activities (consultation of encyclopaedias and works of various types and in various media, collection of information from various persons and entities and from other sources, research on the Internet).	4.389	1.195	1.428
Q10	I carry out evaluations through written work (cards, tests, reports, production of creative texts, projects, response to questionnaires, others).	**5.389**	**1.195**	**1.428**
Q11	I perform evaluations through games (functional games, rule games, role-plays, among many others).	4.111	1.844	3.399
Q12	I carry out evaluations through the use of ICT (information and communication technologies) and various other material resources, such as communication media.	4.389	1.685	2.840
Q13	I carry out evaluations through practical work (application, laboratory, manuals and others).	4.444	1.653	2.732

Q14	I make evaluations through physical activities, of plastic, musical expression and others.	**2.389**	**1.243**	1.546

Nota: μ= Mean; s= Standard Deviation Padrão; s^2=Variance.

It is observed that the individual means were concentrated between μ=2.389 and μ=5.88, and the scale options varied between 1 and 7, which indicates that the respondents have their perceptions about the evaluation methodology applied in their disciplines in a median position. The highest mean (5.88) refers to the question "I always try to use different evaluation methods and instruments", followed by "I carry out evaluations through written works (forms, tests, reports, production of creative texts, projects, answers to questionnaires, others)", with μ=5.389. The lowest mean was that of the variable related to assessments through physical activities, plastic and musical expression, and others, which portrays the non-use of this form of assessment in course of Administration, having a mean μ=2.38. The largest standard deviation was (1.865) in relation to the mean, which allows inferring that there may be no significant differences between the teachers' responses.

The dimension "I carry out evaluations through written work (records, tests, reports, production of creative texts, projects, answers to questionnaires, etc.)" has the lowest standard deviation (1.195) and lowest variance (1.428). It can be concluded that this evaluation method is still the most widely used among the administration teachers submitted to this research.

4.3 RESULTS INTERPRETATION

Based on the questions analyzed, the validated attributes were classified into 4 dimensions related to the Evaluation Methodology. Initially, the intention was to assess how much the teachers are concerned with diversifying the evaluation method, represented by question number 1. In the next block, with 2 questions, we tried to understand the relationship between evaluation with consultation or without consultation and in the third block the degree of participants in the evaluation practices. In the last block, with 8 questions, an attempt was made to observe the tools adopted in the evaluation practices. Thus, the questionnaire was represented by 14 questions, divided into 4 blocks for interpretation of the results.

With respect to the concern in the use of different assessment methods and instruments, it is concluded that this factor is being prioritized by the respondents, since this question presented the highest average, which demonstrates a high frequency in the use of different methods and tools in the evaluations performed by the research teachers.

It can be seen from the second block that the methods of application of the evaluations are still well divided, between tests without consultation or with consultation, and that the means are very close (μ=4.22 and 4.05 respectively).

In the third block, it is concluded that the form of application through autonomous studies, i.e., individual tests represent the largest form of methods applied by teachers, with an average of μ=4.94, followed by evaluation in pairs or pairs, with an average of μ=3.00, very close to the third form, which is the application of group tests with an average of μ=2.77.

Finally, the analysis carried out in the last block, which represents the various forms or instruments of evaluation applied by Management teachers in an institution of the gaucho mountain range, points out that evaluations through written works to which fit records, tests, reports, production of creative texts, projects,

responses to questionnaires are still the most used, with an average of μ=5.389, followed by evaluations through discussion and debate of topics and/or problems with an average of μ=5.167, indicating an evolution in active methodologies, which promote this form of teaching and evaluation.

Thus, when considering the results of the analyses carried out, it is possible to infer that a there is an evolution of the evaluative methods, facing the old practices, based on individual evidence and without consultation. It is evident an interest on the part of teachers in the alternation of assessment tools and methods, in which they are suggested by the literature review.

5 FINAL CONSIDERATIONS

Evaluation is part of the teaching and learning process and should be seen as an instrument that will favour advances and surpasses in the teaching and learning process. The assessment is not just an instrument to give the learner a grade, concluding that it is not restricted to the test alone. Masetto (2003) states that specifically in Higher Education, it is necessary for the teacher to think about assessment instruments that can be used in each assessment modality.

Regarding the research, although not conclusive, it can be analyzed that the conceptions and purposes of assessment of learning currently applied, are in a subtle change, which not only serves as a grade assignment, but to effectively evaluate the entire learning process, constant in each content.

From the answers obtained, it was possible to realize that teachers are using methods and performing evaluations for more than one instrument, that is, not only by tests, but also through seminars, works, oral evaluation, among others. Thus, it is observed the need for evaluative instruments aimed at dialogue, in which they can expose their ideas, exchange and share information.

In this sense, it is up to the teacher, in this case of Higher Education in Administration, to use various evaluative instruments to evaluate the student's learning and thus give importance to the evaluative processes and not only for the results to which it was practiced in the recent past and also with this to contextualize and integrate an effective evaluation.

6. References

[1] ANASTASIOU, L. das G. C. **Ensinar, aprender, apreender e processos de ensinagem**. In: _____. Processos de ensinagem na universidade: pressupostos para as estratégias de trabalho em aula. Joinville: UNIVILLE, 2003. p. 11-38.

[2] BLOOM, Benjamim S. et. al. **Manual de avaliação formativa e somativa do aprendizado escolar.** São Paulo: Livraria Pioneira Editora, 1983.

[3] CENSUP – **Censo da Educação 2013** – INEP Ministério da Educação, 2014.

[4] CHUEIRI, M.S. F. **Concepções sobre a avaliação escolar**. Estudos em avaliação educacional, São Paulo, v. 19, p. 39, 49-64, jan. abr. 2008.

[5] FÁVERO, L. P. et al. **Análise de dados: modelagem multivariada para tomada de decisões**. Rio de Janeiro: Elsevier,

2009.

[6] HAYDT. Regina Cazaux. **Avaliação do processo de Ensino-Aprendizagem**. 6 ed. São Paulo: Editora Ática, 2008.

[7] HAIR JR, J. F. et al. **Fundamentos de métodos de pesquisa em administração**. Porto Alegre: Bookman, 2005.

[8] HAIR JR., J. F. et al. **Análise multivariada de dados**. 6. ed. Porto Alegre: Bookman, 2009.

[9] LACUEV A, Aurora. **La evaluación en la escuela: una ayuda para seguir aprendiendo**. Revista da Faculdade de Educação [on line], São Paulo, v. 23, n.1-2, jan./dez. 1997. Disponível: www.revistas.usp.br/rfe/article/download/59594/62693 [acesso em 26 jul. 2017]

[10] LUCKESI, C. **A avaliação da aprendizagem escolar**. São Paulo: Cortez, 1995.

[11] LUDKE, Menga. **O Administrador Escolar entre o mito da avaliação e os desafios de sua prática**. Estudos em Avaliação Educacional, Fundação Carlos Chagas. São Paulo, n. 12, p. 51-57, 1995.

[12] MARTINS, Gilberto de Andrade. **Avaliação de Desempenho do Docente**. (In): DOMINGUES, Maria José; SILVEIRA, Amélia. Gestão de Ensino Superior: Temas Contemporâneos. Blumenau: Editora da Furb, 2008.

[13] MASETTO, Marcos Tarciso. **Competência Pedagógica do Professor Universitário**. São Paulo: Summus, 2003.

[14] PIMENTA, S.G. **Docência no ensino superior.** São Paulo: Cortez, 2002.

[15] SEMESP – Mapa do Ensino Superior 2015 – SEMESP Sindicato das Mantenedoras de Ensino Superior, 2015.

[16] SILVA, M. H. A.; PEREZ, I. L. **Docência no ensino superior**. Curitiba: IESDE Brasil, 2012.

[17] SORDI, M. R. L. **Alternativas propositivas no campo da avaliação**: por que não? In: CASTANHO S.; CASTANHO, M. E. (Orgs.). Temas e textos em metodologia do ensino superior. Campinas: Papirus, p. 171-182, 2001.

[18] SOUZA, Clarilza Prado de (org.). **Avaliação do rendimento escolar**. Campirlas: Papirus, 1991.

[19] SOUSA, S.M.L.Z.; ALAVARSE, O.M. **A avaliação nos ciclos:** a centralidade da avaliação. In: FREITAS, L.C. (org.) Questão de avaliação educacional. Campinas, SP: Komedi, 2003. Cap. III, p. 71-96.

[20] VASCONCELOS, Celso dos Santos. **Avaliação: concepção dialética libertadora do processo de avaliação escolar.** 11 ed. São Paulo: Libertad, 2000

The Qualification of Manpower and Its Effects on Productivity of Civil Construction in Manaus - Amazonas

Tacil Thayson Reylon Duarte da Cunha
tacil_thayson2@hotmail.com
Centro Universitário FAMETRO – Brasil

Kaio Telles de Oliveira
kaio.telles.de.oliveira@gmail.com
Centro Universitário FAMETRO – Brasil

Sara dos Santos Santarém
engsara.santarem@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade Nilton Lins - Amazonas - Brasil

Abstract

Construction has been growing in recent years in Brazil and the state of Amazonas was no different, however, there are major difficulties in the industry when it comes to skilled labor in this segment, so the overall goal is to analyze the qualification of labor. and its effects on productivity in the city of Manaus. And as specific objectives: to highlight the civil construction in Brazil and Amazonas; show the effects of unskilled labor on construction productivity; To verify the qualification of the workforce in the city of Manaus, Methodology, the work was performed first with bibliographic basis and in the second moment a field research was carried out. Obtained as results, the study showed that skilled labor is a problem to be faced by construction companies in Manaus, because it was realized that some professionals accept the proposal to qualify, but some do not, given the positions, It is clear that the sector needs to charge more for a qualified workforce, as well as the company MRV, which is committed to motivating its workers to seek specialization in this segment.

Keywords: Construction; Skilled labor; Productivity.

1. Introduction

Construction has grown in recent years in Brazil and the state of Amazonas was no different, however, it is perceived great difficulties of the industry when referring to skilled labor in this segment.

For [1] the skilled labor is never constant if we consider the different characteristics of each region of our country, according to the authors, even different legislations and bureaucratic barriers can lead to a postponement in the conclusion of the project or its unfeasibility. In some cities, for example, the construction of multi-storey buildings is not allowed.

Thus, for [2] indicates that the reality of the construction industry, there is a difficulty in finding qualified labor, high turnover rates in companies. Given this situation, this sector needs to propose solutions with regard to unskilled labor.

The research is of great relevance to the construction sector, as well as to academia and society in general, as it is information about the qualification of the workforce in the construction industry, which has been growing increasingly in the city of Manaus- Amazonas.

Given the above the present research has as its general objective: To analyze the qualification of labor and its effects on productivity in the city of Manaus. And as specific objectives: to highlight the civil construction in Brazil and Amazonas; show the effects of unskilled labor on construction productivity; verify the qualification of the workforce in the city of Manaus.

This is a bibliographic and field research, which sought to answer the objectives proposed in this work.

For a better reading, the work was divided as follows: at first a brief contextualization of civil construction in Brazil and civil construction in Amazonas, giving segment the effect of unskilled labor on productivity, after analysis and discussion of the result of field research on skilled labor in the city of Manaus and finally the considerations obtained in the work done through the theoretical framework and field research.

2. Bibliographical Review

2.1 Brief Contextualization of Civil Construction in Brazil

The construction industry has grown in recent years, as it is a sector that develops activities not only with small constructions, but also with large infrastructure works.

According to [3] the sector includes major infrastructure works such as highways, airports, ports, dams, bridges, viaducts, among others, and real estate construction that involves the entire production chain. Thus, the construction of the property to rent income and building maintenance also drive the Brazilian economy.

The civil construction sector in Brazil was marked by two characteristics, the informality of labor contracts and the instability of these service posts. These and other factors directly contribute to the workers' lack of interest in qualifying [4].

Still regarding the construction sector [3], it indicates that due to the fact that this is a multisectoral sector involving several sectors of the economy and being market oriented, real estate construction is highly related to the macroeconomic aspects of the country, contributing to the growth of the sector. industry in this segment.

Civil construction is marked by macroeconomic changes, as these indices directly influence this sector, which is one of the main ones in the composition of GDP - 5.7% of Gross Value Added in 2015 (Brazilian

Chamber of Construction Industry - CBIC, 13 2017) - this data influences the development of a country in various ways, not only economically but socially because it is one of the sectors that employs the most, approximately 7 million [5].

The construction industry consists of: construction companies, manufacturers and traders of materials, machinery and equipment, specialized technical services, real estate services and project consultancy, engineering and architecture, thus constituting one of the most important sectors for the country [6]. The activity of building moves, different areas and causes significant impacts on the Brazilian economy.

According to [2], signals that incentive programs for this investment will be more successful the more stable the macroeconomic environment and, according to the authors, the lower the degree of uncertainty about those variables, whose impacts on construction can be strong. .

According to [7], the construction industry sector has been looking for more efficient construction systems in order to increase productivity, according to the authors, the intention is to reduce waste and meet a growing demand, in this sense the search for new means to increase overall productivity.

To [8], says that allied to facts that the construction market is constantly evolving and companies are increasingly looking for professionals who meet productivity levels and what they find is high-cost labor. However, they do not have the necessary attributes to perform the intended work, due to qualification.

According to [9], the Civil Construction sector was the main highlight of July / 2019. There were 131,726 admissions and 113,005 dismissals, implying a balance of 18,721 jobs, equivalent to a + 0.92% increase over the previous month. The most prominent activity classes were:

• Construction of Highways and Railways (+3.542 posts), mainly in Minas Gerais (+1.079) and Pará (+776)

• Building Construction (+ 3,230 posts), especially in São Paulo (+630) and Pará (654)

• Works for Electric Power Generation and Distribution and Telecommunications (+ 3,182 posts), highlighting Minas Gerais (+641) and Bahia (+549)

In several segments, the construction industry stands out, with its small and large works, not only in the southern states, but also in the other states including the Amazon.

2.2 Civil Construction in Amazonas

In Amazonas, in recent years, the construction industry has stood out with regard to large buildings, ie, this segment has influenced the state's economy, and in the capital of Amazonas are the largest projects in this sector that directly influence the natural resources [10].

Civil construction is known for moving the sector that demands the use of large amounts of natural resources, thus, as one of the most environmentally impacting activities. Due to this, several actions have been established with a view to make this industry less harmful to the environment [11].

The Amazon has several areas under construction, however the exploitation of natural resources and deforestation needs to be carefully analyzed so that it can be successfully carried out.

According to [10], the investments made in the last decades, the construction industry has obtained a significant growth in the infrastructure sector in the Amazon, directly implicating in the use of natural resources. According to the authors, the consequences are imminent in the medium and long term, mainly due to the rapid process of expansion of cities through housing programs such as Minha Casa, Minha Vida.

According to the [12] National System of Costs and Indices Research of Civil Construction highlights the

average cost m² on the currency related to civil construction, in Brazil in August 2019, which can highlight the placement of the state of Amazonas in the table 1 rank:

Table 1: Average Cost m² in currency and percentage changes in the month, year and twelve months Variable - Average Cost m² - currency (Reais).

#	Federation unity	Month: August 2019
1	Sergipe	987,89
2	Rio Grande do Norte	1034,52
3	Pernambuco	1039,88
4	Espírito Santo	1043,67
5	Alagoas	1044,42
6	Ceará	1052,15
7	Bahia	1070,35
8	Piauí	1081,85
9	Mato Grosso do Sul	1090,50
10	Minas Gerais	1092,31
11	Paraíba	1095,67
12	**Amazonas**	**1102,38**
13	Maranhão	1108,09
14	Amapá	1115,78
15	Goiás	1131,83
16	Pará	1136,53
17	Mato Grosso	1140,43
18	Rio Grande do Sul	1160,51
19	Tocantins	1174,13
20	Paraná	1187,16
21	Roraima	1205,79
22	Rondônia	1217,21
23	Distrito Federal	1224,14
24	São Paulo	1246,72
25	Rio de Janeiro	1258,84
26	Acre	1271,62
27	Santa Catarina	1320,67

Source: adapted from [12]

It is possible to observe that Amazonas is in the 12th position of the cheapest states to build in Brazil, that is, compared to the 1st place, state of Sergipe, the construction expense in Amazonas is inexpensive. On the other hand, when we analyze Figure 1, it is possible to observe the economic comparison in the two-

year period of the currency in relation to the average cost of civil construction per m² in the state of Amazonas, which increased the costs, mainly between August and September 2018.

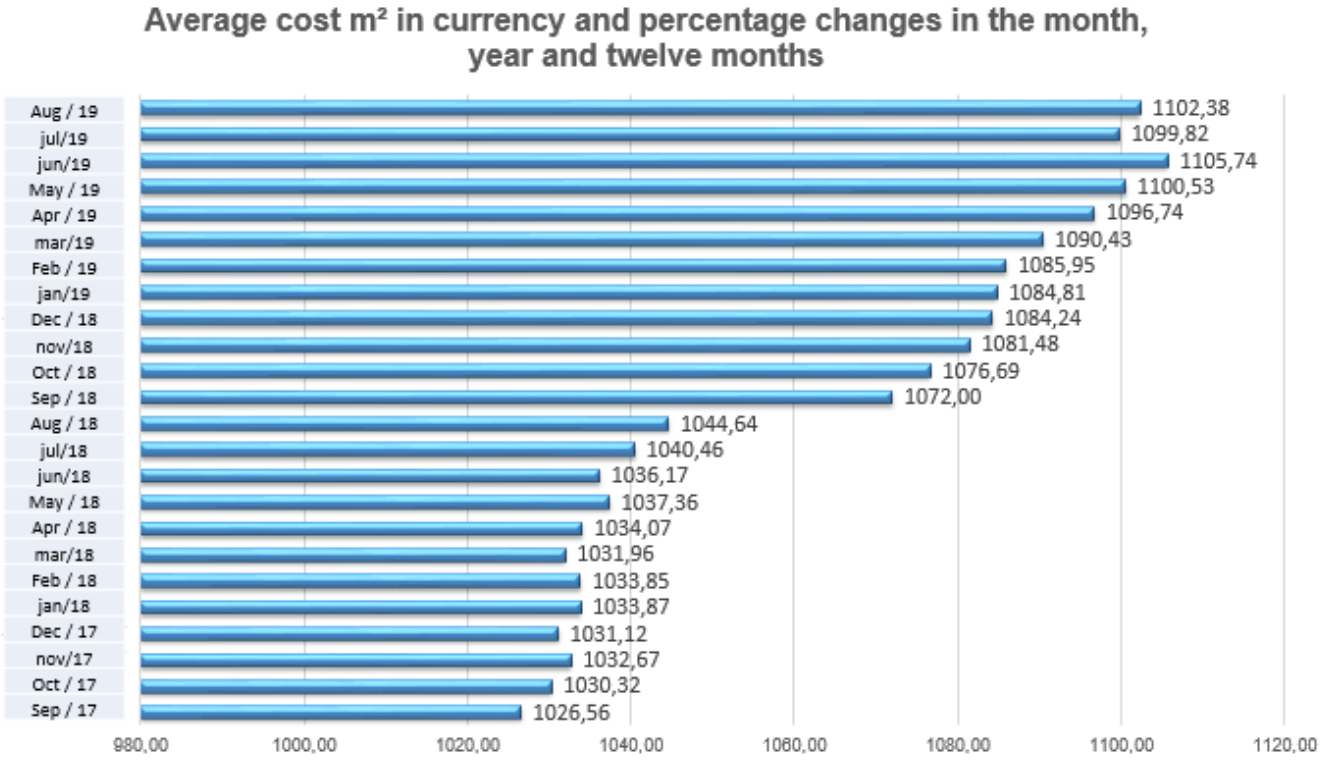


Figure 1 - Average cost in m² in currency and percentage changes in the month, year and twelve months
Source: Adapted from [12]

The cost in the construction industry is a consequence of several factors such as value of material sold by suppliers, weather conditions, waste disposal policy, labor. Looking deeper into the labor factor, we can highlight that the qualification of contracted workers is fundamental, directly influencing productivity and costs.

For [13], the development of the construction sector, generated by the country's economic growth, requires greater labor productivity. According to [13], civil construction is characterized by intense hiring of unskilled labor that, combined with the often precarious conditions of the work environment, reflect the sector's lack of commitment to the category, as well as productivity.

The productivity that is directly related to the qualification of the professional, that is, the higher and better the qualification of the worker, the bigger and better is his production. Thus, it is observed that unskilled labor will directly influence the productivity of construction.

2.3 The Effect of Unqualified Labor on Productivity

According to [14], civil construction for a few years was the main employer of labor, the demand for workers in the industry (masons, servants, electricians and hydraulic installers) was immense, extrapolating supply, a fact that served to reduce the requirements with qualification and experience in general.

The clients of large companies expect quality in the works, but [13], the reality in the construction site goes against this quality aspect, considering the low education level and the lack of technical training on the part

of the workers, being they servants and masons, most.

Regarding unskilled labor [14], in construction sites, this problem translates into high rates of absence and turnover, consequently, resulting in low productivity and quality of works and generating high costs for construction companies, ie the consequence of hiring workers with Low skilled demand has triggered higher expenses for construction companies and productivity at the construction sites.

According to [7], says that unskilled labor to perform the service promotes low productivity, which consequently makes the work costly and prolonged. Also according to the authors, on the other hand, a skilled workforce promotes an increase in productivity. However, to attract skilled workers, it is essential to reduce informality in the construction sector and to change the technological base.

According to [7], the qualification of the workforce ranges from basic education of workers to training on materials, equipment, production processes, assembly, quality and productivity. Only with the qualification of professionals will yield great results in productivity, however few companies make such an investment in their workers.

According to [1], unskilled labor has many difficulties identifying construction materials, climate, and even the labor involved, all of which are related to the amount of debris that is generated in a work. Thus, a skilled workforce knows how to differentiate all these contexts in which their activity is involved, as well as perform their activities without any difficulty.

The unskilled labor can bring to the company several inconveniences due to the accomplishment of the small or large work, for the company that is in charge of the project. Thus, it is necessary to seek greater knowledge and specific training for this branch of construction, aiming at the success of the work in final productivity.

3. Methodology

The literature review was conducted from August to September 2019, focusing on the qualification of labor in the construction industry and its effects on productivity.

The research was done in the academic websites, books, magazines and articles that portray the theme and the following descriptors were used: civil construction, skilled labor.

The inclusion criterion was through literature and abstracts for the classification of eligible articles, also in this stage were paid articles and articles in foreign languages. Articles found 26, articles used in this work 8, discarded articles 18.

In the second moment the field research was carried out, where it was possible to collect important data for this research (application of a questionnaire), as well as to bring the researcher closer to his research object. This is a qualitative research, this method of scientific investigation focuses on the subjective character of the object analyzed.

4. Application of Study

In Brazil, the construction industry has shown significant growth, as well as its contribution to the country's economy. In this sense, companies in this segment have been very concerned about providing quality services.

According to [7], indicates that the city of Manaus already has a history of industrialization process, due to the industrial development of Manaus Free Zone. According to [8], says that, due to the rapid demographic and economic increase, the city started to enhance the construction industry and the market expanded mainly to the functions of masons, master builders, engineering professionals, architecture, among others. Over time, unskilled labor has become a bottleneck for civil construction in the city of Manaus, that is, today the market increasingly demands professional qualification, as this influence directly on the final delivery of services, ie on productivity.

The purpose of this study is related to the qualification of the workforce in construction, where it will be presented the verification of the results obtained through a questionnaire applied to the construction professionals, itself at MRV Engenharia e Participal SA in Manaus-AM.

4.1 Company Characterization

MRV Engenharia e Participal SA, is dedicated to the construction and incorporation of popular residential development throughout Brazil. With a focus on three concepts, location, price and payment methods, MRV is the only builder present in more than 160 Brazilian cities, generates more than 6,000 jobs per year and has already launched more than 400,000 properties.

4.2 Characterization of activities

Storeroom: The storeroom is the professional responsible for receiving, identifying and checking materials recording the incoming and outgoing movements of materials or products, and is responsible for receiving and checking the return of equipment on site, and must keep track of minimum inventory. .

Grouting: Lining the walls and ceramic floors of the apartments.

In charge: Supervises the employees, their services, reading and execution of projects, monitors schedule and measurements of work.

Assembler: He is responsible for the assembly and disassembly service of suspended scales.

Electrician: The electrician installs the entire electrical structure, as well as switches and sockets, and is responsible for installing the wiring passage inside the walls of the building.

General Services Assistant: Responsible for fine and coarse cleaning of apartments after the end of services.

Servant: The servant is responsible for taking care of the heaviest part of the work, such as making the cement masses, arranging and transporting materials, removing and transporting rubble.

Painter: Responsible for internal painting of apartments and hall, external painting of buildings.

Bricklayer: Responsible for the execution of the walls, sidewalks, tactile floor.

4.3 Application of the questionnaire

The questionnaire was applied to 25 construction workers, 22 male and 3 female, belonging to MRV Engenharia e Participal SA. The same was carried out from September 15 to 25, 2019. With the objective of analyzing the profile of labor and its effects on civil construction in the city of Manaus.

Professional Profile Questionnaire

Name: _____

Gender: ( ) F ( ) M

Age:_____

Marital Status: ( ) Single ( ) Married ( ) Other

Name of Company Working:_____

2- What is your level of education?

( ) Elementary School ( ) High School

( ) Undergraduate ( ) Specialization ( ) Master ( ) Doctorate

3- How long have you been working at this construction company?

_____

4- How long have you been working in the construction industry?

( ) 0-4 ( ) 5-9 ( ) 10-14 ( ) more than 15

5- How many employment bonds do you have?

( ) 1 ( ) 2 ( ) 3 ( ) Over 3

6- What is your work shift?

( ) Daytime ( ) Nighttime

7- What is your monthly income?

( ) 2-4 minimum wages ( ) 5-7 minimum wages ( ) over 8 minimum wages

8- What is your weekly workload?

( ) 20 ( ) 30 ( ) 40 ( ) Over 40

9- What do you mean by qualified labor profile?

_____

10- Have you taken any course in your area?

( ) Yes ( ) No - If so, what courses?

11- Are you interested in leaving?

( ) Yes ( ) No

12 - Do you want to qualify?

( ) Yes ( ) No - If so, what prevents you from doing?

Figure 2 - Professional Profile Questionnaire

Source: Author

5. Results and Discussions

The questionnaire was applied to construction professionals, obtained a result that will be presented through graphs, as well as individualized speeches according to the research objectives. Twenty-five (25) construction professionals from the MRV Company participated in the survey, with an average age of 40 years.

Twenty-five people were interviewed, 22 males and 3 females.

The questionnaire was also applied to some companies that provide services to the MRV company, being 12 employees of the same company (MRV), the others are outsourced companies by MRV itself, being 2 from RP Máquinas, 4 from RD Pinturas, 3 from ACS, 2 from JC and 2 from J. Batista.

When asked about schooling the answer was: of the 25 workers, only 13 employees have completed high school, another 11 only elementary school and 1 have completed higher education.

Regarding marital status: 11 employees have marital status of married, 10 with marital status of single and 4 did not respond.

When argued about how many salaries do you get? All employees receive about 2 to 4 minimum wages.

Regarding working time in construction: 6 workers responded from 0 - 4 years; 8 workers from 5 - 9 years

old; 5 workers are 10 - 14 years old; 6 workers aged 15 and over working in construction, as shown in Figure 3.

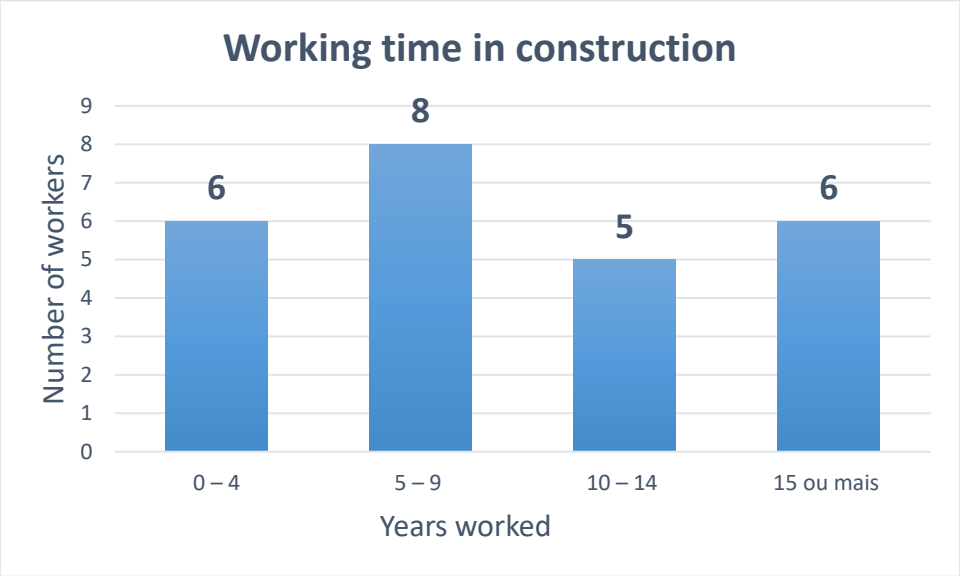


Figure 3 - Working time in construction
Source: Author

When asked about your work schedule? All responded that they work during business hours, totaling a workload of approximately 40 hours worked weekly.

Regarding working time in the company the answers were as follows:

MRV Workers: 6 MRV employees have more than 1 year of relationship with the company, and the others had an average of 6 months working with the company; RP Machinery Workers: Both have more than 2 years of ties with the company; RD Pinturas Workers: The employees have on average 4 months of services rendered to the company; AC Workers: Employees have an average of only 1 month and 15 days with the company; JC Workers: The employees have an average of 4 months of bond with the company; J.Bastita Workers: Employees have an average of 2 months of bond with the company.

Regarding the functions in the Company, MRV employees have the following functions: Warehouse - 1; Grouting - 1 Charge - 2; Assembler - 2; Electrician - 3; General Services Assistant - 3; Servant - 4; Painter - 4; Mason - 5, as shown in Figure 4.

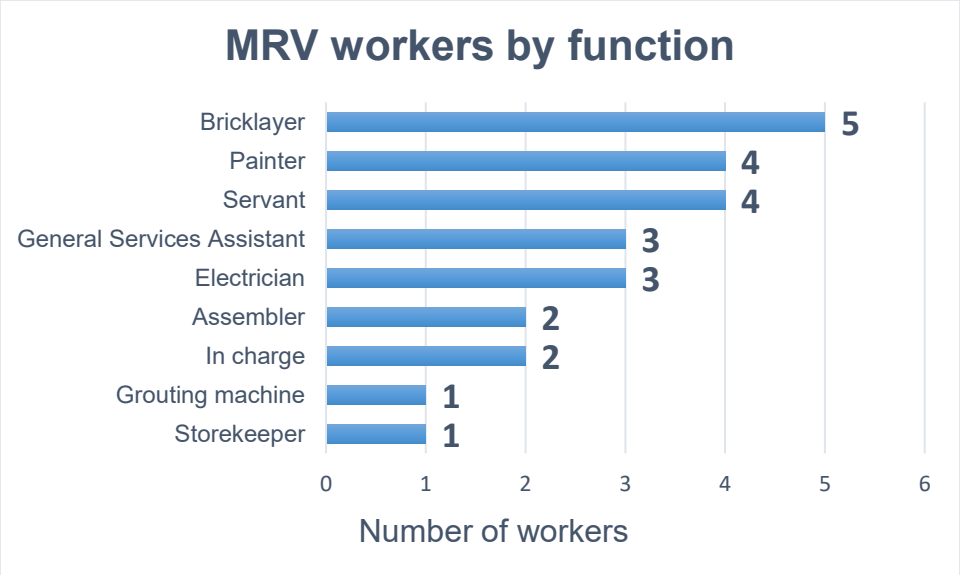


Figure 4 - MRV workers have the following specific duties
Source: Author

Faced with the question "What do you understand by qualified labor profile?" The workers answered that: "qualified labor profile is the worker being qualified and having time of experience with the area of expertise, and having courses and training offered to them to have more training in their services rendered to the company, and thus develop new constructive techniques for their professional growth and in view of increasing productivity on the construction site ".

Faced with the question "Have you taken any course in your area?" 10 respondents answered yes and 15 answered no, as shown in Figure 5.

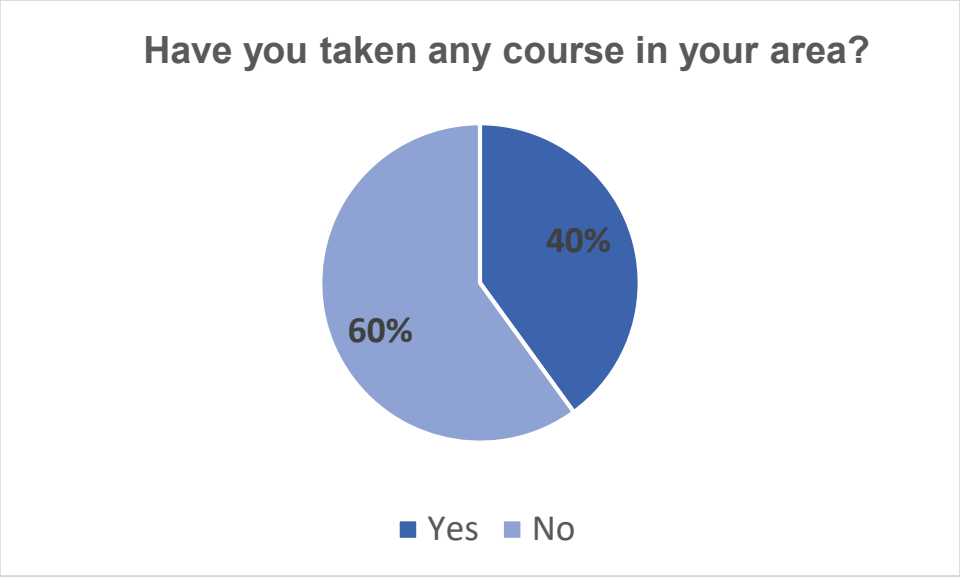


Figure 5 - Course in the area of expertise
Source: Author

Faced with the question having the answer: yes, which courses? the most cited courses were:
In charge: Tec. Electric, residential and building electric, master of works;

In charge: Tec. Electric, Residential and building plumber;
Bailiff: bailiff course;
Electrician: Building electrical course;
Bricklayer: bricklayer and carpenter course;
Bricklayer: bricklayer course, tile;
Painter: course for painter
Painter: painter of works;
Painter: painter of works;
Grouting: Grouting.

Faced with the question “Are you interested in leaving?” 22 respondents answered yes and 3 no. Faced with the question “Do you want to qualify?” 17 answered yes and 8 answered no. If so, what prevents you from doing?

58.82% answered that, what prevents is the lack of time and 41.18% who is unable to afford the courses.

In the studies Silvia et al. (2015), economic development favored the employment of low-educated professionals who had experience with construction. The professional training of masons and builders among other professionals is recent in Manaus through vocational courses. For the most part, for many years, these professionals learned the craft of mason and builder transgenerationally or by “spouting” to make money in their teens. The author also points out that such development and urbanization policies have boosted the economy and the labor market in Manaus / Amazonas. Construction advanced and employed young and veteran masons who made up the mass of construction in the city, as well as contributing to the economy of Manauara.

6. Conclusion

The study showed that skilled labor is a problem to be faced by construction companies in Manaus, because it was noticed that some professionals accept the proposal to qualify, but some do not, in view of the positions, it is clear that The industry needs to charge more for a skilled workforce, as it directly influences the bottom line, which is the company's productivity.

Regarding education, it was observed that most have only elementary school, which makes the workforce disqualified due to the lack of knowledge of both studies and professional practice.

Regarding workers taking courses, most accept to qualify to even grow in the company occupying other positions, as well as earning more. However, it was observed that the lack of time and money makes workers in this sector no longer seeking knowledge.

A proposal for the owner of the company is that, when hiring such professionals, courses are required, as well as 6 months of experience in the segment they want to work with. Another was that the company itself could offer this qualification, in this sense, the company MRV has committed to motivate its workers to specialize more in the activities they perform, thus, all come out winning, especially society, because the requested services end up being delivered before the deadline.

7. Bibliographic References

[1] BEZERRA, Danielle Reis et al. Analysis of management of waste from civil construction: case study (144-151). Journal of Engineering and Technology for Industrial Applications, v. 4, n. 16, p. 144-151, 2018.

[2] GONÇALVES R, et al. A produtividade da construção no Brasil e no mundo. Conjuntura da Construção, v. 13, n. 4, p. 8-11, 2015.

[3] ARAUJO, Matheus Taveira de Brito. Um estudo exploratório de variáveis macroeconômicas do investimento na construção civil imobiliária no Brasil, 2002-2016. 2018. Trabalho de Conclusão de Curso. Universidade Federal do Rio Grande do Norte.

[4] COSTA, E. M.; PIASSA, P.E. Perfil dos trabalhadores da construção civil em Itapejara D'Oeste –PR. 2014. 58f.Trabalho de Conclusão de Curso. Universidade Tecnológica Federal do Paraná, Pato Branco, 2014.

[5] IBGE (2017) Estatística, I. IBGE | Séries Estatísticas & Séries Históricas. Disponível em: <seriesestatisticas.ibge.gov.br>. Acesso em: 19 set. 2019.

[6] FIESP. Mapa da cadeia produtiva da construção, 2015. Disponível em: <http://www.fiesp.com.br/infografico-cadeia-da-construcao>. Acesso em: 18 set. 2019

[7] DOS SANTOS FARIAS, Arliane et al. Feasibility of using the light steel frame system in civil construction works in the city of Manaus/AM (173-178). Journal of Engineering and Technology for Industry Applications, v. 4, n. 16, p. 173-178, 2018.

[8] DIAS, Ernandes Gonçalves et al. QUALIFICAÇÃO DE PEDREIROS ATUANTES NA CONSTRUÇÃO CIVIL DE UMA CIDADE NORTE MINEIRA. DESAFIOS-Revista Interdisciplinar Da Universidade Federal Do Tocantins, v. 5, n. 2, p. 41-50, 2018.

[9] CAGED - CADASTRO GERAL DE EMPREGADOS E DESEMPREGADOS. Lei N. º 4.923/65. Sumário Executivo. Julho de 2019.

[10] CARNEIRO, Misael Pantoja et al. Aspectos socioambientais da rede de abastecimento dos insumos na construção civil na Tríplice Fronteira Brasil-Peru-Colômbia: o caso da cidade de Tabatinga, Amazonas. 2016.

[11] PLESSIS, Chrisna du. Agenda 21 for sustanaible construction in developing countries. Pretoria. CSIR Building and Construction Technology, 2002.

[12] Sistema IBGE de Recuperação Automática – SIDRA. Sistema Nacional de Pesquisa de Custos e Índices da Construção Civil. Disponível em: <https://sidra.ibge.gov.br/tabela/2296>. Acesso em: 21 set. 2019.

[13] GONÇALVES, Caroline de Lima Zanon et al. Aspectos da qualidade de vida no trabalho dentro do gerenciamento estratégico na construção civil: estudo de caso em um empreendimento residencial multifamiliar. 2017.

[14] COIMBRA, G. A construção civil é a maior empregadora do Brasil: Obras já! Debates Culturais. fev.2017.

Implementation of RSA Cryptography Algorithm in Language C in Exchange of Text Messages

Ítalo Rodrigo Soares Silva
italo.computation@gmail.com
Student, Universidade Paulista UNIP - Computer Science Course - Brazil

Ricardo Silva Parente
ricardosilvaparente@gmail.com
Student, Universidade Paulista UNIP - Computer Science Course - Brazil.

Davi Samuel Dias Maia
davisdm39@gmail.com
Student, Universidade Paulista UNIP - Computer Science Course - Brazil

Paulo Oliveira Siqueira Júnior
paulojunior051996@gmail.com
Student, Universidade Paulista UNIP - Computer Science Course - Brazil

Jorge de Almeida Brito Júnior
jorge.brito@itegam.org.br
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Manoel Henrique Reis Nascimento
hreys@itegam.org.br
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Igor Felipe Oliveira Bezerra
igorfelipe.dss@hotmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Abstract

The encryption approach is widely used in mobile applications where there is message exchange and in banking transactions or financial pointers tools. The present research has as a proposal to approach an

algorithm developed in C language and based on the RSA encryption methodology using the symmetric and asymmetric key concepts in order to demonstrate its use in the exchange of messages where there is secrecy of information, thus the importance of information security, its use has obtained interesting results with the manipulation of large scale vectors where the number of characters is a factor the process of letter inversion for encryption and decryption.

Keywords: *Information Security; Data; Symmetric and Asymmetric.*

1. Introduction

The need to gain security in information is something that has been discussed for many years, when Julius Caesar emperor of Rome began with the idea of letter inversion, or in the use of algorithms and techniques in Wars to send encrypted messages in order to prevent the enemy regiment intercepts such information, soon becomes something of many times, the act of encrypting or creating models that aid in the management of information becomes necessary and allows a significant gain in the branch of Computing, understand the methods and ways studied of how to initiate such a feat is within the scope of this research. Encryption has been used for a long time and continues to be used continuously and assiduously by businesses, people and software to protect data that is passed from one place to another, based on the frequent use of encryption was implemented the software instituted by the authors of this work in order to show in a practical way the process that the algorithm does from the pre-encryption to the encryption, taking as an example the algorithm and the software development.

The existing cryptographic types are private (symmetric) keys and public keys (asymmetric), where the present research approaches methodically and technically how to enable an adaptation of the RSA algorithm built in C language to allow better understanding and because it is structural.

There is a big problem with the advancement of technology, data security, in which many people suffer from data interception, whether it is messages, images, videos, audios or other media or files.

The use of encryption becomes increasingly useful as new methods are built to address needs and failures that were once notable, the present research can demonstrate that the use of an adaptive implementation can be functional in several situations.

The main objective of this work is to implement a cryptographic algorithm based on RSA encryption methods and demonstrate its use in C language, analyzing the encryption and decryption methods and contextualizing on the concepts and principles of data security.

2 . The Importance of Data Security

Message encryption is a widely used approach in mobile applications, web systems, and financial support, as its use becomes efficient in data security, transaction of information and secrecy of content processed on the web, which are often at risk to be intercepted by several existing computational techniques.

Evidence of its importance is mentioned by Antunes and Kowada.

"[..] due to the technological evolution of mobile devices with the launch of smartphones and easy access to high-speed Internet, the limitation of the communication feature has become increasingly evident. As a

result, a number of smartphone instant messaging application initiatives have begun to emerge, similar to those currently used in personal computers" [1].

WhatsApp, Facebook, Messenger among others, both act in the connection of people and communication of data through APIs in a large network, responsible for establishing connections with different clients and performing the tasks requested by each user, in the middle of these procedures failures arise.

Montanheiro and Carvalho wrote:

"When malicious individuals identify failures, they can steal information, intercept communications between client and server, stop or even destroy the web service, leaving it unattended or unusable, causing various inconveniences to users of a service" [2].

These are obstacles such as these that cause dissatisfaction and dissatisfaction in large brands and products, the lack of security becomes a problem and ends up being irreversible when a project does not follow standards or methodologies that allow the scalability among other pillars of software engineering that concretize the quality of a product.

Montanheiro and Carvalho affirm that "Failures such as those that generate the Authentication Break and Session Management vulnerability can be avoided if they are thought of in the early phases of the project". These flaws allow attackers to steal user data from the application, either by showing details of user sessions on URLs, non-expiring sessions, or access tokens that are not invalidated when logging out. When designing and modeling a system that does not expose unnecessary data to users, this type of failure can be avoided [2].

Borges exposes the use of new technologies by criminals:

"Obviously, crime would not fail to take advantage of the opportunities offered by new technologies, and the practice of cybercrime on the Internet is perverse, with countless bank frauds, extortions from computer intrusions, viruses and programs scattered across the network to obtain data that allows criminal practice, child pornography and many other illicit or reprehensible behaviors" [3].

Then there are the data interception scanners that have automated features that after initial configuration do not require man-machine interaction, some examples are cited by Gomes, who comments on the purposes "Each scanner has its own methods and different types of attacks, the most common are" [4].

- Authentication Bypass ou Brute forcing
- SQL Injection/Blind SQL Injection
- Cross Site Scripting / Persistent Cross Site Scripting
- Command Injection!XPath Injection!SOAP/AJAX Attacks
- CSRF / HTTP Response Splitting
- Arbitrary File Upload attacks
- Remote File Include (PHP Code Injection)
- Application Errors

Soon the technologies that become viable in several aspects end up being trapped by lack of planning allowing the invasion and vulnerability in small details.

2.1 Cryptography and Description

Data encryption becomes a way to secure information crafted in a computing environment, decryption is performed in order to discover the encrypted information.

According to Zoelner et al. "A type of encryption or cipher is known as Hill Cipher, and is a type of linear algebra-based substitution cipher used for message encoding" [5].

To De Sousa Abreu "In information security jargon, cryptography provides not only to ensure the confidentiality of message content, data and information, but also to integrity and authenticity" [6].

Vicente et al. "The Emperor of Rome Julius Caesar (100-44 BC) also developed such a form of communication with his generals through the displacement of the letters of the alphabet, known today as" substitution cipher "[7].

It states that "The first existing methods such as the" Cipher of Julius Caesar "only used a coding algorithm (mono-alphabetic), therefore the sender only had to know how to subtract from the message three letters to decipher" [7].

Da Cunha comments that cryptography is a technique of maintaining secrecy about information and mainly as a means of security for communications in various technological environments where passwords are used [8].

2.2 Types of Cryptography

Encryption can be based on Symmetric and Asymmetric what for Vieria Filho and Azeredo "the cryptography can also be understood within a process of technological innovation [...] the advance of the cryptographic analysis depends on the managerial abilities that are constructed to explore and to capture knowledge" [9].

According to Silva and Oliveira:

"The need to keep secrets for man has brought the advancement of effective methods of security according to the knowledge that was within his reach [..]. With the passing of the centuries and the improvement of new techniques, security has become a very broad and researched aspect, and thus new inventions have emerged according to the necessity of the moment" [10].

Encryption consists of modifying the original text, known as plain text, into ciphertext so that it can not be read by unauthorized persons. When a text is encrypted, a key is generated that will be used by the recipient to decode the information. At first all information is public, only the key to access it is private [11].

2.3 Symmetric Cryptography

In symmetric encryption the secret key is unique, where the same key will be used to encrypt and decipher the information. To create the key, there must be an agreement between the sender and receiver of the information, since it will be used in the same algorithm before sending and receiving messages [12].

According to France:

"The problem with Symmetric Cryptographic Systems lies in the distribution of the key, which in electronically implemented methods are made through electronic channels (telephone line and radio waves), vulnerable to the" listening" of some intruder. Therefore, these must be exchanged between the parts and stored safely, which is not always possible to guarantee" [13].

This type of encryption has algorithms that perform different tasks and influence its DES, AES and IDEA

performance.

The first one determined by the Data Encryption Standard concept created by International Business Machines (IBM) in 1977, which can allow about 72 quadrillion combinations, its key size is considered small, having been broken in 1972. This was replaced by the next one that is or AES [13].

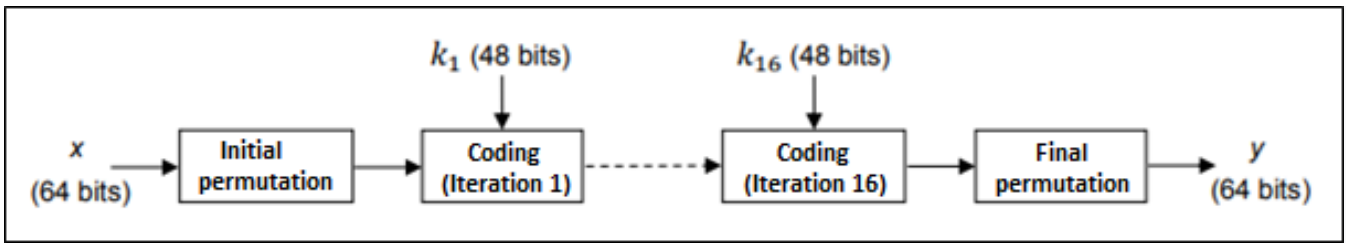


Figure - 1 Symmetric model DAES

Source: Da Silva (2018) [14].

The second concept by Advanced Encryption Standard is applied in Wi-Fi connections was created by the National Institute of Standards and Technology (NIST) in 2003, it is one of the most popular algorithms since 2006, it is fast both in software and in hardware, is relatively easy to perform and requires little memory [13].

Maia et al. explains the operation of this algorithm:

"The AES is a symmetric block cipher, where the current standard operates on a 128-bit data block, which is organized in the form of a four-order square matrix of bytes, called State, where the ordering of the bytes within the array occurs by column. Keys can be parameterized in sizes of 128, 192 and 256 bits. Each iteration, or round of encryption on each block of data (these rounds can vary according to the size of the key: 10, 12 and 14 rounds, for keys of 128, 192 and 256 bits respectively), several operations are performed: Byte substitution (SubByte), ShiftRow, MixColumns and AddRoundKey, which occurs over arithmetic in the finite body GF (28), known as the Field of Galois (GF - Galois Field), for the decryption of the data the mathematical operations are inverted)" [15].

The figure below exemplifies the model addressed by Maia et al in their research.

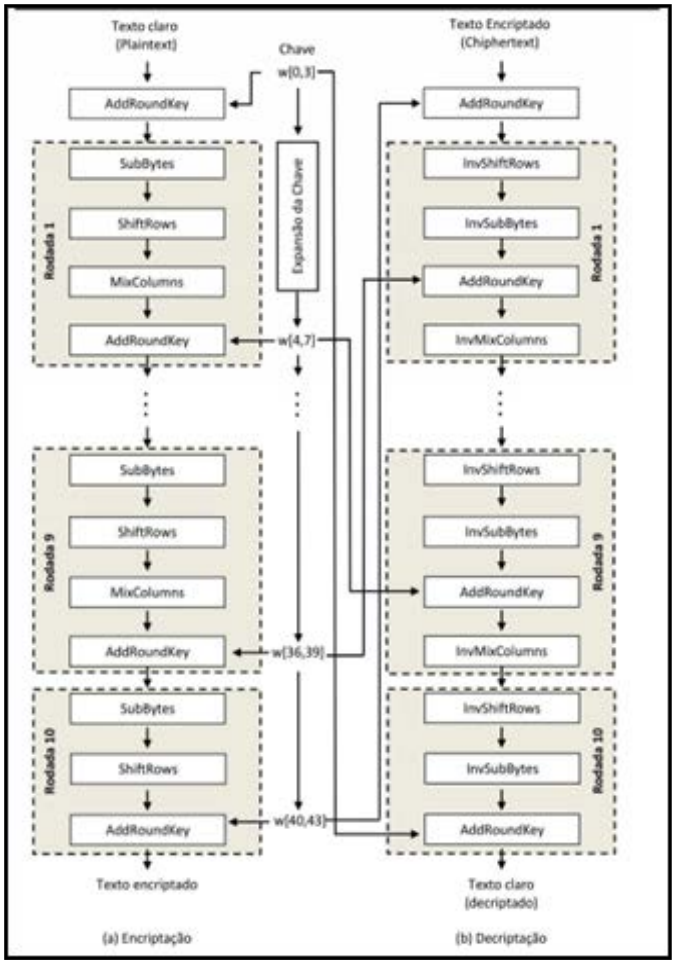


Figure - 2 AES Symmetric Model

Source: Maia et al (2017) [15].

Lastly IDEA The International Data Encryption Algorithm (IDEA) was created in 1991 by James Massey and Xuejia Lai and holds a patent from the Swiss company Ascom Systec. The IDEA is a symmetric algorithm that uses a 128-bit key, so it is considered a power in symmetric encryption.

2.4 Asymmetric Cryptography

For Braga and Dahab "Public key cryptography uses two keys that are mathematically related and constructed to work together" [16]. One of the keys is the private having the other commonly called public and they differ in the logic of the construction only by questions of operational visibility.

Pigatto comments on the functioning of the asymmetric model and its concept:

"The sender uses the public key of the receiver to encrypt open text in ciphertext and after receiving the resulting ciphertext the receiver uses its private key to decrypt the ciphertext, again retrieving readable text" [17].

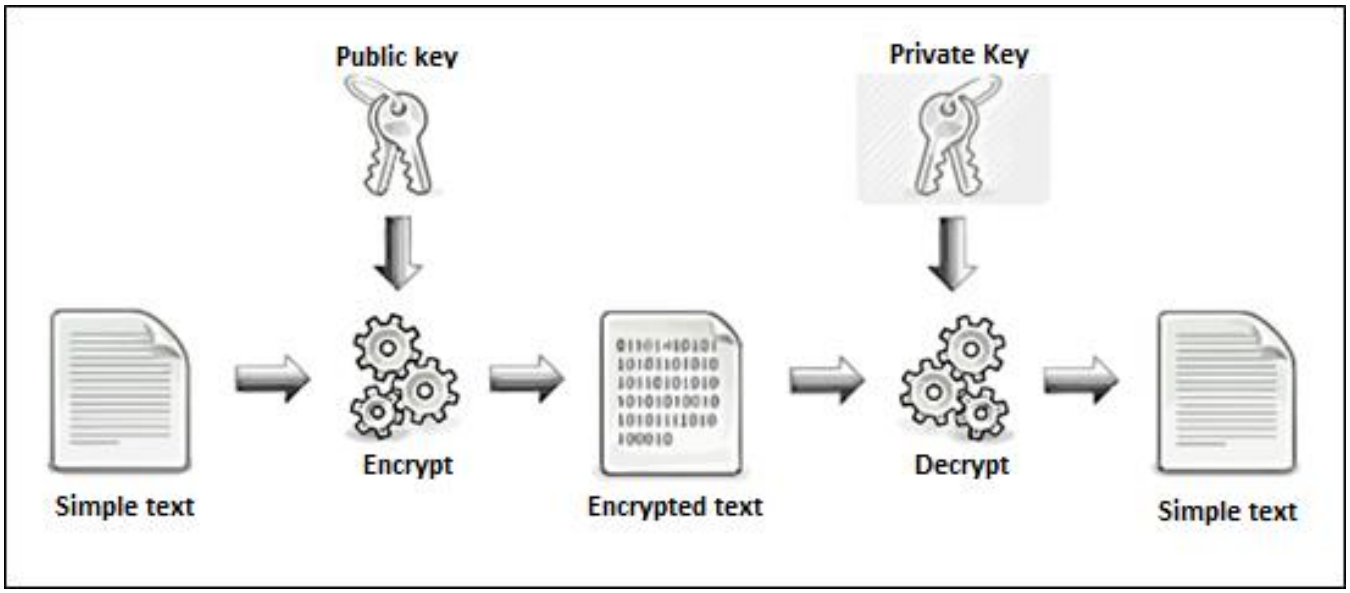


Figure - 3 Asymmetric Cryptography Scheme

Source: Pigatto (2012) [17].

In its model it is easy to determine the flow of the encryption and decryption process according to the key creation steps, where encryption occurs, but only the encryption with the key pair (private, public) can be decrypted.

2.5 Algorithm RSA

The RSA algorithm was created in 1978 by Rom Rivest, Adi Shamir and Leonard Adleman at the Massachusetts Institute of Technology (MIT) and christened with the initials of their surnames. It is currently the most widely used asymmetric cryptography method in the world, mainly in service protocols such as SSH and SSL, which manage a secure communication channel between the client and the server, which depend on the internet [18].

According to Molinari an encrypted public-key code must contain an A-coding methodology and a private decoding scheme B, where A and B are easy to calculate and for a message M, B (A (M)) = A (B (M)) = M, through this method arrive in the original message [19].

The coding key of the RSA consists essentially of n = pq, where p and q are large and distinct primes. By defining the elements, it is possible to calculate Euler's φ (x), that is, the number of numbers that are prime to each other of the chosen number. The next step is to choose a number and where 1 <e <φ (x), so that e is co-prime of φ (x). In other words, one searches for and where the MDC (φ (x) .e) = 1, where e> 1. The reader to identify the message would have to perform the inverse process to that presented, calculating to perform the decoding.

According to Filho and Azeredo the RSA algorithm is one of the most secure methods currently due to the difficulty in breaking the decoding key, that is, its complexity becomes larger when the number of elements becomes larger than is the case of the adaptation addressed in this research [20].

2.6 Proposed Algorithm

The proposed algorithm will be an adaptation of the RSA that has the best qualification in terms of the difficulty to understand cryptographic systems that act in the field of confidential data exchange or require information security, such as API's, mobile applications or financial support systems.

The implementation will be based entirely on the RSA model with small modifications, one of them will be the amount of characters used in the inversions of letters so it will be demonstrated in the methodology the vector used to compose this framework, ie a database in memory of low consumption and that allows the use of several alphanumeric characters.

According to De La Rocha Ladeira and Raugust:

The RSA holds because of the difficulty in factoring a large number (n) into prime numbers (p and q). If b is the number of bits of n, then there are √ (2b-1) possibilities to be tested in an eventual worst case, which results in time complexity of O (√ (2b)). As a matter of curiosity, considering b = 2048, √ (2b) results in a number a little larger than 1.79.10308. Considering a supermachine that can process 1 billion (109) attempts per second, it would take more than 5.10291 years [21].

Another feature to be addressed in the algorithm will be the size of the keys that will be a differential in terms of difficulty, because the larger the number generated as a key the greater the difficulty to decrypt.

2.7 The Algorithm

The RSA is strongly linked to the Theory of Numbers, being based on pillars as the rest operations and factorization by prime numbers. The algorithm can be summarized in the steps described below [22].

1. Get two prime numbers p and q;
2. Calculate n = pq;
3. Calculate Φ (n) = (p-1) (q-1);
4. Choose and | Maximum Common Divide - MDC between e and Φ (n) is equal to 1, that is, e and Φ (n) are co-primes (relative primes);
5. Calculate d | of ≡ 1 (mod Φ (n)), that is, mod Φ (n) = 1;
6. Public key: (e, n); private key: (d, n);
7. Function to encrypt a message m: C (m) = me mod n = c;
8. Function to decipher a message c: D (c) = cd mod n = m;
9. D (C (m)) = m.

3. Development

3.1 Implementation

The procedure below Fig. 4 is responsible for the choice of the numbers p, q and e, which is randomly defined, calling the primes generating function shown in Fig. -2, the variables gain prime numbers.

```
void Randomize(){
    srand((unsigned)time(NULL));
    do{
        p = rand()%150;
    }while(p == 0);

    do{
        q = rand()%150;
    }while(q == 0);
    do{
        e = rand()%150;
    }while(q == 0);

    p = nPrimo(p);
    q = nPrimo(q);
    e = nPrimo(e);
}
```

Figure - 4 Generating random numbers

Source: Authors (2019).

```
int nPrimo(int e1){
    int num = e1;
    int i, div;
    inicio:
    div = 0;
    for (i = 1; i <= num; i++) {
        if (num % i == 0) {
            div++;
        }
    }

    if(div == 2) return num;
    else{
        num++;
        goto inicio;
    }
}
```

Figure - 5 Generating cousins

Source: Authors (2019).

This structure is used to generate the value of n and to compute the function of Φ (n) = (p-1) (q-1), where símbolo is represented by the toti name of the totient function. In addition to obtaining the co-primes between e and n that will form the public key (e, n).

```
void geraChaves(){
    int primo;
    //------
    n = p*q;
    //FUNÇÃO TOTIENTE
    toti = (p-1)*(q-1);

    //CÁLCULO PARA OBTENÇÃO DE CO-PRIMOS ENTRE E e N
    //*e1 = nPrimo();
    do{
        primo = MDC(toti,e);
        e = nPrimo(e);
    }while(primo != 1);

}
```

Figure - 6 Generates keys

Source: Authors (2019).

The following is the method responsible for the maximum common divisor that is very important for the

construction of this system.

```
int MDC(int toti, int e){

    n1 = toti;
    n2 = e;
    mdc = n1%n2;
    while(mdc!=0){
        n1    = n2;
        n2    = mdc;
        mdc = n1%n2;
    }
    return n2;
}
```

Figure - 7 Maximum Common Splitter

Source: Authors (2019).

The modular function in Fig 8 is responsible for making a number represented by the distance between a point A and a point B, which in this case would be the distance between a part of the public key that is represented by the letter e and by the variable named toti, a which is used together with the variable and to create a value, this value will be assigned ad, a part of the private key that is composed of (d, n).

```
int mod(int a, int b)
{
    int r = a % b;

    /* Uma correção é necessária se r e b não forem do mesmo sinal */

    /* se r for negativo e b positivo, precisa corrigir */
    if ((r < 0) && (b > 0))
    return (b + r);

    /* Se r for positivo e b negativo, nova correção */
    if ((r > 0) && (b < 0))
    return (b + r);

    return (r);
}
```

Figure - 8 Modular function

Source: Authors (2019).

Repeated successive subtractions are what the Euclidean function does, so in programming language this Euclid method is implemented recursively until it finds a value that satisfies the necessary conditions.

```
int euclides_ext(int a, int b, int c)
{
    int r;

    r = mod(b, a);

    if (r == 0) {
    return (mod((c / a), (b / a))); // retorna (c/a) % (b/a)
    }

    return ((euclides_ext(r, a, -c) * b + c) / (mod(a, b)));
}
```

Figure - 9 Euclidean Method

Source: Authors (2019).

Function to store the encrypted text in a txt file, then this item will be read and encrypted.

```
void ARQUIVO(){
     arq = fopen("Dados.txt","w");
     int i;
     if(!arq){
        printf("\nErro ao abrir o arquivo!");
        exit(1);
     }
     fprintf(arq,"\tDados de Criptografia!!");
     fprintf(arq,"\n%i\n%i",d,n);
     fprintf(arq,"\n%i\n",strlen(frase));
     fprintf(arq,"\nVetor Convertido:");
     for(i = 0; i< strlen(frase);i++){
         fprintf(arq,"\n%i ",cripi[i]);
     }
     fclose(arq);
}
```

Figure - 10 Write file

Source: Authors (2019).

A process for reading the encrypted file and thus decrypting the message.

```
void LERARQUIVO(){
    char f[1000];
    arq = fopen("Dados.txt","r");
    int i,d1,n1,tam;
    if(arq == NULL){
        puts("\nErro ao abrir o arquivo!!");
        puts("\nFaça a criptografia de uma chave para gerar o arquivo!!\n");
    }else{
        printf("\n\n\t---LENDO O ARQUIVO-----\t\n\t\t<enter>");
        getch();
        fscanf(arq,"\n %[^\n]",&f);
        fscanf(arq,"\n%i",&d);
        fscanf(arq," %i",&n);
        fscanf(arq,"\n%i",&vTamanho);
        fscanf(arq,"\n %[^\n]",&f);
        for(i = 0; i < vTamanho;i++){
            fscanf(arq,"%i ",&cripi[i]);
        }
    }
    fclose(arq);
}
```

Figure - 11 Read file

Source: Authors (2019).

To encrypt the messages a conversion of the characters of the message into numbers is done and then the encrypted message is printed on the screen, after this step is completed the value of d is originated through the Euclidean function as already mentioned above. From there the public key is shown, where anyone can access without compromising the security of the message.

```
void criptografa(){
    int vtam = strlen(frase);
    //int cripi[vtam];
    int i;
    for(i = 0; i < vtam; i++){
        cripi[i] = exp(vFrase[i],e,n);
    }
    //----
    printf("\nFRASE CRIPTOGRAFADA:\n");
    for(i = 0; i < vtam; i++){
        printf("%i ",cripi[i]);
    }
    printf("\n");
    d = euclides_ext(e, toti, 1);
    printf("\nChave Pública: (%i,%i)",e,n);
    ARQUIVO();
}
```

Figure - 12 Encrypt

Source: Authors (2019).

The method for decrypting the encrypted message is just below and the private key is used to decipher character by character until the entire message is completely decrypted, then the message is displayed on the screen in the form of numbers, symbolizing that the encryption occurred, these numbers being the message itself.

```
void descriptografa2(int tam){
    int i;
    int descri[tam];

    for(i = 0; i < tam; i++){
        descri[i] = 0;
    }
    for(i = 0; i < tam; i++){
        descri[i] = exp(cripi[i],d,n);// % n;
    }
    printf("\n");

    int x,y;
    //--
    printf("\n\nFrase Descriptografada!!\n\n");
    for(x = 0; x < tam; x++){
        for(y = 0; y < 79; y++){
            if(descri[x] == y){
                printf("%c",ASCII[descri[x]]);
            }
        }
    }
    printf("\n\n");
}
```

Figure - 13 Encrypt

Source: Authors (2019).

4. Final Considerations

The present research was successful in analyzing the context of encryption, its importance, its use and techniques used to exchange messages, the program developed in C language was implemented through the algorithm addressed during the methodology, the results indicate that its use is made more satisfactory

when the character vector is larger for a more diverse exchange of letters and when the private and public keys are of enormous numbers such as 200 figures, small values were used for better abstraction of the reader. The RSA system can be very well accepted as a security source in mobile applications and web platforms, mainly in the use of financial support tools.

5. Acknowledgement

The Paulista University - UNIP and the Galileo Institute of Technology and Education of the Amazon - ITEGAM for technical and scientific support and collaboration.

6. References

[1] ANTUNES, Igor; KOWADA, Luis Antonio. Explorando o Sistema de Criptografia Signal no WhatsApp. In: SBSeg 2018. SBC, 2018. p. 181-195.

[2] MONTANHEIRO, Lucas Souza; CARVALHO, Ana Maria Martins. Primeiros passos para o Desenvolvimento Seguro de Aplicações Web. In: Anais Estendidos do XVIII Simpósio Brasileiro em Segurança da Informação e de Sistemas Computacionais. SBC, 2018. p. 233-242.

[3] BORGES, Fabiani.Terrorismo Cibernético e a Proteção de Dados Pessoais. Escola Paulista de Direito - EPD. p. 1 – 3. 2015.

[4] GOMES, Eduardo H. Segurança em sistemas de e-learning: uma análise do ambiente Tidia-Ae/Sakai. Perspectiv@ s, v. 14, n. 13, p. 18-24, 2019.

[5] ZOELNER, Éverton Gabriel et al. CRIPTOGRAFIA. Anais do EVINCI-UniBrasil, v. 3, n. 1, p. 333-333, 2018.

[6] DE SOUZA ABREU, Jacqueline. Passado, presente e futuro da criptografia forte: desenvolvimento tecnológico e regulação. Revista Brasileira de Políticas Públicas, v. 7, n. 3, p. 24-42, 2018.

[7] VICENTE, Aparecido et al. A CRIPTOGRAFIA E SUA IMPORTÂNCIA NA ATUALIDADE. Aten@-Revista Digital de Gestão & Negócios-, v. 1, n. 1, 2016.

[8] DA CUNHA, Rhuan Gonzaga et al. CRIPTOGRAFIA DE DADOS UTILIZANDO MATRIZES. RE3C-Revista Eletrônica Científica de Ciência da Computação, v. 11, n. 1, 2016.

[9] VIEIRA FILHO, José Eustáquio Ribeiro; AZEREDO, Paula Prestes. Tecnologia, criptografia e matemática: da troca de mensagens ao suporte em transações econômicas. Desenvolvimento Socioeconômico em Debate, v. 2, n. 2, p. 22-31, 2017.

[10] SILVA, Mariana Godoy; OLIVEIRA, Cintia Carvalho. O USO DA CRIPTOGRAFIA EM ÁUDIO. Anais do Seminário de Pesquisa e Inovação Tecnológica-SEPIT, v. 1, n. 1, 2017.

[11] TANENBAUM, Andrew S. Redes de Computadores. 5º edição. Rio de Janeiro: Campus, 2011.

[12] PETRI, Marcelo. Esteganografia. Sociedade Educacional De Santa Catarina – SOCIESC, Instituto Superior Tupy. Joinville, TCC de sistemas de informação. 2004.

[13] FRANÇA, Waldizar Borges de Araújo. A utilização da criptografia para uma aprendizagem contextualizada e significativa. p. 36-37. 2016.

[14] DA SILVA, Guilherme Gomes Felix. Formalização de Algoritmos de Criptografia em um Assistente de Provas Interativo. 2018. Tese de Doutorado. PUC-Rio.

[15] MAIA, William Pedrosa et al. Projeto, implementação e desempenho dos algoritmos criptográficos AES, PRESENT e CLEFIA em FPGA. 2017.

[16] BRAGA, Alexandre; DAHAB, Ricardo. Introdução à Criptografia para Programadores: Evitando Maus Usos da Criptografia em Sistemas de Software. Caderno de minicursos do XV Simpósio Brasileiro em Segurança da Informação e de Sistemas Computacionais-SBSeg 2015, p. 1-50, 2015.

[17] PIGATTO, Daniel Fernando. Segurança em sistemas embarcados críticos-utilização de criptografia para comunicação segura. 2012. Tese de Doutorado. Universidade de São Paulo.

[18] STALLINGS, W. Criptografia e segurança de redes: princípios e práticas. Pearson Prentice Hall. Protocolo Diffie-Hellman Sobre Curvas Elípticas. 2008.

[19] MOLINARI, José Robyson Aggio et al. Números Primos e a Criptografia RSA. 2016.

[20] FILHO, José Eustáquio Ribeiro Vieira; AZEREDO, Paula Prestes. Tecnologia, criptografia e matemática: da troca de mensagens ao suporte em transações econômicas. Revista Desenvolvimento Socioeconômico em debate v, v. 2, n. 2, p. 23, 2016.

[21] DE LA ROCHA LADEIRA, Ricardo; RAUGUST, Anderson Schwede. Uma análise da complexidade do algoritmo RSA implementado com o teste probabilístico de Miller-Rabin. Revista de Empreendedorismo, Inovação e Tecnologia, v. 4, n. 1, p. 24-33, 2017.

[22] Rivest, R. L., Shamir, A., & Adleman, L. M. (1978, Fev.). A Method for Obtaining Digital Signatures and Publk-Key Cryptosystems. Communications of the ACM, 21(2), 120-126.

Study of the Availability of Alternative Electricity in Communities of Costa do Parú - PA

Caroline Cativo Albuquerque
albuquerquecaroline.33@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

This paper addresses electric power as a relevant factor in the development of a region. For this reason, it highlights the importance of electricity in hard-to-reach communities, since the absence of electricity impacts the economic, social and political aspects. Aiming at rural electrification of low-income and isolated communities, the federal government created the Luz Para Todos program, since access to public energy is the right of the Brazilian citizen and social exclusion is vetoed by existing laws in the country. In this sense, the main objective of this study is to find a possible viable alternative for interconnecting the Costa do Parú communities to the local utility. For this, an analysis of the communities will be done to map the real conditions that portray importance and the necessity of the use of electricity among the families of the community. In addition, a survey will be conducted with the local utility about the Light for All program for the region. A model of photovoltaic system for the region will be elaborated based on surveys made with companies operating in the solar energy area. In the development of the research, it was found the various ways used in the Light for All Program to bring electricity to hard-to-reach regions, as well as the difficulties presented by the community for direct interconnection by the local utility. Relevant results were obtained about the real electric power conditions of the families. Based on this, a photovoltaic system model was designed for a possible LPT project that would meet the local needs of families. It is proposed that the maintenance of the off grid photovoltaic system be carried out by the local power utility.

Keywords: hard to reach communities; rural electrification; photovoltaic solar energy;

1. Introduction

Electricity is a relevant factor in the development of a region. Communities with difficult geographical

access may be delayed in their development due to unavailability of electricity, which impacts many aspects that are essential for any society, such as its economic resources, infrastructure, education and entertainment. The Federal Government has created a program called Luz para Todos, which aims to bring electricity to regions without access [1]. Although many states and municipalities have been covered by the program, there are still many regions where there is no forecast, such as the Costa do Parú Communities. From the location of the communities, it can be observed that there are some challenges for this energy to reach the place.

Electricity brings many benefits to the classes and societies affected by it. In an undeveloped rural community, the presence of electricity would represent an achievement and a new era to be lived, where the region's progress and development would gain space and incentive, as electricity is the fuel for growth in any region. , city or country [2]. In this sense, it is essential that this proposal can be carefully analyzed. Renewable energy plays an important role in accessing electricity in isolated regions, where due to technical or even financial difficulties, it is difficult to bring the grid through off - grid projects [2]. There are many families in rural areas who have been adopting this system because of the benefits it has, despite its high cost.

The present work aims to present a viable possibility of interconnection of riverside communities to the local energy concessionaire, describing the main existing ways of interconnection to the public electricity service, assessing the difficulties encountered in bringing electricity to the local. Despite the forms of interconnection presented, a photovoltaic system model is proposed for Costa do Parú communities including costs based on local needs.

2. Theoretical Referential

2.1 Energy

Energy can be defined as the ability to do work [3]. Energy causes changes in matter and, in many cases, irreversibly. Electricity is the most widely used form of energy in the world. It can be obtained in many ways, but the main source comes from hydroelectric plants [4]. Electricity is fundamental in contemporary society and can be obtained from hydropower, nuclear, thermal, solar, wind and other renewable sources [5]. Electricity is easily transportable, has low energy loss and is essential for the operation of machines, appliances and equipment in general [6]. The viability of electricity refers to all the situations in which it is used.

Guaranteeing access to electricity is a basic right of the population and should be offered by the government. The universalization of electric energy is not implicit in the decrees, ordinances and laws. Therefore it is understood as part of mandatory provision by the concessionaires, according to art. 175 of the Federal Constitution and Article 6 of Law 8.987 of 13/02/95 [7].

Another law that guarantees access to electricity is Law No. 9,074, which vetoes social exclusion, including from rural people [7]. On July 29, 2003, ANEEL (National Electric Energy Agency) established Resolution No. 223 aiming at general conditions for the elaboration of the Electricity Universalization Plan, establishing the responsibility of public utilities and electric power distribution concessionaires [7].

The Light for All Program (PLPT) has as its main objective to expand the grid in isolated regions with a

reduced budget [8]. This program promotes social and digital inclusion [8].

2.2 Photovoltaic Solar Energy

Photovoltaic solar energy, in turn, consists of the direct conversion of sunlight to electrical energy due to the so-called photovoltaic effect which consists of a potential difference in the ends of the semiconductor material produced by the absorption of light [9]. A photovoltaic system has four basic components: photovoltaic panel, charge controller, inverter and battery bank. While an off grid system requires batteries and charge controllers, on grid systems only work with panels and inverters as they do not need to store energy [9]. Solar Panel - Considered the most important part of this system. It acts as the heart due to the ability to carry energy to the system.Charge Controller - Serves to prevent overcharging or excessive discharging of the battery, thereby extending its battery life. Inverter - It is responsible for the transformation of the electric energy in direct current (DC) to the alternating current (AC). Batteries - Work on storing electricity so that the system can be used when there is no sun.

3. Methodology

3.1 Study area

The object of study of this research is the Communities of Costa do Parú, a floodplain region, located near the municipality of Óbidos, in the western state of Pará. In the region, there are approximately 150 families. These communities are not interconnected with the public energy service. Thus, to improve the quality of life and entertainment, many people have opted to use gasoline and diesel engines to generate electricity in their homes. There is a minority that uses solar energy. Despite the mobilization of people to join independent electricity, there are still families who do not have access to any kind of electricity in their homes.

In addition, geographic data of the region will be collected as: the distance between Óbidos and the region, depth of the rivers present in the Óbidos - Parú path, among other data.

3.2 Data collect

Based on many years of experience in the region, an analysis will be made of the communities to map the real conditions that portray importance and the need for the use of electricity among the families of the community.

A survey will also be made at the local utility to obtain data regarding the utility's forecast electricity supply, so that data such as forecast, cost, connection challenges, existing and possible forms of interconnection or supply of electricity can be collected. energy.

Information gathering related to the supply of electricity to rural areas will also be obtained through access to books, articles, websites such as MME (Ministry of Mines and Energy) and Local Concessionaire, as well as through the Operation Manual - Light for All Program 2018/2022 [10].

Based on the realization of the daily needs of families regarding the use of appliances and electronic devices, an off grid photovoltaic system model will be elaborated to meet the energy demand of the homes;

A survey will be made of the possible cost for the installation of the photovoltaic system through budgets and market research.

4. Analysis and Discussion of Results

According to the survey, it is found that for a community to have access to the public electricity service is essential to participate in the National Program for Universalization of Access and Use of Electric Energy - "LIGHT FOR ALL", since its social characteristics social and geographical aspects are in line with items I, II and IV of the first article first of article 7.520 of July 8, 2011, which emphasizes whether the program objectives are rurally electrified. Beneficiaries include low-income families enrolled in the federal government's Single Registry of Social Programs, families with beneficiaries of government programs that use social and economic development objects, and schools, health clinics, and water wells [11]. It is important to highlight that or decrease 7,520 of July 8, 2011 was changed by Decrees 8,387, of December 30, 2014, 8,493, of July 15, 2015 and 9,357, of April 27, 2018, the last business problem. by the Light for All program by 2022 [12]. Families residing in the region fall within these items.

For interconnection to the public utility of Light For All (LPT) are known some ways used for this process performed according to standards set by the utility, which designs the best system to meet the region according to geographical and economic characteristics. Such system models have already been used in other works of the Light for All Program (PLPT) as can be seen.

In Amazonas, to serve the municipalities of Autazes, Barcelos, Beruri, Eirunepé, Maués and Novo Airão through PLPT, Eletrobrás Amazonas Energia implemented the project of 12 mini photovoltaic plants with powers ranging from 9.6 kWp to 16.8 kWp to service 222 households through purely photovoltaic power generation systems and mini distribution grids [13].

In 2007, Eletrobrás Distribuição Acre in partnership with the government and the PLPT State Management Committee developed the Xapuri project to serve about 100 families living in the Chico Mendes Extractive Reserve, in the municipality of Xapuri, Acre [13]. The project consisted of the implementation of individual photovoltaic systems, which can be considered an alternative to the region under study, since the incidence of solar irradiation is considered very high during the year.

Another project developed to serve PLPT communities was the Araras project. The Araras project was developed by CELPA (Power Plants of Pará) in partnership with the Inter-American Institute for Cooperation on Agriculture (IICA), whose objective was to evaluate a sustainable rural electrification model using decentralized generation systems with renewable energy sources and distribution. by mini networks. It serves 80 consumer units of the Araras archipelago in Marajó Island. The project was carried out using three collective photovoltaic systems and one collective hybrid system [13].

In addition to such known processes, one of the alternatives for connecting remote areas is decentralized generation. In the Special Projects Manual, some technological options are considered. These include: Hydroelectric Mini-Central; Micro hydroelectric power station; Hydro kinetic systems; Biofuel or natural gas power generation systems; Photovoltaic solar energy generation systems; Aero Generators and Hybrid Systems resulting from the combination of two or more of the following primary sources: solar, wind, biomass, hydro and / or diesel [14].

An alternative also to bring energy to the community that is separated from the city by the river is the option for underwater cables, a technique used in the state of Pará, Marajó Island, to bring energy to Ponta de Pedras, Soure, Salvaterra, Cachoeira do Arari, Santa Cruz do Arari, Anajás, Chaves, Afuá, São Sebastião da Boa Vista and Muana [15].

The Costa do Parú region never had in its existence any project of public energy services for its communities Our Lady of Graces, New Core and Sacred Heart of Jesus. The household composition of the communities is approximately 70 families, 20 families and 60 families respectively. According to the data obtained from Google Maps, it was found that the straight line distance from the municipality of Óbidos - PA to the region is 39 km as shown in figure 1. However, taking into account the curves of the earth to To get to the place, the approximate distance is 42 Km. The region where the island is located is separated from the city of Óbidos by the Trombetas River. Within the communities of Our Lady of Graces and New Core, there is a river called Paraná Salvador. In late July 2019, the depth of this river was measured and the result was 13.76 m in the deepest part and 11.27 m in the lower part. To measure river depth, a twisted Nylon Mazaferro 210/018 25 kg (400m) wire was used to support a 16 kg stone.

Figure 1 - Straight line distance from Óbidos to Costa do Parú.
Source: Google Maps, 2019.

There is currently no PLPT project record with the local utility for such communities. Residents who do not have public energy should contact their local utility to register their request. The concessionaire advises that in cases of regions such as this, it is essential that a local representative make a document with data of interested residents, requesting the interconnection of their residence to the public energy service to participate in the Luz Para Todos Program. The representative must follow the process that will be reviewed by the Steering Committee. The role of the concessionaire or permissionaire in this scenario is only of executor [16]. In July 2019, a community representative was collecting data from interested residents to take to the local dealership agency located in Óbidos. Based on figure 2, we observed the positioning of families on the adhesion of electricity on their own in case of no public energy in the coming years.

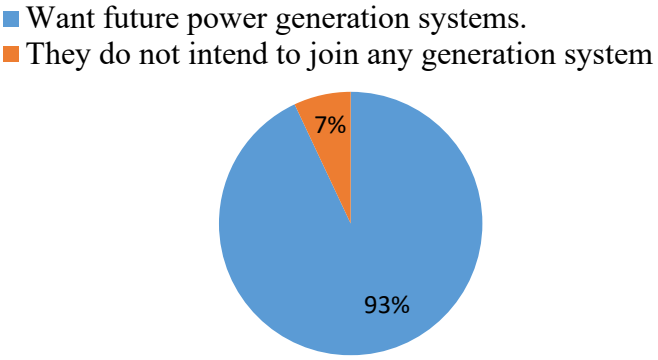


Figure 2 - Adherence to power generation systems.

For the realization of public electricity supply there are some obstacles that can be encountered. They are: high flooding in the region and areas of land affected by erosion with the risk of disappearing. The river begins to flood in November, the ebb period is usually in June. In case of a possible public electrification project for the region, a viable alternative is the generation of photovoltaic solar energy. The region has high incidence of solar radiation as described in figure 3, which allows a good use of this type of system. The solar radiation simulation was performed by the Solar Finger Resource website using a NASA database with surface spatial resolution of about 100 km x 100 km [17].

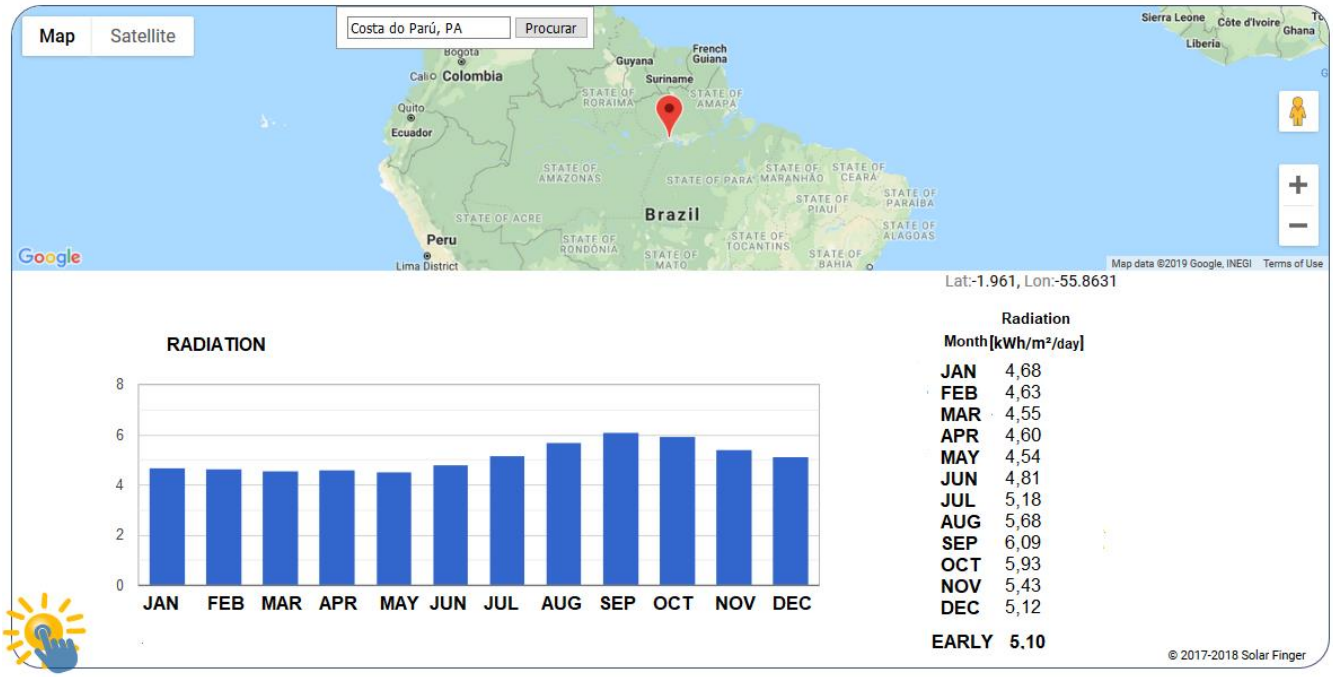


Figure 3 – Solar Radiation Levels in Costa do Parú.
Fonte: Solar Finger Resource, 2019.

As can be seen in Figure 4, it was found that most households that do not have access to energy intend to adopt such a system in case of no public electricity in the region in the future, due to the absence of the monthly cost that solar energy photovoltaic does not present when compared to other sources of electricity generation.

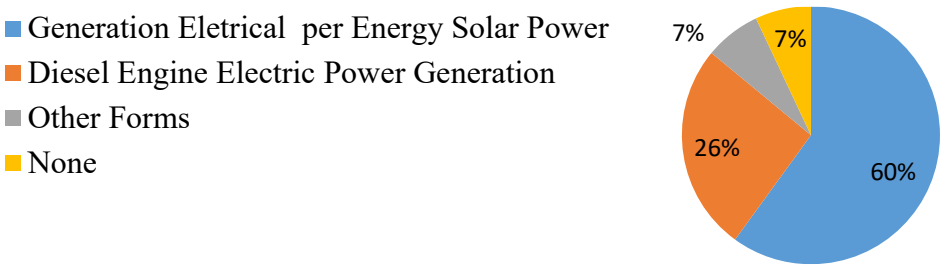


Figure 4 - Future use of power generation systems.

The forms of electric energy are among the main forms known by the community. Currently, as shown in Figure 5, households that have their own energy constitute the following power generation systems:

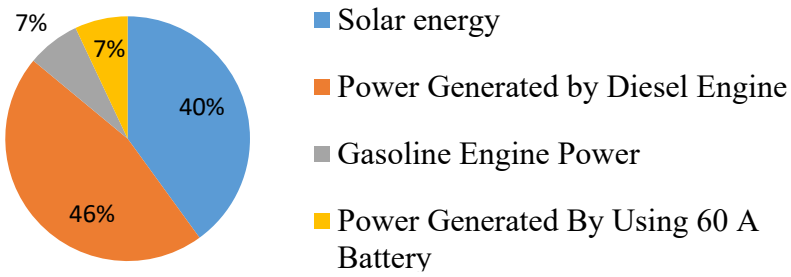


Figure 5 - Electric Power Generation.

However, for many years of experience in the region, it is known that the generation of own energy has changed. When community dwellers began to build their own generation systems, there was only one home that had photovoltaic panel generation. From 2017 - 2019 there was a growth in the use of solar energy. It is observed that 40% of people who have energy already use the Off Grid photovoltaic system today, and some people who have power generated by diesel or gasoline engine intend to switch to solar photovoltaic power generation in the coming years. One of the factors for the change is the cost. Based on a study done, it was observed that to use a gasoline engine for power generation, from 18:30 to 20h, 1 liter of gasoline is consumed, which implies a monthly cost of approximately R $ 150,00/month. During this time, the electronic equipment used is the television, usually 3 cell phones that are plugged in to charge and, on average, 3 lamps. In 2019, the cost of the systems used by households that have their own electricity can be seen in figure 6.

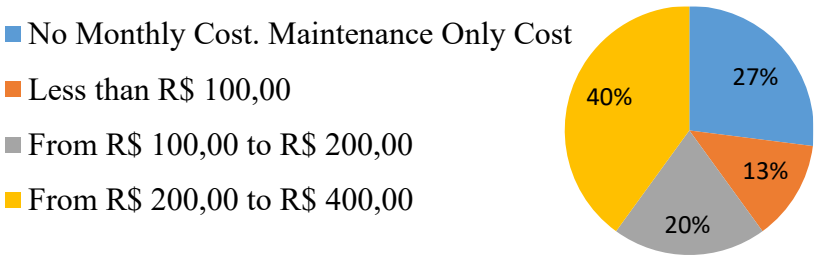


Figure 6 – Cost to maintain standalone generation systems.

The use of solar photovoltaic technology reduces these costs, despite having a high price for its implementation. After the deployment of an off grid photovoltaic solar system, the expected cost is maintenance of the system, since the durability of such a system is 25 years, except for batteries.To meet families, we propose a basic model of Off Grid photovoltaic system for homes, which in case of a possible rural electrification project by LPT, it can be adopted. The proposed system model is described in table 1 below. It is stated that the system designed has as its characteristic to meet the profile of families. The adopted model aims to meet essential services.

Table 1- Alternating Current Loads for a Costa do Parú Community Residence.

Amount	Description	Power(W)	Daily Use Time	Weekly use	Daily intake (Wh/day)
1	Television	380	8	7	3.040,00
5	Led lamps	20	4	7	400,00
4	Sockets	100	2	7	800,00
1	Refrigerator	300	12	7	3.600,00
1	Water pump	368	1	7	157,71
1	Satellite Dish	300	12	7	2.400,00
Alternating Current Consumption					**11.153,02 Wh/day**

Based on the calculations performed and a survey made with companies that work with solar energy, it was found that the off grid photovoltaic system that meets the described consumption must constitute the following structure: 16 330 W Photovoltaic Panels, 14 105 A Stationary Batteries, 1 Inverter with 2640 W to 3696 W power, 1 Charge Controller that supports an input current of 182.8 A, 48 m of Black Cable, 48 m of Red Cable, 1 Male and Female Connectors and 1 Fixing Kit.

The partial total value of the investment for a residence is described in table 2. For labor, the reported value is based on the actual percentage charged against the value of the material. There are many companies that work with 35% of the value of material for the workforce. Depending on the geographical location of the area where the service will be performed, transport, accommodation and food costs will be added.

Tabela 2 – Material and Cost Survey

Amount	Description	Unitary value	Amount
16	Photovoltaic Panel 330 W	R$ 700,00	R$ 11.200,00
14	Stationary Battery 105 A	R$ 1.142,00	R$ 15.998,00
1	Sine Wave Inverter	R$ 2.500,00	R$ 2.500,00
1	Charge Controller	R$ 1.700,00	R$ 1.700,00
1	Fixing Kit	R$ 100,00	R$ 100,00
16	Male and Female Connectors	R$ 16,00	R$ 256,00
48m	Black Solar Flex Cable 6mm	R$ 3,00	R$ 144,00
48m	Red Solar Flex Cable 6mm	R$ 3,00	R$ 144,00
Labor Value			**R$ 11.211,20**
Total Amount of Service			**R$43.243,20**

To serve 150 families, the approximate cost will be R$ 6.486.480,00 without the calculation of BDI (Indirect Benefits and Expenses). The area to be occupied for installation is 40, 35 m^2. The monthly generation of electricity is 670,50 kWh / month. The power of this system is 5,28 kWp.

5. Conclusion

Given the above, the various forms of rural electrification of communities by the LPT were verified, as well as the challenges for the electrification of the region. During the years of PLPT's existence, many cities have already been contemplated, which has helped to improve the lives of many people. Since its initial project, the LPT has been undergoing changes and the program deadline has been extended because there are still many communities without access to the public energy service. It has now been extended until the year 2022.

The importance of the management committee as well as the community representative in PLPT projects is emphasized, since it is the management committee that analyzes the feasibility of the work and the representative monitors the development of the process. Although reports from residents of Costa do Parú communities about the request for electricity were made in other years, it is not known if there was follow-up.

In response to the interests of the communities under study, this work proposes a basic model of off grid photovoltaic system that could be adopted and implemented in case of a LPT project for the region. In addition, it is suggested that the maintenance of the proposed off grid photovoltaic system be performed by the local utility, ensuring the operation and continuous use of the system, since the resident families are low income families, the salary they have is directed to your livelihood.

6. References

[1] FREITAS, Gisele de. **Light program for all: a representation of program theory through the logical model**. Planning and Public Policy, 2015. Available at: <http://ipea. gov.br/ppp/index.php/ PPP/article/viewFile/504/374>. Access on 14 ago. 2019; at 20:31:19.

[2] SILVA, António Luís Gouveia Ribeiro da. **Electricity, Economic Growth and Development: a contribution to the case study of Mozambique**. Porto, [s.n], 2016. Available at: <https: // sigarra.up.pt/fep/en/pub_geral. show_file? pi_doc_id = 66282>. Accessed on 02 May.2019; at 06:18:20.

[3]**Electricity concepts**. Available at: <https://www.iped. com /materias/cotidiano/ conceitos- energia-eletrica.html> .Accessed on: 13 Sep.2019; at 05:30:45.

[4] SOUZA. Lily Alves from. **Forms of energy**. Available at: <https://mundoeducacao.bol.uol. com.br/ quimica/formas-energia.html> .Access 13 Sep.2019: at 04:30:20.

[5] MORAIS, Luciano Cardoso de. **Study on the panorama of electric energy in Brazil and future trends**. Paulista State University. Faculty of Engineering, Bauru, 2015. Available at: <https: // repository. unesp.br/ handle / 11449/132645>. Access on 13 Sep.2019: at 06:46:20.

[6] SILVA, Larissa Carolina da. **Management of equipment spending in standby mode and energy saving**. School of Minas Gerais - UFOP, Ouro Preto, 2016. Available at: <https: // www. monographs. ufop br / bitstream / 35400000/283/1 / MONOGRAFIA_ Spend Management Equipment.pdf>. Access on 13 Sep.2019; at 06: 10: 20

[7] PAZZINI, L.H.A; et al. **Light for Everyone in the Field: The Universalization of Electricity Service in the Brazilian Rural Zone**. Sao Paulo: [s.n]. [s.d] Available at: <http://www.proceedings.scielo.br/ scielo.php? Pid = MSC0000 000 02 2002000200019 & script = sci_arttext & tlng = en>. Access on 17 Mar. 2019; at 21:40:22.

[8] CARDOSO, Barbara Françoise; OLIVEIRA, Thiago José Arruda de; SILVA, Monica Aparecida da Rocha. **Rural Electrification and Regional Development: An Analysis of the Light for All Program**. Unijuí Magazine, [S.I]: Unijuí, Jan / Apr. 2013. Available at: <https://revistas.unijui.edu.br/index. php / development in question / article / view / 231>. Accessed on 18 Mar.2019; at 22:42:45.

[9] **Photovoltaic solar energy systems and their components**. Available at: <https: // www.neosolar. com / learn / learn-more / solar-photovoltaic-power-systems-and-their-components>. Accessed on: 02 May. 2019; at 05:37:20.

[10] **Operationalization Manual - 2018 to 2022**. Available at: <https://www.mme.gov.br/luzparatodos/Asp/documentos.asp>. Access on 11 Sep.2019.

[11] DECREE No. 7,520 OF JULY 8, 2011. National Program for Universalization of Access and Use of Electric Energy - "LIGHT FOR ALL. **Official Gazette**, Brasilia, DF, July 11. 2011Available at: <http: // www. plateau. gov.br/ccivil_03/_Ato2011-2014/2011/Decret/D7520.html>. Access on 04 Aug.2019; at 20:08.

[12] Brazil. Decree No. 9,357, of April 27, 2018. National Program for Universalization of Access and Use of Electric Energy - "LIGHT FOR ALL. **Official Gazette**, Brasilia, DF, nov. 2018.Available at: <http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2018/Decreto/ D9357.html>. Access on 05 Sep.2019; at 20: 39.

[13] **Light for All**. Available at: <https://eletrobras.com/en/Paginas/Luz-para-Todos.aspx> Accessed on 05 Aug. 2019; at 09:28:55.

[14] **Special Projects**. Available at: <https: //www.mme. gov.br/luzparatodos/ downloads / Special_Project_Manual2011-2014.pdf>. Access on 07 Aug. 2019; at 23: 35: 20.

[15] **Celpa uses underwater cables to bring power to the Marajó**. Available: <www.celpa.com.br/checa-a-celpa/press-room/celpa-news/%202016/%202/25/celpa-use-subquaticos-cords-to-power-energy -a-marajo>. Access on 13 Jun.2019; at 08:34:40.

[16] **Light For All Program**. Available at: <http://www.mme.gov.br/ web / guest / 6- light-for-all program>. Access on 08 Aug. 2019, at 22:30:21.

[17] **Solar Radiation in Brazil**. Available at: <https://solarfinger.com.br/radiacao-solar-no-brasil/>. Accessed 10 Sep.2019; at 20:22:38.

Identification of the causes of waste human milk in a human milk bank.

Délia Esmeyre Paredes [1] (Corresponding author)

[1] Epidemiologic Studies. Graduate Program on Health and Development in West Central Region. Faculty of Medicine, Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil. Telephone: 55 (67) 98133 4424. E-mail: deliaesmeyre2005@gmail.com

Maria Lúcia Ivo[1,2], Marcos Antonio Ferreira Júnior[2], Sandra Lucia Arantes[3], Andréia Insabralde de Queiroz Cardoso[1], Albert Schiaveto de Souza[2], Carmen Silvia Martimbianco de Figueiredo[2], Rosangela dos Santos Ferreira[4], Elisabete Kamiya[2], Aniandra Karol Gonçalves Sgarbi[1], Abilio Torres Dos Santos Neto[1], Marcos Vinicius Ivo da Silva[5]

[2] Federal University of Mato Grosso do Sul, Campo Grande, Mato Grosso do Sul, Brazil.

[3] Federal University of Rio Grande do Norte. Natal, Rio Grande do Norte, Brazil.

[4] Dom Bosco Catholic University. Campo Grande, Mato Grosso do Sul, Brazil.

[5] Federal University of Recôncavo da Bahia. Cruz das Almas, Bahia, Brazil.

Abstract

Human Milk Banks (HMBs) are subject to reduced donations and disposal collection to processing. Objective: To identify the causes of human milk waste in HMB. Materials and methods: A descriptive, retrospective, cross-sectional study of the secondary data recorded in the medical records files in the HMB Information during the processing, so it is necessary to identify the main causes of waste from System of a public tertiary hospital, regarding to human milk donors and recipient newborns, between January and December 2000. 2017. Descriptive statistical analysis was performed by Statistic Package for Social Sciences version 25.0. Results: We selected 383 donors and 149 newborns who received human milk that had complete records in the system. From the initial volume (711,854.14 mL of human milk), the 13.74% waste was concentrated in the selection and classification phases (9.04%). The causes of human milk waste were Dornic acidity (6.98%), off-flavor condition (5.50%) and dirt (2.01%). The waste of concentrated human milk in the selection and classification phase. Conclusion: The causes of sample waste in the selection and classification phases are high Dornic acidity, off-flavor condition and dirt. The recommendation is to guide the collection by the HMB team to the donors to reduce waste in the human milk bank.

Keywords: *Human Milk; Human Milk Bank; Quality control; Lactation; Breast-feeding.*

1. Introduction

The Human Milk Banks (HMBs) are facilities aimed to supply human milk (HM) to newborn (NB) under special conditions, who cannot feed on their mothers' breasts. In this way, they receive milk from a donor or from their mother's own milk by a probe or a little cup[2]. It is up to the HMB to receive and process HM from various donors of different ages, economic, social, cultural and nutritional conditions[3]. Prematurity, a

condition considered less than 37 weeks, is one of the special requirements for the recipient, according to RDC no. 171[4].

With the intention of increasing the interest in human milk and breastfeeding, since 1990, a series of legal and internal measures have been created in many public health hospitals so that the infants would receive HM as long as possible since the first hours of life[5].

The repercussion of this interest was replicated in the formation of the Brazilian Network of Human Milk Banks (BNHMBs), considered the most complex in the world, with 218 HMB and 194 collection points in Brazil. The Center-West Region has five HMBs, and Maria Aparecida Pedrossian University Hospital (HUMAP) has been the medical referral center since 1995. These HMBs follow strict standardization and ensure that recipient infants consume an innocuous risk-free product, which is possible from processes and analyzes that consider the packaging, storage, temperature, transport, color, *off-flavor*, physicochemical composition and microbiological evaluation[4]. Thus, one of the challenges in optimizing the services of the Brazilian HMBs is quality control, which begins with the donation and finalises with the HM consumption by the newborn.

It must be emphasized that in order to meet a growing demand for breast milk from the milk bank, there is a need to increase the donations, and this requires capturing, donor maintenance and monitoring of each phase of processing to avoid waste. In view of this finding, this research has established the following scientific hypothesis: If the causes of human milk waste are discovered, interventions can be made, so consequently there will be a reduced waste. Thus, the purpose of this study was: to identify the causes of human milk waste in HMB.

2. Materials and methods

A Descriptive study of a quantitative cross-sectional retrospective approach to secondary data of human milk donors and recipients attended by the Human Milk Bank of Maria Aparecida Pedrossian University Hospital, Brazilian Hospital Services Company (HUMAP-EBSERH), Federal University of Mato Grosso do Sul (UFMS), in 2017.

Records that were available and complete were included in the Human Milk Bank Management System (HMBMSWeb) of the DataSUS Human Milk Bank Network, and the 2017 HUMAP Medical Records File Systems, Campo Grande, MS. Such cutting was given to enable the analysis of one year of assistance of the studied service. Data which presented incomplete, unavailable or with erasures were excluded.
A Descriptive statistical analysis was performed by calculating measures of central tendency, mean and standard deviation, and the *Statistical Package for Social Sciences* (SPSS), version 25, was applied. The *Shapiro Wilk* Test was employed for a significance level of 5%. for determination of normal distribution.
The ethical principles of research involving human beings were respected, according to Resolution 466/12. The research was forwarded to the UFMS Research Ethics Committee under Protocol No. 2,866,363.

3. Results and discussion

In order to identify the causes of human milk waste to reduce human milk losses in a reference milk bank for Mato Grosso do Sul, data were analyzed of 383 donors, of which 93.29% performed prenatal care in a health care unit (HCU), and 149 newborns (NB) admitted to the ICU.

From the initial volume of human milk collected, 711,854.14 mL after defrosting, (Table 1), the volume of HM loss in the processing phases was 97,790.00mL (13.74%). There was a higher concentration in the selection and classification phase with 64,350 mL (9.04%).

In the first phase, selection and classification, there was a higher HM loss than is allowed, due to Dornic acidity (6.98%), non-conforming *Off flavor* (5.50%) and presence of dirt (2.01%). The term nonconforming was applied to classify milk losses that had two or more causes at the same time. By analyzing the second phase, the pasteurization phase, the loss was 0.20% of the total amount of milk due to a single cause, broken vial, which removed the total of 1,400 mL (0.20%). In the third phase, the microbiological quality control (total coliform survey), the total HM waste was 31,640 mL (4.44%) and loss of 400mL by broken vial, totaled 32,040 mL (4, 50%) of the initial volume (Table 1).

Table 1 - Volume of human milk losses according to processing phases of Selection and Classification, Pasteurization, Determination of total coliforms, BLH HUMAP / Campo Grande, MS, Brazil - 2017

Reason of loss	Processing time						Total	
	Selection and classification		Pasteurization		Determination of the total coliforms			
	Vol. loss (mL)	Loss%	Vol. loss (mL)	Loss%	Vol. loss (mL)	Loss%	Vol. loss (mL)	Loss%
Durt	14330	2,01	0	0,00	0	0,00	**14330**	**2,01**
Flavor	39140	5,50	0	0,00	0	0,00	**39140**	**5,50**
Acidity	49660	6,98	0	0,00	0	0,00	**49660**	**6,98**
Colouring	5650	0,79	0	0,00	0	0,00	**5650**	**0,79**
Packaging	3150	0,44	0	0,00	0	0,00	**3150**	**0,44**
Breakage	1020	0,14	1400	0,20	400	0,06	**2820**	**0,40**
Total Coliforms	0	0,00	0	0,00	31640	4,44	**31640**	**4,44**
Total	**64350**	**9,04**	**1400**	**0,20**	**32040**	**4,50**	**97790**	**13,74**

Initial volume: 711.854,14 mL; Final Volume: 614.064,14 mL; Loss volume: 97.790,00 mL (13,74%)

Source: BLH/HUMAP/MS – 2017

In this research, the 383 donors were responsible for a total of 614,064L of processed HM that benefited 149 newborns treated at the HMB, in 2017. In a study carried out in a municipality of Paraná State, from

2013 to 2014, with 57 women registered in the HMB, the production from donations was 402,748 L[6].

When discussing the number of donors registered in the HMBs and the volume of donations collected and processed, divergent aspects were observed among the data presented in these two surveys, which led to questionings. Given the number of women enrolled in HMB / HUMAP in this study, should the HM production not be higher? What factors would actually be interfering? These inquiries led to the assumption that perhaps some of these registered donors would be seeking to donate only in the engorgement phase for pain relief, or only once at their discharge.

In a study with 30 women in labor at HUMAP-EBSERH, an interview was carried out to identify the knowledge and practice of parturients about HM donation. Of the 27 who wished to be donors, nine donated due to "excess milk"[7]. Among those who did not adhere to the practice of donation, the reasons given were: "I did not seek to donate; little milk; difficulty milking"[7]. In another study with 36 donors registered at the MHB/DF, the reasons cited were overproduction of milk and altruism. In the specific cases of multiparous women who first donated, they revealed that they could have donated in previous births. Therefore, the authors believe that non-donation may have occurred due to misinformation, lack of institutional support and initiative[8].

A different experience with effective actions to promote breastfeeding and donor recruitment involved multiprofessional training in a HCU located in a community of Rio de Janeiro, developed during two years. The way the actions were performed at home allowed interactions during management between the nurse and the professional of the HCU. The increase in donor recruitment and donated HM was mainly due to staff support during home visits. This privileged facility, in addition to strengthening the bond between professional and potential donor, allowed the early identification of risk situations[1].

This research revealed that of the initial volume collected of 711,854.14 mL, the total loss in processing and quality control was 97,790.00 mL (13.74%), with the highest concentration in the selection and classification phase. Higher loss was observed in a study conducted at the HMB of Maceió-AL in 2006, in which 175,470 mL of the total volume collected (345,370 mL) were discarded.[9]

The most frequent causes of HM waste during processing were high Dornic acidity, followed by *Off flavor* and dirt. However, in some situations, the loss occurred due to non-compliance of more than one criterion in the present study, which did not occur in the Rio Grande do Norte HMB, where the comparison between raw and pasteurized HM showed no significant difference[10]. Both crematocrit (which estimates fat concentration and its energy value)[11] and Dornic acidity (physicochemical control by titration) serve as classificatory parameters for HM[12].

According to DRC no. 171, the recommended Dornic acidity parameters (expressed in ºD) approved for human consumption is <8 ºD.[13] This method has been shown to be effective in evaluating bacterial growth in 200 samples of HM performed at the HMB Fernandes Figueira Institute in Rio de Janeiro[14].

Off-flavor was found in 5.50% of the waste samples in the selection and classification phase in this study. Human milk has the sorption capacity (absorption and adsorption) of volatile substances; the term flavor means "a physical-psychological sensation of the interaction of taste and odor of a food"[15,] while *off-flavor* designates an unsuitable milk characteristic for consumption[16]. A study of 10 samples of HM donors conducted in Taiwan to verify the rancid taste of stored frozen HM. The milk was distributed in three 50 mL glass vials, one fresh sample refrigerated for less than 24 hours, one sample frozen for seven days and the last one frozen for 30 days. Lipolysis and freezing time have been found to activate the rancid taste in HM[17].

In Minas Gerais HMB, a high HM loss was observed due to inadequate donor practices. They concluded that these were mainly due to non-compliance or total or partial non-compliance with the guidelines for biosecurity of HM extraction and stock by donors. This behavior was persistent even with the prior and continued reception of guidelines[18].

In the donors' homes, the lack of attention to monitoring the temperature of refrigerators causes a favorable condition for microbiological multiplication and consequent increase in acidity[19].

It is noteworthy that the donors in the MHB / HUMAP receive sterile glass vials for the packaging of the HM and are previously oriented about the hygienic-sanitary procedures necessary for the extraction and storage of the HM, according to the rules of the National Health Surveillance Agency and the Brazilian Network of HMB[4]. Home practice tends to differ from what is oriented and most of the problems involving the quality of the HM result from domestic extraction and storage, with frequent contamination by elements of this environment[20].

In this study, the total coliform rate identified was 4.44% (31,640 mL) after pasteurization. However, in a research conducted in 2003 at the same institution, it was shown that, from a microbiological point of view, milk collected from the HMB showed a negative rate for total coliforms after pasteurization, while externally collected milk showed a positive result[21].
From the advice on appropriate utensils, temperatures and practices followed during the procedures, there is a possibility that, through continued actions, health education can reduce process losses and establish safe and reliable habits for the preservation and processing of HM[22].

4. Conclusion

The total processing loss is 97,790.00 mL (13.74%), with the higher concentration in the selection and classification phase. The causes of human milk disposal during HMB processing are Dornic acidity, followed by *Off flavor* and dirt. However, in some situations, the loss occurs due to non-compliance in more than one of these criteria.
The recommendation is the ongoing training of HMB staff to ensure quality of service. In addition to proper donor monitoring and guidance to reduce losses in the human milk bank.

5. References

[19] J.B. Pellegrine, F.F. Koopmans, H.L. Pessanha, C.G. Rufino, H.P.S. Farias, Educação Popular em Saúde: doação de leite humano em comunidade do Rio de Janeiro, Brasil. Interface, Suppl 18, no. 2, pp.1499-506, 2014

[20] Rede Brasileira de Bancos de Leite Humano. RBBLH. Doação de leite humano 2016; disponível em: < https://rblh.fiocruz.br/doacao-de-leite-humano-0>. Acesso em 10 dez. 2017.

[21] E.S. Silva, L.E. De Jesus, E.B. Santos, N.A. Castro, L.B. Fonseca. Donation of breastmilk to human milk bank: knowing the donor. Demetra, vol.10, no.4, pp.879-89, 2015.

[22] Brasil. Agência Nacional de Vigilância Sanitária. Banco de leite humano: funcionamento, prevenção e controle de riscos. Brasília: Ministério da Saúde, 2008.

[23] C.M. Silva, A.L.R. Pellegrinelli, S.C.L. Pereira, I.R. Passos, L.C. Santos. Educational practices in accordance with the "Ten steps to successful breastfeeding" in a Human Milk Bank. Ciência e Saúde Coletiva, vol.22, no.5, pp. 1661-71, 2017.

[24] L.G. Soares, E. Dolinski, L.P.B. Wagner, L.S.F. Santos, L.G. Soares, V.A. Mazza. Human Milk Collection and Utilization in a Milk Bank from a Municipality of Paraná State. Rev Fund Care Online, vol.10, no.3, pp. 656-62, 2018.

[25] K.T.C. Muller, A.I.P. Souza, J.M.F. Cardoso, D.B. Palhares. Knowledge and adhesion to donation of human milk of women who gave birth in a public hospital. Interações, vol.20, no.1, pp.315-26, 2019.

[26] L.C.E. Alencar, E.M.F. Seidl. Doação de leite humano: experiência de mulheres doadoras. Rev. Saúde pública, vol.43, no.1, pp. 70-7, 2009.

[27] C.A. Rozendo, J.B.L. Holanda, R.C.C. Santos, R.C. Valverde. Donated Breast Milk: causes of waste. Rev. Enferm. UERJ, vol.17, no.4, pp. 533-37, 2009.

[28] C.I.V. Pereira, J.F.S. Dametto, J.C.C. Oliveira. Evaluation of human milk titratable acidity before and after addition of a nutritional supplement for preterm newborns. J Pediatr (Rio J), vol.92, no.5, pp: 499-504, 2016.

[29] A. Lucas, J.A. Gibbs, R.L. Lyster, J.D. Baum. Creamatocrit: simple clinical technique for estimating fat concentration and energy value of human milk. Br med J, vol.1, no.6119, pp.1018-20, 1978.

[30] J.A.G. Almeida, F.R. Novak, V. Guimarães. Seleção e classificação do leite humano ordenhado cru. Programa Nacional de Qualidade em Bancos de Leite Humano. Brasília: Ministério da Saúde, 2011.

[31] Brasil. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. Resolução RDC nº 171, de 04 de setembro de 2006. Dispõe sobre o Regulamento Técnico para o funcionamento de Bancos de Leite Humano. Diário Oficial da União; Poder Executivo, de 05 de setembro de 2006.

[32] F.R. Novak, D.M. Cordeiro. The correlation between aerobic mesophilic microorganism counts and Dornic acidity in expressed human breastmilk. J Pediatr (Rio J), vol.83, no.1, pp.87-91, 2007.

[33] F.R. Novak, A.R. Junqueira, M.S. Dias, J.A. Almeida. Sensorial analysis of expressed human milk and its microbial load. J Pediatr (Rio J), vol.84, no.2, pp.181-4, 2008.

[34] J.A. Almeida, F.R. Novak. O leite humano: qualidade e controle. In: L.A.J. Santos, Almeida JA, Castro FS, Gomes AL, Kemp C, Machado MM, et al., organizadores. Fisiologia e patologia da lactação. Natal: Sociedade Brasileira de Mastologia, p. 31-42, 1995.

[35] H.Y. Hung, Y.Y. Hsu, P.F. Su, Y.J. Chang. Variations in the rancid-flavor compounds of human breastmilk under general frozen-storage conditions. BMC Pediatrics, vol.18, no.1, pp.18-94, 2018.

[36] J. Passarini, A.P.R. Canata, K.B.A. Zago, K.G. Tirapeli, M.M.P.M. Medrado, L.R.L.G. Costa, S.C.A. Medeiros, J. Oliveira. Taxa de descarte de leite humano e fatores relacionados. Arch Health Invest, vol.6, pp.126, 2017.

[37] S.L.F Santos, H.H.S. Alves, K.B.N.T. Barros, I.C.J. Bandeira. Contaminação na análise microbiológica de leite humano. Encontro de Extensão, Docência e Iniciação Científica (EEDIC) 12; 2017.

[38] G. Menezes, L. Lima-Cavalcante, A.M. Moraes-Oliveira, R.M. Costa-Pinto, V.O. Steffen-Abdallah. Evaluation of home collection performed by a human milk bank in a university hospital in Brazil. Salud pública de Mex, vol.56, no.3, pp.245-50, 2014.

[39] E. Kamiya, M.I.L. Ramos. Avaliação microbiológica e calórica do leite humano coletado e distribuído no banco de leite humano do Hospital Universitário/NHU/UFMS. Hig Alim, vol.17, no.109, pp.64-8, 2003.

[40] M.G.R. Reiter, C.K. Souza; J.L. Costa, M. Bramorski. Pesquisa de sujidades e fatores de descarte de leite humano coletado e doado ao banco de leite humano de Blumenau – SC. International Journal of Nutrology, vol.11, no.01, 2018

Four-point bending mechanical behavior of aged asphalt mixtures containing charcoal

Alemar Pereira Torres
prof.alemar@gmail.com
Grupo de Geotecnia, Universidade Federal do Amazonas – UFAM - Brasil

Igor Nonato Almeida Pereira
igornonato2010@hotmail.com
Grupo de Geotecnia, Universidade Federal do Amazonas – UFAM – Brasil

Juliano Rodrigues Spínola
julianospinola10@gmail.com
Grupo de Geotecnia, Universidade Federal do Amazonas – UFAM – Brasil

Alex Gomes Pereira
alexgp88@hotmail.com
Grupo de Geotecnia, Universidade Federal do Amazonas – UFAM – Brasil

Consuelo Alves da Frota
cafrota@ufam.edu.br
Grupo de Geotecnia, Universidade Federal do Amazonas – UFAM - Brasil

Abstract

The asphalt coating is the layer responsible for resisting the traffic stresses of a highway. However, the search for new materials to mitigate environmental impacts and improve pavement quality is increasing. Thus, the mechanical behavior of asphalt mixtures was analyzed through the four-point bending test after the molding process and aged, with the participation of residues in the form of charcoal. The frequencies of 1Hz, 3Hz, 5Hz, 10Hz, 20Hz and 1Hz are considered at temperatures of 25°C and 40°C. The aging process contributed to improve the mechanical characteristics of the charcoal mixture at a temperature of 25 ° C, considering that there was an increase in stiffness at frequencies from 1 to 20 Hz, as well as a reduction in phase angle at frequencies of 3 Hz. , 5 Hz, 10 Hz and 20 Hz.

Key words: asphalt mixtures; charcoal; four-point bending;

1. Introduction

The covering of a floor directly receives the efforts from traffic, and it is intended to provide comfort and safety to users (GENTY et al, 2011). Among the materials used for the execution of this layer are:

interlocking floors, bricks, reinforced concrete and bituminous mixtures. Among the hot bituminous asphalt compositions, the Asphalt Concrete (AC) stands out. It can be defined as a suitable mixture of petroleum asphalt cement (PAC), filler, and fine and coarse aggregates. In this composition, aggregates account for approximately 94% to 96% of the weight of the mixture while the binder participates in the formulation with a percentage of about 4% to 6% by weight (GAO, 2014). Considering that asphalt cement is a viscoelastic material, it is affected by small changes in temperature and loading rates (KING, 2004). In this sense, the study of the phase angle and the dynamic modulus becomes important in order to analyze the mechanical behavior of asphalt mixtures, such as the four-point flexural test. The mentioned essay studies a prismatic beam containing four support points (QUITERO, 2016). It is noteworthy that two points are at the extremes and two points are located in the internal region of the beam, being used for the load application. Thus, the bending moment originated in the central third of the beam is constant, conditions to this stretch a state of uniform stress and without shear forces characterizing the pure bending (MARÉ, 2011). It is noteworthy that the aging of such asphalt compositions significantly affects pavement performance (PAN, 2018). In such process a series of chemical reactions occur, like oxidation and volatilization, as well as the influence of external factors such as temperature and oxygen that contribute to the reduction of the coating quality (XIAO-GE, 2015). The present work analyzed the phase angle and complex modulus, as in the studies by King (2004) and Pellinen et al. (2003), according to the four-point bending test of beams containing asphalt mixtures with charcoal shortly after molding and aged for 1 year.

2. Sample Materials and Preparation

The following materials of granite origin were asphalt mixtures: gravel 0 (4.8 mm to 9.5 mm), gravel 1 (9.5 mm to 19 mm) and stone dust (less than 4.8 mm). Also included in the compositions there were sand (fine aggregate), with grains ranging from 0.6 to 2.4mm, and petroleum asphalt cement (PAC).

2.1 Charcoal

The charcoal used in the asphalt formulations came from coal kilns. This material originates from the burning (with temperatures ranging from 300 to 400 ° C) of residues of native Amazonian plant species, such as imbaúba, pau de lacre and others (Figure 1). It was ground by means of a hand grinder, and then passed through a 2mm aperture sieve.

Figure 1. Charcoal

2.2 Dosage

Asphalt mixtures of the asphalt concrete (AC) type of reference and alternative additive with charcoal were obtained, obeying the proportions presented in Table 1.

Table 1: Studied compositions, AC e ACCV.

Asphalt Coating Composites							
Sample	Gravel 0	Gravel 1	Grit	Medium sand	CAP 50/70	Alternative material	Charcoal content
AC	28,2%	14,8%	28,2%	23,8%	5%	-	-
ACCV	28,2%	14,8%	28,2%	23,8%	5%	Carvão	3%

Prismatic beam-shaped specimens were made in a specific, robust and demountable metal mold. In the molding of the CP's a Bovenau P3000 hand hydraulic press was used, with a capacity of 30 tons. The samples were compressed to the preset height according to the compaction test parameters. After the specimens were made, the mechanical behavior was determined by the four-point bending test immediately after molding and after one year of their manufacture (aged beams) at two different temperatures (25°C and 40°C).

3. Test method

The asphalt mixtures made in the shape of beams and tested in the IPC Four Point Bending Apparatus (Figure 2) were subjected to two central loads of the same intensity. Thus, considering that the PC is supported at its ends, the equipment submits the beam to a flexion at 04 points, that is, a structural system in which the central section of the PC presents pure flexion. Therefore, no shear stresses occur.

Figure 2: four point bending test equipment.

It is noteworthy that the IPC Global equipment consists of a pneumatic system for the application of loads, it has transducers for data acquisition and a computer personal unit (CPU) that allow the total control of

the experiment by users and the recording of data acquired. The beam is seated on supports that allow free rotation and horizontal displacement, but restrict the vertical movement of the specimen. The frequencies of 1Hz, 3Hz, 5Hz, 10Hz, 20Hz and 1Hz, temperatures of 25 ° C and 40C, maximum strain amplitude of 50 μm / m and one cycle with 100 repetitions for each frequency analyzed were considered. It is noteworthy that through the four-point bending test it is possible to analyze the mechanical behavior of the structure by studying the phase angle and the complex modulus (stiffness modulus). This gives the possibility of obtaining the behavior of the asphalt compositions in terms of elasticity and viscosity. In determining such parameters, stiffness can be defined as an intrinsic property of asphalt concrete, related to the slope of the stress strain curve (MARÉ, 2011), which depends on a number of factors that influence the achievement of these results such as loading rate, temperature and age of the concrete. sample (PAN, 2018). The four-point bending system consists of a prismatic beam containing four support points, with two points at the extremes and two points located in the inner region of the beam and used for load application. Thus, the bending moment originated in the central third of the beam is constant, which conditions to this stretch a state of uniform stress and without shear forces characterizing the pure bending, as it can be observed in Figure 3.

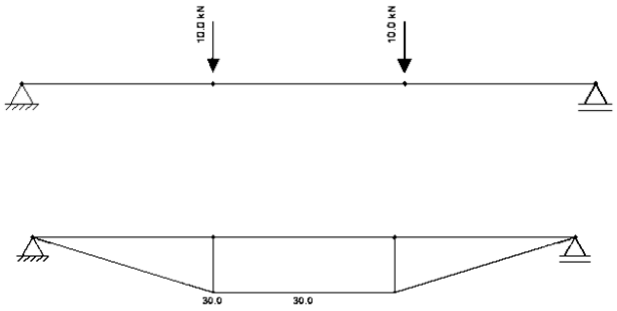


Figure 3: Isostatic beam subjected to pure bending.

Thus, by subjecting in this system a specimen to load pulses, the response they produce in terms of deformation is analyzed. Therefore, the stresses and equivalent deformations are sinusoidal, and the distance between the sinusoid peaks corresponds to the period of the wave motion. It is noteworthy that in the four-point flexion test to be performed, we seek to simulate sections of pavements subjected to vehicle movement. Then, the beam is subjected to load pulses at a certain frequency that produce deformations, as shown in Figure 4. Considering that the loads are applied at different frequencies, both the stresses and the resulting deformations have sinusoidal behavior. parameters ϵ_0, σ_0, δ, ie strain amplitude, stress amplitude and phase angle (amplitude from 0 ° to 90 °), respectively.

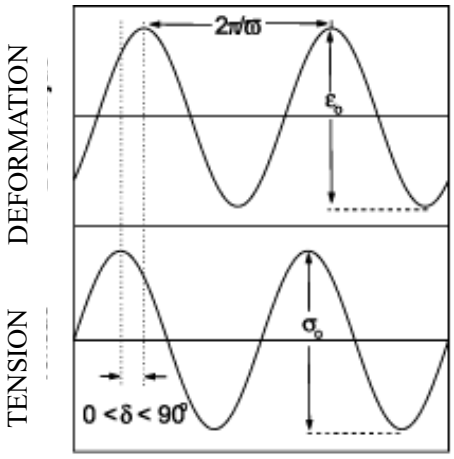


Figure 4: Answer example: stress pulse and its deformation.

Evaluating that asphalt mixtures have viscous characteristics, the parameter called phase angle is responsible for measuring the elasticity or viscosity of the material, considering the gap between the peaks of the stress and strain sinusoidal graphs (LYTTON, 2000). So, when the value of this parameter is closer to 90º, the material has viscous characteristics and it is therefore called Newtonian. If the phase angle value is close to 0 °, the material has elastic characteristics, in this case, it is called hookeno. Thus, period (T) is defined as the distance between the sinusoid peaks, which can be calculated by considering Equations 1, 2 and 3.

$$\omega = 2\pi f \tag{1}$$

$$T = \frac{1}{f} \tag{2}$$

$$T = \frac{2\pi}{\omega} \tag{3}$$

According to Otto (2009), the mathematical equations related to the applied stress and the equivalent strain are derived from the study of Simple Harmonic Motion (SHM) and can be expressed respectively by equations 4 and 5. Thus, when subjected to a stress σ (t) the material, due to its viscoelastic characteristic, responds as a lagged deformation ϵ (t) δ:

$$\sigma\,(t) = \sigma_0.sen(\omega t) = Im\,(\sigma^*) \rightarrow \sigma^* = \sigma_0 e^{i\omega t} \tag{4}$$

$$\epsilon\,(t) = \epsilon_0.sen(\omega t + \delta) = Im\,(\epsilon^*) \rightarrow \epsilon^* = \varepsilon_0 e^{i(\omega t - \delta)} \tag{5}$$

Where:

σ_0 = tension amplitude;

ϵ_0 = deformation amplitude;

ω = pulsation (rad/s);

δ = phase angle;

t = time;

$i = \sqrt{-1}$

In this context, the δ lag makes it possible to analyze the viscous character of the material. If δ = 0, the material is considered elastic. According to Quintero (2016), the relationship between stresses and complex deformations is defined as a complex module, according to Equation 6.

$$E^*(t) = \frac{\sigma^*}{\varepsilon^*} \quad (6)$$

Where:

E^*= stiffnnes modulus;

σ^*=complex tension sinusoidal;

ε^*= complex amplitude of deformation sinusoidal;

Thus, the complex module can be represented by a real and an imaginary part, being physically interpreted as the vector sum between the elastic component (real part) and the viscous component (imaginary part) of the module. Then, from Equation 6, it is possible to describe the viscoelastic behavior in the frequency domain of asphalt mixtures, according to Equation 7, 8 and 9.

$$E^*(t) = \frac{\sigma_0}{\epsilon_o} e^{i\varphi} = \frac{\sigma_0}{\epsilon_0}(cos\varphi + isen\varphi) = E' + iE'' \quad (7)$$

$$E' = \frac{\sigma_0}{\epsilon_0} . cos\delta \quad (8)$$

$$E'' = \frac{\sigma_0}{\epsilon_0} . sen\delta \quad (9)$$

It is noteworthy that the value inherent to the plot E′ represents the elastic portion of the material being called storage modulus or elastic modulus. The value relative to E "corresponds to the portion inherent in the viscous portion of the material being called loss modulus or viscous modulus. Thus, considering that Equation 7 represents a complex number, it can also be represented graphically, as observed. See Figure 5.

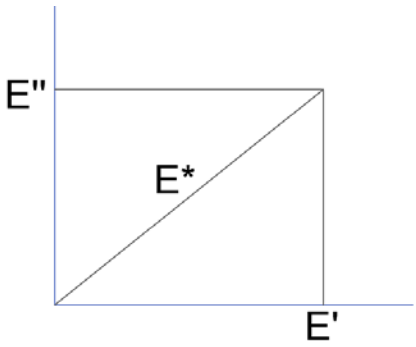


Figure 5: Graphical representation of the complex module.

Therefore, it is noted that the phase angle can be calculated by the tangent of the angle formed between the elastic portion (E′) and the viscous part of the material (E ") resulting in Equation 10. In addition, the

complex module can be calculated by Equation 11 as the square root of the sum of the squares of the elastic and viscous part of the material.

$$tg\delta = \frac{E^{"}}{E^{'}} \quad (10)$$

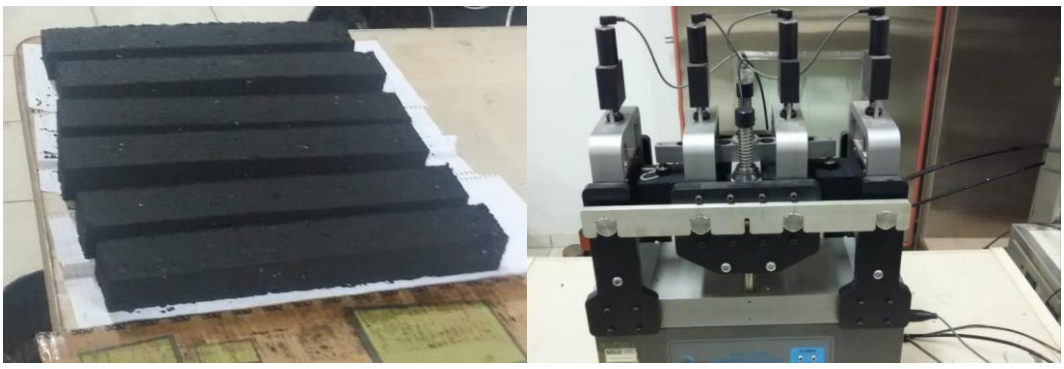
$$|E^{*}| = \sqrt{E_1^2 + E_2^2} \quad (11)$$

4. Discussion of results

AC beams were molded according to two designs, the reference composition and alternative mixture with the participation of charcoal (ACCV), according to the contents informed in Table 2. It is worth remembering that such formulations were tested in two steps, soon after molding and after one year of manufacture (aged beams). The first, at the temperature normally used in articles (Kok, 2012) and (Lytton, 2000) equal to 25 ° C, and the second, at a temperature around 40 ° C, representative of field conditions. Figure 6 shows the asphalt concrete beams, before and after positioning in the equipment, to perform the flexion experiment. The visco-elastic behavior of the studied AC beams, before and after the aging process, can be verified in Figures 7 to 10. The non-alignment of the graphs referring to the peaks force x time and displacement x time is observed. The viscous influence of petroleum asphalt cement is outlined.

Table 2: Asphalt concrete specimens for 4-point bending test

COMPOSITION	SAMPLE	TYPE OF ASPHALTIC MIXTURE	ALTERNATIVE MATERIAL	CONTENT	TEMPERATURE
ASPHALTIC MIXTURES	AC	Asphalt concrete	--	--	25 °C / 40 °C
	ACCV	Asphalt concrete	CHARCOAL	3%	25 °C / 40 °C



(a) (b)

Figure 6: Asphalt concrete beams: (a) before test. (b) positioned on the flexion equipment at 4 points.

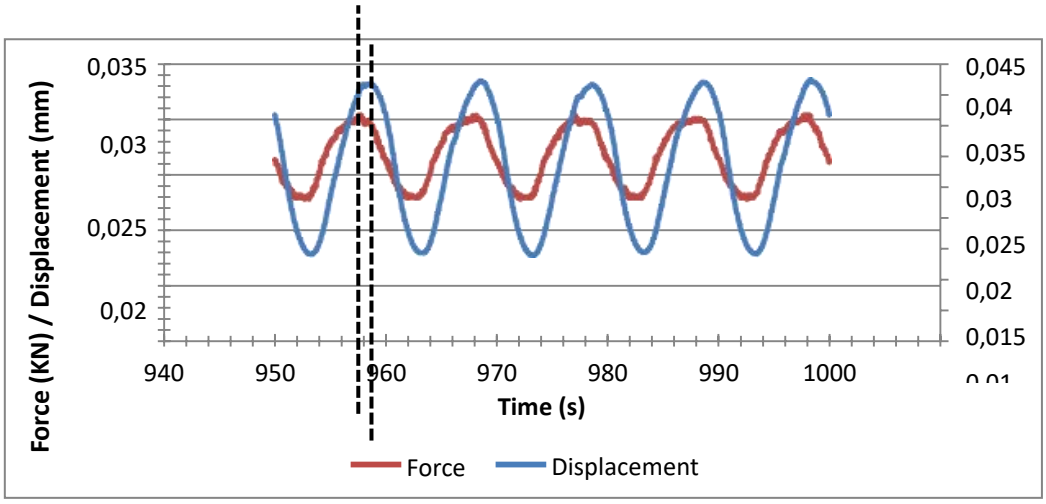


Figure 7: Force and displacement for non-aged AC beams.

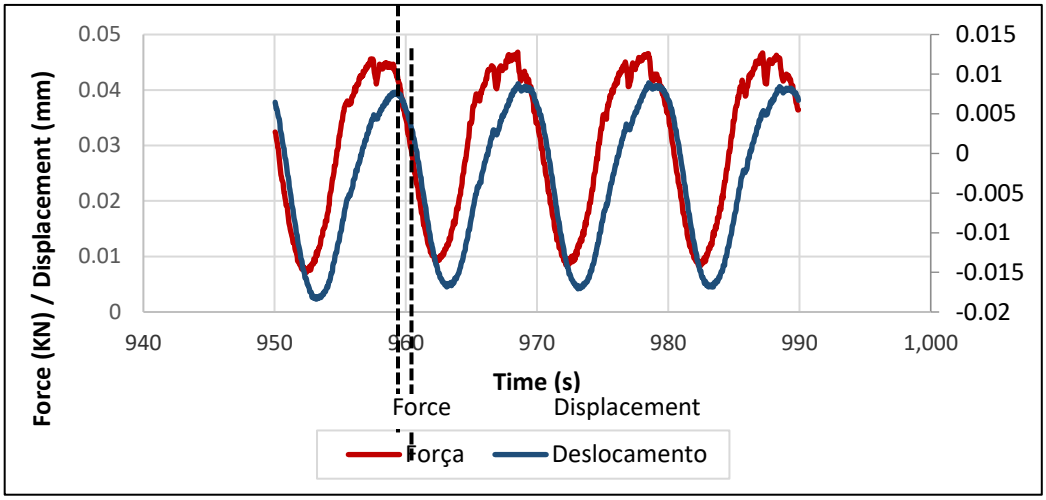


Figure 8: Force and Displacement for Aged AC Beams.

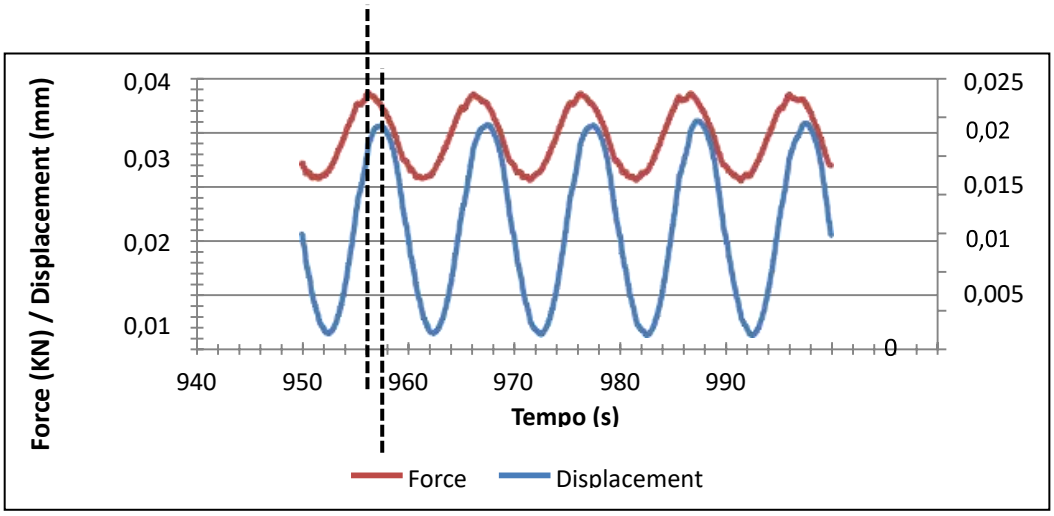


Figure 9: Force and displacement for non-aged ACCV beams.

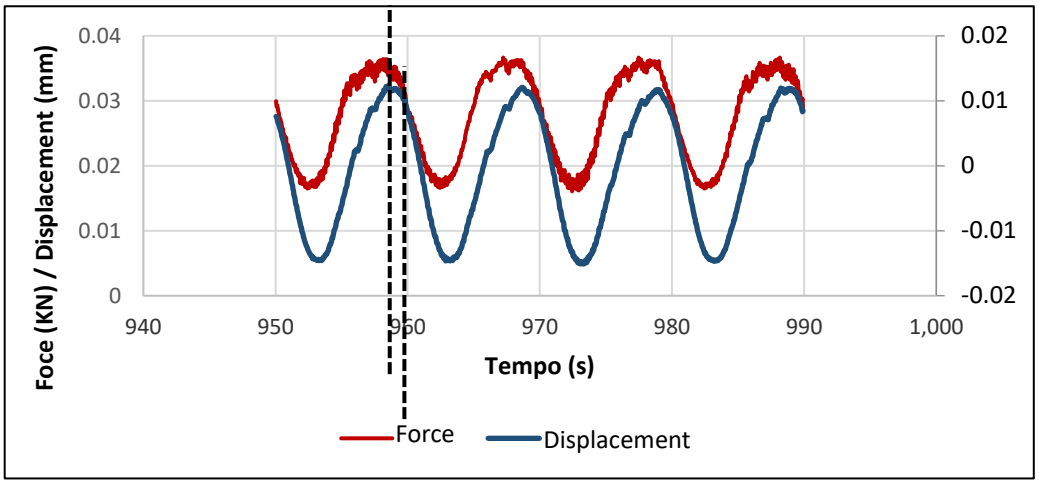


Figure 10: Force and displacement for aged ACCV beams.

Considering the results of the reference beams (without and with aging) shown, the force sine showed maximum peaks of the order of 0.03 kN and 0.045 kN, respectively. Regarding the displacement sinusoid, the resulting values were equal to 0.04 mm and 0.009 mm, respectively. Considering the non-aged and aged beams containing charcoal (ACCV), the sinusoid graphs presented maximum peaks close to 0.036kN. Concerning the displacement sine, the values resulted in 0.02mm and 0.014mm for the aged and non-aged beams, respectively. Concerning the average phase angles for the non-aged and aged beams, these are shown, for each frequency range and at temperatures of 25 ° C and 40 ° C, in Figures 11 and 12. In the non-aged asphalt concrete (AC) beams At 25 ° C, the highest phase angles were recorded for the lowest frequencies (1Hz, 3Hz and 5Hz). Similar behavior was obtained by Xiao-ge (2015). However, in the case of aging beams the highest phase angles occur at the highest frequencies (10 Hz and 20 Hz). Regarding the non-aged ACCV composite and at 25 ° C, compared to the aged ACCV composite at the same temperature, a larger phase angle was noted only at the frequency of 1 Hz, approximately 7.89%. In the other frequencies there was a reduction according to the following percentages: 35.71%, 62.50%, 66.67% and 50% for the partial frequencies of 3Hz, 5Hz, 10Hz and 20Hz.

After raising the test temperature to 40 °C, it was noted that the phase angles for the aged AC mixtures increased compared to the non-aged mixtures. It is noteworthy that the difference is of the order of 16.67%, 63.15%, 78.37%, 84.21% and 85.71% for frequencies from 1 to 20 Hz, respectively. Regarding aged, compared to non-aged ACCV composites, this parameter decreased at 1 Hz frequency (23.68%). In addition, there is a percentage increase of 73.33%, 76.67%, 87.09% and 95.12% in the frequencies of 3 Hz, 5 Hz, 10 Hz and 20 Hz, respectively.

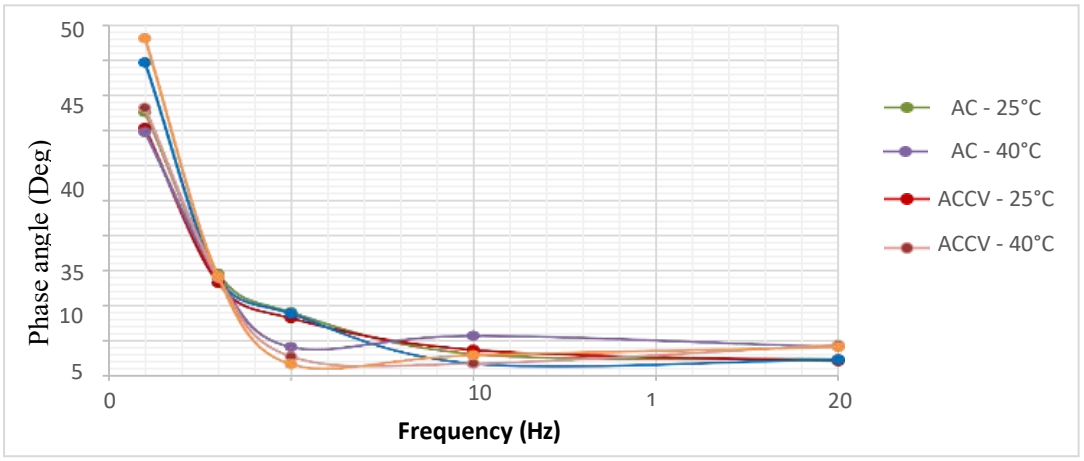


Figure 11: Phase angle of AC and ACCV asphalt concrete beams before aging.

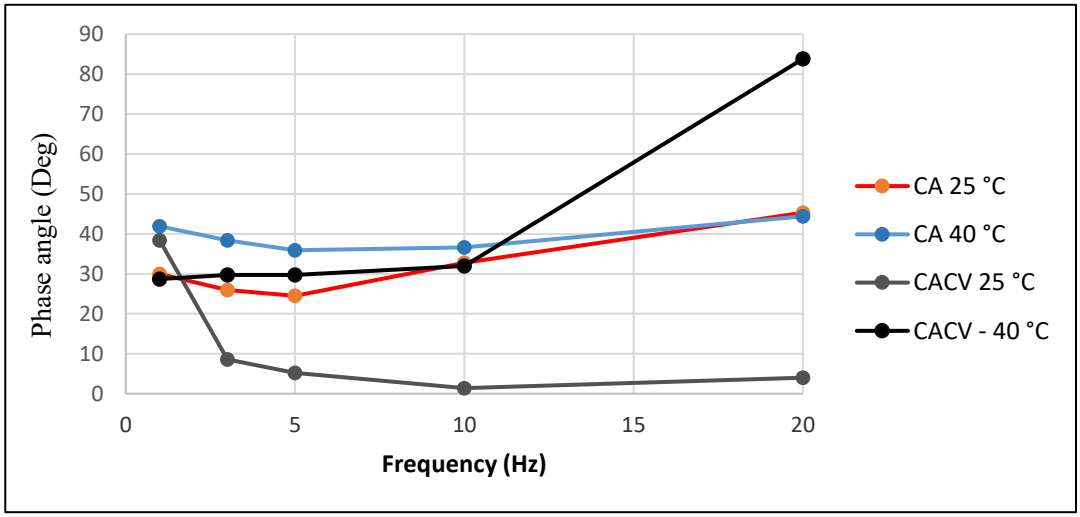


Figure 12: Phase angle of AC and ACCV asphalt concrete beams after aging.

Concerning the complex modulus, for asphalt mixtures, the average results for the non-aged and aged beams are shown in the graphs of Figures 13 and 14. It can be observed at the temperature of 25°C and from the stiffness point of view whether found that aged AC was more advantageous when compared to aged AC, with an increase of 56.67%, 55.66%, 54.82%, 50.91% and 47.81% for the test frequencies of 1 to 20Hz. In turn, aged ACCV showed an increase of stiffness in the order of 23.30%, 10.61%, 12.62%, 10.09% and 8.21% compared to the non-aged ACCV. These conclusions were also obtained by Young (2014) when studying asphalt mixtures. Specific to the 04 point bending test at 40 ° C, it was noted that the values of the modulus of stiffness for the aged beams without additives are higher than those coming from the non-aged beams in the order of 38.71%, 51, 17%, 61.87%, 62.34% and 56.70%, with reference to frequencies from 1 to 20Hz. However, it is found that ACCV composites at this temperature have the most advantageous results with respect to non-aged formulations. Results for the 1Hz, 3Hz and 5Hz frequencies will show a respective percentage change of 10.53%, 16.00% and 22.22%. However, there was a decrease in stiffness in the 10 Hz and 20 Hz partials, 19.35% and 25.45%. In general, the CA and ACCV asphalt

mixtures recorded the values of the complex modulus progressively by increasing the test frequencies, as shown in Figures 13 and 14.

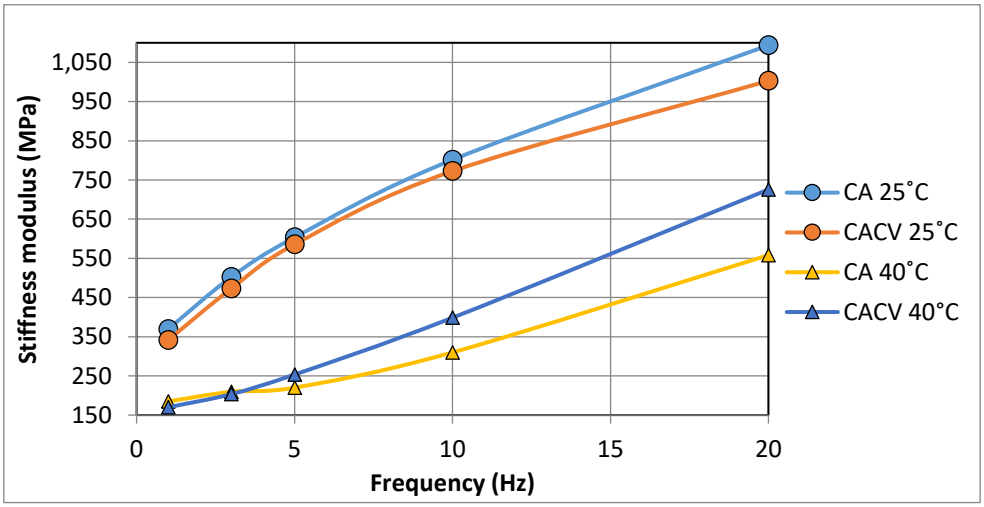


Figure 13: Complex modulus x frequency of non-aged AC and ACCV asphalt mixtures.

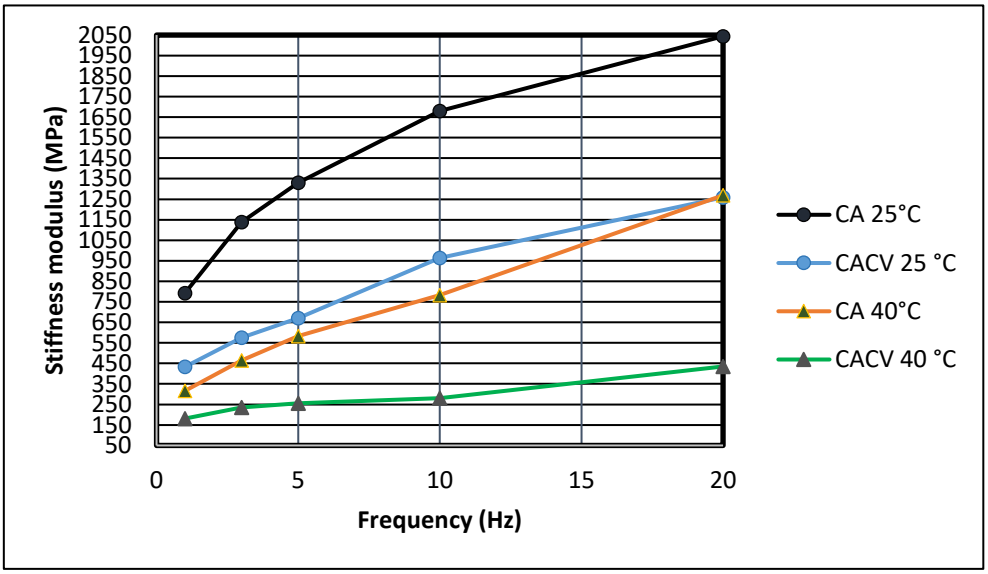


Figure 14: Complex modulus x frequency of aged AC and ACCV asphalt mixtures.

5. Conclusions

Charcoal was used as a participant in non-aged and aged composites intended for the asphalt floor covering layer. Regarding the phase angle, for the compositions without the presence of this alternative material, it was observed that in the most usual and studied temperature in the literature (25 ° C) there was an increase in their values when there is the aging of the beams, especially considering the frequencies. 10 Hz and 20 Hz. Regarding the mixtures containing charcoal, it was found that aging resulted in the reduction of the phase angle value for the frequencies of 3 Hz, 5 Hz, 10 Hz and 20 Hz. However, increasing the temperature to 40 ° C , this parameter for the aged mixtures, both AC and ACCV, increased with a maximum value in the frequency of 20 Hz of the order of 85.71% and 95.12%, respectively. Regarding the stiffness of the beams made of asphalt concrete, it was noted that for the temperature of the order of 25 ° C the aged mixture, with and without additive, provided superior complex modulus to the non-aged beams. For the

AC composition the largest percentage difference occurred at the lower frequencies of 1 Hz (56.67%) and 3 Hz (55.66%), while for the ACCV the percentage difference is higher in the 1 Hz (23 Hz) pair. , 30%,) and 3 Hz (12.62%). Considering the temperature of the order of 40 ° C, it was found that the aged AC presented greater rigidity than the non-aged formulation, with greater difference in the frequency of 10 Hz (62.34%). Regarding the ACCV composite and at this temperature, the stiffness showed an increase of 10.53%, 16.00% and 22.22% in the 1 Hz, 3 Hz and 5 Hz frequencies, respectively, but showed a reduction in the 10 Hz frequencies. and 20 Hz. From the above, the aging process contributed to improve the mechanical characteristics of the ACCV mixture at room temperature (25 ° C), considering that the phase angle reduction and stiffness increase occurred. However, at 40 ° C, the composition with the participation of charcoal showed an increase in phase angle and a reduction in stiffness, especially considering the higher frequencies (10 Hz and 20 Hz).

6. References

[1] BASTOS, W. de L. Mariano Procópio Ferreira Lage – Sua Vida, Sua Obra, Descencência, Genealogia. 2.ed., Juiz de Fora: Edições Paraibuna, 1991.p. 23 e 24.

[2] CNT – CONFEDERAÇÃO NACIONAL DO TRANSPORTE. Pesquisa CNT de Rodovias. Brasil, 2018. Available in: < http://pesquisarodovias.cnt.org.br>. Accessed in August 20, 2019.

[3] GARBER, N. J.; HOEL, L. A. Traffic and highway engineering. Cengage Leaning, USA, 2014.

[4] GAO, Y., Huang, X. & Yu, W. J. Wuhan Univ. Technol.-Mat. Sci. Edit. (2014) 29: 956. https://doi.org/10.1007/s11595-014-1027-z

[5] GENDY, A.E at all. Stereo-vision applications to reconstruct the 3D texture of pavement suface. Internacional Journal of Pavement Engineering, 263 – 273, USA, 2011. DOI: 10.1080/10298436.2010.546858

[6] HUANG, Y H. Pavement analysis and design. Englewood Cliffs, N.J.: Prentice Hall, 1993, 805p.

[7] KOK, B.V et al. Evaluation of the mechanical properties of natural asphalt-modified hot mixture. Carl Harser Verlag, Munich, Germany, 2012.

[8] KING, M. H. “Determination of Dynamic Moduli in Uniaxial Compression for North Caroline Hot Mix Asphalt Concrete.” Master Thesis, North Carolina State University, Raleigh, NC, 2004

[9] LYTTON, R. L. Characterizing asphalt pavements for performance. “Transportation Research Record: Journal of the Transportation Research Board, 1723.1 (2000): 5 – 16.

[10] MARÈ, F. L. História das infra-estruturas rodoviárias. 2011. Dissertação (Mestrado em Engenharia Civil), Universidade do Porto, Porto.

[11] OTTO, G. G. Misturas Asfálticas Mornas – Verificação da Fadiga e do Módulo Complexo. Dissertação apresentada ao programa de pós-graduação da Universidade Federal de Santa Catarina, 2009. Available in: https://core.ac.uk/download/pdf/30374352.pdf. Accessed in October 16, 2019.

[12] PAN, P. at all. A Comprehensive Evaluation of Rejuvenator on Mechanical Properties, Durability and Dynamic Characteristics of Artificially Aged Asphalt Mixture. Mateials (Basel), 2018. DOI: 10.3390/ma11091554

[13] PELLINEN, T., & CROCKFORD, B. (2003). Comparison of analysis techniques to obtain modulus and phase angle from sinusoidal test data. In Sixth International RILEM Symposium on Performance Testing and Evaluation of Bituminous Materials (pp. 301-307). RILEM Publications SARL

[14] QUINTERO, C. F. Q. Influência da Temperatura e da Consistência do Ligante na Fadiga e no Módulo Complexo de Misturas Asfálticas. Tese apresentada ao Programa de Pós-Graduação em Engenharia Civil da Universidade Federal de Santa Catarina, 2016.

[15] SILVA, A.C.L. Comportamento mecânico de compósitos asfálticos com argila calcinada sob flexão a quatro pontos. Dissertação apresentada ao Programa de Pós-Graduação em Engenharia de Recursos da Amazônia da Universidade Federal do Amazonas. Manaus, 2014.

[16] XIAO-GE, TIAN, LIAN-JU, LIU. Relaxation Modulus Modelo of Aged Asphalt Mixture. Journal of Highway and Transportation Research and Development. Vol. 9, N. 3, 2015.

[17] YOUNG, X. Mechanical performance of asphalt mixtures modified by bio-oils derived from waste wood resources. Construction and Building Materials; 2014.

Feasibility Study on the Use of Cold Premixed Asphalt in Coari - AM

Gessica de Castro Mendes
gessicacastromendes@gmail.com
Centro Universitário FAMETRO - Brasil

Lucas Barbosa de Castro Delgado
lbcdelgado@bol.com.br
Centro Universitário FAMETRO - Brasil

Igor Bezerra de Lima
igorblima@hotmail.com
Departamento de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmailcom
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

As road transport is the predominant type of transport for the traffic of people, vehicles and cargo, it is extremely important to ensure the quality of the country's road pavement. Good pavement ensures comfort, safety and economy to road users. There are several types of coatings to be used depending on the project, the traffic demand of the road to be paved and others. Thus, the main objective of this research is to show the feasibility of using cold premixed asphalt in the city of Coari, municipality of the interior of Amazonas. For this, an investigation was conducted in bibliographies, in order to support the study. A budget based on DNIT unit cost compositions was made to compare the costs required to apply this asphalt mix with hot-machined concrete, as this is the most commonly used for pavement construction. Checking the advantages and disadvantages of its use to evaluate its application in the municipality in question. As the cold premix showed to meet most of the requirements for good paving, having a better cost-benefit ratio, it was found that it can be used on low and medium traffic roads, bringing several positive aspects in operational issues. and economical.

Keywords: Paving; Asphalt coatings; Cold premixed;

1. Introduction

Road transport is responsible for most of the production flow of Brazilian industries, making it necessary to invest in infrastructure, redefine priorities and implement measures to provide safety to highway users, focusing on quality pavements to resist this traffic characteristic [1] [2]. Because poor quality or defective

pavements damage vehicles and increase fuel consumption and travel time, making operating costs more expensive, influencing the price of products that reach the consumer and compromise the country's competitiveness in the international market [3].

Thus, it is essential to look for ways to reduce the costs required for paving, either in the choice of coating or in the application means. In this sense, cold premixed asphalt coating has been growing as an alternative to low cost, good quality paving that is not environmentally friendly and offers operational advantages over other types of coating. Therefore, this research aims to study the feasibility of using this coating in the city of Coari, evaluating its characteristics, benefits presented by its application and costs compared to the use of hot-machined concrete, which is more common.

2 Theoretical Foundation

2.1 Paving

For [4], paving, as a fundamental principle in the evolution of transport, arose from the need for displacements to be possible at any time of the year, making it necessary to stabilize the roadbed. [2] corroborates this idea by stating that the difficulty of transporting cargo and people by natural roads made paving the roads necessary.

A better bearing track, according to [2], brings users a significant reduction in operating costs, as operating and maintenance costs are directly related to the surface conditions of the pavements. The precariousness of the road infrastructure has an impact on the country's productive capacity, since it influences product costs, which affects the Brazilian economic situation, highlighting the need for more urgent investments that should improve the road situation [5] [6].

2.1.1 Floorings

The Federation of Industries of the State of São Paulo [7] defines pavement as a system or structure of finite thickness and specific material, built to withstand the stresses of vehicle traffic and weather, providing users with better conditions. bearing with comfort, economy and safety.

The function of this system is to receive the traffic efforts and to transmit them to the lower layers moderately, since they usually have less resistance. In this way, the loads are passed in attenuated way to prevent deformations or ruptures in the pavement that affect the use of the road. A typical cross section of the pavement consists of: subgrade, subgrade reinforcement, subfloor, base [8].

According to [4] and [8], there are two traditional classifications for pavement: rigid and flexible, in which they are normally used in their composition, concrete and asphalt material, respectively.

Rigid floors are those that have a layer of hardness much higher than that of the lower layers, are poorly deformable and almost completely absorb the stresses from the traffic flow. Flexible pavements, as they are composed of several layers, deform to a certain extent and do not break, are normally sized and compressive flexural traction, which lead the structure to permanent deformations and fatigue rupture [9] [4].

2.1.2 Coatings

Being the last layer of the pavement structure and in which the vehicles travel, the coating receives directly the actions of the traffic, it is intended to improve the rolling surface in terms of comfort and safety, and must resist the loads caused by traffic and traffic. weathering to increase the durability of the structure [1] [4].

The thickness of the coating is directly related to the quality of the subgrade, as it depends on its resistance to be thicker or not. Because it needs to be of good quality and strength to ensure good rolling on the track, the material required for the coating is the most costly structure [10].

The asphalt coating is the most used in the Brazilian paved road network. The material employed therein is composed of a mixture of aggregates and asphalt binder. As such a commonly used coating, asphalt is one of the main raw materials used in the construction and maintenance of roads and highways [1]. Its intense use is because it provides strong aggregate joining, is waterproofing, durable and resistant to the action of most acids, alkalis and salts, and can be used heated or emulsified, in broad combinations of mineral skeleton, with or without additives [11].

Asphalt for paving in Brazil, according to [7] has four forms of production and commercialization: petroleum asphalt cement - CAP, diluted petroleum asphalt - ADP, asphalt emulsions - EA and modified asphalt.

For a certain asphalt to be considered suitable for paving, simple measures of the physical characteristics of the binder are used, for its ease of execution in the laboratories. There are two main characteristics that are used, namely: “hardness”, which is measured by penetrating a standard needle into the binder sample, and flow resistance, measured by viscosity tests. Over the years, other criteria have been added to indirectly assess future binder performance in paving works [11].

2.2 Pre-Mixed Cold Asphalt

Cold premixed asphalt, according to the Paraná State Department of Roads - DER / PR [12] p.05, “is the asphalt mixture performed at room temperature, in an appropriate plant, composed of mineral aggregates and emulsion. asphalt, cold spread and compacted ”.

The origin of cold premixed asphalt, or simply PMF, was in the United States around 1950, using open grading on bases and coatings. This technique arrived in Brazil from 1966 only in regularization layers and bases and only in 1980 began the use of PMFs in the form of dense graduation in thin coatings [13].

According to Cerentini [14] and DER / PR [12], the PMF can be divided into the following categories:

a) Open - PMFA: has a large volume of voids, greater than 20%, in its structure, and has open grain size;

b) Semi-Dense - PMFSD: presents little graded grain size and void volume ranging from 10 to 20%;

c) Dense - PMFD: has a low void volume, less than 10%, and a well graded particle size.

According to ABEDA [13], open-type PMF as an asphalt coating has the advantage of high roughness, allowing for high tire-pavement grip quality, increasing skid safety. As an intermediate or transitional layer it can serve as a bond, joining its resilient modulus of the asphalt concrete bearing layer with the underlying granular layer of less strength. It is an excellent solution for medium and light traffic lanes because of the ease of production, storage, transportation, application and handling in the field. In addition, having a longer storage period than dense PMF allows flexibility in service scheduling and immediate release of the

executed layer to traffic, thus allowing the construction of the work in stages.

The dense and semi-dense PMF, as an asphalt coating, presents a great structural and functional behavior for medium traffic volume roads, having a good mechanical and safety performance and rolling surface comfort. Dense PMF has a storage period of up to 7 days and work should only be conducted when ambient conditions are appropriate, ie with ambient temperature above 10 ° C and stable weather without rain [13].

2.2.1 Components of Cold Premixed Asphalt

The constituent materials of the cold premix are mineral aggregate, filler and asphalt emulsion, which must follow the standards prescribed by [11]. The main characteristics of these are indicated by [13] as follows, shown in Figure 1:

AGGREGATE BIG	They are stone materials (crushed rock, crushed slag, crushed or uncrushed gravel), durable free of clods, harmful substances and good adhesion to asphalt binders.
AGGREGATE SMALL	Stone dust, washed river sand (except pit sand) or a mixture of both, provided that it is of adequate shape and strength and does not contain clods of clay and other impurities. The maximum amount of sand allowed is 20% of the total aggregate to be confirmed in the project.
FILLING MATERIAL (FILER)	Portland cement, hydrated lime or limestone powder are mineral materials of known particle size and free from clays or other impurities. Portland cement and hydrated lime, as well as composing the particle size curve, improve the cohesion and workability of the asphalt mass assisting the emulsion rupture and curing processes: while limestone powder acts only in the particle size.

Figure 1: Constituent materials.
Source: [13].

Due to the importance in the composition of the PMF, the choice of aggregate should be judicious, and its performance should be known through the analysis of its properties and behavior when used in an asphalt mixture [15]. Another important component of PMF is the asphalt emulsion, which works as an alternative to PAC and is defined by [11] as a stable dispersion between asphalt and water.

To maintain emulsion stability, this mixture requires an auxiliary product called an emulsifying agent, which allows the asphalt globules to remain suspended in water for a certain period of time [11]. For this to occur, emulsifiers have a polar part that has affinity for asphalt hydrocarbons and an apolar part with affinity for water molecules. In general, asphalt emulsions consist of 30% to 50% water, 50% to 70% asphalt cement and the amount of emulsifier used in this mixture does not exceed 2.5% [16].

Asphalt globules are obtained by a colloid mill specially prepared to break down the asphalt [13]. This breakage or rupture occurs when the asphalt globules, dispersed in water, come into contact with the surface of mineral aggregates in a bituminous mixture, undergoing ionization by these aggregates, resulting in the formation of a water-insoluble compound that precipitates. on this surface. Some of the water is absorbed by the aggregate and some is lost by evaporation. The aggregate is covered with a water-repellent grease film and fixes the binder to the aggregate, thus asserting its binding properties [17].

The choice of type and concentration of emulsifying agent end up conferring electric charges, positive or negative and in some cases do not confer ionicity to the asphalt globules, making it possible to classify

them according to their particle charge, being known as anionic for the particles. negatively charged or cationic for positively charged [13] [11]. Cationic emulsion is the most used in paving because it usually meets the conditions required for numerous phases of services economically [17].

EAs are also classified according to the breakthrough time and the asphalt content contained in their composition [18], specifies that for open and medium break premixtures, emulsions of types RM-1C and RM-1 will be used. 2C differentiated by the degree of asphalt content. For dense or semi-dense, the slow break type RL-1C is applied, according to what is specified in the project.

2.2.2 Executive Process

In the process of building a PMF layer, the dosage should be accompanied by the general specifications of the paving project, and the pavement construction services should be subdivided into four categories: mixing, conveying, spreading and compacting [15].

Mixing aggregates with emulsion should be processed in specific equipment such as concrete mixers or plants, fixed or mobile, and it is advisable to use a plant with 3 silos because it is usual to use 3 types of materials such as gravel, gravel and sand [15].

The fixed plants are the same used in the production of mixtures of soils, gravel, soil-cement and others. Those with the highest production capacity are those that have individual aggregate silos that unload them on a conveyor belt leading them to the mixer to be injected with the asphalt emulsion [19]. Mounted on truck chassis, mobile plants are functional and practical as they can be put into operation within hours. Smaller in situ production plants are employed in a restricted manner to a small amount of premix for routine corrective hole-type preservation [7].

The PMF produced is transferred to dump trucks that transport it and unload it in an appropriate depot or on the road to be spread by motor grader or directly on the paver. In hole or small discontinuous segment services, spreading is manual [7].

The compaction process depends on the type of mixture to be considered. In open and semi-dense PMFs, compaction can be started immediately after spreading, or give a cure of 1 to 4 hours due to the small wetting water content. For dense PMFs, compaction should be performed near the optimum moisture determined in the laboratory, as the hot in the field is considered equal to that in the laboratory, although this depends on the type of roller used in the compaction and its respective energies [15].

As for deposits for asphalt emulsion, they must be completely sealed, avoiding contact of this material with air, water and dust, having capacity for at least three days of service, the tanks must have devices for homogenization and heating, as well as, thermometers for temperature control if required. In addition, the connection of the tank with the plant mixer should have a system that allows perfect flow control of the bituminous binder. Aggregate deposits must have silos divided into compartments to properly separate and store fractions of aggregates, and must also have silos storage capacity at least three times the capacity of the mixer. Water deposits, on the other hand, must be able to hold the water to be used [12].

The flowchart below, Figure 2, presents the order of instructions for making a layer of PMF in a very brief way.

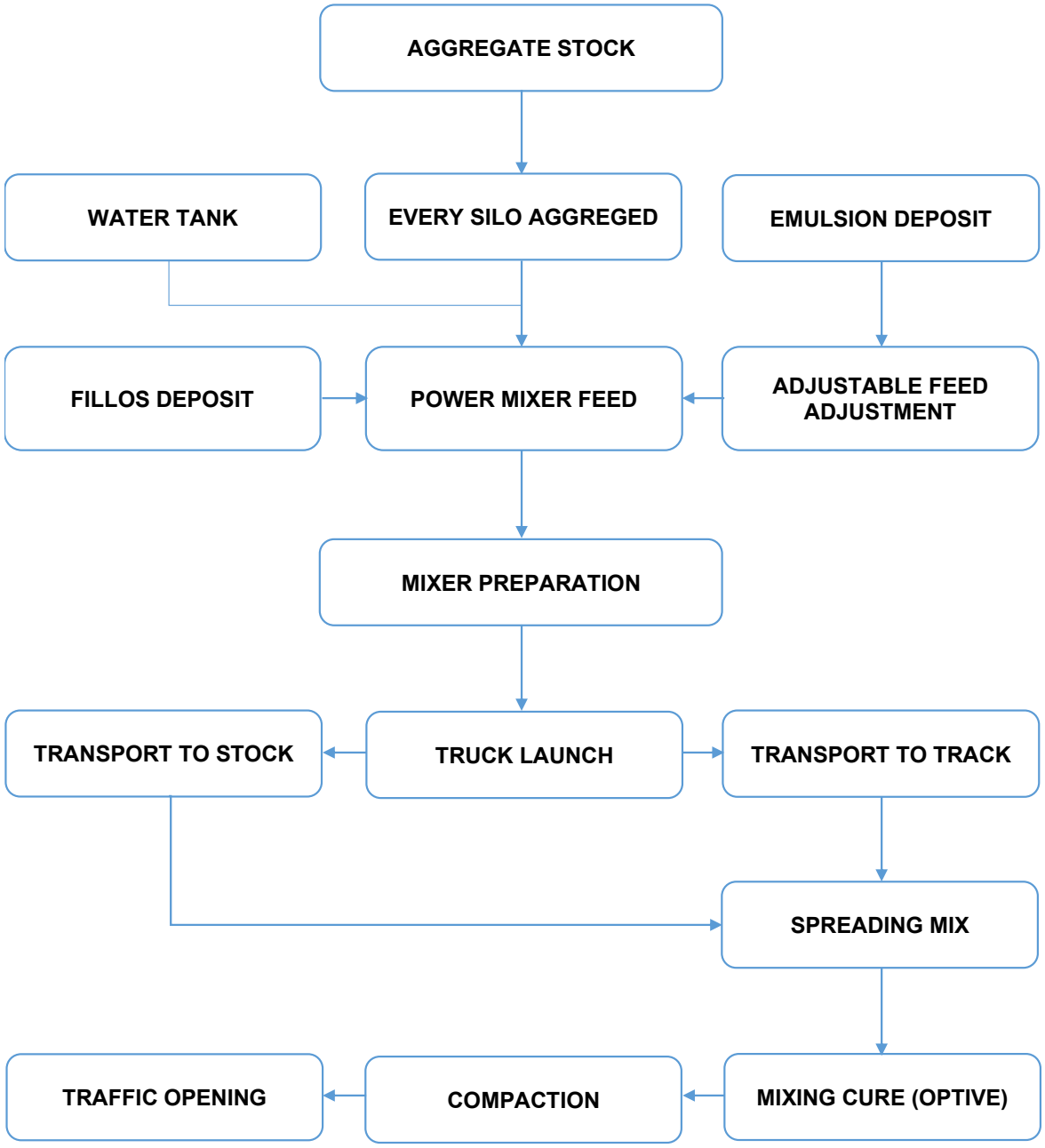


Figure 2: Executive process of a PMF layer.
Source: Adapted from [13].

3 Methodology

To prepare the study on the application of cold premixed asphalt in road pavements, readings and studies on the above-mentioned themes in the theoretical foundation were performed.

The city in which the research is focused is Coari, a municipality in the state of Amazonas, shown in Figure 3, with 57,921.9 km² in length, 75,909 inhabitants in the last census and previously known for banana production, today standing out for oil production. and natural gas.

Figure 3: Coari Municipality.
Source: [25].

After conducting a study on asphalt pavements, the required budget for PMF application was made using DNIT's SICRO 2 spreadsheets, compared to the costs of using a hot-rolled bituminous concrete coating - CBUQ, which is the most commonly used. used. Then, an evaluation of the performance of the coating is made, its feasibility of use according to the knowledge acquired through the theoretical foundation.

4 Results and Discussion

4.1 Executive Cost

The [20] SICRO 2-unit cost compositions from Amazonas from November 2016 were used to compare the costs of using PMF and CBUQ. In the execution of cold premixed coating, taking into account the unit cost of execution of the service and machining, the total unit cost of R $ 218.80 is reached, as shown in Figure 4.

DNIT – Road Cost System			Road Construction	SICRO 2
Reference Unit Cost	Mês: November/2016		AMAZONAS	RCTR0320
2 S 02 530 50 – Cold premixed AC/BC			Team Production: 22,00 m³	*Real Values*
			Custo Unitário de Execução	33,82
Auxiliary Activities	Quant	Uni	Unit price	Unit cost
1 A 01 397 52 – Machining P.M.F. AC/BC	1,00	M³	129,08	129,08
			Total cost of activities	129,08
			Total direct unit cost	162,90
			Indirect Income and Expenses (34.32%)	55,91
			Total unit price	218,80

Figure 4: Unit cost of cold premix.
Source: Adapted from [18].

In the cost composition of CBUQ, considering the same unit costs of the PMF, the figure is R $ 120.34, as

shown in Figure 5. However, it is noted that the unit of execution of this coating is in ton. Therefore, when making the conversion, considering its density around 2.4 t / m3, we found a total unit price of R $ 286.52, which is slightly more expensive than the PMF service.

DNIT – Road Cost System			Road Construction	SICRO 2
Reference Unit Cost	Mês: November/2016		AMAZONAS	RCTR0320
2 S 02 540 51 – CBUQ – bearing cover AC/BC			Team Production: 75,00 t	*Real Values*
			Custo Unitário de Execução	09,22
Auxiliary Activities	Quant	Uni	Unit price	Unit cost
1 A 01 390 52 – CBUQ machining (bearing cover) AC / BC	1,00	t	80,37	80,37
			Total cost of activities	80,37
			Total direct unit cost	89,59
			Indirect Income and Expenses (34.32%)	30,75
			Total unit price	120,34

Figure 5: CBUQ unit cost.
Source: Adapted from [18].

Costs between coatings do not have a high price difference, so it is a variable that does not give much weight when choosing between the two mixtures.

4.2 PMF Behavior as Coating

As we have seen from the theoretical foundation, cold premixed asphalt mix comes as a good alternative in paving because of its ease of application, lower costs than other coatings, among other advantages.
Despite being a more basic mixture, this asphalt coating, as emphasized by Vieira [15] and ABEDA [13], has a high roughness allowing a higher quality in relation to the grip of the tires with the rolling surface. In addition to being easy to produce, store, transport, apply and handle in the field, it is an ideal solution for roads where vehicle traffic is light or medium.
Regarding hot asphalt mixtures, the main advantages of using cold premix, according to Batista [21], begins with the need not to heat asphalt binder and aggregates for its manufacture and application on site. And because they are manufactured and applied at room temperature, they bring advantages such as: reduction of pollutant emissions, possibility of less complex mobile preparation plants, which provides a reduction of costs and transportation in works, as well as easier use of local aggregates. .
It is also possible to highlight its good affinity with any type of aggregate, which enables the use of wet aggregates, avoiding the waste of fuel to dry them and allows storage at room temperature in simple installations, thus avoiding the risk of fire and explosion [22].
However, despite its many advantages, PMF is still limited in its applications because depending on the traffic load on the road, its use may not be as beneficial as using CBUQ. For hot-machined concrete, PMF deteriorates and ages faster and its strength develops more slowly [15]. In order to opt for the use of one or another one must take into account the project criteria, its destination and the available resources.
For [22], there should be three main concerns about PMFs, namely: the high porosity of their compacted

mixture, the low initial resistance due to water of their composition and the long cure time caused by water evaporation and volatiles, and must be exceeded to achieve their maximum performance.

4.3 Feasibility of PMF use in COARI

The city of Coari is 463 km from Manaus by water and is bordered by the Solimões River. It is only accessible by air or water, with no connection to the national road network or neighboring cities [23]. According to [24], only 21.3% of the population has urban dwellings on public roads with adequate urbanization, containing manhole, sidewalk, paving and curb.

According to the [25], the city has a road network of 50 km of paved roads and 60 km of its 15 back roads. Currently, in 2019, Coari Prefecture has been doing asphalt resurfacing work throughout its road network, as shown in Figures 6.

Figure 6: Resurfacing in Coari Street.
Source: [25]

As it is a municipality with few inhabitants in relation to the capital and not having such a heavy vehicle traffic and assuming that the volume of public transport and cargo traffic is also light, asphalt pavement using cold premixed it's viable. As stated earlier, PMF is more effective on light and medium traffic roads, and the low cost and ease of transport and application of PMF would make it more applicable in the city than other more complex coatings.

Another observation to be made is regarding the climate, being a city of tropical climate, the ambient temperature is favorable to the execution of paving with cold asphalt mixture that needs to be executed at temperatures above 10 ° C. However, the downside is the city's rainfall, which is high throughout most of the year with Coari rainfall averaging 2290 mm, according to Climate-data.org [26].

5 Final Considerations

The use of cold premixed asphalt is still being applied more in layers of regularization and reinforcement of pavement structure than as asphalt coating. This as a coating is best used on roads where traffic demand is not so demanding, having the job of providing safety and comfort to users.

This research aimed to analyze the feasibility of using PMF in Coari, taking into account its characteristics

as coating and the advantages and disadvantages of its application, comparing the costs required with hot-machined concrete. When this comparison occurs, PMF only lags behind its slow development of resistance, its low efficiency on heavy roads and faster aging and wear, as in other respects PMF comes out ahead. These advantages make it possible to use cold premix in cities that want to pave and do not have as many technological or financial resources. Therefore, in view of the aspects mentioned during the work, it is concluded that when well designed and well executed, cold premixed asphalt can be used both as a reinforcement of the pavement structure and as a coating on low and medium roads. traffic demand.

6 Bibliography References

[1] CNT. CONFEDERAÇÃO NACIONAL DOS TRANSPORTES. Pesquisa CNT de Rodovias 2018. Brasília: CNT, 2018. Disponível em: <https://pesquisarodovias.cnt.org.br/>. Acesso em: 04 set 2019.

[2] ZATARIN; et al. Viabilidade da Pavimentação com Asfalto-Borracha. Revista Gestão e Sustentabilidade ambiental, Florianópolis, v. 5, n. 2, p. 649-674, out.2016/mar. 2017.

[3] CNT. Transporte rodoviário: impactos da qualidade do asfalto sobre o transporte rodoviário. Brasília: CNT, 2019. Disponível em: <https://cnt.org.br/impactos-qualidade-asfalto-transporte-rodoviario>. Acesso em: 04 set 2019.

[4] SENÇO, Wlastermiler de. Manual de técnicas de pavimentação: volume I. 2. ed. São Paulo: Pini, 2007a.

[5] RAMALHO, A. V. F. Uma análise dos benefícios com a utilização do asfalto borracha nas rodovias do Brasil. São Paulo – SP, 2009. Disponível em: <https://docplayer.com.br/14422360-Uma-analise-dos-beneficios-com-a-utilizacao-do-asfalto-borracha-nas-rodovias-do-brasil-faculdade-de-tecnologia-da-zona-leste.html>. Acesso em: 14 set 2019.

[6] ZAGONEL, ANA REGINA. Inovações em Revestimentos Asfálticos Utilizados no Brasil.2013. 115f. Trabalho de Conclusão de Curso. (Graduação em Engenharia Civil). Departamento de Ciências Exatas e Engenharias, Universidade Regional do Noroeste do Estado do Rio Grande do Sul, Ijuí – RS.

[7] FIESP. Departamento da Indústria da Construção. Pavimento de vias no Brasil: infraestrutura de transportes terrestres rodoviários e cadeias produtivas da pavimentação. São Paulo: 2017.

[8] CNT. Transporte rodoviário: por que os pavimentos das rodovias do Brasil não duram? – Brasília: CNT, 2017.

[9] FERRARA, Renata D'Avello. Estudo comparativo do custo x benefício entre o asfalto convencional e o asfalto modificado pela adição de borracha moída de pneu. Universidade Anhembi Morumbi. São Paulo, 2006. Disponível em:<https://docplayer.com.br/5376555-Estudo-comparativo-do-custo-x-beneficio-entre-

o-asfalto-convencional-e-asfalto-modificado-pela-adicao-de-borracha-moida-de-pneu.html>. Acesso em: 14 set 2019.

[10] ROSSI, Anna Carolina. Etapas de uma obra de pavimentação e dimensionamento para uma via na Ilha do Fundão. Trabalho de Conclusão de Curso. (Graduação em Engenharia Civil). Rio de Janeiro: UFRJ/ Escola Politécnica, 2016.

[11] BERNUCCI, Liedi Bariani, et al. Pavimentação asfáltica: formação básica para engenheiros. Rio de Janeiro: Petrobras; ABEDA, 2008.

[12] DER/PR. ES-P 23/05. Departamento de Estradas e Rodagem do Estado do Paraná. Pavimentação: Pré-Misturado a Frio. Curitiba, 2005.

[13] ABEDA. ASSOCIAÇÃO BRASILEIRA DAS EMPRESAS DISTRIBUIDORAS DE ASFALTO. Manual Básico de Emulsões Asfálticas. Rio de Janeiro: Ultraset, 2ed., 2010.

[14] CERENTINI, Nícolas Pieniz. Dosagem de um Pré-Misturado a Frio Utilizando Material Asfáltico Fresado. Trabalho de Conclusão de Curso (Graduação em Engenharia Civil). Santa Cruz do Sul, 2016.

[15] VIEIRA, Bruno Cardoso. Análise da Viabilidade do Uso de Pré-Misturados a Frio em Aeródromos. 2009. 104f. Trabalho de Conclusão de Curso. (Graduação em Engenharia Civil). Instituto Tecnológico de Aeronáutica, São José dos Campos.

[16] CERATTI, Jorge Augusto Pereira et al. Utilização de ligantes asfálticos em serviços de pavimentação. Rio de Janeiro: ABEDA, 2015, 144f.

[17] SENÇO, Wlastermiler de. Manual de técnicas de pavimentação: volume II. 2. ed. São Paulo: Pini, 2007b.

[18] DNIT. DEPARTAMENTO NACIONAL DE INFRAESTRUTURA DE TRANSPORTES. DNIT 153/2010- ES. Pavimentação Asfáltica – Pré-misturado a frio com emulsão catiônica convencional. 2010. 11p.

[19] BROCHADO, Matheus Matos Lepesqueur. Estudo da Viabilidade do Asfalto Pré-Misturado a Frio em Rodovias de Médio e Baixo Tráfego. Trabalho de Conclusão de Curso (Graduação em Engenharia Civil). UniCEUB - Centro Universitário de Brasília, 2014.

[20] DNIT. Custos e pagamentos: SICRO 2. Norte, Amazonas, 2016. Disponível em: <http://www.dnit.gov.br/custos-e-pagamentos/sicro-2/norte/norte>. Acesso em: 18 set 2019

[21] BATISTA, Fátima Alexandra Barata Antunes. Novas Técnicas de Reabilitação de Pavimentos. Dissertação (Doutorado em Engenharia Civil), Universidade do Porto, Faculdade de Engenharia – FEUP, 2004.

[22] CHAVES, Franklin José. Estudo de Misturas de Areia Asfalto a Frio em Pavimentação de Baixo Volume de Tráfego no Estado do Ceará – Contribuição ao Método de Dosagem. Tese (Doutorado em Engenharia Civil). Universidade Federal do Rio de Janeiro, COPPE/UFRJ, 2010.

[23] SOLER, Cláudia. A Cidade de Coari/Am e os Reflexos da Exploração de Petróleo e Gás Natural pela Petrobrás. Papers da NAEA n0 23. Núcleos de Altos Estudos Amazônicos, 2009.

[24] IBGE. Instituto Brasileiro de Geografia e Estatística. Panorama – Coari. Cidades IBGE, 2010. Disponível em: <https://cidades.ibge.gov.br/brasil/am/coari/panorama>. Acesso em: 20 set 2019.

[25] COARI. Prefeitura de Coari. Plano Diretor de Desenvolvimento de Coari. Tomo 1, 2007. Disponível em: < https://issuu.com/danielmacielgomes/docs/tomo_1.2_-_27-02-08_anexo>. Acesso em: 16 set 2019.

[26] CLIMATE-DATA.ORG. Clima Coari. [entre 1982 e 2012]. Disponível em: <https://pt.climate-data.org/america-do-sul/brasil/amazonas/coari-25367/>. Acesso em: 22 set 2019.

Proposal for a Polysportive Framework with a Community Center Integrated in Petrópolis - Manaus-AM

Mariana Ribeiro Alves
mari.mra91@gmail.com
Centro Universitário FAMETRO - Brasil

Mazurkevs Matos dos Santos
mazurkevssantos@hotmail.com
Centro Universitário FAMETRO - Brasil

Igor Bezerra de Lima
igorblima@hotmail.com
Departamento de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmailcom
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

The objective of this work is to propose a project of a multi-sport court with integrated community center for the community square of Petrópolis neighborhood, located at Marginal Street, without number, Manaus - Am. Being an important reference point in social inclusion and life promotion healthy, the proposal also aims to contribute to the valorization of the urban space. The community square of the Petrópolis neighborhood has no structure to practice multisport exercises. The purpose of the proposal is to provide a suitable place for physical activities, provide an environment for residents' meetings, especially encourage young people to practice sports, in order to keep them away from drugs and crime.

Keywords: Public Square; Structure; Revitalization;

1. Introduction

With the rapid growth of the population, there are many impacts on urban areas. Due to this growth, in some cases there are certain difficulties of public agencies in meeting the needs of a particular region. For this to happen, it is necessary to conduct surveys of public infrastructures in the neighborhoods, assess existing conditions and propose improvements.

Sport has been fundamental in the lives of people, not only young people, but also in the lives of the elderly and people with disabilities. The practice of sports brings numerous health benefits and improvements in

the quality of life of practitioners. However, there must be adequate facilities to perform these physical activities and in some situations people look for paid places, because they do not have in the vicinity of their proper place to practice sports.

Through the study and analysis of existing sites it is possible to plan and develop spaces that meet the expectations of the community of a given area.

The proposal of a multi-sport court with integrated community center adds value to the Petrópolis neighborhood square, besides being a space that can be explored in several ways. It is also important to mention that the population needs social interaction, needs a suitable place to meet friends and have fun. A multi-sport court can provide moments of leisure and fun, in addition to awakening people to exercise, which benefits directly in health. Proposing a new building for a community center meets the needs of the surrounding population, who need to hold meetings to discuss issues of interest to residents, as well as being a structure that can also be explored for social events, activities such as theater, capoeira, dance and even accomplishments of various courses.

2. Theoretical Foundation

2.1. The Sport

According to [1] around AD 83 the sport began to stand out in Greece and Rome, the modalities practiced at that time were gymnastics, races and fights. According to the information in this period arose the gyms and sports complexes, which were the areas intended for the practice of these competitions.

2.1.1. The Concept

The sport can be described as physical exercises that must follow rules for its performance and that aims to develop competition between the practitioners, and can be performed individually, or between two or more people on the same team. Depending on the sport there is no need to be practiced with equipment.

Leisure is directly linked to the free time that a person has, are activities performed in a non-compulsory way, may or may not be physical exercises. It is the time for recreation and relaxation, where the person has fun and ends up releasing the hormone "endorphin", which acts directly in reducing stress.

2.1.2. The Benefits

Playing sports directly influences the physical and mental well-being of the human being, also being of great importance for body development and health care. The sport goes further, through sports practices the person can understand and respect others, develops discipline and understands the importance of commitment to the team.

Among the many benefits that sports and exercise can provide the person we can mention: the development of the body's organic system, increased confidence, overcoming limitations, greater agility and flexibility, decreases the chances of developing chronic diseases and body strengthening.

The sport provides the practitioner with the release of energy, pleasurable and satisfying moments. It can also provide better physical conditioning and body strengthening.

The person who practices some sport tends to have a better quality of life, more willingness to perform

daily tasks. And if performed correctly and consistently, this practice increases the life expectancy of the individual.

However, it may also be mentioned the improvement of body posture, relief of muscle pain, combat diseases such as diabetes and osteoporosis, strengthens immunity and reduces the percentage of body fat.

2.1.3 Incentive Programs for Leisure Structures

The [2] was essential to regulate the State's duties regarding the modernization and adaptation of spaces for sports and leisure in all Brazilian municipalities. Being social right of the population to have access to public space to develop physical and sports activities.

With the creation of the city's Sport and Leisure Program (PELC) [3], the municipalities will be able to set up places for recreational and leisure sports, such as squares, courts, sports halls, soccer fields and social clubs.

Thus, the National Secretariat of Sport, Education, Leisure and Social Inclusion encourages the Government to invest in the construction of adequate structures for the practice of various physical activities and to promote the democratization and development of citizenship through sport and leisure.

2.2. Sport Practice

The extinct Ministry of Sport in 2013 conducted a survey to obtain information on sports and physical activity related to that year. The study pointed out that 45.9% of Brazilians did not practice any physical activity or sport, 28.5% were practitioners of physical activity and 25.6% were practitioners of sports [4].

According to the study Pnad 2015: Practice of Sport and Physical Activity, in 2015, over 100 million people did not practice any kind of sport during this period. One of the reasons cited for the absence of sports was the “lack of accessible or nearby sports facilities” [5].

2.3. The Place

Located in the south of Manaus, the Petrópolis neighborhood was founded in 1952 [6], its population was 41,210 inhabitants. The neighborhood is among one of the most dangerous regions of the capital, the high number of violence is linked to the lack of investment for development of the area, the implementation of social projects and monitoring with the health of families.

FIGURE 01: Neighborhood Location Map
Source: [7]

In 2016, Raimundo Vinhote Square, popularly known as Petrópolis Square, was reopened by the Manaus City Hall, after partial revitalization of the 800m². The revitalization included painting in the surroundings, accessibility for people with special needs and also the implementation of an outdoor gym containing 12 exercise equipment. However since the reopening there has been no maintenance and improvement in the public space of the square. [8]

The square has an extensive area that allows exploration for new infrastructure projects that may enhance the public space and provide new options for sports and leisure practices in the surrounding community.

FIGURE 02: Square Location Map
Source: Google Maps [9]

2.4. Constructive Steps

2.4.1. Workbook

The plaque serves to identify the work to be performed, as well as the data of the technicians responsible and must be installed in a visible place.

2.4.2. Tapume Installation

According to [10] the ground shall be insulated by a provisional fence made of sturdy structure, such as timber parts and galvanized steel parts. Must have a minimum height of 2.20 meters in relation to the ground level.

2.4.3. Demolitions and Withdrawn

Demolitions must be performed following the guidelines of [10] and should be planned and accompanied by a qualified professional. Prior to demolition, the mains and other facilities must be disconnected, protected and isolated. Soon after, fragile elements such as glass, frames and lamps should be removed.
The structure should be demolished with the utmost care, using appropriate tools and personal protective equipment as per [11].

2.4.4. Clearing Terrain

Before carrying out the lease of the work, it is necessary to remove the existing vegetation layer on the ground, thus preventing the inappropriate soil from causing damage during the work.

2.4.5. Works Lease

This step should be performed with the monitoring of the topographic professional, and there should be level checking, axis alignment, terrain markings and road alignment. All information should be as per project.

The jig is made with a wooden structure, obeying a minimum distance of 1.00 meters from the position of the side closing walls and a maximum height of 1.50 meters relative to the ground. It is important that the jig structure is level and with the correct square. With the use of the nylon line the wall segments should be marked, because from this information it will be possible to identify the alignments of the foundations and pillars.

2.4.6. Earth Movement

Trench excavations should follow the guidelines of NBR 9061: 2015 - Open pit excavation safety [12] and should be performed by qualified professionals using appropriate tools and safety precautions in accordance with [10]. During the excavation operation the stability of the ground walls must be maintained so that no accidents occur. In this case, it is essential to observe the acting loads, such as lateral thrust, accumulation of excavated material at the excavation edge and the traffic of machines and equipment.

2.4.7. Foundations

According to NBR 6122: 2010 - Design and execution of foundations [13], load is transmitted to the ground through the foundation elements. Such as:

2.4.7.1. Fundations Base

It is the surface foundation element of reinforced concrete, can have in plant the square, rectangular or trapezoidal shape. They are interlocked by baldrames and must have a compressive strength of at least FCK 25 Mpa, and may vary according to structural design. Its function is to support the weight of the construction and distribute the loads to the ground [13].

2.4.7.2. Beam Baldrame

Made of reinforced concrete and rectangular in shape, the baldrames are defined with shallow support foundation, located below ground level and executed following the perimeter of all masonry. Assists in the weight distribution of the construction and performs the locking of the pillars. Like the shoes, they must have a compressive strength of at least FCK 25 Mpa. After the deforming procedure of the concrete element is completed, it is important to waterproof the faces of the rafters, so that the structure is protected against moisture and seepage [13].

2.4.8. Superstructure

They are reinforced concrete elements responsible for distributing the loads to the foundation elements. They must resist horizontal and vertical actions and their function is to ensure the stability of the structure. The superstructure consists of pillars, upper beams and slabs. Being these dimensioned and specified through Structural Projects.

3. Tools and Methods

To verify the need for a place to practice polysports and community center, a survey was conducted in the Petrópolis neighborhood, to verify what types of structures are available in the urban spaces of this region. Visits were made to the following blocks in the neighborhood that are for public use:

• Thomas Meireles Municipal School
• Valley of the Sun Court 2
• SOMAP court

A visit was also made to Petrópolis Square to evaluate the existing community center and to analyze the physical activities that can be developed in the square.

The research was developed through IN LOCO visit, a form was used to fill in the information related to the place such as: typology, description of the place, conditions of the existing structure and type of activities that can be developed in the space.

The proposal for a multi-sport court with integrated community center was prepared following the guidelines of ABNT standards, such as:

• NBR 6118: 2014 - Design of concrete structures - Procedures; [14]
• NBR 8800: 2008 - Design of steel structures and mixed steel and concrete structures of buildings; [15]
• NBR 6122: 2010 - Design and Execution of Foundations, [13]
• NBR 5626: 1998 - Cold water building installation, [16]
• NBR 8160: 1999 - Building sewage systems - Design and execution, [17]
• NBR 5410: 2004 Corrected Version: 2008 - Low voltage electrical installations. [18]

To prepare the budget worksheet, the costs presented by the worksheet SINAPI - National System for Research on Costs and Indices of Civil Construction, issued on 08/12/2019, were considered. [19]

4. Structural Calculation Methodology

The concrete volume calculation was performed using the ConstruCalc 2019 Program, the following measures were adopted:

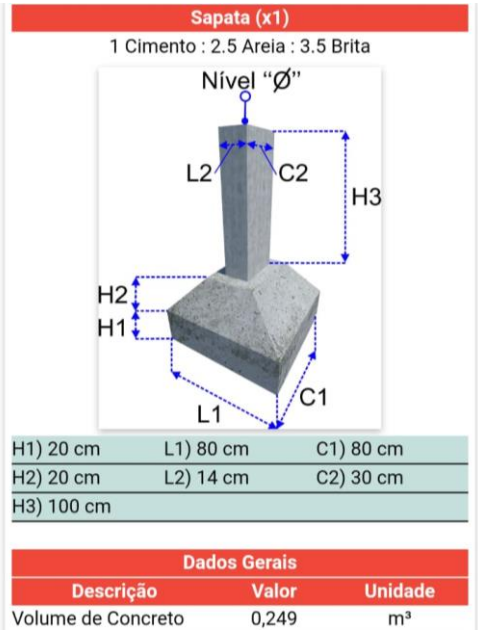


Figure 3 - base: 0.80 x 0.80
Source: [20]

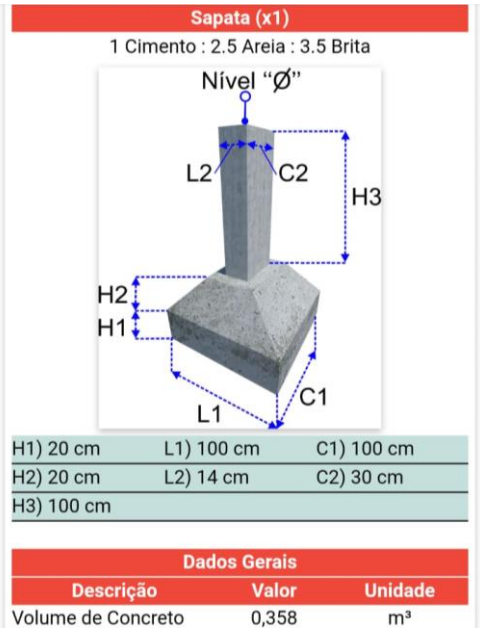


Figure 4 - base: 1.0 x 1.0
Source: [20]

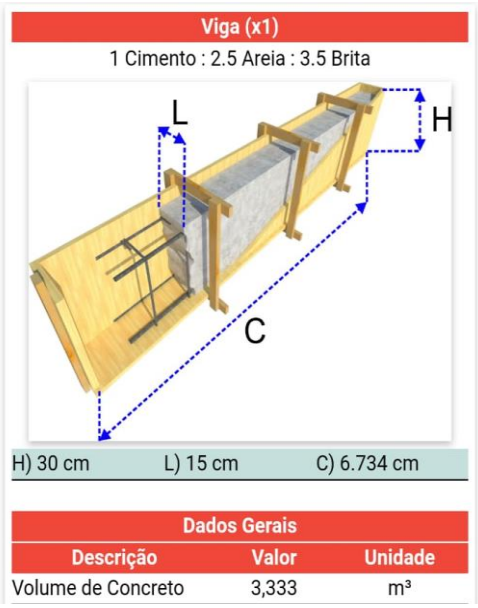


Figure 5 - Girder Community Center
Source: [20]

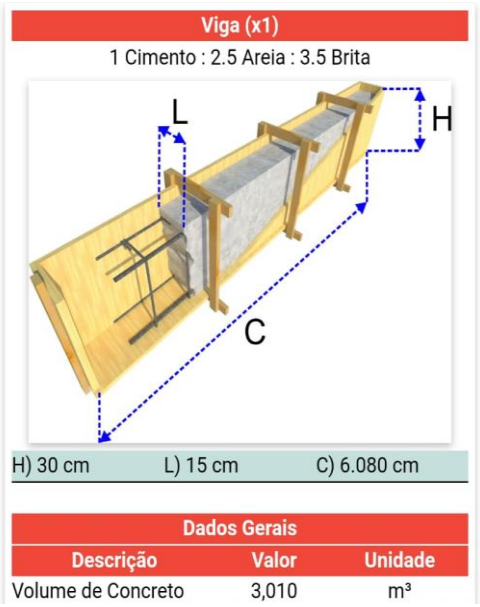


Figure 6 - Court beam
Source: [20]

For the survey of the steel quantity was adopted 91.68 kg / m3 and for formwork area was adopted 9.01 m2 / m3, according to Table 01 - Usual demand for the formwork, reinforcement and concreting services for the execution of 1m³ of structure of reinforced concrete. (TCPO 13th EDITION, p. 19) [21]

Table 01: Demand for 1.00 m³ of concrete.

DEMAND FOR 1.00 M³ CONCRETE				
SERVICE	UNITY	MIN.	MED.	MÁX.
Shapes	**M²**	**8,01**	**9,01**	**12,52**
Frame	**Kg**	**81,78**	**91,68**	**160,00**
Concreting	**M³**	**1,00**	**1,00**	**1,00**

Source: TCPO 13th Edition [21]

5. Results and Discussions

5.1. The Petrópolis Square Community Center

The existing community center has an area of 108.00sqm, however due to not receiving maintenance is in a state of degradation. The coverage structure presents several pathologies that endanger site users.

FIGURE 07: Community Center - Petrópolis Square
Source: Personal Archive

FIGURE 08: Community Center - Petrópolis Square
Source: Personal Archive

5.2. The Place For Polyportive Framework

The area chosen for the proposal regarding the multi-sport court is located next to the existing Community Center in square of Petrópolis, which is 20,00 meters long and 15,00 meters wide.

FIGURE 09: Place for Proposal
Source: Personal Archive

5.2. Projects

5.2.1. Location and Location

Figure 03 presents the Situation and Location Project where it is possible to identify the area foreseen for the implementation of the proposal.

The place is 15,00 meters wide and 29,00 meters long, totaling 435,00m² of area that will suffer interference.

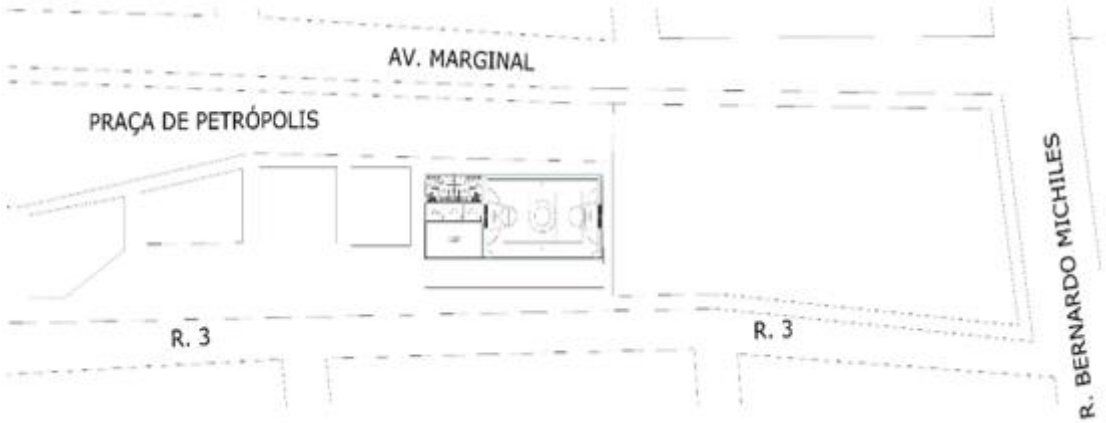


FIGURE 10: Situation and Location Project
Source: Personal Archive

5.2.2. Front Facade

The facade has a length of 28.66 linear meters. In figure 04 it is possible to understand how the installation of the Multi-Sport Court with integrated Community Center was designed.

FIGURE 11: Front Facade
Source: Personal Archive

5.2.3. Polyesportive Frame

For the multi-sport court, the dimensions of the masonry closures were estimated measuring 19.40 meters in length and 11.40 meters in width, totaling 221.16m² of built area, considering masonry with a ceiling height of 1.00 meters throughout the perimeter of the building. block and above this closure it was foreseen the installation of metallic structure for closing with a mesh screen.

Starting from the masonry level, the dimensions of the fence structure are respectively: 19.24m in lateral length, with right foot measuring 1.70m and 11.25m in bottom width and 3.20m in right foot. The valid games area is 18,00m long and 10,00m wide, totaling 180,00m².

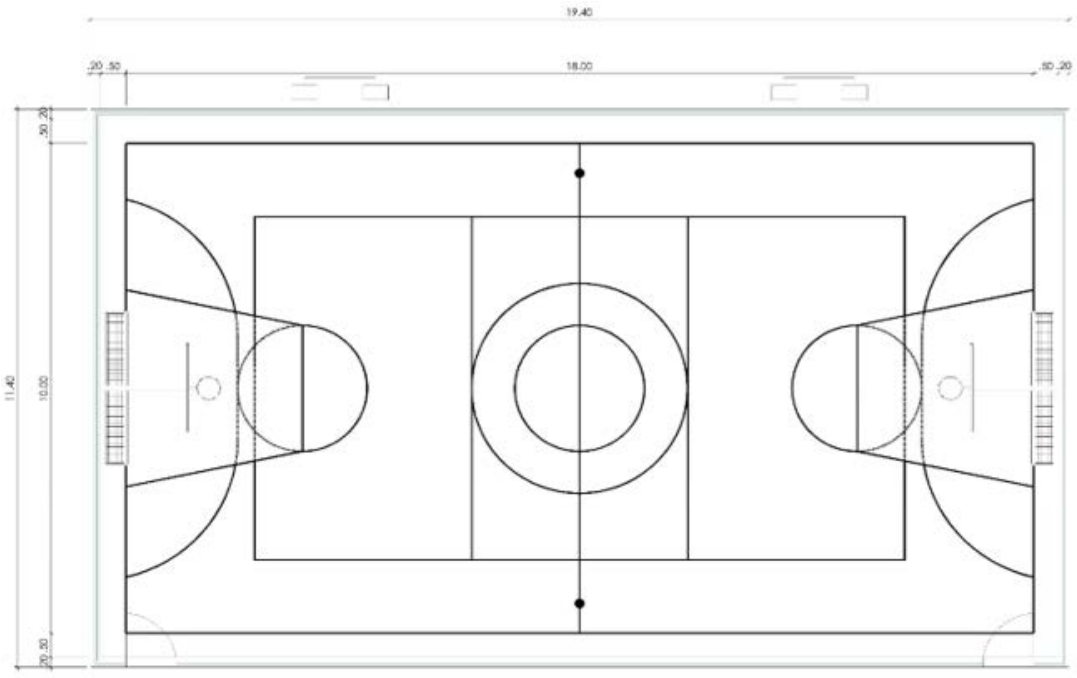


FIGURE 12: Floor Plan Multi-Sport Court
Source: Personal Archive

5.2.4. Community Center

The Community Center was designed with a width of 9.60 meters and a length of 11.40 meters, totaling a built area of 105.56m². The building has toilets for female and male use, rooms for administrative, didactic, warehouses and for purposes. It also has a lounge with an area of 42.12m² where various types of activities

can be performed, such as theater, capoeira, meetings and presentations.

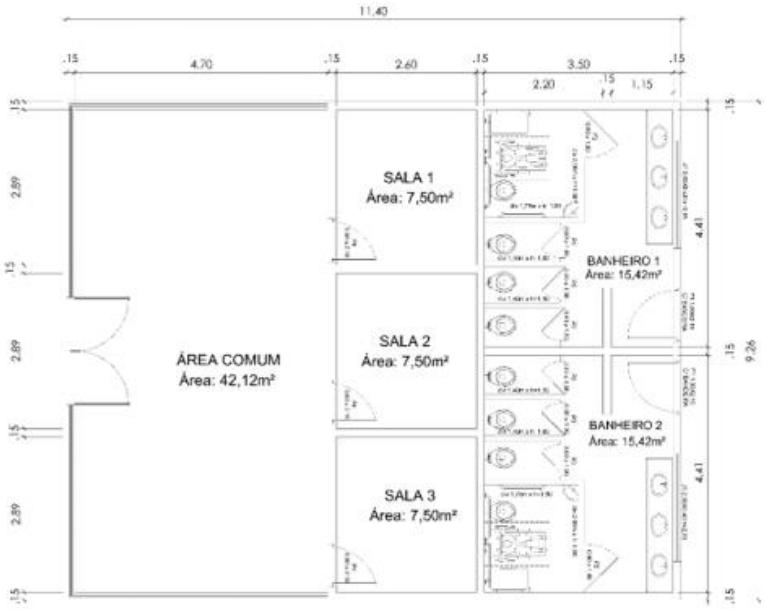


FIGURE 13: Floor Plan Community Center
Source: Personal Archive

5.3 Synthetic Budget Worksheet

TEM+A1:I7	DESCRIPTION OF SERVICES	TOTAL	
1.0	PRELIMINARY SERVICES	R$	30.666,48
	COMMUNITY CENTER	R$	115.238,72
2.0	FOUNDRY MOVEMENT FOR FOUNDATIONS (base and beams)	R$	738,93
3.0	FOUNDATIONS	R$	12.061,67
4.0	WATERPROOFING	R$	270,30
5.0	SUPERSTRUCTURE	R$	7.743,95
6.0	INTERNAL AND EXTERNAL VERTICAL SEALING SYSTEM (WALLS)	R$	21.150,35
7.0	INTERNAL AND EXTERNAL COATINGS	R$	19.218,13
8.0	INTERNAL AND EXTERNAL FLOOR SYSTEMS (PAVING)	R$	3.554,17
9.0	PAINTING	R$	9.037,41
10.0	SQUARES	R$	8.605,95
11.0	COVERING SYSTEMS	R$	24.896,82
12.0	TABLEWARE AND METALS	R$	3.063,68
13.0	HYDRAULIC FACILITIES	R$	730,08
14.0	SANITARY INSTALATION	R$	730,08
15.0	ELECTRICAL INSTALLATIONS	R$	3.437,20
	MULTISPORT COURT	R$	72.290,53
16.0	LAND MOVEMENT FOR FOUNDATIONS	R$	948,42
17.0	FOUNDATIONS	R$	12.291,26
18.0	SUPERSTRUCTURE	R$	30.692,93
19.0	INTERNAL AND EXTERNAL VERTICAL SEALING SYSTEM (WALLS)	R$	3.838,30
20.0	INTERNAL AND EXTERNAL COATINGS	R$	3.047,30
21.0	PAINTING	R$	4.121,67
22.0	ADDITIONAL SERVICES	R$	17.350,66
	TOTAL COST OF WORK		218.195,72
	BDI VALUE 23.15%		50.512,31
	GRAND TOTAL		268.708,03

FIGURE 14: Synthetic Budget Worksheet
Source: Personal Archive

The items for sealing masonry closures and roofing systems are the most costly of the Community Center. In all, 273,00sqm of masonry and 99,46sqm of coverage will be built with metal structure and aluminum tiles.

For the multi-purpose sports court the biggest cost will be to build the superstructure, this item contains the floor slab execution service that has an area of 209.00m².

For foundations, 0.80m x 0.80m and 1.00m x 1.00m shoes were considered, and 0.15m x 0.30m concrete beams with FCK 25 Mpa and 8mm and 10mm CA-50 steel.

The superstructures were dimensioned with pillars with the dimensions of 0.14m x 0.30m and upper beam of 0.15m x 0.25m. For the Community Center an 8cm-thick roof slab was designed with 8mm CA-50 10mm CA-50 steel positive and negative frames. For all elements, concrete concreting with FCK 25Mpa was considered.

The internal and external vertical sealing system (walls) was developed considering 9x19x19cm horizontally drilled ceramic blocks, with internal and external cladding and mortar plastering in a 1: 2: 8 stroke. For the bathrooms of the Community Center, the installation of ceramic tiles on all internal walls was considered.

The execution of the floors of the Community Center and Quadra Poliesportiva was designed with the application of 5cm thin concrete ballast, mounting of CA-50 steel frames of 8mm mesh 15cm x 15cm and concrete with FCK 25Mpa. Being the floor finish of the Community Center with ceramic tile and the finish of the floor of the court will be executed with own paint for floors.

The assembly of the Quadra Poliesportiva fence should be structured by galvanized steel tubes, with seam, din 2440 and 2 ”diameter. And its sealing should be performed with 5cm x 5cm mesh galvanized wire mesh. The entire fence structure should be finished with synthetic enamel paint.

Facade finishes should be performed initially with the application of acrylic putty on the walls, after two coats it is necessary to sand the surface, then apply two coats of acrylic latex paint.

6. Final Considerations

With the knowledge acquired through the research, it was possible to analyze the existing structures in the neighborhood of Petrópolis, understand what the residents' needs were, plan the construction stages of the project, following the guidelines of the Brazilian Regulatory Standards and develop the works cost spreadsheet.

Therefore, the purpose of the Proposal for a Multi-Sport Court with an integrated Community Center is to propose a suitable structure for sports and leisure, to propose a new Community Center, thus meeting the needs of the residents around Petrópolis Square.

7. Bibliographic References

[1] Duarte, O. História dos Esportes. São Paulo: Senac; 2003.

[2] Ministério do Esporte. Resoluções da III Conferência Nacional do Esporte. [acesso em 13 set 2019]. Disponível em: http://www2.esporte.gov.br/conferencianacional/resolucoesIIICNE.jsp

[3] Ministério do Esporte. Programa Esporte e Lazer da Cidade. [acesso em 13 set 2019]. Disponível em: http:www.esporte.gov.br/index.php/institucional/esporte-educacao-lazer-e-inclusao-social/esporte-e-lazer-da-cidade

[4] Ministério do Esporte. A prática do esporte no Brasil. [acesso em 09 set 2019]. Disponível em:

http://www.esporte.gov.br/diesporte/index.html
[5] Instituto Brasileiro de Geografia e Estatística. PNAD: Prática de Esporte e Atividade Física. Brasília. IBGE; 2015. [acesso em 09 set 2019]. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/livros/liv100364.pdf
[6] Instituto Brasileiro de Geografia e Estatística. Dados Municipais de Manaus. [acesso em 09 set 2019]. Disponível em: https://cidades.ibge.gov.br/brasil/am/manaus/panorama
[7] Google Maps. Bairro Petrópolis. Manaus – AM. [acesso em 05 set 2019] Disponível em: https://www.google.com/maps/place/Petr%C3%B3polis,+Manaus+-+AM/@-3.1109489,-60.0007083,14.5z/data=!4m5!3m4!1s0x926c053031441c4f:0x7f62f9b1b6ea9524!8m2!3d-3.1088793!4d-59.9941528
[8] Araújo, O. Prefeitura abre espaço revitalizado no bairro de Petrópolis. Manaus: Amazonia na Rede; 1 maio 2016. [acesso em 05 set 2019]. Disponível em: https://amazonianarede.com.br/prefeitura-abre-espaco-revitalizado-no-bairro-de-petropolis/
[9] Google Maps. Praça de Petrópolis. Manaus – AM. [acesso em 05 set 2019]. Disponível em: https://www.google.com/maps/place/Petr%C3%B3polis,+Manaus+-+AM/@-3.1056032,-59.9909176,330m/data=!3m1!1e3!4m5!3m4!1s0x926c053031441c4f:0x7f62f9b1b6ea9524!8m2!3d-3.1088793!4d-59.9941528
[10] Ministério do Trabalho. Norma Regulamentadora - N° 18 – Condições e Meio Ambiente de Trabalho na Indústria da Construção. Brasília: MT; 2018. [acesso em 05 out 2019]. Disponível em: http://trabalho.gov.br/images/Documentos/SST/NR/NR18/NR-18.pdf
[11] Ministério do Trabalho. Norma Regulamentadora N° 6 – Equipamento de Proteção Individual – EPI. Brasília: MT; 2018. [acesso em 05 out 2019]. Disponível em: http://trabalho.gov.br/images/Documentos/SST/NR/nr-06-atualizada-2018.pdf
[12] Associação Brasileira de Normas Técnicas. NBR 9061 – Segurança de escavação a céu aberto. Rio de Janeiro: ABNT; 1985.
[13] Associação Brasileira de Normas Técnicas. NBR 6122 - Projeto e execução de fundações. Rio de Janeiro: ABNT; 1996.
[14] Associação Brasileira de Normas Técnicas. NBR 6118 – Projeto de estruturas de concreto. Rio de Janeiro: ABNT; 2004.
[15] Associação Brasileira de Normas Técnicas. NBR 8800 – Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edifícios. Rio de Janeiro: ABNT; 2008.
[16] Associação Brasileira de Normas Técnicas. NBR 5626 - Instalação predial de água fria. Rio de Janeiro: ABNT; 1998.
[17] Associação Brasileira de Normas Técnicas. NBR 8160 - Sistemas prediais de esgoto sanitário - Projeto e execução. Rio de Janeiro: ABNT; 1999.
[18] Associação Brasileira de Normas Técnicas. NBR 5410 Versão Corrigida - Instalações elétricas de baixa tensão. Rio de Janeiro: ABNT; 2008.
[19] Caixa Econômica Federal. SINAPI - Sistema Nacional de Pesquisa de Custos e Índices da Construção Civil. Brasília: Caixa Econômica Federal; 2019.
[20] Tresium Soluções. ConstruCalc. Ipatinga: Tresium Soluções; 2019. [acesso em 05 out 2019].

Disponível em: http://www.tresium.com.br/index.html

[21] Pini. Tabelas de Composições de Preços para Orçamentos. 13. ed. São Paulo: Pini; 2008.

Liability in Civil and Environmental Subjects for Carbon Capture and Storage (CCS) Activities in Brazil

Raíssa Moreira Lima Mendes Musarra (Corresponding author raissa@musarra.com.br +5511949519425)
Ph.D. in Social Sciences, Postdoc research at Institute of Energy and Environment, São Paulo University
São Paulo, Brazil.

Silvia Andrea Cupertino
Master Student at Institute of Energy and Environment, São Paulo University
São Paulo, Brazil.

Hirdan Katarina de Medeiros Costa
Ph.D in Energy and Visiting Professor at Institute of Energy and Environment, São Paulo University
São Paulo, Brazil.

Abstract

This article intends to organize and understand the theories and norms related to civil and environmental liability in the Brazilian legal system and its relations with the potential implementation of CCS (Carbon Capture, Transport and Storage) projects in Brazil. Thus, in view of the protection of the environment, safeguarded as a Brazilian constitutional norm and related normative organization, the questions concerning civil and environmental liability are introduced. In addition, international guidelines on the subject in selected country standards are exposed through the composition criteria of the International Energy Agency (IEA) CCS normative repository. Then, notes are made on the fundamental importance of Civil and Environmental Liabilities in the prevention and control of environmental accidents, social risk management and safety in storage and carbon activities, as well as conclusions drawn from the current scenario of Brazilian Environmental Law.

Keywords: Environmental Liability; Environmental responsibility; Carbon Capture and Storage (CCS); Carbon Capture, Transport and Storage.

1. Introduction

As the complexity of legal relations in society increases, new rights and obligations emerge to be regulated and ensured by control mechanisms. The obligations arising from the legal system for their implementation require the imposition of responsibilities that generate patrimonial effects that incubate to recompose the states of legal fact to their parity with the rights and obligations. Thus, under the law, protected legal assets must be economically relevant to be considered as such, and non-compliance with

the protection of these assets generates patrimonial effects.

Anti-juridicity as an action contrary to the Law, carried out through the positivized norm and the principiologically protected values, does not find, according to Bezerra et al. (2005), embryonic difference between anti-juridicities and consequent sanctions, but they can be differentiated by reference to their guardianship objects, resulting in the existence of three types of sanctions: criminal, civil and administrative.

According to Bezerra et al. (2005), the criterion immediately used for the identification of these sanctions is the object protected by them, so that in offenses provided for by the Penal Code, the sanction to be applied will be of a criminal nature and will generally consist of a restriction on individual liberty. With regard to civil sanctions, the safeguarded interest will require the patrimonial reparation of individual, collective or both damages and the administrative sanctions have the purpose of defending, through repression and prevention, the collective interests.

The Federal Constitution, when dealing with the fundamental rights in article 5, inscribed the right to life, bringing as a reflection the right to an ecologically balanced environment, essential to the healthy quality of life, in view of paragraph 2 of the article that prescribes : “The rights and guarantees expressed in this constitution do not exclude others arising from the regime and the principles adopted by it”. Article 225 of the Magna Carta, which in itself elevates the ecologically balanced environment to the category of fundamental right, from which its power / duty of protection derives.

This protection is closely related to the conception of "damage", which would be that of "injury to legally protected interests", environmental damage, in turn, would be the action or omission that undermines the various conditions, laws, influences and interactions of order. physics, chemistry and biology that allows, shelters and guides life in any form (SETTE, 2013).

Environmental damages are difficult to repair, especially due to their characteristics that are hardly found in non-ecological damages and, therefore, according to Colombo (2017), have the following specificities: they are irreversible; pollution has cumulative effects; the effects of ecological damage may manifest beyond neighboring surroundings; they are collective and diffuse damage in their manifestation and in establishing the causal link; have direct repercussions on collective rights and indirect on individual rights.

Several gases that exist naturally in the atmosphere when emitted in excess intensify the greenhouse effect: methane (CH4), nitrous oxide (N2O), ozone (O3), Hydrofluorocarbon (HFCs) and carbon dioxide (CO2) (NISHI at al, 2005). The study of carbon is of great importance because of its close relationship to the climate change of the earth (NOVAES FILHO et al, 2007). The large amount of gases emitted from human activities, mainly from the burning of fossil fuels and deforestation, has been causing greenhouse gases accumulation in the atmosphere and, consequently, the rise in global temperature (COTTA et al, 2006).

In the current context of climate change aggravated by the emission of anthropogenic greenhouse gases, new technologies for the decarbonization of production processes have been used as tools to mitigate carbon dioxide emissions.

Among the strategies for reducing the concentration of carbon dioxide in the atmosphere, the following stand out: a) the reduction of emissions from burning fossil fuels; b) reduction of burning of plant material;

and c) carbon sequestration through forest planting and management; and d) carbon capture and storage in geological formations (SOARES et al, 2002; COSTA et al, 2018b).

The so-called "carbon sequestration" occurs when conserving, preserving, restoring or planting forests due to the emergence of a carbon sink as forests remove part of the CO2 from the atmosphere through photosynthesis (SILVA et al. 2008) and so-called geological storage of carbon dioxide occurs when the gas is injected into a certain underground geological formation containing it.

Among these are the techniques of CCS (Carbon Capture, Transport and Storage), which, in the storage phase, despite its global importance for decarbonization, when performed in geological structures, cause changes in the environment that can result in possible environmental damage.

Carbon capture through CCS technologies can be stored in several ways, the most representative being hydrodynamic trapping, solubility trapping and mineral trapping. The choice of the most suitable stocking method should consider in its decision process several factors, among them the safety of the geological reservoir and its economic viability. Geological substrate storage is a storage mode that occurs by injecting CO2 into predetermined geological formations identified as specific target formations, including depleted oil and gas reservoirs, unexplored coal deposits and saline aquifers.

There are studies that point out the potential of the Brazilian territory for the geological storage of carbon dioxide in the Pre-salt region, in halite formation saline domes (KETZER, 2016; MAIA, 2018). Thus, the carbon dioxide emitted in hydrocarbon production and exploration in this region would be especially covered by geological storage, which means a considerable amount given the projections for production in the region for the next 20 years (SENADO, 2019).

Carbon dioxide storage is not provided for by current Brazilian regulation. Thus, it is necessary to study the current norms related to the subject, as well as studies that point out the best conducts performed internationally and those that can be applied in the country, since the conduct cannot be excluded from the legal appreciation on the grounds that there is no specific regulation (COSTA and MUSARRA, 2018).

Many of the technologies that are part of the CCS chain are well established and their practical application is well understood and based on practical experience gained in the context of various industries that deal similarly with underground geology (ROMEIRO-CONTURBIA, 2014). However, several risks associated with CCS have been identified at the local level, potentially affecting the environment, health and human property, and in relation to the global climate (ROMEIRO-CONTURBIA, 2014).

Geological storage risks carbon dioxide leakage and other substances related to the separation, transport and injection process, as well as the collapse of the storage structure and its consequences for biota, and in the pre-salt region there are still Consideration should be given to the effects of salt concentration (NACL) on the marine environment resulting from gas drilling / injection (BUI et al, 2018; COSTA et al, 2018).

In case of possible damage arising from the implementation of CCS techniques, the need to repair them occurs, this corresponds to the institute of liability, which concerns the duty not to injure anyone, providing compensation for any unfairly harmed interest by the causative agent. . Such legal institute requires civil reparation proportional to the damage on the part of the person who caused it, as a form of replacement or compensation.

Damages to civil liability are material or moral in nature. Those of a material nature reach an

identifiable economic value, characterized by the form of emerging damages or lost profits. The moral ones are characterized by non-transferability and subjectivity, such as the honor and dignity of the human person, and cause greater difficulty in their measurement (MUSARRA, 2009).

Thus, in order for reimbursement to occur, there must be, in addition to the damage, unlawful conduct that has generated it, would be the case of damage to property when caused by CCS activities. Already the environmental liability aims to set the parameters for the verification of the damage caused and the liability of the causative agent, whether individual or legal entity, public or private (MUSARRA, 2009) when reaching the environment, in case environmental damage.

The Federal Constitution of 1988 in the chapter devoted to the Environment establishes three types of liability as a form of reparation for environmental damage: civil, criminal and administrative, independent and autonomous. Thus, a single action or omission can give rise to three types of autonomous wrongdoing and receive the sanctions imposed. It is the result of an anti-juridical conduct, from which causes injury to be compensated. In addition, associated with objective responsibility is the polluter 's duty to fully repair the damaged environmental good, either through restoration or through ecological compensation (MUSARRA, 2019).

Therefore, it is intended to discuss, in this work, how the institute proceeds in terms of potential civil reparation of environmental damage in relation to CCS in geological structures in Brazil.

2. Liability in Brazilian Environmental Law

As pointed out, there are several forms of accountability, that is, manifestation of the obligation to answer for something, within the scope of the Brazilian Environmental Law. There are three types of "liability", ie three types of environmental liability: administrative liability, civil liability and criminal liability. They all derive from the constitutional provision (art. 225, par. 3) which states that "conduct and activities deemed harmful to the environment will subject offenders, individuals or legal entities, to criminal and administrative sanctions, regardless of the obligation to repair damages". , translation of the polluter pays principle. Liabilities can be divided into objective and subjective, civil liability falls under objective liability, and administrative and criminal liability fall under subjective liability (MORAES et al, 2018).

Civil redress for environmental damage is closely related to the polluter pays principle, which also achieves preventive and repressive measures and the costs associated with the use of natural resources (MORAES et al, 2018). Thus, administrative and criminal responsibilities are those classified as instruments of repression of conduct and activities considered harmful to the environment (MILARÉ, 2018).

2.1 General Liability

In general, liability expresses the obligation to answer for something, either by contractual obligation or by legal determination, in order to satisfy or execute a legal act arising from a legal obligation. Civil liability refers to the obligation to repair damage or to compensate it, being regulated in its general

principles and some special topics by the Civil Code, and may be covered in other legal acts in the face of the evolution of life, progress and forms. of new behaviors that arise over time (RIZZARDO, 2007).

The general civil liability is the obligation to repair damages caused not foreseen by a legal business, based on the fault (subjective liability, provided for in article 927 of the Brazilian Civil Code) and the risk (objective liability, provided for in paragraph 927 of the Civil Code). Thus, article 927 of the Civil Code states that "he who, by illicit act (arts. 186 and 187), causes harm to another, is obliged to repair it" and, in his sole paragraph, says that "there shall be an obligation to repair the damage, regardless of fault, in the cases specified by law, or when the activity normally performed by the perpetrator of the damage entails, by its nature, a risk to the rights of others ".

According to Dower (2007), liability arises when there is damage caused by someone, acting with intent or guilt, which is obliged to indemnify. The violation of one's subjective right is based on voluntary action or omission (intent), recklessness, malpractice and negligence (guilt), occurring an unlawful act and finding the guilt or intent of the cause of the damage. However, there is the incidence of exceptions, such as risky activities that cause serious damage, where there is presumption of guilt in the face of difficulty in proving guilt. Thus, in civil relations not caused by environmental damage, as a rule, guilt is the basis of liability.

According to Diniz (2012), civil liability is generated from the interest in restoring the legal balance altered or broken by the injury, recomposing the status quo or reimbursing the equivalent amount so that the victim may have repaired the damage caused. Such liability is defined in the application of measures to repair the moral or property damage caused to third parties by reason of their own act, considering the existence of illicit (subjective liability), and the risk, ie, liability without fault (liability objective). Merely civil liability is linked to CCS activities through individual or collective property damage, without any environmental consequences.

The exclusionary causes of liability are fulminating circumstances of the indemnity claim for attacking one of the general elements or assumptions of civil liability, which breaks the causal link (GAGLIANO and PAMPLONA FILHO, 2010). It can be said that they rule out the agent's responsibility for uncharacterizing the fault, breaking the causal link, excluding the authorship, ruling out the intent or rendering the damage unprovable, and there should be legal provision for such exclusion. They are classified into the state of necessity, self-defense, the regular exercise of law, act of God or force majeure, the sole fault of the victim or the fact of a third party.

As stated by Miranda (2012), the human being exposed to damage must be protected by material law in order to have right, claim and action tells the offender. The indemnity aims to render indemnity what was damaged, which could be damage to the body and psyche. In this sense, the human being who has inflicted harm on others must compensate.

According to the principle of civil liability, as a rule, situations are illiquid, where the reparation of the damage consists in the specific restoration of the injured legal property, that is, the in integrum recomposition, so that the victim will find himself in a situation as if the harmful event had not happened. When faced with the impossibility of returning to the original situation due to excessive burden or the impossibility of its excessive realization, it should be offered its pecuniary equivalent, adding the loss of profit limited to what was reasonably left to earn, and the interest (PEREIRA, 2011).

From this perspective, the calculation criterion is set by art. 402 of the Civil Code: “rt. 402. Except as expressly provided for by law, the loss and damage due to the creditor covers, in addition to what he effectively lost, which reasonably failed to profit ”(BRAZIL, 2002). Since the harmful event interrupts the normal succession of the facts, the new state of affairs must be as close as possible to the original situation, and the reparation must be supported because, according to human experience, in the abstract, the initial situation would be that existing had the damage not occurred. Therefore, the criterion of the extent of damage applies perfectly to the repair of material damage, as it has a reparatory character (MONTEIRO, 2010).

Therefore, the extent of the damage is the measure of compensation, which is the general criterion for setting the amount due in order to compensate the property damage, by quantifying the amount of the reduction experienced by the creditor's equity, in all its aspects. , and then sets the principal of the obligation of the debtor. It bears interest, monetary restatement and attorney's fees, under the conditions examined for general obligations (COELHO, 2012).

The property damage, for Maria Helena Diniz (2001, p.61), “becomes the concrete injury, which affects an interest related to the victim's property, consisting in the loss or deterioration, in whole or in part, of the material property that belongs to her. , being liable to pecuniary assessment and compensation by the person responsible ”. And the moral damage is for Sergio Cavalieri (2008) the injury to the integral good of the personality, such as honor, freedom, health, psychological integrity, causing pain, suffering, sadness, shame and humiliation to the victim, reveals, in essence, the offense to a personality right, without material prejudice.

Objective liability, again, that in which there is an obligation to repair the damage, regardless of fault, was specified by law as to the damage to the environment, the law in question is that by Law no. 6.938 / 81, National Environmental Policy Law, which states in its article 14, § 1: “Without prejudice to the application of the penalties provided for in this article, the polluter is required to indemnify or repair the damage caused to the environment and the third party affected by your activity (...) ”.

Even if there was no such provision, the same objective liability, provided for in the assumptions that “when the activity normally performed by the perpetrator entails, by its nature, a risk to the rights of others” is also related to CCS activities regarding damage. “by its very nature”, since it entails risks to the rights of others, especially the right to an ecologically balanced environment.

3. Liability for Environmental Damage

Environmental civil liability aims to set the parameters for the verification of the damage caused and the liability of the causative agent, whether individual or legal entity, public or private law. Thus, a single action or omission can give rise to three types of autonomous wrongdoing and receive the sanctions imposed. It is the result of an anti-juridical conduct, from which causes injury to be compensated. In addition, associated with objective responsibility is the polluter 's duty to fully repair the damaged environmental good, either through restoration or through ecological compensation (MUSARRA, 2019).

Everyone has the right to an Ecologically Balanced Environment, as stated in the caption article 225 of the Federal Constitution. Are they:

Article 225 - Everyone has the right to an ecologically balanced environment, a good for the common use of the people and essential to a healthy quality of life. The Government and the community are obliged to defend and preserve it for those present and future generations.

Having the concept of environment as a shelter of naturalistic aspects and factors that condition human life and its development in relation to the ecosystem to which it belongs. Thus, in addition to the well-known concept of Natural or Physical Environment, we currently find, as a way to identify this relationship at different levels of human activity, allusion to the Cultural Environment, Work and Artificial Environment (integrated by man, form of buildings and equipment).

Still in article 225, caput, of the CF, there is the concern of the legislator with the protection of the environment in an intergenerational way, which is extracted from the excerpt "imposing to the Public Power and the collectivity the duty to defend it and preserve it for present and future generations ", drawing attention to the need for joint protection in the search for the necessary balance (COSTA, 2018).

According to Dourado (2008), civil liability under environmental law is based on article 37 § 6 of the Federal Constitution and art. 14 Paragraph 1 of Law 6,938 / 81. Thus, according to the author, the objective nature of the civil liability imputed to the cause of environmental damage becomes unquestionable. It also notes that since 1969, when the International Convention on Civil Liability for Oil Pollution Damage was promulgated, and eight years later, when Law No. 6.453 / 77 on Nuclear Damage was issued, objective liability Insurged in our legal system, as a way to punish, and educate those responsible for the generation of energy and curb practices harmful to the environment.

Fiorillo (2017) asserts that in view of the difficulties present in the system in proving the guilt of the agent in the accomplishment of the damage, the subjective responsibility gradually ceases to be the rule, because the world tendency is to effectively seek justice. This would mean seeing the damage repaired "only through the eyes of the victim." This would be, for the author, a reason for attention of environmental law, considering the importance of the protected goods.

As stated, according to article 14, §1º, of the National Environmental Policy, Law nº 6.938 / 81, the civil liability is objective, that is, the polluter is liable regardless of the existence of guilt, and obliged to indemnify or repair the damage caused to the environment and third parties that have been affected by its activity (COSTA et al., 2017).

In addition, the Public Prosecution Service has the legitimacy to bring civil and criminal liability for environmental damage and that paragraph 5 of the same article states that the execution of the polluter 's required guarantees does not prevent the application of the obligations indemnity and compensation for damages provided for in § 1 of this article.

Federal Laws No. 4,717, 1965 and No. 7,347, 1985, which deal respectively with Popular Action and Public Civil Action, are also related to civil liability, including the possibility of signing a Conduct Adjustment Agreement, in an extrajudicial way, faster, which, if not fulfilled, can be executed in court by its legitimates, as established by art. 5, § 5, of Law 7347 of 1985. The term would act as a mechanism of procedural speed, especially with regard to situations that imply environmental civil liability (MUSARRA, 2009).

According to Leite (2004), environmental damage must be understood as any intolerable injury caused by any human action (guilty or not to the environment), directly as a macrobem of interest of the

community, in a totalizing conception, and indirectly to third parties in view of individualized self-interests that reflect the macro-good. The indivisibility of environmental damage, its transboundary character and the plurality of polluters contribute to the softening of the causal link according to Colombo (2017).

Thus, the criterion of certainty is replaced by the criterion of likelihood in examining the causal link between the cause and the effect of the damage (COLOMBO, 2017). Thus, civil liability for environmental damage has the following components: I- Activity; II- Damage; III- Authorship; and IV- Causality Nexus. The activity is that conduct that promotes environmental damage by action or omission, as well as by law or illicit. The nature of the damage: a) Individual; b) Collective; c) Economic; d) Non-economic. The authorship or imputation link is the attribution to a given person for the environmental responsibility for the damages occurred, it is a link between the harmful fact and the responsible, either by the risk or the fault. The Causality Nexus is the cause and effect indicative of the damage and the consequences of the fact or even the aggravation of its effects, observing, first, the causes of the damage, and then attribute the authorship.

According to Mirra (2019), the extension of the effects of civil liability includes the reparation of the damage to the environment itself and the suppression of the fact harmful to the environmental quality, whereby the definitive cessation of the activity that causes the degradation of the environment is obtained. environment**.**

3.2. Environmental Damage Repair

For Mirra (2019), the notion of reparation applicable to environmental damage always brings with it the idea of compensation because the degradation of the environment and environmental goods never allows the return of environmental quality to the state prior to the damage, and there is always something irreversible. environmental damage, which does not mean irreparable from a legal point of view. Thus, remediation of environmental damage should lead the environment to a situation equivalent (as is practically possible) to that which would have benefited if the damage had not been caused, and further compensates for environmental degradation that may prove irreversible. Hence the impact of the principle of full compensation of damage (MIRRA, 2019).

Comprehensive remediation of damage to the environment covers damage to the environmental good or resource immediately affected, and the full extent of damage produced as a result of damage to environmental quality, including: (a) the ecological and environmental effects of the initial assault on a certain environmental good that are in the same causal chain (such as the destruction of specimens, habitats and ecosystems interrelated with the immediately affected environment; the contribution of degradation caused to global warming); b) the environmental quality losses between the occurrence of damage and the effective restoration of the degraded environment; (c) future environmental damage that appears to be certain; d) irreversible damage to environmental quality, which must be compensated in some way; e) the collective moral damages resulting from the aggression to certain environmental good (MIRRA, 2019).

In accordance with the provisions of Articles 4, VII and 14, paragraph 1, both of Law no. 6,938 / 81, as well as paragraph 3 of article 225 of the Federal Constitution, it is up to the polluter / degrader to restore and / or indemnify the environmental damage caused.

Therefore, it is intended to recover the damage (reconstitution of the injured property) and, in its factual impossibility, the indemnity in cash. Natural restoration consists of the repair of the affected natural assets in order to restore the balance of the ecosystem. The Law no. 6.368 / 81 deals with the subject in the hypotheses of recovery of environmental quality (art. 2, caput) and in the principle of the recovery of degraded areas (art. 2, VIII). In dealing with the preservation and restoration of natural resources with a view to rational use and permanent availability (art. 4, VI). And when dealing with the imposition on the polluter and the predator, the obligation to recover and / or compensate the damage caused.

Environmental compensation is the adoption of a measure of equivalent importance within the same ecosystem in which damage has occurred or will occur, given the impossibility of specific remediation of environmental damage (TOZZI, 2019). Provided, for example, in Article 36 of Law no. 9.985 / 2000, in which ventures causing significant environmental impact, thus considered by the competent environmental agency, based on environmental impact study and its report - EIA / RIMA[6], the entrepreneur is required to support the implementation and maintenance of the conservation unit of the Integral Protection Group[7], in accordance with the provisions of this article and the regulation of this Law.

Machado (2010) understands that if the environmental impact study is not carried out (or has been incompletely prepared) and / or the environmental licensing does not happen (or happens irregularly), this does not eliminate the obligation of the entrepreneur to compensate the environment. harmed". Ecological compensation may be equivalent in situ; equivalent substituting for another location and monetary compensation, whose legal grounds are found in the Biodiversity Convention by Legislative Decree no. 2 of 1994 and in Law no. 7.347 / 85 (Public Civil Action Law) Article 3, enabling the condemnation in cash or condemnation of the obligation to do or not to do.

The equivalent substitution to be made at the place of damage will be partial regarding quality when only a few functions are replaced and quantitative for the impaired functions. The equivalent substitution in another place may occur when there is technical impossibility for expertise and other evidence admitted in law and the monetary compensation will be in the hypothesis of impracticability in the use of the other forms of reparation of the environmental damage, or of complementation of the reparation.

The sanction does not reach the major objective of recovering environmental damage, being a subsidiary form of reimbursing environmental damage. When the form of reparation is pecuniary in accordance with article 13 of the Public Civil Action Law (Law No. 7347/85), these resources are reverted to a fund managed by a Council (federal or state) in which they necessarily participate and the prosecutor and community representatives (TOZZI, 2019).

---

[6] Environmental Impact Study and Environmental Impact Report.

[7] Conservation units (UCs) are territorial spaces, including their environmental resources, with relevant natural characteristics, which have the function of ensuring the representation of significant and ecologically viable samples of the different populations, habitats and ecosystems of the national territory and of the jurisdictional waters, preserving the existing biological heritage. Full Protection Units: the protection of nature is the main objective of these units, so the rules and regulations are more restrictive. In this group only the indirect use of natural resources is allowed; that is, one that does not involve consumption, collection or damage to natural resources. Examples of indirect use of natural resources activities are: recreation in contact with nature, ecological tourism, scientific research, environmental education and interpretation, among others. The strict protection categories are: Ecological Station, Biological Reserve, park, natural monument and wildlife refuge (MMA, 2019).

The criticism made for the Brazilian diffuse rights defense fund is that the sums received will not necessarily be applied to the area specifically affected in the specific case, which, for reasons of convenience and opportunity, may be used for the restoration of any other injured property (TOZZI, 2019).

According to Pereira (2019), the damage can reach microbens, which will be the individual damage that harms homogeneous individual interests and / or macrobens, which are collective in a broad sense. The latter are divided into: 1) Diffuse: when it reaches an undetermined number of people connected about the same fact; 2) Collective "in the strict sense": when it hurts interests belonging to a group of determinable persons, linked by the same legal relationship; 3) Homogeneous individual: These are environmental damages of common origin, which may or may not be cumulative, with several elements together (reaching, for example, fauna and flora and generating homogeneous individual damage.

For CCS activities, according to Romeiro-Conturbia (2014), understandably, the concern that most prominently appears in the minds of policy makers and the general public relates to the risk of CO2 escaping storage formation for the environment. surrounding (either the atmosphere or the water column) with the associated potential to undermine the very purpose of climate change mitigation. However, it is emphasized, as stated in an introductory way, that offshore geological storage has, as well as the leakage of carbon dioxide and other substances related to the separation, transport and injection process, the collapse of the storage structure and its consequences. depending on the geological structure to be used, its peculiarities, such as groundwater contamination, must be considered and, in the Prá-sal region, specifically, the effects of salt concentration must be considered. (NACL) in the marine environment due to gas drilling / injection (COSTA et al., 2018).

4. Relevant Aspects of Civil Liability in Carbon Storage Activities

According to Romeiro-Conturbia (2014), long-term liability for carbon capture and storage corresponds to the legal responsibility to compensate or repair any significant damage resulting from CO2 injection already ceased in a geological formation. The allocation of long-term liability requirements is a key issue for CCS's widespread deployment, as operators would be more likely to invest in technology in countries that have established clear rules on the extent of their liability (STRACO2, 2009). And, above all, for having implications on the cost of implementing the enterprise itself.

Among the various types of CCS, application to large point sources of emissions is considered the most promising for climate change mitigation purposes (ROMEIRO-CONTURBIA, 2014). The technological processes involved aim to ensure that CO2 resulting from power generation and other industrial activities, rather than being vented to the atmosphere, is stored underground within suitable geological formations for thousands of years.

As already said, the CCS chain can be broadly divided into three operations: CO2 capture, transport to storage, and underground sequestration. The storage phase is composed of three stages, namely CO2 injection, site closure and post closure. In the capture phase, substances from the gaseous mixture emitted by point sources are separated to obtain an almost pure flow of CO2, which is then transported to the storage location, which may be located on land or sea, by pipeline or ship (ROMEIRO-CONTURBIA, 2014).

As explained by Romeiro-Conturbia (2014), practical experience gained in the context of various industries that deal similarly with subsurface geology contributes to the expertise of CCS activities such as hydrocarbon exploration and production, mining, underground waste disposal. as well as underground storage of natural resources. However, according to the author, there is still limited commercial-scale operational experience of the CCS chain, which inevitably leads to a degree of uncertainty about its environmental integrity, and there are several potential risks associated with CCS locally. environment, health and human property and the global climate.

In the international context, the operational liability issues of CCS activities may be related to the capture, transport, injection or storage processes. Thus, Romeiro-Conturbia (2014) states that in order to define short, medium and long term liabilities, ie the legal liability to compensate or repair any damages during a CCS project, three phases are defined: (i) phase operating with CO2 injection and monitoring to track migration and behavior; (ii) structure closure phase and removal of removed infrastructure; and (iii) post closure with the demonstration that CO2 has been properly stored. For each phase, a responsible entity is allocated. According to the author, for the operation and closure phases, the storage operator is typically the entity responsible for correcting infiltration events.

Romeiro-Conturbia (2014) reports that many countries have been working to create and improve their own CCS legal and regulatory framework. Australia, for example, was the first country to establish a CCS legal and regulatory framework in 2006, and the European Union established a Directive in 2009 with post-closure cost financing mechanisms. Table 1 contains the implications for long-term post-closure responsibilities.

Table 1 - CCS legal and regulatory frameworks: implications for long-term liabilities

Country	**CCS legal and regulatory framework**	**Adoption**	**Minimum period for transfer of long-term liability**
Australia	Offshore Petroleum and GHG Storage Act	2006	At least 15 years after the issue of the site closing certificate.
United Kingdom	Energy Act 2008 and EU CCS Directive	2008	No shorter than 20 years
European Union	EU CCS Directive	2009	No shorter than 20 years
Norway	EU CCS Directive	2009	No shorter than 20 years
Canada, Alberta	CCS Statutes Amendments	2010	No shorter than 10 years

	Act		
United States	EPA UIC Class VI Regulation	2010	50 years following the cessation of injection
United Nations*	CDM Modalities and Procedures for CCS	2011	No shorter than 20 years or after ending the issuance of CERs

Source: Romeiro-Conturbia 2014,

Considering this regulatory scenario, item 5.1 describes the international experience, punctuating concepts and highlighting the normative evolution in selected countries. This exercise aims, mainly, to verify which lessons can be incorporated in Brazil, given the existing principles and the reality of the country.

4.1. The international experience

The Institute of Environmental Liability in other countries is based on Principle 13 of the Rio de Janeiro Declaration (1992), which states that "the State shall establish its national legislation regarding the liability and compensation of victims of pollution and other forms of aggression to the environment ". Each signatory state should therefore develop a system for the prevention and repair of environmental damage caused by activity within its jurisdiction, in order to prevent damage to the environment of other states (COLOMBO, 2017).

Machado (2010) reports that in France there is the understanding that the continuous transformations of the technique of the law of responsibility have the sole objective of greater assurance of the bodily safety of men living in society and that, thus, the notion of guilt was submerged from responsibility before industrial and mechanical accidents of the contemporary world. According to him, in Spain the constitution itself establishes the obligation to repair the damage caused. In Sweden, objective liability was introduced in the 1969 "Environmental Protection Act" (§ 30) when the nuisance is substantial and unreasonable to tolerate under the circumstances (MACHADO, 2010). In addition, in Germany special legislation provided for objective liability for water pollution and for the construction and operation of nuclear installations.

However, Romeiro-Conturbia (2014) points out that due to the uniqueness associated with the implementation of permanent CO2 storage, some aspects such as post-closure and long-term liability may require the creation of new structures for the liability institute.

According to Romeiro-Conturbia (2014), in many jurisdictions there is a transfer of responsibility from operators to the host country (a relevant authority) as it is shown that CO2 behaves as expected and must be effectively stored in a long-term stabilization. projection period (WARREN, 2011 apud ROMEIRO-CONTURBIA, 2014).

The Government of Australia established in 2008 an offshore regulation for CO2 storage based on existing petroleum legislation, through an amendment of the Offshore Petroleum Act 2006, now renamed

the Offshore Petroleum and GHG Storage Act, providing that the transfer of responsibility The long-term operator to Government will be made at the end of the post-closure period of storage.[8]

In Canada, in the face of solid regulatory experience of similar oil and gas activities in Alberta, including acid gas injection and use of carbon dioxide for advanced oil recovery and high pressure pipelines, the Provincial Government provides comprehensive legislative amendments to reduce CCS barriers and policy decisions to take long-term responsibility for stored CO2 (ROMEIRO-CONTURBIA, 2014). Depending on the regulation of the issue in Canada, the definition of liability may be attributed to "actions or omissions in relation to CO2 injection" (Alberta CCS Bylaws Amendments Act, 2010).

Ownership of stored CO2 is conferred on the government by issuing a certificate of injection closure issued by a Ministry. With this, the Government of Alberta assumes all responsibilities resulting from activities previously agreed with the CCS operator. Although the Alberta CCS Bylaws Amendments Act (2010) does not specify the minimum closing period (ROMEIRO-CONTURBIA, 2014).

The Alberta CCS Regulatory Framework Assessment (Alberta Energy, 2013) recommends long-term liability, including that a minimum closing period is required before accepting responsibility for the operator's website. The Government of Alberta should only grant a foreclosure certificate after a period of not less than 10 years after the start of the foreclosure period and when the lessee has demonstrated continued compliance with the required performance criteria for foreclosure (ROMEIRO-CONTURBIA, 2014).

Romeiro-Conturbia (2014) goes on to explain that this period is shorter compared to other countries and jurisdictions, but if there are any remaining issues regarding site performance and monitoring, a longer period may be imposed to demonstrate sufficient compliance if case (Alberta Energy, 2013). In addition, prior to issuing the closure certificate, the operator is required to contribute to a post-closure management fund to cover the responsibilities assumed by the government, as well as reservoir monitoring and management costs.

According to the Alberta CCS Bylaws Amendments Act (2010), the post-closure management fund is intended to cover the costs of monitoring stored CO2 related to the corresponding agreement between the operator and the Government of Alberta. It also has the purpose of satisfying the remaining responsibilities assumed by the government (ROMEIRO-CONTURBIA, 2014).

In Germany, Romeiro-Conturbia (2014) reports that the government attempted to pass CCS legislation in 2011 in which the operator would need to contribute post-closure costs to cover probable site monitoring costs for another 30 years after the transfer of the site. responsibility (apud Global CCS Institute, 2012). However, according to Romeiro-Conturbia (2014) Germany did not enact such a milestone in 2011, and

[8] In accordance with the Law, the Relevant Authority may declare the closing guarantee period for a CO2 sequestration project if: (a) the site closure certificate is in effect for an identified GHG storage formation; (c) on the day of the decision, which is at least 15 years after the site closure certificate is issued, the responsible Commonwealth Minister is convinced that: (i) the GHG injected into the training is behaving as provided for in Part A the approved local training plan; and (ii) there is no significant risk that a greenhouse gas substance injected into the formation will have a significant adverse impact on the geotechnical integrity of all or part of a geological formation or geological structure (...) (Australia, 2006). . In addition, section 391 of the Act requires a pre-certificate notice related to a site closure certificate to calculate the total costs and expenses of the long-term monitoring program and the value of the guarantee to be equal to these estimated costs (ROMEIRO-CONTURBIA, 2016).

only in 2012 was an agreement reached, with different conditions set and forcing CCS operators to retain responsibility for up to 40 years instead of the proposal and 30 years after the closing period.

According to POP (2018), the European Union (EU) did not seek to intrude on the choice of national legislation more than necessary to provide a general framework for CCS regulation, particularly as regards the liability regime. The challenge is to develop a set of reforms that carefully balances the achievement of three objectives: ensuring political acceptability, ensuring environmental sustainability and integrity of CCS projects (avoiding moral hazard) and encouraging rapid and commercial deployment.

The European Union CCS Directive provides for a division of responsibilities between the operator and the competent national authority[9]. According to POP (2010), the Directive's deadlines are extremely long and are foreseen for the management of CO2 storage sites with the idea that storage is intended to be permanent. The deadlines involved exceed the usual lifetime of the private entities managing the CCS storage sites (Article 18 (1)), whereby most of the responsibilities result from storage, so the location should be transferred to a competent authority after a sufficient period of time, indicating post-closure stability (POP 2018).

The site can be closed when the CO2 injection is permanently interrupted, with the operator being responsible for sealing the site and removing the injection facilities. In accordance with Article 17 of the Directive, the operator retains the responsibility to monitor, report and provide corrective action after closure.

The EU Directive also addresses the transfer of operator responsibility to the competent authority by proving that CO2 storage has been permanently contained and provided that a minimum period is determined by the competent authority.

In accordance with Article 18 of the Directive: This minimum period should not be less than 20 years unless the competent authority is satisfied that the criteria for evidence indicating that stored CO2 will be completely and permanently contained is met. before the end of this period (European Union, 2009). In addition, as a post-transfer obligation, the operator must provide a financial contribution to the competent authority before formalizing the transfer of responsibility as a way to cover projected monitoring costs for a period of 30 years.

The set of rules contained in the Environmental Liability Directive may perhaps be characterized as the only type of liability that is insufficiently stringent from the point of view of environmental protection, as in theory the defense of “authorization” and the defense of "State of the art". In theory, operators may use these defenses in cases of leakage where there is no fault or negligence on their part and where they were fully complying with the terms of their storage permit or the activity that caused the leak was not considered likely to be harmful in time. However, as some Member States may have chosen not to implement such defenses, they may not apply (POP 2018). This is the case of countries that opt for the theory of full responsibility, which is objective and does not discuss culpability.

[9] According to (POP, 2018), the leakage of CO2 from the storage site may have legal consequences such as administrative liability arising from the provisions of the Directive itself (transposed into national law); liability for environmental damage; the obligation to purchase allowances; liability under tort and other laws at national level.

4.2. Prevention and control of environmental damage

If the risk of leakage materializes, its consequences depend on the storage location and the way incidents are managed. In theory, leakage from onshore storage sites is likely to affect a much larger number of people than offshore areas, especially if they are located in valleys (ROMEIRO-CONTURBIA, 2014).

The effects of high levels of CO2 on human health and local fauna are well understood, depending on concentration, the effects range from rapid breathing, headache and tiredness to the most serious dangers of brain malfunction, loss of consciousness. and death by asphyxia (ROMEIRO-CONTURBIA, 2014). Lethal incidents involving the natural release of CO2 are often invoked to illustrate the dangers of potential leakage from storage sites, notably the 1986 Lake Nyos incident in Cameroon with 1700 human deaths (ROMEIRO-CONTURBIA, 2014).

However, there are theses portrayed by Romeiro-Conturbia (2014) who maintain that if a CO2 release occurs from a CCS site, it is more likely to take the form of gradual infiltration rather than sudden and rapid leakage, meaning that the amount of CO2 escaped would be at least initially much smaller. In addition to the unpredictable nature of such events, CO2 storage sites are subject to close monitoring by those who have a legal duty to remediate the leak immediately, so there would be an opportunity to restrict public access to the site in question. until it dissipated.

The main feared consequence of CO2 leakage from offshore storage sites is related to ocean acidification and its adverse effects on marine ecosystems and the livelihoods of populations that depend on them. Possible harmful consequences include: change in salinity index, disturbance in planktonic, benthic and ichthyofauna community due to sea leakage, disruption of ecosystems, change in ocean water quality from effluent disposal, change in air quality, contribution to greenhouse effect, accidental release of chemicals at sea (GOSAC, 2004).

There is also concern regarding water contamination, leading to adverse effects on the health of marine ecosystems. Regarding the impact on the global climate, the danger is that an extensive leak would render the climate change mitigation claim of CCS activities useless (ROMEIRO-CONTURBIA, 2014).

In case of storage in saline structures, as in the case of pre-salt, the concern with the elimination of brine should be mentioned. There are some salinity water quality guidelines for the protection of aquatic life in this regard in the jurisdictions of Canada (CCME, 1996). In US guidelines human activities should not cause salinity to fluctuate by more than 10% of the expected natural level and depth (EPA). In Australia, the rules require salinity to be within 1.2 ppt (parts per tonne) of usual environmental levels within 50 m of the discharge point and within 0.8 ppt of depth levels within 1000 m of the point. of salt discharge.

There is also concern about the temperature of the fluids during injection. For example, the Canadian Water Quality Guidelines (CWQG) for the protection of marine life limit the maximum temperature range to 1% of the ambient water temperature for any human activity (CCME, 2008).

Moreover, while CCS is only one of the greenhouse gas reduction strategies, several authors emphasize that it is the only option that can help achieve the required scale of emission reductions within the relevant timeframe (ROMEIRO-CONTURBIA, 2014).

But, according to Nardelli e Griffith (2003) environmental transformation is not simply structural, it also involves a change of values, which will guide future strategies. For them, the concept of "sustainability" seeks an alternative vision of the future to effectively respond to the environmental crisis.

4.3. Safety in Carbon Storage Activity and Social Risk Management

The consolidated environmental jurisprudence of the Brazilian Superior Court of Justice already guides some theses about environmental law, those that point to the social management of risks include the non-existence of acquired right to pollution or degradation of the environment, solidarity co-obligation in relation to degradation. environmental, the obligation to recover for the owner of the property even if it has not contributed to the damage outbreak and the already discussed objective liability for full risk.[10]

For CCS activities it should be borne in mind that there will be no exhaustion of the duty of non-degradation even in the event of compensation. As for the obligation to recover for the property owner, it must be considered that the geological storage may occur in cases where the property owner is the State, and, by its nature, proposes the damage (ie accompanying the thing) , may appear in the liability pole in liability actions, jointly or severally with the operator of the activities.

Another institute that deserves to be mentioned is the environmental insurance, the theme is provided for in Laws 6,938 / 81, 11,284 / 2006 and 12,305 / 2010. Thus, coverage for environmental risks aimed at the full remediation of environmental damage, provided for in the Brazilian legal system, may, according to (COSTA, 2011) exceed the economic and financial capacity of the person responsible, which does not relieve him / her from doing so. assumed the risk of its activity / undertaking and the resulting encumbrances, becoming, according to the author, relevant the adoption of financial guarantees that help and complement this repair, as insurance.

According to (COSTA, 2011), in 1991, the Brazilian model of the Environmental Pollution policy was elaborated, which was changed in 1997, remaining until the present day, which, however, was not successful, the author notes that, although it is Standardized, including as an economic instrument of PNMA, environmental insurance needs regulation, which is the primary condition to enable its adoption as a guarantee of resources to repair damage caused by activities / enterprises potentially degrading the environment. This results in the lack of technical and legal definitions, which implies a broad and deep debate between the Government, the insurance market and other representatives of civil society interested in the issue (academy, environmentalists) and makes the implementation of environmental insurance unfeasible.

Thus, it is necessary to regulate based on the best technical-legal solution for the elaboration of a coverage modality that can meet both the normative requirements (prevention / precautionary duty and reparation of environmental damage) as well as the insurance market reality (COSTA, 2011).[11]

---

[10] Theses STJ in environmental scope: Thesis 3: There is no acquired right to pollute or degrade the environment, and there is no permission to the owner or squatter to continue practices prohibited by the legislature. Thesis 7: Those responsible for environmental degradation are jointly and severally liable, forming, as a rule, in public or collective civil actions. Thesis 9: The obligation to recover environmental degradation rests with the property owner, even if it has not contributed to the outbreak of the damage, given its propter rem nature. Thesis 10: Responsibility for environmental damage is objective, informed by the theory of integral risk, with causation being the binding factor that allows the risk to be integrated into the unit of the act, and the invocation by the company responsible for environmental damage is inappropriate. of liability excluders to depart from their obligation to indemnify.

[11] Insurance to cover environmental risks is already included in PNMA, Law no. 11,284 / 2006 and Law no. 12.305 / 2010, in this case, in the civil liability group, and the matter still needs regulation and not other rules that establish practically the same

For CCS could be provided financial guarantees permitted by law to cover environmental risks on a mandatory basis, including the contraction of insurance. That could be required of the entrepreneur when licensing (bidding in some cases, such as in the forest concession) of his activity / enterprise, to cover any damage caused to the environment, the purse and third parties, understanding set out in articles 20 and 21 of Law no. 11,284 / 2006 (COSTA, 2011). The insurance market, as a rule, requires a supplementary questionnaire to the insurance proposal and risk inspection, which provide information on compliance with environmental and related standards and companies' initiatives regarding their prevention, thus contributing to the management of the risks.

In addition, the internationalization of environmental quality standards, especially in relation to specific CCS standards, such as those cataloged by the International Energy Agency (IEA)[12], can contribute to safety and thus to risk management and its consequent liability in all spheres, including civil.

Regarding activities with potential implementation in the Pre-salt region, it is necessary to take into account already established environmental standards for the oil and gas industry that may be related to the injection and storage of carbon dioxide, namely, as provided by Law 9,966 / 00 for the prevention, control and supervision of pollution on offshore platforms, requiring Emergency Plan and independent biennial audits by operators (in the case of the CCS of those who build and / or make use of facilities), and the provisions of Normative Instruction IN 01/2018, ie the Fluid and Gravel Monitoring Project.

As for eventual leaks, the current regulation in terms of analogy can be considered, as regards the storage of natural gas (CH4, methane), which already has rules in force in Brazil from the production and exploration of Oil and Natural Gas, as ANP Resolution No. 52/2015, as well as its transportation, through ANP Resolution No. 6/2011, and the incident reporting procedure, ANP[13] Resolution No. 44/2009, all of which are superseded by the Gas Law (Law 11909/2009).

5. Conclusion

Among the CCS activities, the greatest concern in terms of environmental risks is the safety of CO2 storage in a geological reservoir, which must be stable in its structure and consider geological containment parameters predetermined by experts. In addition to being environmentally acceptable, this storage does not harm the environment or society by ensuring that no fluid leaks into the atmosphere and therefore has the least possible impact. It should also be noted, as pointed out by Ravagnani and Suslick (2008), that CO2 storage is necessarily less harmful to the environment than the continuous emission of uncaptured gas and must be subject to all national and international laws and regulations. international as the social comes to predominate over the individual, increasing the sense of collectivization and the affirmation of the dignity of the human person and their security and social justice.

object, requiring regulation themselves (COSTA, 2011). There is Bill 10494/2018 that aims at the requirement of environmental insurance when the preparation of EIA / Rhyme is necessary, however, still in process.

[12] Following the example of IEA Greenhouse R&D Programme (IEA GHG) “Remediation of Leakage from CO2 Storage Reservoirs, 007/2011, September 2007”, Orchard Business Centre. Stoke Orchard, CCheltenham Glos. GL52 7RZ. UK, 2007.

[13] ANP - National Agency of Petroleum, Natural Gas and Biofuels.

Since, as a result, civil liability is the one that aims to repair the damage, whether property or off-balance sheet, and the Federal Constitution of 1988 welcomed article 14, § 1 of Law No. 6.938 / 81, which already dealt with objective liability by damage to the environment, where the conduct of the agent causing the damage has nothing to do with its legality and is obliged to repair it.

Even with regard to long-term rules, which, as seen at international level, follow at least reasonable deadlines for the transfer of responsibilities and certificates with studies proving their stability, the claim of non-compliance could not be accepted in the current Brazilian legal system. responsibility. Moreover, even if some countries, such as those mentioned in the European Union, which adopt the theory of objective liability and may serve as a comparison, there has not yet been sufficient time for administrative and judicial discussion to conclude how any post-transfer liability demands of traders would be resolved.

This corroborates Romeiro-Conturbia's (2014) observation about long-term liability rules for a CO2 that says the storage site and any associated responsibilities (including measures to remedy damage) is one of the most challenging issues when designing a CCS legal and regulatory framework therefore, such as carbon capture and storage are relatively recent mitigation technologies.

There are currently no real cases of real conflicts with long-term liability, and therefore policy makers and scientists are challenged to anticipate questions about the extent of the possible damages and the type of liability that the parties will have to include and fulfill. Lack of definition of long-term liabilities and associated implications can increase the risks and costs for a CCS project.

But again, it is the environmental liability in Brazilian law that results from its own autonomous system in the context of liability, with special rules that apply to the matter, to the detriment of the general rules of the Civil Code that are not compatible with them and that is subject to a specific legal regime, established from the Federal Constitution and the National Environmental Policy Law, which does not include any mitigation rule for the full compensation of damage, being derogatory from the general regime of the Civil Code (MIRRA, 2019).

Thus, at the present stage of Brazilian Environmental Law, no limitation to the full reparability of environmental damage is accepted, as the right to the environment is unavailable, which means that no legislative provision, litigation agreement or court decision that has as its purpose or the effect of limiting the extent of compensation for environmental damage may be considered legitimate (MIRRA, 2019).

This means that the instruments analyzed here, such as environmental compensation and, eventually, the provision of financial guarantees and environmental quality standards, must be perfectly aligned with the interest in maintaining a balanced ecosystem. Therefore, it is possible to create legal instruments in Brazilian law that provide a balance between objective environmental liability and common time constraints in international law, through the establishment of funds, insurance or other forms of securitization. In addition, the reflections of CCS activities on property rights must be clear enough that social risk management can be raised for accountability in the event of a long-term transfer of rights and obligations.

6. Acknowledgement

The authors gratefully acknowledge support from FAPESP and SHELL Brazil through the ‘Research Centre for Gas Innovation – RCGI’ (FAPESP Proc. 2014/50279-4), hosted by the University of Sao Paulo,

and the support given by ANP (Brazilian National Oil, Natural Gas and Biofuels Agency) through the R& D levy regulation.

7. References

[1] ANP, Agência Nacional de Petróleo, Gás Natural e Biocombustíveis. Resolução ANP nº 46 de 01 de novembro de 2016. Aprova o Regime de Segurança Operacional para Integridade de Poços de Petróleo e Gás Natural. Disponível em: <http://nxt.anp.gov.br/NXT/gateway.dll/leg/resolucoes_anp/2016/novembro/ranp%2046%20-%202016.xml?f=templates&fn=document-frameset.htm>. Acesso em 10 dez. de 2017.

[2]_____. Glossário do Anuário Estatístico Brasileiro do Petróleo, Gás Natural e Biocombustíveis. Rio de janeiro: ANP, 1997. Disponível em: <www.anp.gov.br/wwwanp/?dw=82255>. Acesso em 10 dez. 2017.

[3]_____. Resolução ANP nº 27 de 18 de outubro de 2006. Aprova o Regulamento Técnico de Desativação de Instalações e especifica condições para devolução de áreas de concessão na fase de produção. Disponível em: <http://nxt.anp.gov.br/NXT/gateway.dll/leg/resolucoes_anp/2006/outubro/ranp%2027%20-%202006.xml?f=templates$fn=document-frame.htm$3.0$q=$x=$nc=7537>. Acesso em 10 dez. de 2017.

[4] BENSON, S.M. Lessons Learned from Natural and Industrial Analogues: Carbon Dioxide Capture for Storage in Deep Geologic Formations—Results from the CO2 Capture Project, Vol. 2. London: Elsevier Publishing, 2005. p. 1133-1141.

[5] BEZERRA, Fabiano César Petrovich; Cabral, Indhira; Evaristo, Michelle. Tipos de Sanções – Efetividade das Sanções Patrimoniais e Administrativas ao Dano Ambiental – Concomitância de Punições Aplicação à Indústria de Petróleo e Gás. In: Direito Ambiental aplicado à indústria do Petróleo e Gás Natural, Nobre Júnior, Edilson et al, Fundação Konrad Adenauer, 2005.

[6] BRASIL. Constituição Federal da República do Brasil, 1988. Available in:: http://www.planalto.gov.br/ccivil_03/constituicao/ConstituicaoCompilado.htm. Access in: 12 sep. 2018.

[7] BRASIL. Lei da Política Nacional do Meio Ambiente de 1981. Available in:: http://www.planalto.gov.br/ccivil_03/Leis/L6938.htm, 1981. Access in: 12 sep. 2018.

[8] BRASIL. Lei de Introdução às normas do Direito Brasileiro, 2012. Available in:: http://www.planalto.gov.br/ccivil_03/Decreto-Lei/Del4657compilado.htm. Access in: aug. 2018.

[9] BRASIL. Lei Federal n. º 10.406, de 10 de janeiro de 2002. Institui o Código Civil. Brasília: Casa Civil, 2002. Disponível em: <http://www.planalto.gov.br/ccivil_03/leis/2002/L10406.htm>.

[10] BUI, Mai et al, 2018. Carbon capture and storage (CCS): the way forward. In. Energy Environ. Sci., 2018, 11, 1062.

[11] CAVALIERI FILHO, Sergio. Programa de Responsabilidade Civil. 8. ed. rev. e ampl. São Paulo: Atlas, 2008.

[12] CCME, Canadian Water Quality Guidelines for the Protection of Aquatic Life SALINITY (Marine) https://www.ccme.ca/files/ceqg/en/backup/209.pdf.

[13] COELHO, F. U.. Curso de Direito Civil: Obrigações e Responsabilidade Civil. 5ª edição, São Paulo: Saraiva, 2012.

[14] COLOMBO, S.. O princípio da precaução no Direito ambiental. REMEA - Revista Eletrônica do Mestrado em Educação Ambiental, [S.l.], v. 14, set. 2012. ISSN 1517-1256. Disponível em: <https://www.seer.furg.br/remea/article/view/2889>. Acesso em: 10 dez. 2017.

[15] COSTA, Hirdan Katarina de Medeiros; SANTOS, M. M. ; MATAI, P. H. L. S. . Questões ambientais e Licenciamento ambiental - Cap. 17. In: José R. Simões Moreira. (Org.). Energias Renováveis, Geração Distribuída e Eficiência Energética.. 1ed.Rio de Janeiro: LTC editorial - Grupo GEN, 2017, v. 1, p. 354-367.

[16] COSTA, Hirdan Katarina de Medeiros. Princípio da Justiça Intra e Intergeracional e o Art. 225 da Constituição Federal de 1988. In: Hirdan Katarina de Medeiros Costa; Mariana Fernandes Miranda. (Org.). Temas de Direito Ambiental: 30 anos da Constituição. 1ed.Rio de Janeiro: Lumen Juris, 2018, v. 1, p. 151-172.

[17] COSTA, Hirdan K. de M.; MIRANDA, Mariana F.; MUSARRA, Raíssa M. L. M. M.; SANTOS, Edmilson M. dos. Environmental License for Carbon Capture and Storage (CCS) Projects in Brazil. Macrothink Institute, Journal of Public Administration and Governance ISSN 2161-7104 2018b, Vol. 8, No. 3.

[18] COSTA, Hirdan K. de M.; MUSARRA, Raíssa M. L. M. Salt Cave and Experimental Activity of CCS (Carbon Capture and Storage) in Brazil (mimeo), 2018.

[19] COSTA, Hirdan K. de M.; MUSARRA, Raíssa M. L. M; MIRANDA, Mariana F. The main environmental licensing requirements on CCS activities in Brazil. Sustainability & Development Conference, SDC 2018 Annual Meeting, University of Michigan, EUA, 2018c.

[20] COSTA, Sildaléia Silva. Seguro Ambiental: garantia de recursos para reparação de danos causados ao meio ambiente. Orientador: Prof. Dr. José Aroudo Mota Tese de Doutorado Brasília-DF, UNIVERSIDADE DE BRASÍLIA CENTRO DE DESENVOLVIMENTO SUSTENTÁVEL outubro/2011.

[21] COTTA, Michele Karina et al. Análise econômica do consórcio seringueira-cacau para geração de certificados de emissões reduzidas. Rev. Árvore [online]. 2006, vol.30, n.6 [cited 2019-10-08],pp.969-979. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-76220060006000012&lng=en&nrm=iso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622006000600012.

[22] COUTO E SILVA, C.. Principes fundamentaux de la responsabilité civile en droit brésilien et comparé, p. 9. s.d.

[23] DINIZ, M. H.. Curso de Direito Civil Brasileiro: Responsabilidade Civil. Volume 7. 26ª edição. São Paulo: Editora Saraiva, 2012.

[24] DOURADO, Maria de Fátima Abreu Marques. Responsabilidade civil ambiental. Disponível em:https://jus.com.br/artigos/7689/responsabilidade-civil-ambiental.

[25] DOWER, N. G. B.. Curso Moderno de Direito Civil. 3ª edição. Editora Nelpa; São Paulo, 2007.

[26] EPA, United States Environmental Protection Agency. Carbon Dioxide Capture and Sequestration. Washington: EPA, 2016. Disponível em: <https://www.epa.gov>. Acesso em 03 dez. de 2017.

[27] FIORILLO, C. A. P.. Curso de Direito Ambiental. 17ª edição. São Paulo: Editora Saraiva, 2017.

[28] GAGLIANO, P. S.; PAMPLONA FILHO, R. Novo Curso de Direito Civil: Responsabilidade Civil – Volume III. 8ª edição. São Paulo: Saraiva, 2010.

[29] GOSAC, Relatório PH4 / 37, Agência Internacional de Energia, Programa de Pesquisa e Desenvolvimento de Gases de Efeito Estufa, Cheltenham, Reino Unido, 2004; 96 pp.

[30] IEA, International Energy Agency. Carbon Capture and Storage. Available at: https://www.iea.org/topics/carbon-capture-and-storage/. Accessed on: 07 Sep. 2018.

[31] IPCC, 2018. Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Summary for Policymakers.

[32] INTERNATIONAL ENERGY AGENCY, IEA. Agência Internacional De Energia. Captura e Estocagem de Carbono. Available in: https://www.iea.org/topics/carbon-capture-and-storage/. Acesso em: 07 set. 2018.

[33] KETZER, J. M. Medina et al. Atlas brasileiro de captura e armazenamento geológico de CO2 = Brazilian atlas of CO2 capture and geological storage – Porto Alegre: EDIPUCRS, 2016.

[34] LEITE, Jose Rubens Moratto. Aspectos Processuais do Direito Ambiental. Rio de Janeiro: forense Universitária, 2004.

[35] MACHADO, Paulo Affonso Leme. Direito ambiental brasileiro. 18º ed. São Paulo: Malheiros Editores, 2010.

[36] MAIA, Álvaro. Central Co2 Disposal Station of Santos Basin, mimeo. Set. 2018.

[37] MILARÉ, Edis. Direito do Ambiente: a gestão ambiental em foco: doutrina, jurisprudência, glossário. 6. ed. São Paulo: Ed. Revista dos Tribunais, 2009.

[38] MIRANDA, P. de. Direito das obrigações: direito de obrigações, fatos ilícitos absolutos. Atualizado por Rui Stoco – São Paulo: Editora Revista dos Tribunais, 2012. p. 93.

[39] MIRRA, Álvaro Luiz Valery. Responsabilidade civil ambiental e a reparação integral do dano, Conjur, 2016. Disponível em: https://www.conjur.com.br/2016-out-29/ambiente-juridico-responsabilidade-civil-ambiental-reparacao-integral-dano.

[40] MMA, Ministério do Meio Ambiente. Efeito estufa e aquecimento global. Available in: http://www.mma.gov.br/clima/energia/item/195-efeito-estufa-e-quequecimento-global. Access in jun de 2019.

[41] MONTEIRO, W. B. Curso de Direito Civil: Direito das Obrigações. 37ª edição. São Paulo: Saraiva, 2010. p. 603.

[42] MORAIS, R. F. V.; REIS, D. F.; PEDROZA, D. C. Auditoria de Conformidade Legal: Compliance Ambiental na prática. 1. ed. RIO DE JANEIRO: LUMEN JURIS, 2018. v. 300. 252p.

[43] MUSARRA, Raíssa Moreira Lima Mendes. Termo de Ajustamento de Conduta e Ação Civil Pública. Trabalho de Conclusão de Curso, Especialização em Direito Público, Universidade Gama Filho, Rio de Janeiro, 2009.

[44] NARDELLI, Aurea Maria Brandi e GRIFFITH, James Jackson. Mapeamento conceitual da visão de sustentabilidade de diferentes atores do setor florestal brasileiro. Rev. Árvore [online]. 2003, vol.27, n.2 [citado 2019-10-08], pp.241-256. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-67622003000200013&lng=pt&nrm=iso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622003000200013.

[45] NISHI, Marcos Hiroshi et al. Influência dos créditos de carbono na viabilidade financeira de três projetos florestais. Rev. Árvore [online]. 2005, vol.29, n.2 [citado 2019-10-08], pp.263-270. Disponível em:<http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-67622005000200009&lng=pt&nrmiso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622005000200009.

[46] NOVAES FILHO, João Paulo et al. Distribuição espacial de carbono em solo sob floresta primária na Amazônia meridional. Rev. Árvore [online]. 2007, vol.31, n.1 [cited 2019-10-08], pp.83-92. Available from:<http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-67622007000100010&lng=en&nrm=iso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622007000100010.

[47] PEREIRA, C. M. S.. Instituições de Direito Civil: Volume III – Contratos. 15ª edição. Rio de Janeiro: Forense, 2011. p. 529.

[48] PEREIRA, C. M. S.. Instituições de Direito Civil: Volume III – Contratos. 15ª edição. Rio de Janeiro: Forense, 2011.

[49] POP, Anda. The EU Legal Liability Framework for Carbon Capture and Storage: Managing the Risk of Leakage While Encouraging Investment, 2018. Disponível em https://www.abdn.ac.uk/law/documents/ASLR_Vol6_Dec15_32-56_Pop.pdf

[50] REZENDE, D. Sequestro de carbono: uma experiência concreta. 2ª edição. Palmas: Instituto Ecológico, 2002.

[51] RIZZARDO, A. Responsabilidade Civil. 3ª Edição. Rio de Janeiro: Forense, 2007.

[52] ROMEIRO-CONTURBIA, V. R. D. S. Carbon Capture and Storage Legal and Regulatory Framework in Developing Countries: Proposals for Brazil. (2014) PhD Dissertation, Institute of Energy and Environment, University of São Paulo.

[53]SENADO FEDERAL. Entenda o PreSal. Disponível em https://www12.senado.leg.br/noticias/entenda-o-re/pre-sal. Acesso em junho de 2019.

[54] SETTE, Marli Teresinha Deon, Manual de Direito Ambiental. Curitiba: Juruá, 2013.

[55] SILVA, Rodrigo Firmino da et al. Projeção do estoque de carbono e análise da geração de créditos em povoamentos de eucalipto. Rev. Árvore [online]. 2008, vol.32, n.6 [cited 2019-10-08], pp.979-992. Available from: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-67622008000600003&lng=en&nrm=iso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622008000600003.

[56] SOARES, Carlos Pedro Boechat and OLIVEIRA, Marcio Leles Romarco de. Equações para estimar a quantidade de carbono na parte aérea de árvores de eucalipto em Viçosa, Minas Gerais. Rev. Árvore [online]. 2002, vol.26, n.5 [cited 2019-10-08], pp.533-539. Available from:<http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-67622002000500002&lng=en&nrm=iso>. ISSN 0100-6762. http://dx.doi.org/10.1590/S0100-67622002000500002.

[57] TOZZI, Rodrigo Henrique Branquinho Barboza. As Teorias do Risco na Responsabilidade Civil Ambiental. Disponível em http://www.lex.com.br/doutrina_24857023_AS_TEORIAS_DO_RISCO_NA_RESPONSABILIDADE_CIVIL_AMBIENTAL.aspx

[58] UNFCCC - United Nations Framework Convention on Climate Change. Modalities and Procedures for Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Mechanism Project Activities. http://unfccc.int/files/meetings/durban_nov_2011/decisions/application/pdf/cmp7_carbo n_storage_.pdf Last accessed in February, 2014.

[59] UNITED NATIONS ORGANIZATION, UN. ORGANIZAÇÃO DAS NAÇÕES UNIDAS. Conferência das Nações Unidas sobre Meio Ambiente e Desenvolvimento (Agenda 21), adotada de 3 a 14 de junho de 1992. Available: http://onu.org.br/rio20/img/2012/01/rio92.pdf.

Development of Mathematical Worksheet for Junior High School Based on Guided Discovery Oriented by PISA

Yerizon1*, Dony Permana1 and Cici Afrilia1
1Universitas Negeri Padang, Indonesia
*corresponding author: yerizon@fmipa.unp.ac.id
phone: +6281363455577

Abstract

The problem solving ability is one of the most important skills to students. However, in reality these skills do not seem to have been optimally achieved in schools, as students are less involved in the development ofthe concepts learnt and teacher-centered learning. Possible efforts are the development of a guided, discovery-based worksheet based on the PISA model. In which the students are given instructions to understand the concept directly. Students are then asked key questions so that they can think, analyze by themselves, and are confident in dealing with arguments. The purpose of this study is to create a worksheet based on a guided discovery that is PISA-based and valid, practical and effective in improving students' problem solving skills. This research is a bulging research model consisting of four internships. The subjects of this study was the 7th grade students or SMP N 1 Lembang Jaya. The tools used were validation, internship sheets, interview guidelines, observational sheets and questionnaires. The results obtained are valid worksheets and can be well understood by the students.

Keywords: Guided Discovery, PISA, Problem Solving

1. Introduction

The problem-solving ability is an essential capability that students must possess. Furthermore the overall aim of studying mathematics in high school is to enhance this skill (Nasution and Yerizon, 2019). This skill is the ability for students to accurately identify any appropriate data that requires problem-solving, create mathematical models, to choose and implement strategies, to interpret results according to original problems and to verify the truth of results or answers (Susanti, 2017)..

Unfortunately this ability is not yetoptimalfor Indonesian students as seen from the PISAresults(Program for International Student Assessment). An international assessment by the OECD on the skills and competences of 15-year-old students (OECD, 2013; Shiel et al., 2007), the age at which students in most countries end compulsory education (Stacey, 2011).Skills and abilities assessed in PISA include math, reading and science (OECD, 2013; Stacey, 2012), PISA was first implemented in 2000 and then held every 3 years (Stacey and Stephens, 2008). The results of other studies also showed the same results (Kim, 2014; Hunter, 2015; Amir, 2015; Lein, 2016; Widodo, 2017; Yuniwati, 2017; Suastika, 2017).. This is due to students not being used to solving problems which PISA deemed examinable under their problem criteria.

PISA questions are developed and based on content, context and competence (OECD, 2013). The four main forms of content includes: form and space, change and relationship, quantity and uncertainty. While in the context of the PISA question consists of four, namely with regard to the situation / personal context (personal), work (professional), social / general (social) and scientific (scientific). Competencies in PISA are then classified into three groups (clusters), namely reproduction, connection and reflection (OECD, 2013).

For this reason it is most necessary to include the PISA model questions when learning. The student worksheet (SW) is then made with a guided discovery model by entering the PISA question model (Khasanah et al, 2017). The steps of learning with Guided Discovery are as follows: (1) Stimulation, (2) Problem definition, (3) Data collection, (5) Verification (6) Generalization. The guided discovery model gives students the opportunity to learn by involving their minds in thinking, reasoning and solving problems to find the final results (Yerizon et al, 2018).. Anything obtained in this way will be more meaningful and remembered for longer (Wijayanti, 2016); Yurniwati, 2017).

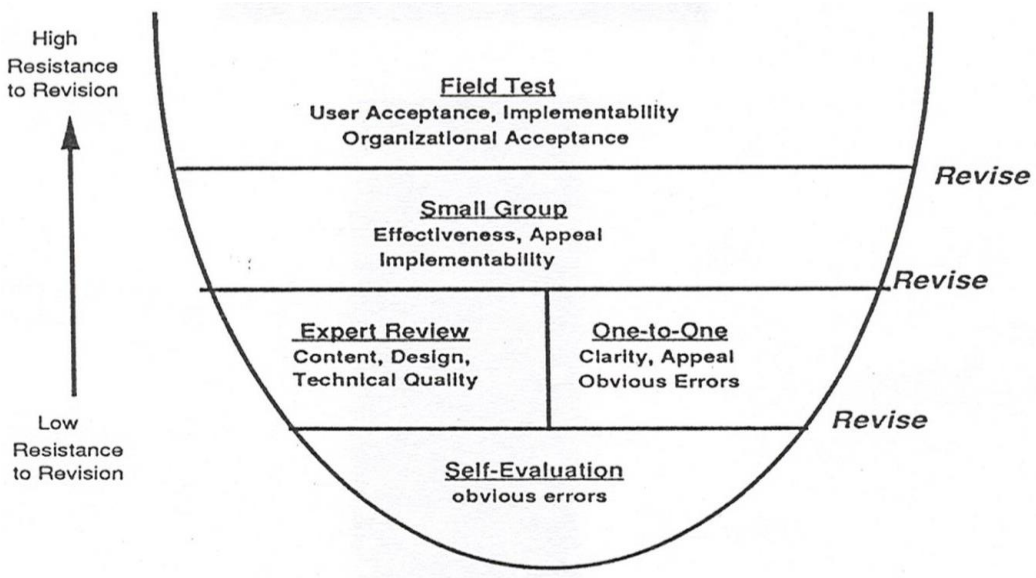
Some of the benefits of the guided discovery model are (Hosnan, 2014):

a. Contributes to students' improvementin their cognitive skills and processes.
b. Can help to improve the ability of students to solve problems.
c. The knowledge gained through this strategy is very personal and powerful because it strengthens understanding, memory and transfer.
d. Encourages students to direct their own learning activities by involving their own spirit and motivation
e. Students will better understand basic concepts and ideas
f. Encourage students to think and work on their own initiative
g. Encourage the involvement of student activity
h. Gives satisfaction to students
i. Can increase motivation
j. Train students to learn independently

By applying this discovery model, individual talents and skills can be developed to achieve good results. This result is supported by various previous studies (Akanmu, 2013; Rahmawati, 2016; Adelia, 2017). For this reason it is necessary to make a student worksheet based on guided discovery of the PISA questions (SW-DL-PISA).

2. Methods

This research is based on the Plomp model developed by Tjeerd Plomp that consists of three phases, namely preliminary research, development or prototype phase and assessment phase that has also been used by previous researchers (Plomp, 2013). The development phase refers to formative evaluation (Nievenn, 1999) as Figure 1 .



Picture1. The formative Evaluation Layer of the Plomp Development Model

3. Result and Discussion

PISA questions are developed based on content, context and competence (OECD, 2013),

a. Math content

The mathematical content in PISA is determined on the basis of the results of in-depth studies and on the basis of consensus between OECD countries, so that students' performance can be compared internationally by taking into account the diversity of each participating country. The content is divided into four parts: 1) space and form, 2) change and relationship, 3 quantity and 4) uncertainty.

b. Mathematical competence

PISA does this by looking at the ability to reason, analyze, communicate ideas, formulate and solve problems. Competences in PISA are subdivided into three clusters, namely reproduction, connection and reflection (OECD, 2013).

c. Mathematical context

In PISA, the mathematical context is divided into the following four situations:

1. Personal context directly related to the daily activities of students.
2. Educational and work contexts related to the lives of students at school and / or at the workplace.
3. General context with regard to the use of mathematical knowledge in social life and the wider environment in daily life.
4. Scientific context that is specifically related to scientific activities, that is more abstract in nature and requires understanding and command of theory in solving mathematical problems.

3.1. The result of One to one evaluation

In the previous activity it appeared that SW-DL-PISA was valid in terms of content, construction, graphics and language. The “one on one” evaluation method was then utilized. The “one on one” evaluation was performed on 3 students from class VII of SMP Negeri 1 Lembang Jaya. The three students have different academic skills, 1 student with high level skills, 1 student with an average skills and 1 student

with low skills. Students are asked to read, respond to and work on SW-DL-PISA. Researchers conducted a “one-on-one” evaluation of 6 SW with the following description:

In SW 1 there are typos in the SW instructions. The obstacles that students encounter when working on SW 1 are that students do not fully understand the existing instructions, students often ask questions so that they still need guidance from researchers so that students understand the use of the SW 1 offered. Students do not understand how to conclude the concept material of any given activity. Students have difficulty putting together their own sentences, so they need guidance from the researcher. Subsequently, students in problem 2 ofSW 1 do not understand the assignment sentence in SW 1, namely "note the number line in point 2". Students don't understand the purpose of point 2 in the assignment sentence, so a review of the question phrase is needed to better understand it. In the practice questions on SW 1, students still have difficulty answering, students are not used to working on PISA model problems. So much supervision is needed from researchers so that students understand the purpose of the problem. From the observations of researchers it can be concluded that SW 1 still needs a review of the errors found.

In SW 2, students still have difficulty in concluding the concepts in each activity. But students have come to understand the command questions in SW 2. Students are still confused to conclude the material concept of each activity, so the “conclusions” column is still empty. In addition, students find unclear question assignments in SW 2, so that students are confused in answering and asking researchers questions. Then exercise number 2 on SW 2 is still categorized by students as difficult, so it requires guidance from researchers to understand the problem. From the results of researchers' observations, it can be concluded that SW 2 still needs a review of the errors found. The same results can still be found in SW 3, 4 and 5.

The one-on-one evaluation activities on SW 6 were conducted in the same way as the previous meeting. The subject at meeting 6 was "multiplication and fraction distribution". Based on the results of observations on SW 6, students found no typos. The instructions for using SW are clear enough and can be understood by students. In SW 6 the students did not understand, the PISA questions are in the form of story questions. Students also still have difficulty completing the concept as a whole, so students need guidance from the researchers. It can be concluded from the results of researchers' observations that SW 6 has not been revised.

General results of observations on SW 1 to SW 6 are shown in Table 1.

Table 1. Summary of the results of the observation phase of*One to one Evaluation*

SW	Observation Results
SW 1	There was a review of typing, the instructions on the SW were not fully understood by the students, so they still needed guidance from the teacher.
SW 2	There was a revision in typing, the students began to understand the instructions in SW, but still had difficulty filling in the PISA questions that were asked.
SW 3	There is a revision in typing, students have tried to solve the problem of the PISA model in SW, but still need guidance from the teacher, students still have a lot to ask ..
SW 4	There is a revision in typing, among students have been able to solve the problem of the PISA model in SW, but still need

	guidance from the teacher
SW 5	There is a revision in typing, students still need guidance from the teacher when working on PISA questions.
SW 6	There are no mistakes when typing, students still need guidance from teachers when working on PISA questions, because there are still things that students don't understand.

3. 2 The Result of Small group evaluation

After performing one-to-one evaluation activities, improvements were made to SW-DL-PISA. The following activity is an evaluation of a small group. This small group evaluation was performed on 6 students from class VII of SMP Negeri 1 Lembang Jaya with different academic skills. In this activity, students are divided into 2 groups, with 1 group consisting of 3 students consisting of 1 person with high capacity, 1 person with moderate capacity and 1 person with low capacity. Evaluation activities of small groups conducted during 6 meetings on the material numbers.

During the evaluation of the small group, the researcher was assisted by an observer who had to observe the implementation of learning using SW-DL-PISA. Observations were made about the acceptance and enthusiasm of students about the learning process, the implementation of the learning process, the suitability of the time with the allocation of available time, as well as the activities of the teacher and students.

The following are the results of the activities carried out during the evaluation process for small groups.The overall results of the small group evaluation in the form of an observer evaluation from meeting 1 to meeting 6 are shown in Table 2.

Table 2. Summary of the Results of the Observation Phase of Small Group Evaluation

Meeting	**Hasil Observasi**
1	Students are confused at completing SW and many ask the teacher that the time used is not in accordance with the specified assignment.
2	Students started with enthusiasm in learning, but have not been too active and are also guided by many teachers in solving problems in SW, especially many PISA questions, which are still not understood.
3	Students get used to having discussions, but the time allocation is not suitable. Students have become accustomed to PISA-oriented problems, but they still need guidance.
4	The discussion has already active so that students are enthusiastic and enjoy learning.
5	Time allocation is appropriate and the learning process is in accordance with the lesson plan.
6	Learning is going well, students have become active, but the time used is not in accordance with the specified assignment

The results of the one-to-one review and a small group review were continued with the field test. The assessment phase is performed to determine the usability and effectiveness of the developed SW-DL-PISA. Field tests were performed on 30 students of group 4 of SMP Negeri 1 Lembang Jaya. In practice, students are divided into 5 groups, with each group consisting of 6 students. Field tests were performed 6 times.

The practical data of SW-DL-PISA were obtained from the questionnaire of the teacher, the questionnaire of the students' answers to the SW. The results of the teacher questionnaire analysis are shown in Table 3.

Table 3. General answers from teachers to questionnaire in field tests

No	Aspects	Practicality	Category
1	Ease of use	75%	Practical
2	Attractiveness	75%	Practical
3	Allocation of Time	75%	Practical
4	Ease of Understanding	75%	Practical
5	Advantages of Student Worksheet	100%	Very Practical
The Average Practicality		**80%**	**Practical**

In Table 3 above we can see that the results of the teacher's overall answers to usability have been given a practical value of 80%. The usefulness of SW-DL-PISA is explained on the basis of the established criteria. It can therefore be concluded that the teacher is of the opinion that SW-DL-PISA is practically used in learning mathematics in grade VII of high school.

Answers to questionnaires from students that have been completed after students have learned with SW-DL-PISA. The results of the analysis of the answers to the student's questionnaire are shown in Table 4.

Table 4. The Results of the Analysis of the Answers to the Student's Questionnaire

No	Aspects	Practicality	Category
1	Ease of Use	88,37%	Very Practical
2	Attractiveness	77,56%	Practical
3	Allocation of Time	83,62%	Practical
4	Easeof Understanding	82,25%	Practical
5	Advantages of Student Worksheet	89%	Very Practical
The Average Practicality		**84,16%**	**Practical**

In table 4 above we see the results of the answers to the questionnaire obtained from students with practical values of 84.16%. The SW-DL-PISA is explained on the basis of the established criteria.

Observations of the implementation of learning is focused on seeing if learning has been carried out according to the steps of the guided discovery and identifying the obstacles experienced during the implementation process. Observation of the implementation of learning is intended to see if learning is consistent with what is designed. Observation was performed 6 times.

Based on observations, the teacher explains to students about the instructions for using SW that are not understood. Students are guided by the teacher to find the concept of the material by working on the activities in SW. Students are also trained to conclude the concept of material in each activity in SW 1, but

when implementing learning, students still have difficulty compiling sentences to conclude the concept of each activity, students still have a lot to ask to the teacher.

When answering PISA-oriented problems that exist in SW 1, there are still many people who are confused to answer. So the teacher meets every group experiencing difficulties and tries to guide students in answering questions in SW 1 that they don't understand.

During the 2nd meeting When the students have tried to solve the problem, but there are still questions that they do not understand, the teacher tries to explain the questions that the students do not understand. At the end of the lesson, students are asked to collect the work that SW has done. The teacher invites students to conclude as a whole about the material "sorting and comparing fractions". In the final phase, the teacher informs about learning for the next meeting and ends the learning by saying greetings.

The learning process went very well during the fifth and sixth meetings, students already understood the steps to be taken. After SW 5 and 6 are completed, the teacher appoints a group to present their work to the class. Other groups are asked to compare their work with that of the presenter groups. After the presenter group presents their work, the other groups respond enthusiastically if there are answers that differ from what they get.

Based on these results, it can be said that SW-DL-PISA can help teachers improve students' problem-solving skills. With the PISA model questions, students are trained to develop their skills (Hartono et all, 2017). This is in line with earlier research that has shown that the guided discovery model can improve students' mathematical skills (Marta et al, 2017; Khomsiatun et al, 2015). This way SW-DL-PISA can be used well by teachers and students.

4. Conclusion

Based on the results of the study, it concluded that:

1. SW-DL-PISA can be well understood and used by students.
2. SW-DL-PISA can help students improve their math skills. well used by teachers and students.

5. References

[1] Adelia, Windah Sari dan Edy Surya. Resolution to Increase Capacity by using Math Students Learning Guided Discovery Learning (gdl). International Journal of Sciences: Basic and Applied Research (IJSBAR) Volume 34, No 1, (2017). pp 144-154

[2] Akanmu, M. Alex dan M.Olubusuyi. Guided-discovery Learning Strategy and Senior School Student Performance in Mathematics in Ejigbo, Nigeria. Journal of Education and Practice, ISSN 2222-1735 (Paper) ISSN 2222-288X (Online), Vol.4, No.12. (2013).

[3] Amir, Mohammad Faizal. Pengaruh pembelajaran kontekstual terhadap kemampuan pemecahan masalah matematika siswa sekolah dasar. Prosiding Seminar Nasional Pendidikan : Tema “Peningkatan Kualitas Peserta didik melalui implementasi Pembelajaran Abad 21” Fakultas Keguruan dan Ilmu Pendidikan Universitas Muhammadiyah Sidoarjo. (2015).

[4] Hartono, Wahyu dan Muchamad Subali Noto. 2017. Pengembangan Modul Berbasis Penemuan Terbimbing untuk meningkatkan Kemampuan Matematis pada perkuliahan Kalkulus Integral. Jurnal JNPM

(Jurnal Nasional Pendidikan Matematika) Vol. 1, No. 2, September 2017. pp. 320

[5] Hosnan. Pendekatan Saintifik dan Kontekstual dalam Pembelajaran Abad 21. Bogor : Ghalia Indonesia. 2014.

[6] Hunter, R. Pengembangan perangkat pembelajaran untuk meningkatkan kemampuan pemecahan masalah matematis dan self efficacy siswa. Jurnal Pendidikan Matematika dan Terapan FKIP–Univ. HKBP Nommensen,Vol. 1, 2015. Hal. 1-14.

[7] Khasanah, et al. Guided Discovery Learning in Geometry Learning. International Conference on Mathematics, Science and Education 2017 (ICMSE2017).

[8] Khomsiatun, S dan Heri, R. Pengembangan Perangkat Pembelajaran Dengan Penemuan Terbimbing Untuk Meningkatkan Kemampua Pemecahan Masalah. Jurnal Riset Pendidikan Matematika Volme 2 – Nomor 1. (2015).

[9] Kim, K. The relationship between problem solving ability, professional self concept, and critical thinking disposition of nursing students. Namseoul University. Interenational Journal of Bio-Science and BoiTechnology. 6, 2014. Hal. 131-142.

[10] Lein, A.El. Assessing the relation between seventh- grade students engagement and mathematical problem solving performance. Journal Preventing School Failure, Vol. 60, 2016. Hal. 117-123

[11] Martaida, T et al. The Effect Of Discovery Learning Model On Student's Critical Thinking And Cognitive Ability In Junior High School. IOSR Journal of Research & Method in Education (IQSR-JRME) e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 6 Ver. 1 (2017).

[12] Nasution, D, Yerizon, Development Of Student Worksheets Based On Discovery Learning To Improve Student Mathematical Problem Solving Ability In Class X Senior High School. International Journal Of Scientific & Technology Research Volume 8, Issue 06 June 2019 Issn 2277-8616228

[13] Nieveen, N. Design Approaches and Tools in Education and Training. Netherlands: Kluwer Academic Publishers. 1999.

[14] OECD, PISA 2009 Results: Executive Summary. (2013)

[15] Plomp, T. An Introduction to Educational Design Research :SLO – Netherlands Institute for Curriculum Development. 2013.

[16] Rahmawati, D. Meningkatkan Pemahaman Konsep Siswa Kelas X IPS dalam Belajar Matematika Guided Discovery Instruction. A Journal of Language, Literature, Culture, and Education POLYGLOT Vol. 12, No.2. (2016).

[17] Sahrudin, A Implementasi Strategi Pembelajaran Discovery Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis da Motivasi Belajar Siswa SMA. Jurnal Pendidikan UNSIKA, Volume 2 Nomor 1, (2014). ISSN 2338 2996.

[18] Stacey, K. & Stephens, M. Performance of Australian school students in international studies in mathematics. Schooling Issues Digest 2008/1. Canberra: DEEWR. (2008).

[19] Suastika, Ketut. Mathematics Learning Model of Open Problem Solving to Develop Students' Creativity. International Electronic Journal Of Mathematics Education E-Issn : 1306-3030, Vol. 12, No. 3, 2017. pp. 569-577.

[20] Susanti. Pengembangan Perangkat Pembelajaran Matematika Materi Statistika Berbasis Penemuan Terbimbing untuk meningkatkan Kemampuan Pemecahan Masalah Matematis Materi Statistika. Jurnal

JNPM (Jurnal Nasional Pendidikan Matematika) September 2017 Vol. 1, No. 2, 2017. Hal. 305

[21] Widodo, S. A. Development of teaching materials algebraic equation to improve problem solving. Infinity, Journal of Mathematics Education. 6 (1): 2017. 59-68.

[22] Wijayanti, D. Pengembangan Perangkat Pembelajaran Statistika Dan Peluang Dengan Metode Penemuan Terbimbing Berorientasi Kurikulum 2013 Untuk Siswa Kela X. Jurnal Riset Pendidikan Matematika Volume 3, Nomor 1. (2016).

[23] Yerizon, Putra, AA, Subhan, M. Mathematics Learning Instructional Development based on Discovery Learning for Students with Intrapersonal and Interpersonal Intelligence (Preliminary Research Stage). International Electronic Journal of Mathematics Education E-Issn: 1306-3030, Vol.13,No.3, 2018. 97-101

[24] Yurniwati. Improving mathematics achievement of indonesian 5th grade students through guided discovery learning. Journal on Mathematics Education Volume 8, No. 1, 2017. Hal 77-84

Technology-Enhanced and Personalised Laboratory Learning Experience for Undergraduate Electrical Engineering and Electronics Students

Ali Al-Ataby and Waleed Al-Nuaimy
Department of Electrical Engineering and Electronics, University of Liverpool, Liverpool, UK
Emails: aliataby@liverpool.ac.uk, wax@liverpool.ac.uk

Abstract

Teaching large and multicultural cohorts in lecture theatres is often a challenging task, and it becomes more challenging when it comes to laboratory teaching where students carry out practical work is involved. Students often complain about the quality of delivery with regards to the support they get from teaching assistants and technicians, and the lack of meaningful and personalised feedback they receive afterwards. Taking into consideration the fact that cohort sizes are often caused to increase from year to year, a serious sustainability issue therefore arises. Students in such cohorts may eventually disengage from their studies as a result of their perception of a lack of personalised learning experience. This often combines with other compounding factors into a downward spiral of disillusionment and demotivation that further jeopardises their studies and makes subsequent re-engagement less likely. Furthermore, the physical capacity restrictions of the laboratories and resources impose a further limit on how work is organised, and with constant budget cuts and increasing expectations and workloads, some form of crisis may seem inevitable.

This paper portrays how such a crisis was averted by implementing a package of transformational change delivered in a planned, incremental fashion over a period of 5 years to bring a notable improvement in the overall laboratory and practical coursework provision to second year Electrical Engineering and Electronics students, by employing a number of innovative approaches to enhance student experience. Moreover, the incorporation of tools such as instructional videos, online pre-lab and post-lab questions, blogs for student projects, weekly FAQs and Twitter feeds were particularly innovative and effective in their deployment, and resulted in a win-win situation in which both students and staff were able to communicate instantly and asynchronously in a manner that was hitherto not possible. This is particularly timely as the continuous increase in student numbers means that such techniques will be used increasingly. As a result, student satisfaction has improved in a steady and quantifiable manner, with a 29% increase over three academic years.

Keywords: Technology-enhanced learning; personalised lab experience; large cohorts; multicultural; student satisfaction; personalised feedback; motivation; engagement.

1. Introduction

In the current educational environment, class sizes are often under pressure to increase, resulting in a unique set of learning and teaching issues related to large cohort teaching. Such large cohorts (in this context, 'large' refers to classes in excess of 150 students) are predominantly encountered in the first and second years of study in many universities. This often accompanies a further commitment from the academic staff to support students at these stages to help them in the process of transition to university

while introducing them to their new discipline. Accordingly, academic staff require skills and expertise such as developing and delivering effective teaching sessions, engaging students, audience management and control, and experience with interactive learning tools (Al-Ataby, 2016). In line with this, many science and engineering faculties around the world are facing a common issue regarding student satisfaction with laboratory teaching (Nikolic et al, 2015). Since the early days of engineering education, laboratories have been a vital and integral part of undergraduate and post-graduate programmes, and addressing students' needs and requirements while carrying out practical work have been a major concern. Student satisfaction is paramount in many universities because of the competitive nature of the higher education market. In the UK, national student survey (NSS) (NSS, 2017) has added to that competition for national and overseas students. Moreover, accreditation bodies (such as the IET) consider laboratory/practical skills to be part of the learning and teaching programme outputs (NSS Academic Accreditation, 2015). To improve student experience and satisfaction for such large and multicultural cohorts in laboratories, and to deliver personalised and rich experience, technology may be adopted to address the related problems (Kukulska-Hulme, 2012).

Information technology (IT) tools are now embedded in many people's daily lives and they are greatly incorporated in higher education environment nowadays. The majority of today's students are highly digitally literate, mobile, always connected (on-line) and efficient at multitasking during classes (Oblinger, 2004). The National Union of Students (NUS) has requested universities and academic staff to review the adopted teaching methods and to evaluate whether they are adequately making use of new technologies or not. Furthermore, the Higher Education Funding Council for England (HEFCE) has commissioned the NUS to carry out research to gather student perspective about technology and to assess the need, awareness and training required for students in higher education. The results of this research have shown without a doubt that the students believe that the use of technology would definitely improve their learning experience (NUS, 2010). Furthermore, the students have requested that their academic staff should use more technological tools in teaching, and they think that lecturers need more training when it comes to the use of technology. The research also showed that that the students have asked for the use of the state-of-the-art tools in teaching, and requested this to be an integral part of their learning experience. The students also requested that the electronic Blackboard system (or more generally, the VLE: Virtual Learning Environment) should be integrated with the lectures, laboratories and entire learning and teaching process (NUS, 2010).

This paper presents a package of transformational change that is based on the use of a number of innovative tools to substantially improve student satisfaction and experience with teaching laboratories. Moreover, the incorporation of tools such as instructional videos, pre- lab and post-lab online questions, blogs for the student projects, weekly FAQs and the Twitter feed were particularly innovative and effective in their deployment, and resulted in a win-win situation in which both students and staff were able to communicate instantly and asynchronously in a manner that was hitherto not possible. This is particularly timely as the sharp increase in student numbers will mean that such techniques will be used increasingly. Student feedback has improved in a steady and quantifiable manner, and student satisfaction rate has gone up from 68% to 88% in three academic years.

This paper is organised as follows: next section is about laboratory teaching methods and process; Section 3 is about the case study used in this paper; Section 4 is showing performance results and Section 5 is conclusions.

2. Laboratory Teaching

Laboratory work is an integral part in engineering education to the level that no engineering programme can be respected, accredited or approved without laboratories and some level of practical work (Feisel and Rosa, 2005, Wolf, 2010, Nikolic et al, 2015). Laboratory teaching offers unique skills to students such as team work, time management, problem solving, ethics and research skills. It requires a high level of interaction with peers, academic and support staff, teaching assistants and laboratory technicians. Lab teaching staff must have the appropriate skill set in order to be able to deliver successful lab sessions. Examples of these skills are communication, facilitation and crowd management, in addition to the specialist technical skills and knowledge. On the other hand, laboratory teaching suffers from a number of serious issues, especially with large and multicultural cohorts. Students often complain about the quality of delivery with regards to the support they get from teaching assistants and technicians, and the lack of meaningful and personalised feedback they receive afterwards. Subsequently, this contributes to the disillusionment and demotivation of the students that further jeopardises their studies and makes subsequent re-engagement less likely.

3. Research Methodology and Case Study

In this paper, a laboratory module for second year students will be used as a case study. This is a 15-credit module consisting of assessed practical experiments, coursework, reports and a group project, and is delivered across two semesters (full academic year). The students that are enrolled in this laboratory module are the UK home and EU students, a few international students from the Middle East and Africa, and a majority direct intake students from a partner university in China (referred to here as XJTLU), with an overall of over 300 students. Accordingly, it is both a large and highly diverse student cohort. This module is essential and is a core module for Electrical Engineering and Electronics students because it fosters a range of skills (hands-on and transferable) required for any electrical/electronics engineer. It requires a solid foundation in electrical and electronic circuit theory and design, mathematics, besides other knowledge and skills such as software development and engineering ethics.

This lab module was known to have a high workload, and it is not very popular amongst students. Student satisfaction rating was consistently low (in the range of 50- 60% in the best of cases). Furthermore, the level of student engagement and enthusiasm in this module was a real concern. Students used to give negative comment about the amount and quality of feedback that they receive after carrying out an experiment or submit a report/coursework, besides the complicated process to run the labs/experiments and the vague instructions, not to mention components/equipment problems. Equally, this module was a burdensome on teachers, teaching assistants and administrative staff.

To address the aforementioned issues, and to improve student experience, a package of transformational change was suggested and implemented over three years by remodelling lab delivery by employing a set of innovative tools that have substantially improved student engagement. Subsequently, a number of tools and utilities have been chosen and tested to engage the students in the large cohort with the labs and provide better quality and timely feedback. The tools were mainly self-developed, along with other tools that were off-the-shelf. It is worth mentioning that these tools were used in the Electrical Engineering and Electronic Department for the first time. The main motive behind using these innovative tools was to engage the students in- and off-labs through the localised version of the VLE (referred to VITAL or Virtual Interactive Teaching At Liverpool). The used tools and utilities were integrated within this VLE for student convenience and to avoid the burdensome of accessing various systems, portals and websites (Cann, et al, 2002). In this case, the VLE is considered as a single point of access for the students to all the tools for better experience (O'Leary and Ramsden, 2013, Salmon, 2001). Figure 1 shows the list of tools in the Learning Resources page of the VLE.

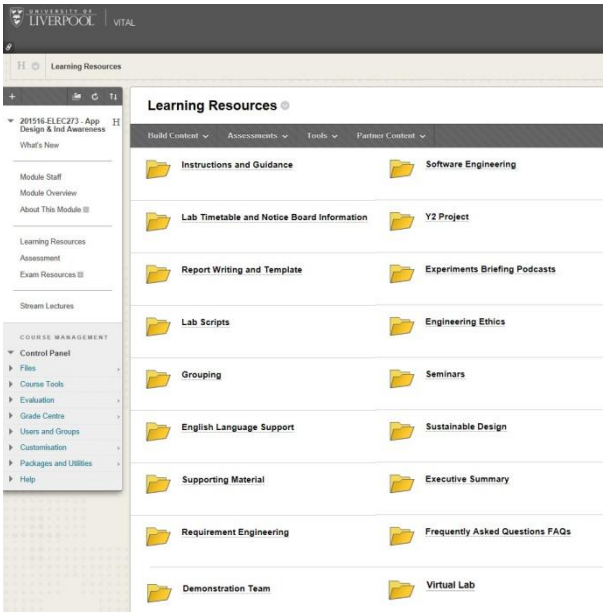


Figure 1. Folders accessible from Learning Resources page of the VLE.

The following sub-sections provide a brief description of some of the tools used in this research:

3.1. The Virtual lab tool

Student often complain about the lack of time to carry out practical work. Moreover, the labs are only accessible in certain times because technicians and safety staff must be present. Students would like to test various theoretical concepts practically, and the practical sessions cover a small range of these concepts only. Simulation tools and software packages can be used as a way to help students practice some of these theoretical concepts. As a result, a virtual lab tool was created and made available to the students through the VLE. The tool was built using GeoGebra, which is a Java-based free web tool. Experiments can be designed using this tool and students can run these and even collect data, measurements and test different component values. Since these experiments are available in the VLE, they are accessible anytime from any device (mobile or PC) with any operating system because the tool is cross-platform and the experiments are embedded in the VLE. Figure 2 and 3 show two examples of the virtual experiments.

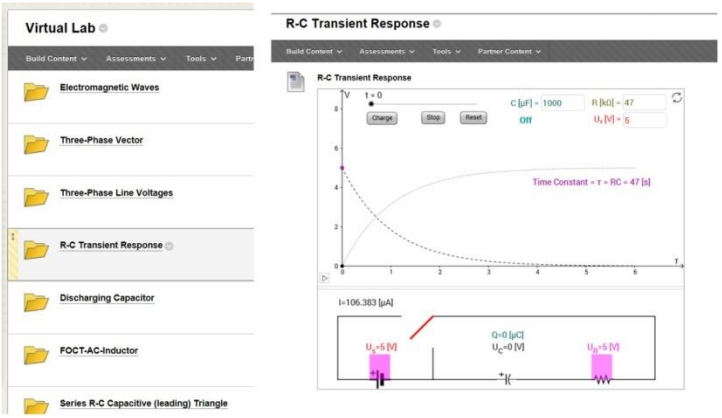


Figure 2. Virtual Lab Tool - Transient Circuit.

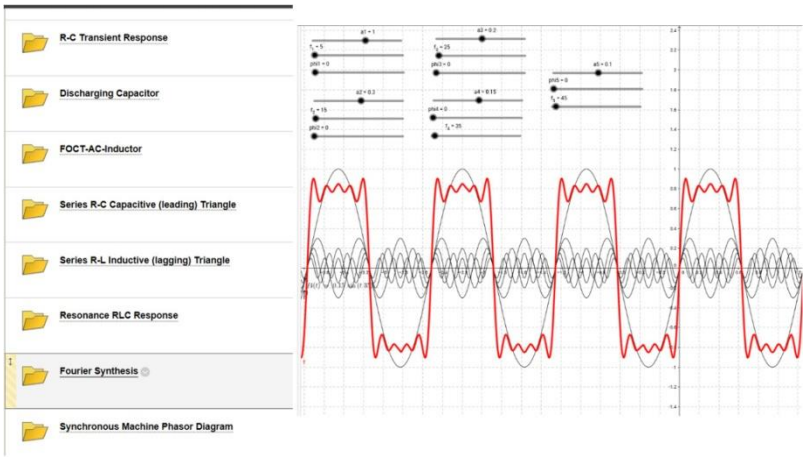


Figure 3. Virtual Lab Tool - Fourier Synthesis.

3.2. Smartphone and tablet applications

Smart phones and tablets (whether standard tablets or PC tablets) are now widely used devices and integrated in our daily life. Almost all the students nowadays have these gadgets on them while they are studying. It is noticed that when students lose interest during a lecture or lab session, they start directly using their gadgets for either gaming or accessing social media applications. It was realised early on that there would be enormous potential for such devices and gadgets to be harnessed for the purpose of students learning and teaching. Accordingly, a decision was made to utilise mobile applications for educational purposes by developing and customising applications for lab experiments. Moreover, lab manuals and experiment script can be made available as a mobile application for the students, by which students can follow the steps and record data/measurements and capture screenshots from an oscilloscope or take a photo for circuits and experimental kits. It was envisaged that this would certainly engage the students in, during and after lab sessions. It is evident that developing such mobile applications may take some time and require advanced programming skills, but it is obviously a one time effort exercise. Developing a new application can be avoided if a free version of the required application can be found in the application stores (which are now packed with loads of applications). This may require customisation of the lab scripts and experiments. An example of a mobile application that was developed in-house is the Fourier Synthesiser that is required to carry out an experiment for the second year students as part of the lab module. The application was developed using iOS (XCode) to work on Apple devices such as iPads. This application generates waveforms using harmonics. Figure 4 shows the main user interface of the application, Figure 5 shows the possible presets and Figure 6 shows the main settings options. With this application, standard time-domain waveforms such as square, sawtooth, triangle, half sinewave and modulated waveform can be generated. Actual signals can be generated from the iPads and viewed on an oscilloscope through audio output using special connection leads as shown in Figure 7.

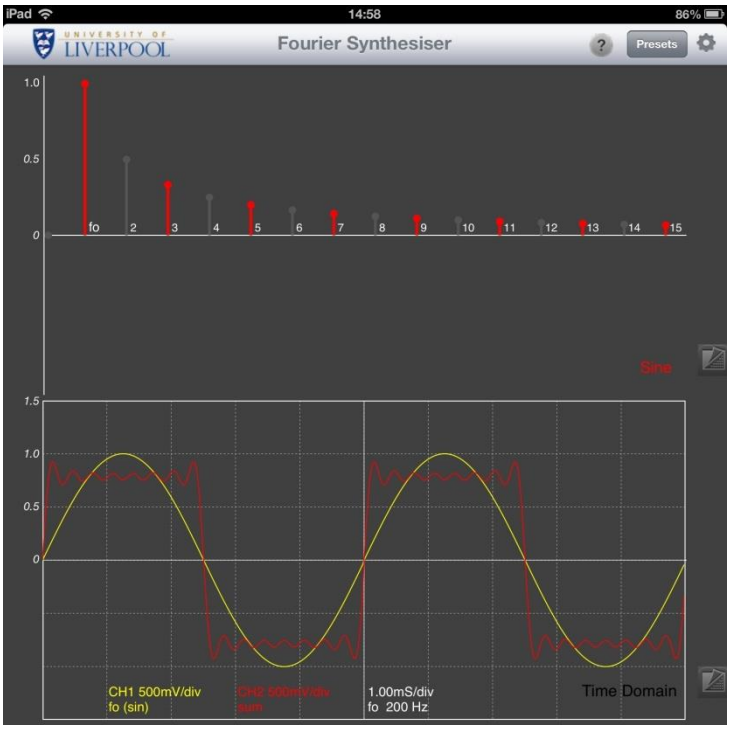


Figure 4. Fourier Synthesis Experiment iPad environment – 1.

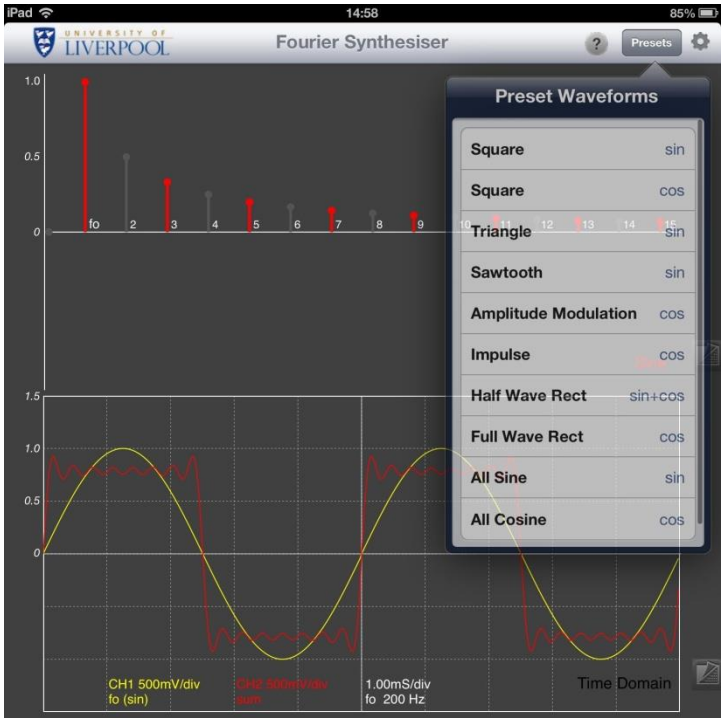


Figure 5. Fourier Synthesis Experiment iPad environment – 2.

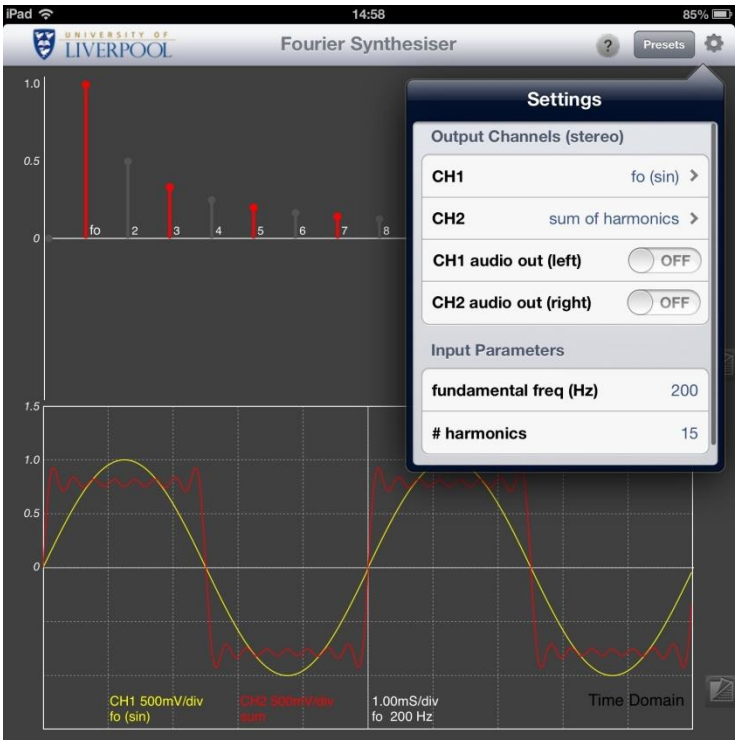


Figure 6. Fourier Synthesis Experiment iPad environment – 3.

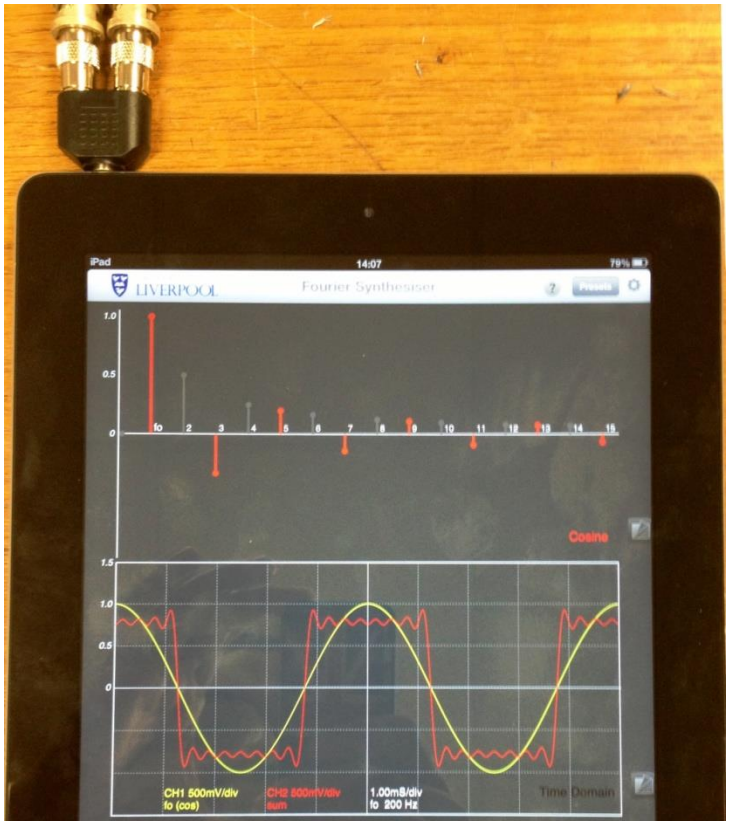


Figure 7. Fourier Synthesis Experiment iPad environment – 4.

3.3. Pre- and post-lab on-line tests and exercises

The employed VLE system has a built-in on-line test tool that can be used for many purposes such as pre-requisite assessment, pre-lab and post-lab tests, homework and exercises. In the context of laboratory assessment, the on-line test tool was used extensively. In particular, the pre-lab tests were used as a means

to ensure that the students have read the lab script and prepare for the experiment before the lab day, which has proven to be more effective in terms of student performance in the practical session. These tests were usually assessed (summative tests), and are marked electronically because they are designed to be multiple choice, true/false, numerical answers matching and hot spot questions. Figure 8 shows an example of a question from a pre-lab test. This type of test is required to be submitted before the lab session. The on-line testing tool was also used for other purposes such as post-lab tests, lab procedures induction quiz and safety induction quiz. Moreover, in-lab on-line assessment and feedback were very useful in terms of cutting marking cost of the student teaching assistants (STAs) and providing a prompt feedback to the students (in contrast with marking hard copy or electronic reports which may take weeks for the feedback to be available).

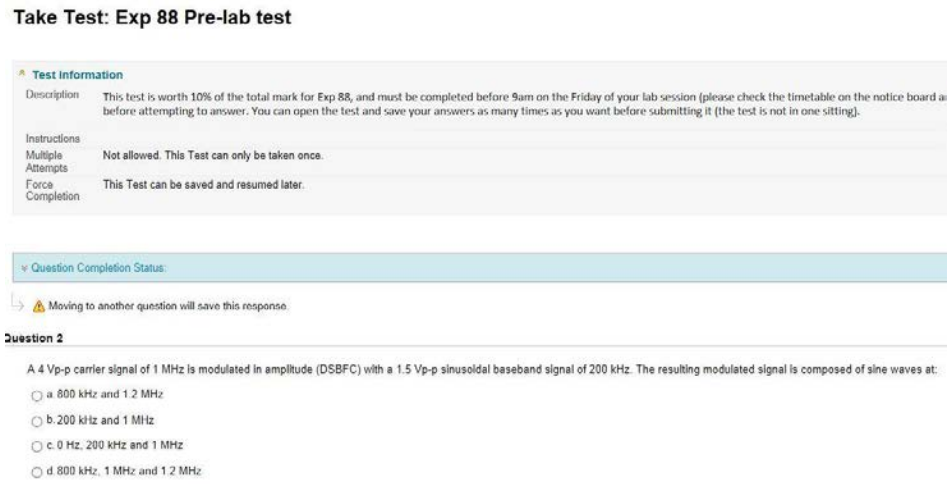


Figure 8. Sample of pre-lab on-line test.

3.4. On-line enquiry tool

When a cohort is large and multicultural, it is highly likely that students will have many questions about lab procedures, timetable, marks, feedback...etc (Burnett and Krause, 2006), and the most convenient way for the students to ask questions will be by sending emails to the lab organisers. Student questions are usually of the same nature and they are mostly repeated ones, and individual reply to such questions may take time from the organisers. It would be beneficial if the answers to such questions are communicated to all the students in the cohort. Accordingly, a decision was made by the lab organisers not to answer questions by emails but rather by using an on-line question tool. This tool was built using Google forms (which is free) and allows students to send anonymous questions to the lab organisers from the VLE. Using this tool, a student can send a question to the lab organisers, who will be notified by email and text message. Then, one of the organisers approves and answers the question and both will become visible in one page (referred to Student Questions - Q&A Page) in the VLE, which is accessible by the students. Furthermore, the questions and answers can be archived and made available for the student in the upcoming year's cohort. As a result of using this tool, less emails and questions were exchanged between the students and the lab organisers due to the fact that students will have common questions every year. Figure 9 provides a screenshot of the tool.

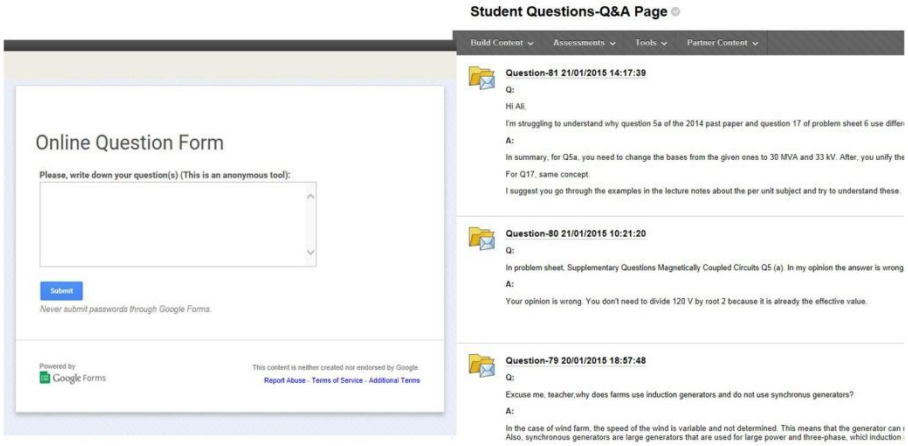


Figure 9. The On-line Question Tool.

3.5. Lab briefing, podcast, stream capture and instructional videos

Recorded media (video or voice) can be very useful in the context of laboratory teaching. They can be used to record experiment briefing in the form of podcast to brief the students before attending the lab session about the work they will be carrying out. Also, they can be used to provide generic feedback information and hints/tips about the lab in general. Students (in particular international) were found to be very interested about the idea of finding a recorded media about the lab that can be viewed many times conveniently before attending the lab session. For each lab experiment, a briefing video was created and made available via the VLE. These videos can also be embedded in other systems and can be reused frequently. Figure 10 shows experiment briefing podcast folder. There are many free tools that can be used for that purpose. Any software to capture the desktop of a PC besides a recording a voice will be suitable. For example, CamStudio can be used to generate the video files, and then these files can be uploaded and plugged in the VLE page of the lab module. The University of Liverpool now has an in-house developed software (called Stream Capture) to video-record lectures, practical sessions, tutorials, etc. All the lecture theatres in the University are equipped with the required hardware and software to record lectures. Stream capture software can also be installed on any PC in the campus and used to record the required media. The videos will be automatically saved in the University Stream Server and can be linked to a module so that they are all accessible from the module VLE page automatically. Figure 11 provides a screenshot of the stream capture system. Recorded media was found to be very useful for other purposes such as recording instructional videos for important lab events (e.g. procedures for the group project demonstration day). By checking the number of views, it was found that the students are viewing the recorded material extensively, and for lectures, it was verified that this is not affecting student attendance rate.

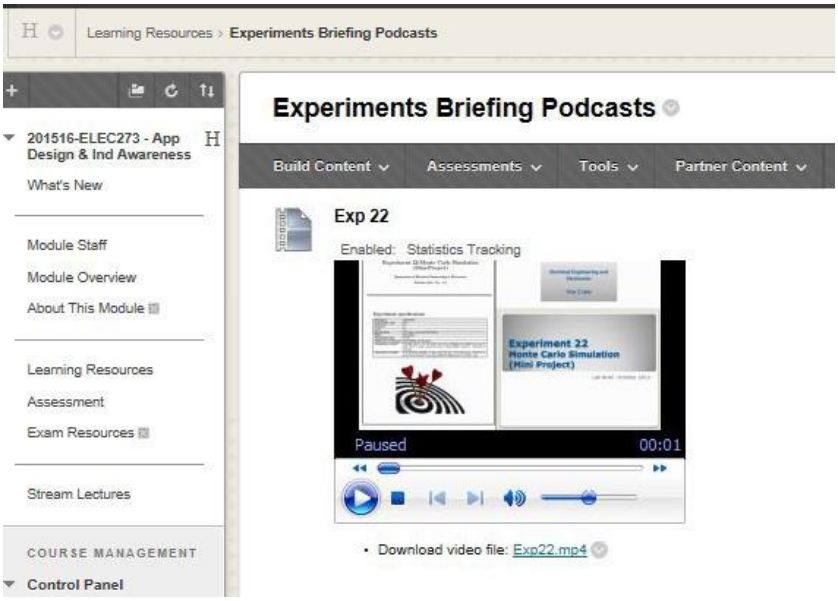


Figure 10. Experiment briefing podcasts.

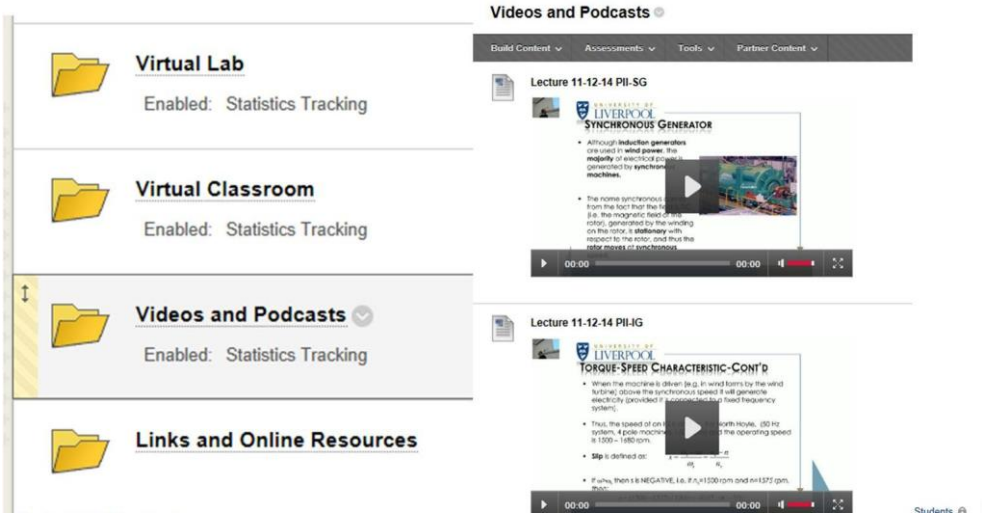


Figure 11. Stream Capture System.

3.6. On-line feedback tool and student polls/surveys

The students were provided with an on-line anonymous feedback tool (accessible from the VLE) that is available always so that they can express their lab experience after each lab day. Similar to the on-line question tool, the feedback tool was built using Google forms. The feedback form provides questions with a rating scale plus free text input, and a detailed feedback report can be obtained from the tool for the benefit of the lab organisers. The feedback was always monitored and responded to before the next lab session and remedial actions were taken immediately. It is worth mentioning that student feedback was collected independently from the Departmental feedback collection process, which collects student feedback at the end of each semester. Figure 12 provides a screenshot of the feedback tool.

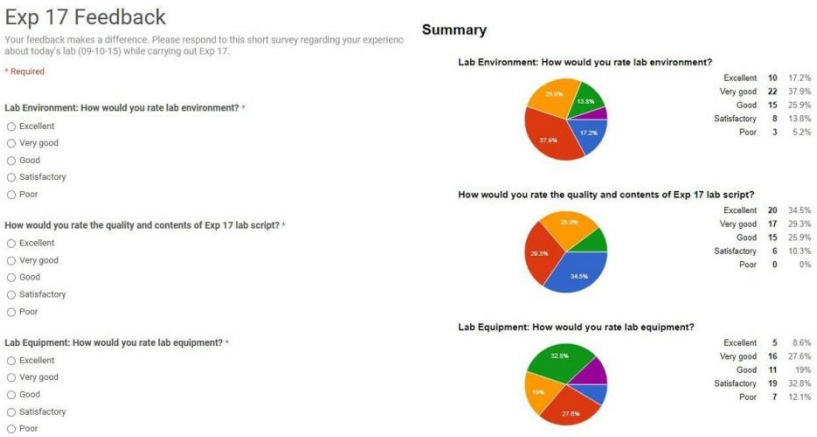


Figure 12. The on-line feedback tool.

3.7. Weekly FAQs page/email and Twitter feed

In order to communicate important notifications and by the way of feedback, responses to some common questions were sent to the students on weekly basis. This was done by an email and also a document that is stored in the VLE. It was evident that this has reduced tremendously the number of enquirers and questions of the students, reduced confusion and reminded the students about what is expected from them each week of the semester. After one year of using this method, there was a pool of FAQs emails and documents that were used in the following years by only updating (adding and modifying) some questions to make everything suitable for the current year. Figure 13 shows the VLE page were all the FAQs documents are stored and a sample of the contents is shown in Figure 14.

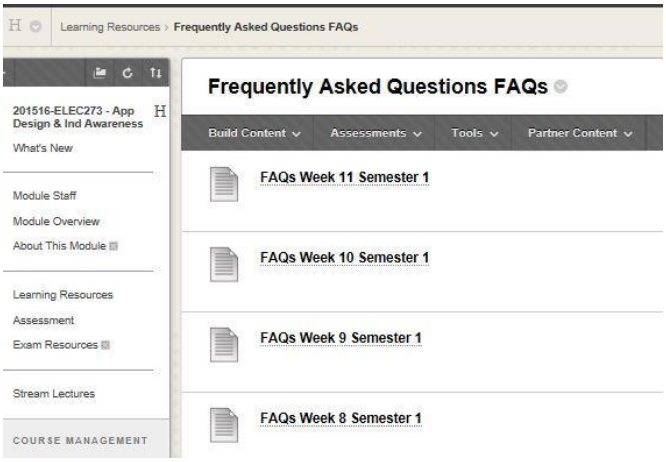


Figure 13. FAQs VLE Page.

FAQs Week 2 Semester 1, 2015-16

Q: When is the deadline for the Lab Induction Quiz and the Safety Induction Quiz?
A: It is going to be 9am Friday 9th Oct for both quizzes (before the first practical lab session). Both are formative tests.

Q: How do I know what experiment I'm doing this week?
A: Check the timetable. This week, you should have Exp 17 (Error Analysis)

Q: Where is the lab timetable?
A: The provisional timetable is on the notice board of the third floor labs and on VITAL.

Q: When is the deadline of Exp 17 pre-lab test?
A: it is 9am Friday 9th Oct. Its mark is counted (10%).

Q: How is Exp 17 going to be assessed?
A: By means of a formal report (check the instructions on the lab script). The deadline for submitting the report is Mon 19th Oct midnight (10 days after the lab day). The report is worth 90% of Exp 17's mark.

Q: If I need some information about the equipment used in the lab for Exp 17 this week (oscilloscopes in particular), where can I find such information?
A: There is a document called "Exp-Q The Oscilloscope" on VITAL learning resources under "Supporting Material" folder. You may have a look and obtain information.

Q: Where can I find a hardcopy of the lab script?
A: You should have a copy if you attended the lab tour.

Figure 14. Example of FAQs email/document.

The educational use of social networking applications (such as Twitter and Facebook) has been considered widely in the last five years. Although a number of researchers have shown that digital literacy may not be transferred to academic learning or professional practices, the educational advantages of using social networking can be seen as better learning experience and higher student engagement, compared to using other means such as emails or text messages. In particular, Twitter can be highly used as a way to quickly update and remind the students, ask short questions to open discussions, or to improve student teaching and learning by improving their engagement (Kim et al, 2015). In the lab module, Twitter was used and a plug in was employed to view the tweets from the Blackboard system. Figure 15 shows an illustration of this. According to student feedback, the use of Twitter feed was particularly innovative and effective. It has resulted in a win-win situation in which both students and staff were able to communicate instantly and asynchronously in a manner that was hitherto not possible.

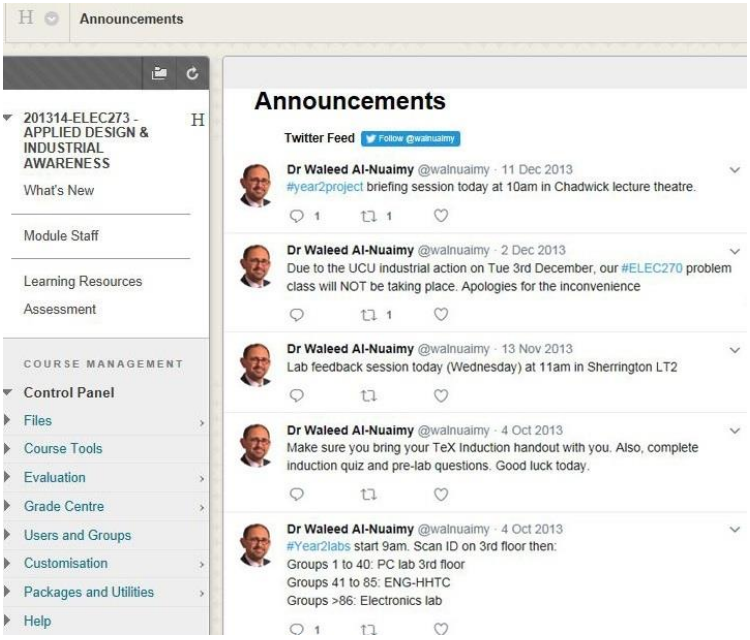


Figure 15. Twitter feed in the VLE.

3.8. Inclusion of (self-taught) LATEX

As a way to enhance report writing and technical documentation skills, the LaTeX typesetting system was included in the lab module. The students were asked to self-learn LaTeX, and an induction exercise was provided as an opportunity to start this process with supervision and support in the lab. As such, this was a formative task that is not directly assessed. A one lab session was timetabled in the PC room, and a number of STAs were made available to support the students during that session. There are several free LaTeX distributions and editors; the students can install and use MikTex on campus, but to get started, the suggestion was to sign up to use the free online LATEX editor and compiler at www.sharelatex.com. The students were advised to create a free account on this site, and create a new blank project named with the experiment name.

The students were provided with files that can be downloaded from the VLE, and asked to upload these to Sharelatex website to start creating the lab reports. Another template was provided for Y2 project report as well. The students were advised to contact the lab organisers and the STAs in case they have a problem with generating lab reports, who will be able to access Sharelatex and help the students with a specific report remotely.

3.9. Student project blogs and posters

Second year students are required to carry out a project. The project is a group project that is required to be carried out during the first 5 weeks of semester 2 and a project demonstration event (assessment day) is held on week 6. The deliverables of the project are a bench showing a functional system or software, a poster, a blog, a log book and a report. It can be a hardware-based, software-base or a mixture of both. Students are assigned a project during week 12 of the first semester and start immediately in the second semester. The projects are suitable for year 2 students and the main idea behind the project is to familiarise the students to group/team work and prepare them for the final year project in the final year, besides it is a requirement for IET accreditation. The project also contains an element of self and peer assessment (using WebPA peer assessment system). As a way to promote year 2 projects, and to give external visibility to students' work, it was suggested that all year 2 projects be posted on a public blog website, so that anyone can access. This will be a permanent way of showcasing of work to visitors as well as act as an aid to future students. The students are required to submit the blog to a designated website following a certain procedure, and the deadline is usually during the demonstration week. Figure 16 shows an example of a blog. The blog for the EEE students at Liverpool can be found at http://year2projects.blogspot.com. The blog website contains a permanent record of previous second year projects.

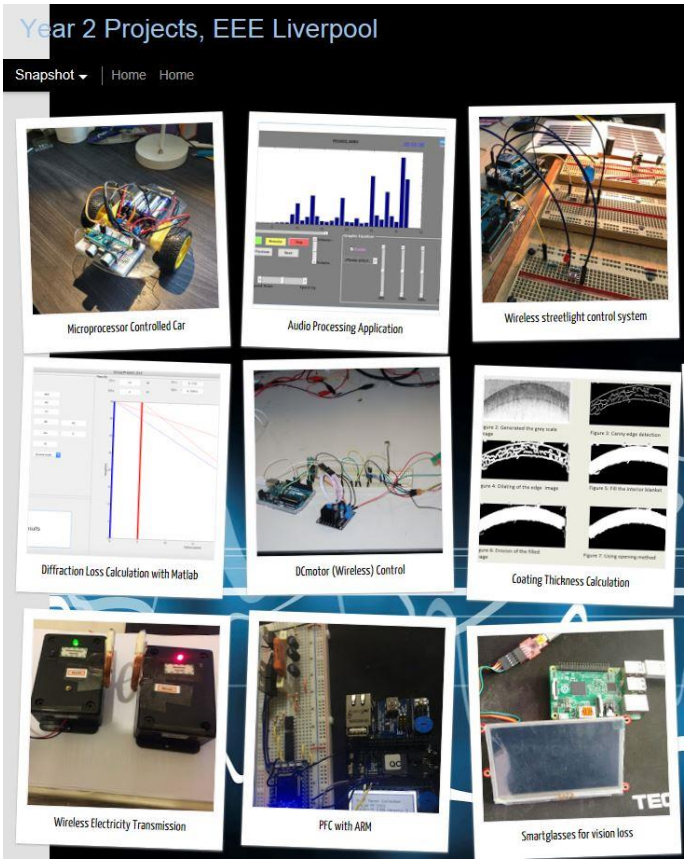


Figure 16. Year 2 Projects blog of EEE Students at Liverpool.

The students are also required to produce a poster of their project. The poster is meant to be used by the students to present their work in a visually appealing way, summarising their achievements so it should include what the aim of the project was, what they did, what the results were and their conclusions in a brief form. Samples of these posters can be found at http://year2projects.blogspot.com/p/posters-2012-13.html#!/p/posters-2014-15.html. The benefits of this exercise were very evident in the third year (final year), where the students are required to prepare a poster of their individual project.

3.10. Electronic coursework submission, marking and feedback

At very early stages, lab organisers have recognised the importance and benefits of the electronic submission, marking and feedback of all the coursework components related to the lab modules. The advantages of this are huge, including cutting the cost of paper submission for both the department and the students, printing hassle, ease of submission, automatic plagiarism check (through Turnitin system) and quick and better quality feedback. All the components of the lab module are submitted electronically since many years, an exercise which is ahead of many schools and department in the University.

3.11. Circulation of 'you said/we did' tables to promote feedback

Feedback should be an integrated element of any educational programme or module. Student feedback is collected online feedback/survey links that are available in the VLE and sent to the students after the lab day. Moreover, there is a questionnaire system that is used to collect student feedback in week 7 every semester. The students can also express their feedback and comments to the lab organisers directly (in person). As a result, there will be a good amount of comments that can be utilised. The lab organisers usually compile a list of feedback in the form of a table. This table is circulated to the students as 'you said/we did' email or VLE announcement, which incorporates lab organisers response and action plan to

the given feedback. According to student feedback, the circulation of such tables was very effective and useful, and promotes the concept of feedback and significance of student voice in education.

3.12. Engineering Ethics, Requirements Engineering and Software Engineering

Much of the electrical engineers work involves developing and implementing solutions to problems where ethical considerations must be addressed by adopting a set of standards, and hence, ethical principles are required. The lab organisers have incorporated engineering ethics into the taught programme for the first time. Aspects of professional ethical conduct are key employment skills that will be further embedded into the curriculum. This was widely welcomed by the students (as evidenced by feedback on Twitter and verbal feedback in class). Other industrial sessions and concepts were also incorporated in the lab module. For example, requirements engineering, which defines a list of activities related to identifying and communicating the purpose of a system, covering all the activities involved in discovering, documenting and maintaining a list of requirements, was incorporated for the first time in the EEE programme. Moreover, software engineering concept was also introduced to the students because of its role in today's technological advancement.

4. Performance Results

The lab module has been transformed from being a demanding (high workload) and disengaging practical module into a module that the majority of students enjoy and appreciate. According to student feedback, the module has become one of the top rated EEE modules in year 2. Figure 17 shows student satisfaction rate for five consecutive years collected by departmental student surveys. As it can be seen, the satisfaction has increased year after year, with 2014-15 academic year being the highest in terms of satisfaction (88%). Historically, in the EEE department, lab modules usually do not score high in student satisfaction because of many reasons and the fact that many elements are involved (e.g. equipment, technicians, teaching assistant...etc), but getting this high percentage indicates that the students are quite happy with the experience overall.

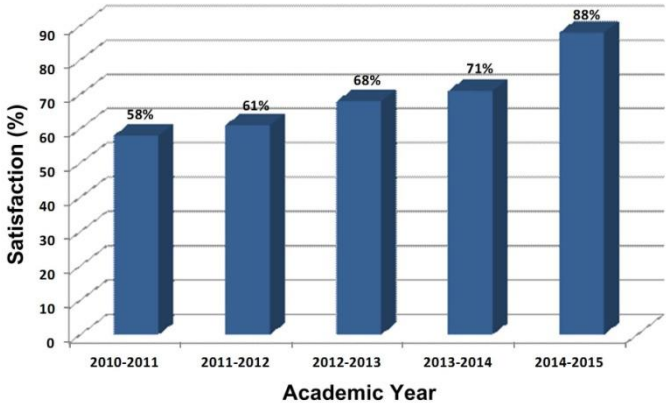


Figure 17. Lab module student satisfaction rate in five years.

As another way to express students' satisfaction, Table 1 shows the number of student enquiries/complains for three consecutive years. It can be seen that although the number of students has increased considerably, the number of student enquiries has reduced dramatically, with a reduction from > 20% to < 2% in the ratio of enquiries to the number of students, an indication of satisfaction and clarity of the lab management process and procedures, signposting and pro-active addressing of student needs. It is worth to mention that student enquires used to be collected in paper form only, but now they are completed

electronically (on-line), which reduced hardcopy wastage significantly and helped in tracking enquires efficiently.

Table 1. Number of student enquires per year.

Year	No. of students	Enquiries	Ratio of Enq./No. of students
2012-13	168	36	21.43%
2013-14	260	15	5.77%
2014-15	320	5	1.56%

Finally, it was noticed during the course of this research that student performance has also improved from year to year for the three consecutive years. The highest increase was in 2012-13 session, where module average has gone up by 9.2% compared to the previous year. The subsequent years have also seen an increase in performance with respect to the previous year. Consequently, an overall improvement of about 15% in student performance was therefore resulted over three academic years. Table 2 shows lab module average improvement for the last three years of this research.

Table 2. Lab module average improvement per year.

Year	Module Average Improvement
2012-13	9.2%
2013-14	2.5%
2014-15	2.9%

As an ultimate result of this research, the lab module average was above the expected range with a very low failure rate. It has become one of the most popular modules in the second year.

5. Conclusions

Laboratory teaching of a large multicultural cohort is often a challenging task. This paper has proposed a number of innovative approaches to enhance laboratory experience, improve satisfaction levels and reduce complaints while catering for a more than 80% increase in student numbers yet constrained with a reduced budget. This was achieved by the implementation of a package of transformational change that has brought about a notable improvement in the overall laboratory provision in the second year, and was delivered in a planned, incremental fashion over a period of 5 years, each year focussing on a particular aspect. Emphasis was on aspects such as academic report writing, professionalism and improved feedback, and this has been notably successful in bringing about a step change in the quality of the written work produced by year 2, by means of a number of specific, targeted and co-ordinated steps, and reflected on the quality of their final year work and beyond as well. The incorporation of the blogs (for the student projects, posters and weekly FAQ) and the Twitter feed were particularly innovative and effective in their deployment, and resulted in a win-win situation in which both students and staff were able to communicate instantly and asynchronously in a manner that was hitherto not possible. This is particularly timely as the sharp increase in student numbers locally mean that such techniques will be used increasingly. Student feedback has improved in a steady and quantifiable manner. As a result of employing the aforementioned approaches in this paper, student satisfaction rate has increased remarkably to 88%, an indication that the students are quite happy with the experience overall. Moreover, an overall improvement of about 15% in

student performance was resulted over three academic years, with module average being above the expected range besides a very low failure rate, and it has become one of the most popular modules in the second year. This has highly added value to the Departments reputation and the good performance in the NSS. It is worth mentioning that the approaches proposed in this paper are now well established in the laboratory module and are being used successfully in other modules in the Department.

Acknowledgments

The authors would like to thank the staff of the Department of Electrical Engineering and Electronics, University of Liverpool, for supporting of this work, and Paul Watkinson for developing the iOS application. Also, thanks are extended to the staff of the Computer Services Department (CSD) and the Centre for Innovation in Education (CIE) for their help and encouragements.

References

A. Al-Ataby, Innovative teaching tools for large multicultural cohorts in electrical engineering and electronics, 11th European Workshop on Microelectronics Education (EWME), 2016.

S. Nikolic, C. Ritz, P.J. Vial, M. Ros and D. Stirling, Decoding Student Satisfaction: How to Manage and Improve the Laboratory Experience, IEEE Transaction on Education, vol. 58, no. 3, 2015.

NSS, The National Student Survey, http://www.thestudentsurvey.com/about.php, 2017.

NSS Academic Accreditation, http://www.theiet.org/academics/accreditation/, 2015.

A. Kukulska-Hulme, How Should the Higher Education Workforce Adapt to Advancements in Technology for Teaching and Learning?, Internet and Higher Education, Vol. 15, Issue 4, pp. 247-254, 2012.

D. Oblinger, The Next Generation of Educational Engagement, Journal of Interactive Media in Education, 2004.

NUS, Student Perspectives on Technology-Demand, Perceptions and Training Needs, http://www.hefce.ac.uk/media/hefce/content/pubs/2010/rd1810/rd18 10.pdf, 2010.

L. D. Feisel and A. J. Rosa, The Role of the Laboratory in Undergraduate Engineering Education, Journal of Engineering Education, Media in Education, vol. 94, pp. 121130, 2005.

T. Wolf, Assessing student learning in a virtual laboratory environment, IEEE Transaction on Education, vol. 53, no. 2, pp. 216222, May 2010.

S. Nikolic, P. J. Vial, M. Ros, D. Stirling and C. Ritz, Improving the Laboratory Learning Experience: A Process to Train and Manage Teaching Assistants, IEEE Transaction on Education, vol. 58, no. 2, 2015.

C. Cann, S. Ball and A. Sutherland, Towards Accessible Virtual Learning Environments, TechDis, http://www.techdis.ac.uk/resources/VLE001.html, 2002.

R. O'Leary and A. Ramsden, Virtual Learning Environments, University of Bristol, https://www.economicsnetwork.ac.uk/handbook/printable/vlev5.pdf, 2013.

G. Salmon, E-Moderating: The Key to Teaching and Learning Online, Kogan Page, London, 2001.

L. Burnett and K. Krause, Teaching Large Classes: Challenges and Strategies, GIHE Good Practice Guide on Teaching Large Classes, 2006.

Y. Kim, S. Jeong, Y. Ji, S. Lee, K. H. Kwon and J. W. Jeon, Smartphone Response System Using Twitter to Enable Effective Interaction and Improve Engagement in Large Classrooms, IEEE Transaction on Education, vol. 58, no. 2, 2015.

Evasion of Industrial Engineering students of FT/UFAM

Jéssica Barbosa da Silva (jessica.silva@gmail.com)
Jonas Gomes da Silva (jgsilva@ufam.edu.br)
Eureka Laboratory
Department of Industrial Engineering, Federal University of Amazon (UFAM)
Manaus, Amazon, Brazil

Abstract

The undergraduate degree in Industrial Engineering at the Faculty of Technology (FT) of the Federal University of Amazonas (UFAM) completed 15 years in the first semester of 2019. During this period, enrolled 837 students, of which 238 (28%) have already graduated, 335 (40 %) continue to study and 263 (32%) have left the course. Given this percentage of dropout and the need to research more about the topic, this article aims to investigate the main causes of abandonment in this course in order to propose strategies to minimize the problem. The method used was the Survey, which applied a five-part electronic questionnaire sent to 203 dropout students who had e-mail. After analyzing the answers of 39 (19.21%), it was concluded that most students did not receive vocational orientation before joining the University and the main reasons that influenced the students to quit the course were the didactic-pedagogical deficiency of the teachers, the difficulty in conciliating study and work, and the course did not satisfy their expectations.

Keywords: Industrial Engineering; University`s Evasion; Causes;

1. Introduction

The evasion is one of the problems that affect Higher Education Institutions whether public or private, thus affecting the society in its social, academic, economic and political field (SANTOS; LAGE JUNIOR; RIBEIRO, 2015).

It can be said that student evasion, whether in higher education or basic education, is a phenomenon that will always exist, even if it reaches minimum limits. It is the duty of the institutions, at least, to ensure this (AMARAL, 2013).

Although evasion commonly means a student quitting a university course, the different factors involved cannot be overlooked when the objective is to analyze this concept in specific local and courses. (FEITOSA, 2016).

Gomes et al (2010) emphasize that dropout may occur for different reasons: financial difficulties, lack of vocation, discontent about the institution's didactic-pedagogical method, personal reasons such as serious illness or death, transfer of domicile, etc. Therefore, evasion is a problem to be faced in several higher education courses, including engineering.

When analyzing the situation of the Federal University of Amazonas (UFAM), it can be seen that in October 2018, it was considered the 12th public University with the lowest dropout rate (10.81%) among the Public

Universities of Brazil, according to survey conducted by Quero Bolsa (2018), a platform for the inclusion of students at higher education, using the database of the National Institute for Educational Studies and Research Anísio Teixeira (INEP) for 2017.

Although the statistics presented by Quero Bolsa (2018) are encouraging, as the national average was 24.58%, studies need to be performed with scientific rigor in Engineering courses, since the evasion rate may be higher and there are Engineering` students of the Faculty of Technology (FT) of UFAM which were affected. FT has twelve courses, one of them being Industrial Engineering, created in 2004 and which until the first semester of 2019 already enrolled 837 students, 238 (28%) have already graduated, 335 (40%) are still studying and 263 (32%) have left the course. Even this course is 15 years old, so far no scientific research has been conducted to understand the problem of dropout and its causes to find ways to combat it over time.

Thus, the general objective of this article is to investigate the main causes of the evasion of Industrial Engineering students of FT/UFAM, aiming to propose strategies to minimize the problem. The specific objectives are: a) identify the profile and the school trajectory of the dropout students; b) identify if they have received vocational orientation during high school and the reasons for choosing the course; c) investigate the main causes that contributed to student leaving the course; d) suggest action strategies to reduce dropout rates of students in this course.

The topic is relevant since the dropout in higher education generates irreparable losses both economic and in the formation of skills for the country, which needs to increasingly insert itself in the globalized world. The research is important for the managers of the Industrial Engineering course at UFAM since the course received grade "4" in 2018 in the evaluation of the Ministry of Education (MEC) and aims to reach grade "5" in 2021. Thus, knowing the main causes will help find ways to combat them, reduce costs, raise the concept and increase the number of graduates in society. For the academy, the research will foment debates and new research projects to be implemented over time, focusing on the study of dropout in all Engineering courses of FT/UFAM.

1.1 University Evasion

Joining higher education does not guarantee students' educational success, as the characteristics of this level of education are quite different from those of high school. This new phase causes to students some uncertainty about what is to come and sometimes requires significant changes in habits.

University evasion can be understood as the student's permanent withdrawal from the course in which he/she is inserted. It is a problem that generates great debates since public and private investments are significant for society to have access to higher education. (SANTOS; JUNIOR; RIBEIRO, 2015).

The dropout in higher education is problematic because the undergraduate process has cycles, that is, a course has a minimum time of completion, so any dropout is very difficult to reverse and generates an idle vacancy for several years. Given this characteristic, evasion is a problem that affects all undergraduate educational institutions (WEISE, 2015).

In Engineering, the reasons leading to evasion are multiple, the main cause of abandonment of the course is the deficiency that students have with a basic education in mathematics, algebra, and physics, compromising their performance throughout the course.

The national average of evasion in engineering courses was 50% between 2001 and 2011. Develop innovative projects and mechanisms to combat high dropout rates would be helpful to increase the number of engineering graduates so there is no need to add courses or vacancies (OLIVEIRA, 2016).

For the student, dropout is also a problem. The sooner a college student graduates, the sooner he will be independent and in the job market. However, that student who leaves the course is delaying their insertion in the job market as a professional with higher education or, worse, is giving up the search for a diploma and a better-paid profession (STOFFEL; ZIZA, 2014).

When the university is unable to keep the student until the end of the course, there is an institutional failure, ranging from the teacher who has not been able to play its role to the programs and plans established by HEI for not fulfilling the institutional mission of forming its student. In other words, evasion prevents HEI from fulfilling its purpose of producing knowledge and providing services to society (SOUZA, TOMIO, 2010).

1.2 Types and Evasion Causes

The types of evasion vary by author. According to Colvero e Jovino (2014) there are three types of evasion: evasion of the course, evasion of the institution and the evasion of the university system, characterized as follows:

a) Evasion of the course - occurs when the student leaves the course in various situations such as abandonment (cease enrolling), waiver (official), transfer or reentry (change of course), locking, exclusion by institutional rule;

b) Evasion of the institution - happens when the student leaves the institution in which he/she is enrolled;

c) Evasion of the university system - occurs when the student permanently or temporarily leaves higher education.

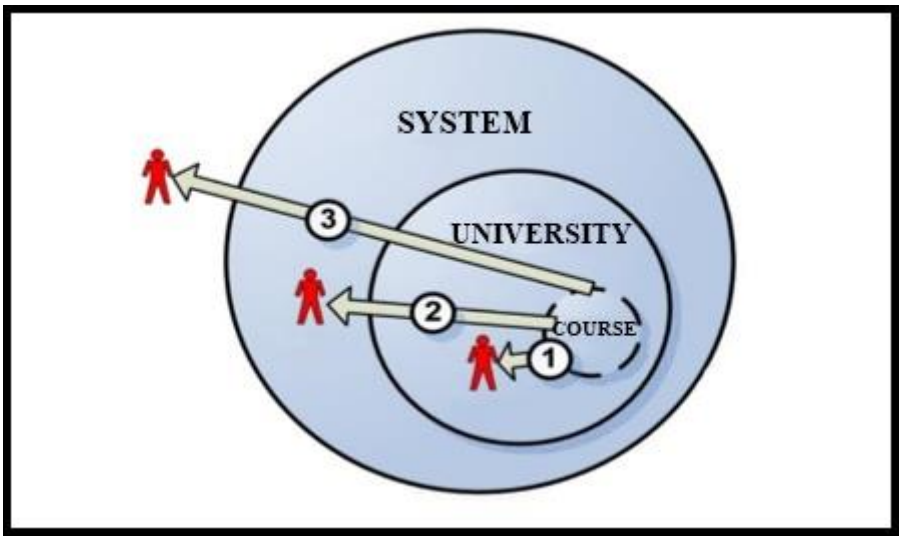


Figure 1. Higher Education`s different levels of evasion

Source: Ney (2010).

Ney (2010) used Figure 1 to illustrate student dropout. The existence of evasions of the institution and the system depends primarily on evasion of the course since a student can only evade the institution if evaded the course. The evasion of the system depends on the simultaneous occurrence of both the evasion of the course and the institution.

Thus, course dropout may occur without abandonment from the institution when dropout occurs by transferring from one course to another within the same institution. If the student leaves the course of an institution to attend another course in another institution of higher education, in this case, the course evasion and the institution evasion occurs, however, the system does not occur because the student keeps a link with the University education.

The evasion of the system occurs when the student leaves the course and the institution and does not migrate to another higher education institution. Besides, the author also highlights that evasion can occur due to work need, serious illness, death, transfer of domicile, among others.

Augustin (2005) relates another important factor: the students do not know how to choose the profession they want to pursue:

> A good career choice considers at least three elements: who is the person, what is the job market and what is university life. The major causes of university dropout [...] are related to the student's misinformation about himself, about market difficulties and college subjects (AUGUSTIN, 2005).

Regarding the faculty and considering that the first periods of the courses are the ones that have the most relevant impact on the student, Bardagi (2007) discusses that the bad performance of the teacher contributes in a way to the student giving up the course. In the author's view, teachers, especially from these periods, should develop motivating, qualified and meaningful methodological practices to stimulate the academic to create a bond with the educational institution.

For Campos (2016) the incompatibility between the schedules of courses and work characterizes a reality that must be faced by Higher Education Institutions (HEI) seeking solutions to avoid dropout. Still in the line of thought of this author:

> The difficulty of conciliating workday and class is a very important factor in the decision to leave college. When professional obligations conflict with study commitments, these last ones are the most often postponed (CAMPOS, 2016, p.18).

Personal Factors	Internal Factors	External Factors
- The course did not satisfy the expectations; - Lack of vocational orientation; - Unsatisfactory basis of previous education; - Difficulty to keep pace (fail); - Need to work due to financial difficulties; - Difficulty in conciliating studies and work; - Childbirths; - Health problemas.	- Didactic-pedagogical deficiency of the teachers; - Rigid prerequisite chain; - High failure rates; - Precarious infrastructure (classroom, laboratories) - Lack of student financial support program; - Lack of student adaptation to the university system	- Go on strike; - University Location; - Devaluation of the profession; - The financial difficulty of the university.

Chart 1. Types of Dropout Causes Organized by Factors
Source: Adapted from Cislaghi (2006).

Also, the causes of evasion can be classified as personal, internal and external. Chart 1 presents eight personal factors, six internal factors and four external factors that can be considered causes of dropout, such as the course did not satisfy the expectations, lack of vocational orientation, rigid prerequisite chain, precarious infrastructure, etc.

1. 3 Profile of Industrial Engineering Course of FT-UFAM

In 1998, the idea came to implement the Industrial Engineering course at FT / UFAM to meet the growing demand of the Manaus Industrial Pole (PIM) for professionals in this area. However, the formal implementation of the course only took place on November 6, 2003, authorized by UFAM's Resolution 12/2002.

Over the years, the Pedagogical Project of the Industrial Engineering Course of FT / UFAM has already been revised at two different times, and its last version was approved in the second semester of 2018, which was implemented in the first semester of 2019. In this new version, the course is offered in a face-to-face mode, evening-night period, with five years of duration and a maximum integration time of 7 years and 6 months. The course load is 3,685 hours, of which 3,645 hours contain mandatory subjects, 120 hours optional subjects, 180 hours supervised internship, 120 hours of Final Paper, 100 hours in academic, scientific and cultural activities.

According to the new Pedagogical Project of the Course (UFAM, 2019), the purpose of the course is:

> Train citizens with full, technical and scientific training in the areas of knowledge of Industrial Engineering, with skills to develop and optimize products and processes of organizational systems, considering the political, economic, technological, social, environmental and cultural aspects and professional conduct guided by ethical and citizenship principles.

Regarding the infrastructure offered, there are about 32 classrooms, several laboratories, and the Industrial engineering department has an effective faculty with 11 professors (10 with doctoral degree and 1 with master's degree).

2. Methodology

For the data collection, the target was students who evaded the course in the last 15 years, whose data were obtained from the Dean of Undergraduate Teaching (PROEG) of UFAM. According to PROEG the types of abandonment are evasion, dismiss, withdrawal, transfer, and initial withdrawal, where:

a) Evasion - Student's absence from the course in which he/she was enrolled before completing it;

b) Dismiss - occurs when the student has not been able to complete the course within the deadline set by the Council for Teaching and Research (CONSEPE) and not enrolling for more than four semesters;

c) Withdrawal - cancellation of enrollment by request;

d) Transfer - the departure of the student from UFAM to another institution by formal request;

e) Initial withdrawal - occurs when the student does not enroll for the beginning of the school year.

After analyzing PROEG data, it was noticed that between 2004/1 and 2019/1, among the 837 students who enrolled in the Industrial Engineering course, 264 (31.4%) evaded as follows: 181 were dismissed (21.62%),

70 requested withdrawal (8.4%), 12 (1.4%) were transferred and 1 concluded but did not attend graduation ceremony. Altogether, 206 students had registered an e-mail while 58 only registered the telephone number. Another analysis showed that of these 206 students, 3 were able to reverse the dismiss and complete the course, which is why the research focused on 203 students with e-mail since they will be contacted by mail electronic.

A questionnaire was developed in Google Forms (Appendix 1) consisting of five parts: section 1 has four questions about the student's educational profile; Section 2 has two questions regarding the reasons why the student chose the course and if he had any orientation in high school; Section 3 consists of three questions that focus on the main reasons for evasion; Section 4 has only one open question for suggestions to reduce evasion; Section 5 concludes with three questions about the student's data.

To evaluate the level of comprehension of the questionnaire, the pilot test was applied with 50 randomly selected students from June 13 to 17, 2019, which was sent to each of them by e-mail.

Among the 50 emails sent, 12 emails returned (24%) without target students receiving, while another 12 (24%) correctly answered the questionnaire. After completing the pilot test, some adjustments were made to the questionnaire, and on June 18, 2019, an invitation containing the link to access the online questionnaire was sent, which was available for 14 days.

In the end, from 203 emails sent, 34 (17%) returned because of the incorrect addressee, while 39 (19.2%) answered the questionnaire, whose data were collected and analyzed with spreadsheet editor, for discussion of results.

3. Results

3.1 Profile and School Trajectory of the Respondents

One of the first questions concerned about gender, where 33 (84.6%) answered and 6 (15.4%) did not wish to identify themselves. Regarding the respondents, most (56.4%) are male and 33.6% are female.

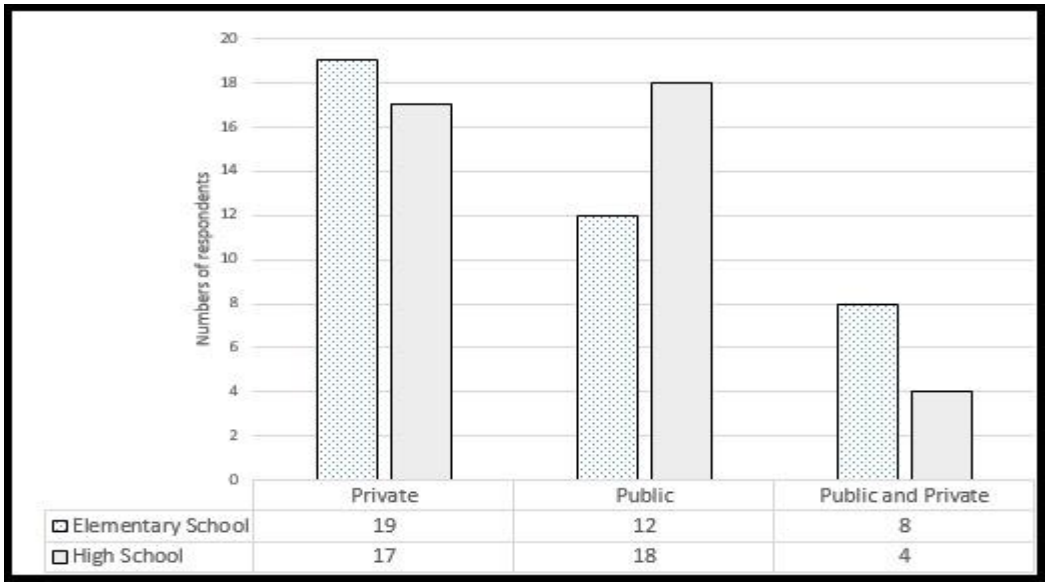


Figure 2: School trajectory of respondents before University enrollment

Source: Author (2019)

Figure 2 presents the school trajectory of 39 respondents before University entrance. During their

elementary school time, 19 (48.7%) attended only private elementary schools, 12 (33.33%) only public schools, while 8 (20.5%) studied in both types of schools. Concerning to high school, the situation changes for public school preference, with 17 (43.59%) of respondents reported having studied in a private school, another 18 (46.15%) in public school. Only 4 (10.25%) of the dropout students attended public and private schools.

When asked about switching to another course, 56.41% said they had completed another college course, while 43.49% said they did not completed other undergraduate course. Other courses completed by students include Civil Engineering, Mechatronic Engineering, Quality Management, Psychology, History, Economy, Biology, Medicine or Law, all the information were also checked by consulting the information of respondents in Brazilian CNPQ Search Research web site < http://buscatextual.cnpq.br/buscatextual/busca.do>.

3.2 Vocational Orientation and Reasons for Choosing Industrial Engineering

Section 2 asked about vocational orientation and the reasons for choosing the course.

Regarding the question "During high school, did you receive any vocational guidance about the Industrial Engineering course ?", 37 answers were submitted, and the majority (31; 83.78%) reported that they did not receive the guidance, while only 6 (16.22%) gave a positive answer. This result shows that high school students have no instructions about university courses. Due to their lack of experience, they choose the undergraduate course without criteria, resulting in its abandonment over time.

About the question "What are the top three reasons why you chose UFAM's Industrial Engineering course ?", 38 answered the question. Among the eleven options placed on multiple choices, the three most prominent reasons were (Figure 3): wide scope (20; 52.63%), good financial remuneration (17; 44.74%) and vocation (10; 26.31%).

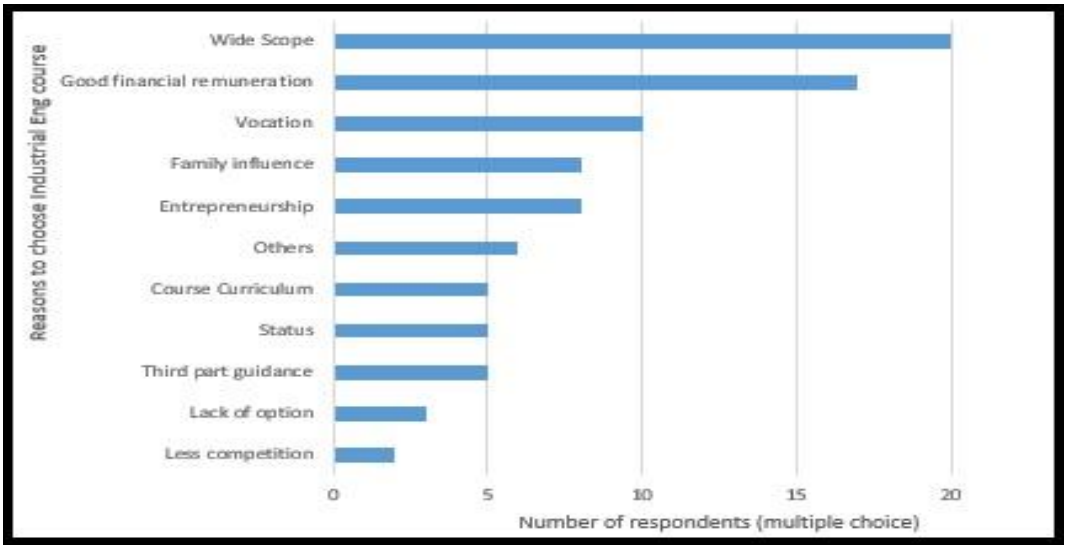


Figure 3. Reasons for choosing the Industrial Engineering course in FT/UFAM.
Source: Author (2019)

In this sense, it is important to mention that the Industrial Engineering course is divided into ten areas with 56 subareas, according to the Brazilian Association of Industrial Engineering (ABEPRO). This makes the course attractive because of its wide scope.

According to Leppel (2005), students expect to be successful and see in the undergraduate course a

possibility of future gains to improve their living conditions. On average, an Industrial engineer in Brazil earns close to R$ 6,228.85 (CATHO, 2018), varying by region, working time, experience, type and size of the company. Because of this, the item "good financial remuneration" had relevance in the answers. Besides, the respondents who marked the item "by vocation" are noteworthy since they did not finish the course.

3.3 Major Causes of Evasion in the Industrial Engineering Course

To identify the main reasons for evasion, the third section asked the respondent three times to report the main reason for abandonment, dividing the answers into the following classes: external causes with 5 possible answers; institutional causes with 5 choices and personal causes with 9 options, as explained ahead.

3.3.1 External Causes

About this question, 38 answered correctly, while only 1 declined to answer. Of those who responded (Figure 4), it is noteworthy that the majority (20; 52.6%) reported that there was no external factor that contributed to their withdrawal, which is the largest response when compared to institutional (17; 44,7%) and personal causes (5; 12.8%). Regarding external reasons, the two main ones (Figure 4) were the location of the university (7; 18.42%) and strikes (5; 13.16%).

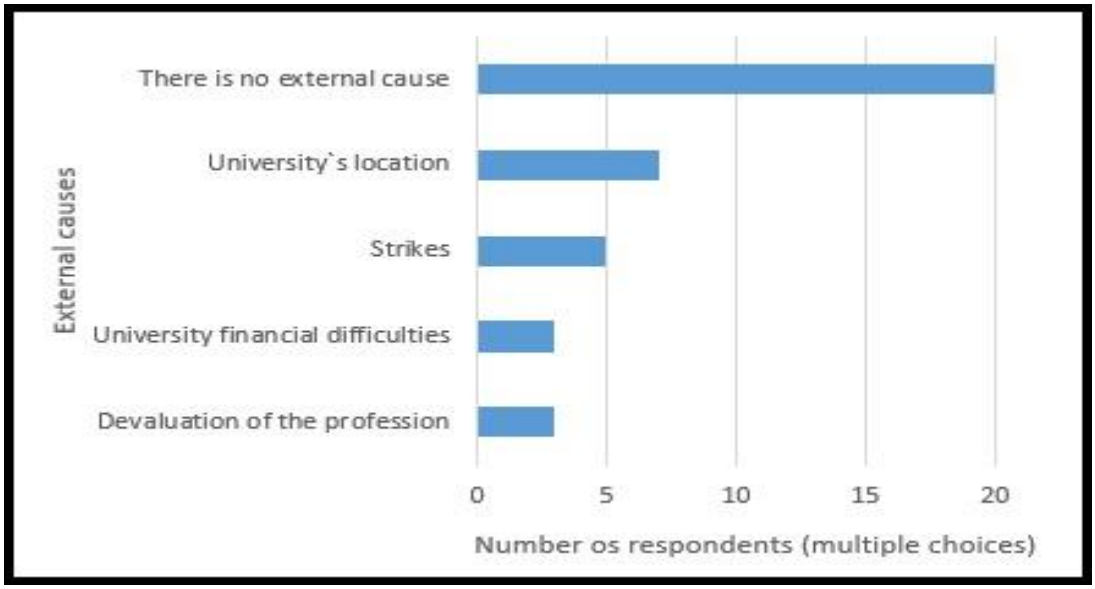


Figure 4. External causes that contribute to student dropout

Source: Author (2019)

Regarding to location of the university, it is suggested to speed up the construction of the Student Residence, which is located near UFAM to shelter especially low-income students who live in distant neighborhoods or neighboring cities of Manaus.

The strike, however fair it may be, when it paralyzes activities for a long time ends up affecting students' motivation, especially those who urgently need to advance their studies within the planned timeframe, due to a job promotion or other personal dream.

3.3.2 Internal Causes of the Institution

Regarding this question, 39 returned correctly, while only one preferred not to answer (Figure 5). Of the 38 respondents, the majority (17; 44.7%) reported that there was no internal cause.

However, the main internal reason that contributed to the dropout of the students of the course was the

didactic-pedagogical deficiency of the teachers (16; 42.1%), which shows the necessity of UFAM to perform constant pedagogical training for the teachers, aiming to improve the didactics teaching them over time. Great teaching and learning practices could also be cataloged and disseminated throughout the institution, recognizing those teachers who each semester seeks to innovate in providing their services to students.

3.3.3 Personal Causes

About this question, the 40 respondents contributed (Figure 6) and the personal reasons most relevant were the difficulty of conciliating study and work (10; 25.64%), the course did not satisfy their expectations (10; 25.64%) and transfer of work/residence (6; 15.38%).

It is noteworthy that the Industrial Engineering course is evening-night period and some students have difficulty conciliating their studies with work. A possible solution to this problem would be for course managers to raise funds for research or extension projects by allocating studentships to students, especially those with greater social vulnerability.

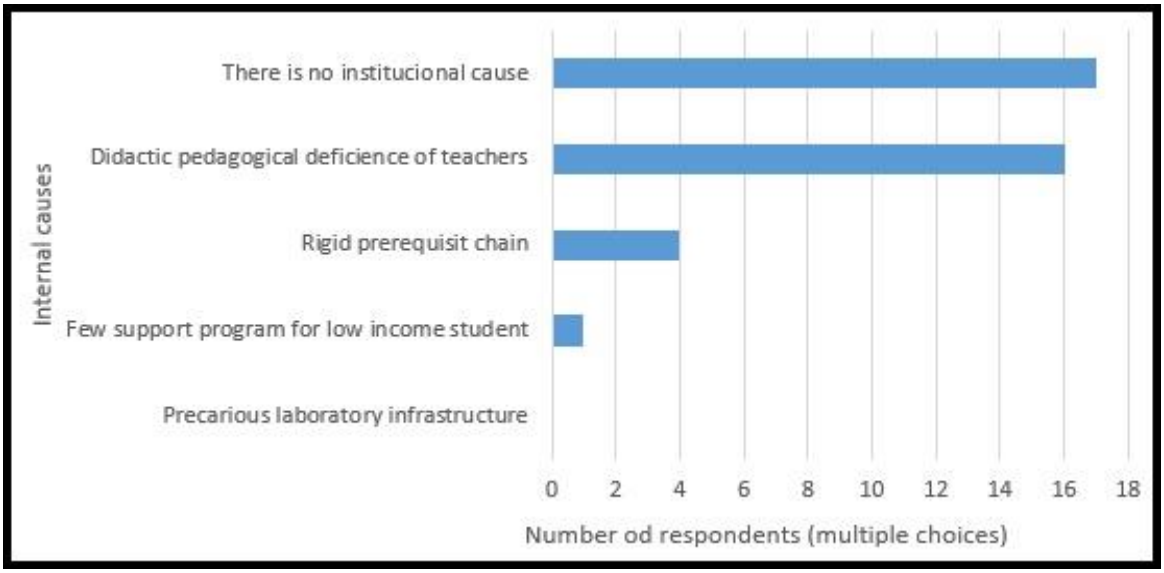


Figure 5. Internal Causes of the Institution.

Source: Author (2019)

Figure 6: Personal Causes.

Source: Author (2019)

3.4 Suggestions from dropouts to tackle evasion in Industrial Engineering

In this section, each respondent was asked to present actions or suggestions that could reduce the causes of evasion in the course. As a result, 30 (77%) respondents answered and the most common suggestions presented were: accompany and encourage students with psychological administrative and pedagogical supports (20%), realize activities and promote lectures in schools about the Industrial Engineering course (13%), promote more practical lessons (10%) with content aligned with the reality of the market, developing teaching weeks (29%) to discuss and disseminate good teaching practices (7%), conducting lectures with inspire guests (7%), and offer out-of-period courses for unperiodized students (7%). Not common suggestions considered interesting were: be flexible with presence and timing by using distance learning approach, identify and create an approach to be flexible the returning of dropouts.

4. Conclusions

The research aimed to investigate the main causes of the evasion of Industrial Engineering students of FT/UFAM, aiming to propose strategies to minimize the problem. To this end, a five-section questionnaire was designed and answered by about 39 students who dropped out of the course over the 15 years. Based on the results, it is concluded that:

a) Regarding the school trajectory, the majority (49%) attended only private schools in elementary school, while 31% only public school and 20% studied in both types of schools. During high school, 44% of respondents attended only private, while 45% public schools. Around 11% of respondents studied both types of schools;

b) Most (84%) of dropouts reported that they did not receive vocational guidance in high school, while only 16% gave a positive answer;

c) The main reasons that led the students to choose UFAM's Industrial Engineering course were the scope of the course, great financial remuneration and the vocation for the course;

d) In 15 years, the course has lost almost 1/3 of its students, mostly by dismiss, and the course coordinator needs to conduct a study to identify which of the dismissed students would need a few subjects to graduate to run an incentive campaign for students to complete the course.

e) Concerning external, internal and personal causes, the personal cause tends to be decisive, highlighting the difficulty in conciliating the study and work, the course did not satisfy their expectations, and the transfer for work or family reasons.

f) Regarding external causes, the location of the university and the strikes were the most relevant;

g) Concerning internal causes, the didactic-pedagogical deficiency of teachers was highlighted.

To reduce evasion in the course, it is suggested to implement a significant number of scholarships or grants to encourage students to stay, such as research grants, work grants, food allowance, housing allowance (Student House) and transportation allowance. Scholarships are not the definitive solution, but they would help reduce students' drop out due to personal causes. There is also the need to conduct psycho-pedagogical follow-up with students. A new pedagogical program should be developed in order to improve teachers' teaching competencies, as well as to identify, recognize and disseminate the best teaching methodologies, including the use of new technologies and contents more aligned with the professional reality.

It is necessary to carry out course dissemination and vocational guidance actions for high school students,

even encouraging them to visit the university to meet teachers, laboratories and their extension and research projects. It could be done by partnership between Government Educational Secretary and University.
Finally, it is suggested that other similar research could be conducted to reach at least 50% of dropouts to make the analysis more robust and perhaps initiate a rescue process, especially among the dismissed students who dropped out with few subjects missing. Also new research could be done to identify main predictive factors that point out the possibility of the student quitting the course, such as misbehavior, failing in Physics or Calculus, poor attendance, lack of motivation, etc.

5. Acknowledgment

To UFAM Department of Engineering professors that contributed for the evaluation of the article during the finalization of the course, as well as for their improvement suggestions: Dr. Joaquim Maciel da Costa Craveiro and MSc Ely Sena de Almeida.

6. References

[1] AUGUSTIN, C. **Dinâmica das Vagas**, 2005. UERJ. Available at: <www.uerj.br/niesc/datauerj/estudos/Dinamica_texto.htm>. Accessed on May 15, 2019.

[2] AMARAL, J. B. **Evasão discente no ensino superior: estudo de caso no Instituto Federal de Educação, Ciência e Tecnologia do Ceará** (Campus Sobral). 2013. 100 f. (Dissertação de Mestrado) Programa de pós-graduação em políticas públicas e gestão da educação superior da Universidade Federal do Ceará, Fortaleza – UFC, 2013.

[3] BARDAGI, M. P. **Evasão e comportamento vocacional de universitários: estudos sobre o desenvolvimento de carreira na graduação**. Programas de Pós-graduação da CAPES. 2007. Available at: https://lume.ufrgs.br/handle/10183/10762. Accessed on: 10 June 2019

[4] BATISTA, E; FALCO, J; FERREIRA, W; JR, E; PEREIRA, M. **Evitando evasão em cursos de engenharia, um estudo de caso-** Campo Grande, 2006.

[5] CISLAGHI, R. **Balanced Scorecard em Instituições Públicas do Ensino Superior: benefícios, limitações e desafios**. In: VI Colóquio Internacional sobre Gestão Universitária na América do Sul, 2006, Blumenau.

[6] CAMPOS, J. D. S. **Fatores explicativos para a evasão no ensino superior através da análise de sobrevivência: o caso da UFPE**. 2016. 97f. Dissertação (Mestrado em Engenharia da Produção) – Universidade Federal de Pernambuco, Recife, 2016.

[7] CATHO. **O que faz um Engenheiro de Produção?** Available at <https://www.catho.com.br/profissoes/engenheiro-de-producao/>. Accessed on October 15, 2018.

[8] COLVERO, R. B.; JOVINO, D. P. **Evasão acadêmica nas IES do Brasil: uma análise do ano de 2010**. Revista Argentina de Educación Superior, v. 6, n. 8, p. 62-85, jun. 2014.

[9] FEITOSA, J. **Análise de evasão no ensino superior: uma proposta de diagnóstico para o campus de laranjeiras**. Sergipe: São Cristóvão, 2016.

[10] GOMES, Maria José; MONTEIRO, Mariana; DAMASCENO, Anderson Medeiros; ALMEIDA,

Tereza Jacy Silva; DE CARVALHO, Raquel Baroni. **Evasão acadêmica no ensino superior: estudo na área da saúde**. Revista Brasileira de Pesquisa em Saúde, v. 12, n. 1, p. 6-13, 2010.

[11] NEY, O. **Sistemas de informação acadêmica para o controle da evasão**. 2010. 145 f. Dissertação (Mestrado em Engenharia de Produção) - Programa de Pós Graduação em Engenharia de Produção, Universidade Federal da Paraíba, João Pessoa, 2010.

[12] OLIVEIRA, J. **Prejuízos da evasão nos cursos de engenharia: um estudo de caso**. SÃO PAULO 2016

[13] PINSONNEAULT, T; KRAEMER, K.L. **Survey reseach in management information: an assessement**. Journal of Management information System, 1993.

[14] QUERO BOLSA. **25 Universidades públicas com menor índice de abandono no Brasil**. Available at <https://querobolsa.com.br/revista/indice-de-abandono-universidades-publicas>. Accessed on October 10, 2018.

[15] SOUZA, T. Contribuições para a Construção de uma Teoria de Gestão Universitária. In: SILVEIRA, AMÉLIA; DOMINGUES, José Carvalho de Sousa (Coords). **Reflexões sobre Administração Universitária e Ensino Superior**. Edifurb: Blumenau 2010.

[16] STOFFEL, W. P. ZIZA, C. R. **Evasão escolar em cursos superiores: Estudo comparativo entre os pedidos de trancamento e o aproveitamento escolar.** In: Simpósio Pedagógico e Pesquisas em Comunicação. 9ª ed. Resende. Anais. Resende, 2014.

[17] SANTOS, Nicolas Victor Martins. JUNIOR, Muris Lage. RIBEIRO, Monica Luiz de Lima. **Evasão no curso de Engenharia de Produção da Universidade Federal de Goiás – Região Catalão**. Fortaleza – Ceará. 2015.

[18] SILVA, N; JÚNIOR, M; CABELLO, A. E**vasão Aparente entre engenharias sob a ótica da análise de redes sociais**. Brasília, 2017.

[19] SILVA, R; MORAIS, A; COSTA, G. **Fatores que podem interferir na evasão escolar em uma instituição de ensino superior privada**. Revista CESUMAR**,** julho/dezembro. 2018, v. 23, n. 2, p. 205-228.

[20] SOUSA, T. **Estudo sobre a evasão em cursos de graduação presenciais na Universidade Federal de Goiás**. Goiás: Catalão, 2017.

[21] UFAM (2019). **Projeto Pedagógico do Curso (PPC) do Curso de Engenharia de Produção**. Departamento de Engenharia de Produção da Universidade Federal do Amazonas, Manaus, Amazonas, 2019.

[22] YIN, R. K. **Estudo de caso: planejamento e métodos**. 4. ed. Porto Alegre: Bookman, 2010.

[23] WEISE, A. **Educação em engenharia de produção: um estudo bibliométrico dos anais do CONBREPRO**, Paraná, 2015.

Appendix 1: Industrial Engineering student evasion questionnaire.

Section 1 - Schooling Profile of interviewed

1.1- Which type of school did you study in elementary school?

(a) Public;
(b) Private;
(c) Public and Private

1.2- Which type of school did you study in high school?

(a) Public;
(b) Private;
(c) Public and Private

1.3- Have you completed another higher-level course?

(a) No;
(b) Yes

1.4- If answer 1.3 is positive, inform the name of the course and institution.

Section 2 - Vocational orientation and reasons for choosing the course

2.1 - During high school, did you receive any professional guidance about the Industrial Engineering course?

(a) No;
(b) Yes

2.2 - What are the top three reasons why you chose UFAM's Industrial Engineering course?

(a) Wide Scope;
(b) Good financial remuneration;
(c) Less competition;
(d) Vocation;
(e) Entrepreneurship;
(f) Family influence;
(g) Course curriculum;
(h) Third party guidance;
(i) Status;
(j) Lack of option;
(k) Others.

Section 3 - Identification of causes of abandonment.

3.1- Enter the main external cause that caused your evasion of the course:

(a) Devaluation of the profession;
(b) University financial difficulty;
(c) Strike;
(d) University location;
(e) There is no external cause.

3.2- Enter the main institutional cause that caused your evasion of the course:

(a) Few support programs for low-income students;
(b) Rigid prerequisites chain;
(c) Precarious laboratory infrastructure;
(d) Didactic-pedagogical deficiency of teachers;
(e) There is no institutional cause.

3.3- Enter the main personal cause that caused your evasion of the course:

(a) The course did not satisfy my expectations;
(b) Lack of vocational orientation;
(c) I felt alone during the course;
(d) Failure in subjects;
(e) Difficulty of conciliating study and work;
(f) Health problems;
(g) Death of family member;
(h) Transfer of residence/work;
(i) There is no personal cause.

Section 4 - Suggestions to reduce evasion.

4.1 -What do you suggest for course managers to reduce their students' evasion?

Section 5 -Respondent Information.

5.1 - Full name:

5.2 - Year of entry to the course:

5.3 - Email:

Thank you very much for your participation.

Improvement Proposal for Cell Phone Signal Reception in Tabatinga-Amazonas

Anne Valéria da Silva Grandes Reis
anne_sgrandes@hotmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Aristeu Souza da Fonseca
aristeu.eng@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

This article will explain the signal difficulties that the city of Tabatinga in Amazonas and will propose a possible analysis of signal repetition improvement and signal regeneration in relation to the demographic issue of the city. It will show that the use of cell phone repeaters with regenerators is a possible technical application that would improve the city's signal issue and its difficulties that lead to a financial and social economic backwardness for the municipality.

Keywords: amplifier; modulator; cell phone.

1. Introduction

A survey conducted by the Getulio Vargas Foundation in June 2016 points out that there were 168 million smartphones in Brazil, a data that shows today many mobile phones are much more than to receive call, today it is possible by mobile to perform many tasks and shows the trace of development of the country and that is not just a matter of luxury today cell phone is a necessity [1].

The municipality of Tabatinga, in the state of Amazonas, is one of the reference municipalities in the interior, being a point of entry for other municipalities, as it is the only one in Alto Solimões that has an airport. The municipality has 3,239.3 km², with 64,448 inhabitants (IBGE) with a demographic density of 16,2 inhabitants per km2. Situated at 73 meters altitude, Tabatinga has the following geographical coordinates:

Latitude: 4 ° 15 '12' 'South, Longitude: 69 ° 56' 19 " West[2].

Tabatinga is one of the municipalities of Alto Solimões with the highest rate of problems both using mobile telephony and internet, the population suffers a quality service and is at the mercy of the service offered precariously to its consumer [2].

Mobile communication in the Alto Solimões region is one of the most precarious in the northern region with a high rate of processes related to signal failure and non-use of services, the declared services are not fulfilled or poorly done, and this hinders the development of the region. , since most people have cell phones, not landlines [3].

One of the main reasons for poor signal quality is because of the satellite link. As Tabatinga is a municipality that does not have fiber, mainly due to its geographical location, the signal goes out via satellite internet link, as the cost is very high, the operators do not hire the necessary capacity to support the basic consumption of the population.

The cellular mobile phone system is a wireless, wireless communication system consisting of mobile radios, user terminals, ERBs, fixed base radio stations. The system allows consumptions by voice, video, alphanumeric messages, etc. [4].

Nowadays we live in the age of internet communication, you have the possibility of being connected in real time with the happenings around the world, but in a municipality like Tabatinga that the internet connection happens only via radio, it is an expensive cost to the consumer that often does not work, which often hinders not only personal communication, but the economic development of the municipality,which makes it not develop, making the city not seen as a tourist spot, making economic transactions and even emergency care difficul. Today with the technology we have and in the development process that mobile telephony has undergone over the years it is unacceptable that a municipality does not have the minimum connection services.

The analysis of the project given by the problem lived within the municipality that lives in a growing economic and social moment of the population, within the project seeks to study the propagation of data traffic signal and voice to understand the current functioning in environments with dense vegetation. and in micro cellular systems through prediction methods. Point out a possible basic concept that may show an improvement in relation to the signal used within the municipality. Show that the use of signal repeaters can be an economical alternative to the existing mobile phone service in the municipality, enabling the basic concept of signal amplification and regeneration.

2. Theoretical Reference

2.1 How the Mobile Phone Framework Works

It is a system that has coverage areas to be serviced by a mobile service that are divided into hexagonal cells, which are illuminated by base stations (ERB) located in the center of the same, usually on top of towers or masts in the areas of. among other factors, the output power of the radio transmitter and the frequency band used. This mobility is only possible thanks to wireless communication between the terminal and a Base Station (ERB) that is connected to a Control Center and which has an interconnection with the switched fixed telephone service and other centrals.This is why calls between cellular terminals and

landlines are possible[4].

The ERB communicates between the mobile terminal (TM), which can be cell phones, tablets, etc., with the CCC (Switching and Control Center), which in turn makes the calls.Some factors are analyzed and define the extent of coverage of an ERB such as: the output power applied to the antenna; the frequency band to be used; antenna height and location; antenna type; area topography and receiver sensitivity.

The waves propagate in a straight line, called the line of sight, from the ERB. There are cases where the user has no direct sight with the ERB, due to major obstacles. These areas without coverage are called the shadow area. The shading effect caused by these uncovered areas is minimized by buildings in large cities, due to the refractive and reflective capacity of transmitted radio waves, and by the large amount of small cells in these regions.

Basically we have two types of ERB, commonly called:

- Greenfield - thosethat are installedonland, ieontheground.
- Roof Top - thoseinstalledonbuildingroofs.
    - Both can use indoor telecommunication equipment, whose manufacturing characteristics determine the need for a climate infrastructure, suchas outdoor equipment, which are stand alone unit spreviously designed for exposure to air. Freeand dimensioned for properventilation.

All mobile operators have different frequencies, and even the same carrier can operate in different bands in certain cities and states, and it is also possible for different carriers to use the same frequency [4].

In Brazil we currently have 3 types of technologies:

- **2G**: In Brazil sincethe 90's, GSM (Global System for Mobile Communications) isusedwhichismainlyused for telephonecalls. When it comes to the internet, this technology leaves a lot tobe desired. Their frequencies are 900 and 1800 Mhz.
- **3G**: Uses thetechnologies WCDMA or CDMA, is the most popular in Brazil. It hás speed from 200 kbpsand is in thefrequencies 850 and 2100 Mhz.
- **4G**: Is very popular in Brazil using the LTE (LongTerm Evolution) standard. Delivers superior speed and performance superior to 2G and 3G Technologies with 700, 1800 and 2500 MHz having availability in the frequencies [5].

2.2 Types of Cells

There are two most common cell types, omnidirectional cells and sectored cells. Omnidirectional cells consist of an ERB with an omnidirectional antenna that will radiate in all directions, thus making the ERB the center of a circular transmission area. In the sectored cells, there are in ERB several directive antennas, which together will cover an entire area.

The area of a cell is defined by the density of telephone traffic, such that the higher the traffic, the smaller the cell projected for this region. Thus, suburban or rural areas will have larger cells than urban centers. Regardless of cell size, care should be taken to reuse frequencies in cells.

There are two solutions when traffic in a cell grows, the addition of new cells or the sectorization of a cell. In cell sectorization the omnidirectional antennas are replaced by directional antennas sectoring the old cell. This method is more economical and more used by operators as it uses existing structures [4].

Cells in any method overlap, but without co-channel interference.

There are other processes used within the telephony is the so-called handoff and must be unnoticeable to the user when he moves across from one cell to another, the CCC should automatically transfer the user to a new channel with a different frequency.

The CCC must make sure that the user's signal drop comes from a signal shift rather than a momentary signal drop before making the handoff. The other roaming process is given when a user enters a cell belonging to a CCC other than their home exchange. The visited switch (CCC-V) must inform the user switch that it is no longer about your domain. Thus, the user's home CCC should record the fact and release the user to use the visited home exchange normally as if it were his home exchange.

When you switch from a cell belonging to one CCC to a cell belonging to another CCC, during a call, you have the handoff between switches. This handoff must also be imperceptible to the user.

A fast moving user is a problem for CCC, as in the same cell there are also pedestrian users or even slow moving users. For this particular case, there is a technique called umbrella cell, which provides a large coverage area for fast moving users and small areas for slow moving or non-moving users.

Signal propagation environments can be classified as:

- Urban: When they are in large cities, metropolitan regions with a predominance of high buildings;

Suburban: Low-rise residential environments;

- Rural: Characterized by regions with low demographic densities, where the population is dispersed in large areas such as farms, farms and farms;
- of houses and buildings (indoor): Treated differently from the environments described above, because they are external and the waves are easier to travel through them. These places are the subject of much study today, as it is the place where mobile phones are most used, however the large amount of obstacles such as walls and slabs attenuate the signal strongly and the service works inefficiently on many occasions [6].

In a large environment all these users will get the signal from mobile networks. And because carrier antennas are often unable to reach the intensity levels needed to reach those locations with poor coverage (blind spots or no signal) and large numbers of subscribers, there are reasons to use existing technologies that can remedy the absence of the signal, or amplify them. In the area and market of telecommunication technology there are several possible technologies that can solve the absence of mobile signal, some require end customer investment and others are the responsibility of the local operator [4].

As shown in table 1, thefrequenciesused in Brazil are:

Table 1. Signal Frequencies

Transmission of		Blocks(MHz)	Operators / Area
Mobile Station (MHz)	ERB (MHz)		
708-718	763-773	10+10	Algar/ Sectorsof PGO (3,22,25 e 33) ;RestofVacantBrazil
718-728	773-883	10+10	TIM BRASIL
728-738	783-793	10+10	VIVO BRASIL
738-748	793-803	10+10	CLARO BRASIL

Fonte: teleco.com

2.3Introduction to Cell Repeaters

Within cities, it is often the case, at small points within an ERB's coverage area, that the signal level is very low, unable to provide the quality of service needed for good communication, such as tunnels, subways, stadiums and even the forest among others.These points, called shadow zones or silence zones, are mainly motivated by topographic factors (hills, valleys, etc.) and artificial constructions. This is also common in areas not far from the coverage area contemplated in the original design of a cell due to its large geographical size and the low demand potential generated.

A return on investment in these areas, even in the long run, is difficult to achieve. To remedy this problem, deploying a new ERB would in principle be a good option.

However, the high cost and the need for a new set of frequencies make this alternative subject to careful studies to verify its technical and economic viability, often against its implementation. The use of Cellular Repeaters is a good alternative to the case presented, since it represents advantages in most of the verified points, including in the attendance of rural areas adjacent to cities served by only one ERB and that have sufficient traffic capacity to meet the demand generated [5].

2.4 Basic Concept of Signal Repeater and Amplifier

A repeater is an electronic device that works only on the physical layer of the OSI model. When data is transmitted over the network, it is carried by signals from one host to another. Signals carrying information may travel a fixed distance on the network because as the signal travels it experiences a loss or attenuation that may result in loss of information and some information, thus causing loss of signal in voice transmission and data.

Attenuation is generated because the medium through which the signal is traveling produces some resistance, such as building in urban areas and forest in rural areas. Thus, to overcome the attenuation problem, a repeater is installed on a link that receives the signal before the signal reaches its limits or becomes extremely week long. The repeater listens for the input signal and regenerates the original bit pattern, not the noise, and relays the updated signal to the network correcting some errors that occur during the transmission process.The only problem is the noise, especially the demodulation of QAM systems, which added to the signal will also suffer the same filtering. [10]

A repeater provides only a means to extend the physical length of the network. It does not change any network functionality and is not smart enough to interrupt the input frame or redirect the input frame in another direction. It receives the signal, corrects and redirects again. The use of an amplifier which is also an electronic device whose purpose is to increase the amplitude of the signal waveform without changing the other parameters such as frequency or waveform. It is one of the most widespread circuits in electronics and can be used for various functions. Amplifiers are generally used in wireless communication.

Unlike the repeater, an amplifier is not capable of generating an original bit pattern, it only amplifies whatever is fed because it cannot discriminate between the intended signal and noise ie other words even if an input signal is corrupted and contains some noise, the amplifier only increases the signal amplitude despite correcting the corrupted signal. The differences between repeater and amplifier are generally simple from a technical point of view.

The repeater is used to regenerate the original signal with the help of the received signal pattern and relay

the regenerated signal. On the other hand, the amplifier amplifies the signal increasing its amplitude. Since the amplifier cannot differentiate between the desired signal and the noise, the signal strength increases with the built-in noise. In contrast, the repeater removes signal noise while regenerating the signal bit by bit.The repeater has high gain power and low output power. On the other hand, the amplifiers have low power gain and high output power. Repeaters are used in a stationary environment where the radio frequency signal is stable, as in buildings. In contrast, amplifiers are used in the mobile environment, where the radio signal is weak and constantly changing, for example, remote areas. The implication of the amplifiers results in a minimized signal to noise ratio and increased noise. On the other hand, repeaters increase the signal to the noise rate, which decreases the error associated with the signal. An amplifier is part of a repeater. Amplifier increases signal amplitude, regardless of the noise contained in this signal. Inverse Repeater regenerates the signal, gradually using the input signal and removes the display of noise in the signal [5].

2.5 Covering and Capacity Concept

Coverage is the geographical area (also called lighted area) reached by the signal emitted by a BTS or a set of BTSs within which the cellular mobile service operates. In this cover, the emergence of shadow zones, which indicate voids that must be filled.

Capacity is the expression of the number of calls that occur within the coverage area over a set period of time or, in other words, the number of talking subscribers that a given system can handle simultaneously. Capacity may also be associated with the availability of carrier-purchased radio channels for the region under consideration.

Current techniques for capacity enhancement are narrowband radios (lower bandwidth per channel), microcells, sectored cells, and the use of enhanced digital techniques. This often involves acquiring new frequencies [7].

In the current landscape of mobile telephony, there is a considerable increase in capacity, mainly through the use of sophisticated digital techniques. The adoption of smaller and smaller cells, tending towards the concept of micro cells, causes the range of each of these cells to become smaller and smaller. Cell sectorization, a common practice in any system, also leads to capacity increases.

The concepts of coverage and capacity are to some extent associated, despite the antagonistic condition between them. Indeed, the activation of a new BTS implies the expansion of both. However, it is often the case that the above capacity building techniques end up in overcapacity geographical areas which, despite this, continue to lack coverage due to shadow zones.

The deployment of BTSs in these shaded areas is neither a practical nor an economical alternative due to the cost of a BTS and an even greater increase in capacity, which is not necessary in this case. çThe solution is to increase coverage considering the same capacity already installed. This is exactly the proposal of cellular repeaters. A very important factor when using cellular repeaters is the isolation between the antennas. Without it, the signals transmitted by the subscriber antenna can be picked up by the collecting antenna and vice versa, since most repeaters do not perform frequency translation, causing a signal resorption by the system [5].

3. Methodology

This research is done through a technical study of equipment feasibility, being carried out a study of the city of Tabatinga that has a signal deficiency. In this case study was done research between sites, telecommunication books about what is the mobile phone system and prediction methods, which is the use of basic signal amplifiers and regenerators that can be used, more economically, taking into account Considering that an analysis of a public-private partnership can even be done to encourage the acquisition, installation and maintenance of the equipment.

Before installation it needs to be checked whether or not the use of amplifiers will be compatible with all frequencies, so there must be a compatibility check between the signal donor operators, the telephone plan technology and the frequency delivered by the amplifier to be used. . The range and signal distribution capability of the amplifiers. In this case “the more the merrier”.

It is essential that in the installation process there is a minimum of signal in the area where it will be installed as it needs to pick up the frequency of the signal to be able to amplify and deliver a satisfactory quality, it is also essential that there are not many physical barriers in the environment, since This is a factor that impairs the distribution of signal, ie it can be installed in squares, where there is a greater circulation of people. It is also important to analyze the environment where the signal amplifier will be installed, as barriers such as walls and plumbing negatively influence the signal distribution. Amplifiers are indispensable for remote areas or even in locations in large centers where the telephone signal is low. The most important thing in the case of antennas is dBi, isotropic decibel, which is important for measuring antenna gain, which is what evaluates signal strength, so you should look for amplifiers with higher antenna ratings. dBi to get a better frequency. The amplifier model that can be used by the problem will expose the value and brand of the amplifier, the analysis and measurement of antenna db search, frequency and range, but it is necessary an analysis of the locations and sizing. of the spaces to be implemented, so that there is a better result of the study [7].

The project allows communication correction between users and signal failures within the municipality, as the signal in the region is weak (poor quality) and cable service is not available. The user interface is via the handset's own antenna (the user's mobile station, the handset itself) and on the other side the base station's antenna. Any signal received on one antenna should be amplified and transmitted to another antenna. The system will have a symmetrical shape. Antenna “A” receives signals from the base station and transmits back to the base station in amplified and corrected versions of the signal originating from the mobile phone. Symmetrically, antenna “B” receives signals from the cellular mobile phone and transmits amplified versions of the signal originating from the base station back to the telephone. The upper amplifier amplifies the signals received from the base station, while the lower amplifier amplifies the signals received from the user's handset. This system requires the use of duplexing devices that act as a filter that prevents the transmitting radio from interfering with the receiving radio, but must be adjusted to the frequency to be used to prevent coupling of an amplifier's input signals and output signals. from the other. The biggest design question will be to project the repeater gain over the chosen frequency range. The system must be able to amplify all received signals that fall within the frequency bands. For simplicity, the aim was to project a signal gain from the lower band limit lower than the upper band upper limit, that is, from 700 to

850 MHz. The system must satisfy the frequency conditions of the base station as well as , from handset´s. The biggest challenge lies in calculating and designing repeater amplifier gain [5].

4. Results Analysis and Discussion

According to modulation frequency translation calculations and digital analog calculations, frequency range dBs can be obtained by modulation calculation.

$$V_t = N \, . V_m$$

Where:

- ✓ Vt - baud rate
- ✓ N - Number of bits
- ✓ Vm - ModulationSpeed [9].

4.1Amplifier

The choice of amplifier that was made for repeater design application will be developed with an electronic circuit for signal amplification that is captured by the external antenna. This circuit will use the RP-760S signal amplifier as its main component, which has a 60 dB gain and typical frequency range of 700-750 MHz and can be used to work in CDMA technology only.

4.2 Antennas

The choice of antennas is designed to meet three objectives: operating frequency range, 700 - 750 MHz; low standing wave ratio (SWR) over this frequency range; and radiation in all directions except in the direction of the repeater output. The third item ensures that a radiated signal is not received by another antenna, amplified again and retransmitted (infinite loop), causing amplifier saturation and repeater performance degradation. The choice of antenna for this project was made technically, will be used two fixed antennas one directional type and the other satellite dish 1.70 M hollow for transmission and reception, working as server and donor antennas. Feedback does not depend on system performance, the repeater must be mounted to achieve minimal isolation between the servo antenna and the collector The duplexers will work so that both antennas will be receiving and transmitting signal at the same time, causing a signal to enter without interfering with the output, the duplexers will act as bandpass filters. The duplexer will be configured in the desired signal will have the function of filtering and differentiating the signals, for the project to work will need two separate amplifiers with filters for the handset transmission frequency and base station reception frequency bands. Then the upper amplifier will work by amplifying the signals captured from the base station, while the lower amplifier will amplify the signals captured from the user's handset [5].

The installation process will be very simple, as antenna installation, a technician can do all installations, because the amplifier and duplexer programming will be done before the installation in the frequency selection process.

4.3Cost estimates for project implementation

The chosen components were analyzed via frequency range, range and db, in order to make the choice and estimate values. Remembering that the values of infrastructure, installation and maintenance were not analyzed, the values are only of the components that can be used within the applied system. Table 2 shows the description of each component.

Table 2. Components Used for Installation

Description	Amount	Component Value
AntennaPanelSector - 806-960/1710-2170 - 15.0dBi/17.5dBi	1	R$ 1.828,90
Jumper AntennaPanel Sector - 2 Meters - N Male / DIN Male	1	R$ 152,90
AntennaLeakedSatelliteDish 1,70 M	1	R$ 353,30
Parable Illuminator 850 MHz	1	R$ 326,90
Cellular Drop Cable RGC-213 15 meters	1	R$ 312,14
Connector N Male RGC-213	2	R$ 28,00
Signal AmplifierRP-760S	1	R$ 1.259,32
Directional Grid Satellite Dish - CF-2620	1	R$ 82,37
FrequencyDuplexer 70W MTDPLX160A	1	-
AMOUNT	10	**R$ 4.343,83**

*Values of the components to be used.

Distributed Antenna System (DAS) technology is highly visible from the moment it enables support for all technologies (2G, 3G, 4G) under a shared infrastructure model among operators, a feature that is part of the suite of solutions for Indoor coverage and environments with high concentration of public, it is also possible to suggest for future studies the facilities and applications that any technology to be presented that may bring to the city, because for any solution that is chosen, a condition that brings a series benefits and a range of possibilities for the municipality [8].

The operator most used within the municipality can be analyzed, so that the installation can be made so that the research is conducted within the municipality for use evaluation. The objectives were partially achieved by the method of research techniques and analysis so that studies prove that the use of repeaters can improve the signal within certain locations and areas, and because it is the small developing municipality, and there may be partnerships, so that no installation and application not applied due to lack of financial resources [7].

5. Conclusion

This work showed the operation of telephony, its technical processes and its possible failures, so that the use of repeaters, amplifiers and signal regenerators can promote the improvement. Being that if there are partnerships and mainly political will of the municipal government to not only take this idea to the operators, because it is known that within the municipality signal failures and lack of it often interfere not only so much the media, but also the economic process within the municipality, proposing and encouraging them so that what was analyzed within this project can be applied.

As a suggestion for future work, it should be considered that the model presented using repeaters, amplifiers as well as the methods, and making the study of propagation loss calculations and coverage prediction form, can serve as a basis for improving the telephone signal. mobile phone, with physical characteristics similar to the case studied, making the appropriate adaptations and, if possible, using professional equipment to obtain more faithful the theoretical results.

6. Thanks

I thank my advisors, MSc. Teacher Livia da Silva Oliveira – Fametro
TeacherAristeuFonseca de Souza – Fametro
Teacher Lauro Rosas - Fametro
Teacher Claudio Henrique Albuquerque Rodrigues – Fametro

7. Bibliographic references

[1] Business Season: Brazil has 230 million smartphones in use.
Available in: <https://epocanegocios.globo.com/Tecnologia/noticia/2019/04/brasil-tem-230-milhoes-de-smartphones-em-uso.html> Access in: March 31, 2019.

[2] FIND ALL AND REGION. History of the Municipality of Tabatinga AM. Available in: https://www.achetudoeregiao.com.br/am/tabatinga/historia.htm> Access in: March 02, 2019.

[3] CITY BRAZIL.COM.BR. Municipality of Tabatinga. Available in: <https://www.cidade-brasil.com.br/municipio-tabatinga.html> Access in: March 02,2019.

[4] TELECO GSM Network I: Cellular Telephony.
Available in: <http://www.teleco.com.br/tutoriais/tutorialalambcel1/pagina_2.asp> Access in: 03 in may in 2019.

[5] LUIZ, Bruno Maia Antônio. GSM systems coverage planning using repeaters. Available in: <www.wirelessbrasil.org>. Access in: April 13, 2019.

[6] Medeiros, J. C. (2015) Telecommunication Principles - Theory and Practice. 5. ERICA. Date pp 13-87.

[7] NETO, V. S. (2015). PROJETOS DE TELECOMUNIÇÃO. METODOLOGIAS, TÉCNICAS E ANÁLISES. (ERICA-2015) Date pp 35-91.

[8]WORNET. TECHNOLOGIES AND INFORMATION. Basic operation of cellular telephony. Available in: <http://www.worknets.com.br/2016/05/28/basic-functioning-cellular- telephony/> Access in: March 20,

2019.
[9] TELECO Wimax: Modulation. Available in: <https://www.teleco.com.br/tutorials/tutorialwimaxiee802/page_2.asp> Access in: October 13, 2019
[10] Brandão/ Alcaim/SampaioNeto. Principles of Communications. (Interciencia Publisher -2014) Date pp 261-295.

Grounding Measurement Applied to a 13.8 kV Substation in Manaus - Amazonas

Carlos Gilmar França dos Santos
gilcarlos7@hotmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Francisco Carlos Tavares Amorim
amorim.mao17@gmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

The aim of this study is to show a practical grounding measurement method for 13.8 kV step-down sheltered substation to serve as support material for use in the area.If required, an analytical comparative method for groundmeasurementthroughtheterrometer measurement equipment in the ground measurement process of a step down 13.8 kV substation with its equipment,comparing the data obtained referring to the commonly used methods, thus identifying among the most efficient grounding processes.The development of this study was based on the measurement of electrical grounding with a terrometer in a factory located in the city of Manaus. The procedure used was to perform resistance measurements, to record through measurements and images all the system measurements, to compare the values through Conventional measurement method, with electrical ground ohmic resistance meter, displaying tables and graphs to demonstrate whether the electrical grounding of the entire system would be at adequate levels.

Palavras chaves: electricity; electrical grounding; sheltered substation.

Introduction

Electricity was one of the phenomena that, when studied, most revolutionized the development of technology in history.Today, electricity is indispensable and essential for the accomplishment of industrial tasks or simpler activities that would require more time.For the correct handling of electrical energy, it is

necessary to take protective measures of the electrical installations and the people who frequent the installation, in this case, the grounding system is used.

Electrical grounding is basically one of the safest ways to use electricity resources to protect and ensure the proper functioning of the electrical installation as long as it is designed to the specific parameters under which the system is subjected to all adverse conditions, and meet regulatory requirements[1]-[2].The grounding still raises many questions and is still ignored by many professionals working in this area, either for lack of knowledge or lack of interest in seeking technical information for the correct implementation of the grounding system, because it is perceived that in many places the simple grounding is not performed. in the right way[3].

The scarcity of technical content about grounding in electrical substations does not encourage the development of new methods for the area, its wrong dimensioning brings risks to people who pass near the substations, as well as can cause equipment damage, which generate strict fines from the agencies responsible for inspecting these sites, it is necessary to maintain an electrical system in a regulated situation to provide safety for people and equipment.

The work in question seeks to demonstrate the most common type of grounding used in a 13.8 kV sheltered substation lowering, in practice, from theoretical analysis, avoiding the most common faults through measurements so that in case of inappropriate values to be The project makes the necessary adjustments for security and stimulates the search for new technologies in development from other regions and countries with a view to upgrading to future new local techniques,making it clearer if what is used today in other locations can be used more efficiently in the city of Manaus.

An analytical comparative method for ground measurement by the terrometer measurement equipment is required in the ground measurement process of a step down 13.8 kV substation, and the data obtained are compared by reference to the commonly employed methods, thus identifying between the grounding, themosteffective.

Grounding System

Grounding systems are designed to protect people, animals, and materials against possible system failure.This failure can range from a slight leakage of current to a visible electrical arc that could damage equipment and cause a fire in a serious situation. The main concern, in fact, is to protect the life of living beings by avoiding their exposure to dangerous electrical potentials which, when exposed, may be adequately protected[4].

Grounding is the connection of structures or installations with the earth, in order to establish a reference for the electric network and allow to flow to the earth electric current of various natures, such as lightning currents, electrostatic discharges, filter currents, surge suppressors and line arresters, earth fault current (faults)[5].

Grounding systems are important with regard primarily to personal safety from electric shock. Therefore, it is crucial that everyone knows how to protect themselves from dangerous electrical currents that can even lead to death.

Grounding is a system that is intended to provide a safe, controlled, low-impedance path to earth to protect people and animals from exposure to hazardous potentials.Grounding is implemented by the grounding electrodes, which are conductive parts, are purposely buried or are already buried, and ensure good electrical contact with the earth.[4].

The grounding criteria for low voltage installations are well established in the current technical standard[1], they may be supplemented with the recommendations in the Technical Standard for Protection of Structures against Lightning[2].

Classification of Low Voltage Systems in relation to Food and Masses in Relation to Earth

Distribution networks are classified according to various grounding schemes, which differ according to the power supply and grounding situation, following the letter code in the form XYZ[5].

The type of grounding system to be adopted depends on the importance of the power system involved, the location and the cost; the most efficient system is, of course, the earth grid. Grounding schemes are mentioned in the Low Voltage Electrical Installations standard[1].

The material of the earthing rods should have characteristics of being good conductors of electricity, suffer the smallest possible action of galvanic corrosion, and mechanical resistance compatible with crimping and ground movement [4].

Grounding Systems Resistance

Grounding resistance is the resistance offered to the passage of electric current when a voltage is applied to the grounding system, which consists of: conductors, cables, rods, busbars, connectors, plates, etc. The measurement consists of the ratio measured between the remote ground electrode and the current injected into the electrode. The device used for the measurement is the terrometer and the applied method is thepotentialdrop [6]-[7].

Factors that influence the value of a Ground Resistance

Soil resistivity in the vicinity of the electrodes, in this case if resistivity is a factor that influences, then all the factors that compose it also determine its value.

Electrode geometry (Dimension and shape), for electrodes, one can consider their dimensions, shapes, number employed, relative positioning and spacingbetweenthem[8].

Frequency of Grounding Measurements

It is known that the soil usually presents unsatisfactory conditions, such as homogeneity, constant humidity, etc. In such cases there is a need to carry out periodic checks, according to item 7.2 of the technical standard regarding the protection of structures against atmospheric discharges[2].

Soil resistivity

Soils with similar characteristics may have different resistivities, there are several factors that may influence the value of soil resistivity, such as soil type; mixing of different types of soil; soils consisting of stratified layers with different depths and materials, moisture content, temperature, compaction and

pressure, chemical composition of salts dissolved in retained water; concentration of dissolved salts in retained water[4].

Measurement Methods

Grounding resistance measurement, when prescribed, shall be performed with alternating current, and one of the two methods described in Annex J of the Low Voltage Installation Technical Standard may be used [1].

Methodology

The research methods of this study are field research, since it is performed from data obtained at the place where the phenomenon occurs in a natural situation spontaneously [11]; since it requires the consultation of articles, norms, books and manuals and is descriptive, since it aims to describe the characteristics of certain populations or phenomena [12].

The object of this study was an asphalt emulsion factory X located in the city of Manaus, where the electrical grounding system of a sheltered substation of 13.8 kV was measured. To perform this procedure, it began with soil measurement. To measure the variables voltage, current and resistance of the ground, 02 ground electrodes were used, interconnected to the conductors of the terrometer. During the measurement, records were made through images and annotations of all measurements of the grounding system.

The equipment used to collect the measurement data was the Minipa model MTR 1520D digital terrometer with calibration n° AM06523 / 14. Resistance Scales v: 0-20 Ω, 0-200 Ω; 0-2000 Ω and 0-20KΩ, tension scale: 0-200 Vac, resistance measurement: ± (2% reading + 1% full scale), voltage measurement: ± (2% reading + 1% full scale), reading resolution: 0.01Ω for resistance measurement and 0.1V for resistance measurement. Output voltage, power and current: Operates with output power less than 0.5 W and current less than 15 mA (peak to peak) and operating temperature: 23ºC ± 2ºC.

Components Evaluated by Measurement

The components evaluated by the measurement were 14 (fourteen) tanks, 02 (two) mixers, 01 (one) diesel tank, 01 (one) water tank, 01 (one) Franklin lightning rod and 01 (one) scale. .

After collecting all the material researched in the field, the samples were verified to compare with the theoretical methods provided in the current norms, besides updated bibliographic material, the expected analysis time will be 4 months.

The analysis is performed through intensive direct observation, observation to a data collection technique to obtain information and use the senses in obtaining certain aspects of reality. It consists not only in seeing and hearing, but also in examining facts or phenomena that one wishes to study [13].

For the measurements two galvanized iron piles were inserted in the ground, the current pile E3 and the voltage pile E2, and connected through the cables supplied to the terminals (P) and (C) respectively. Terminal E1 was connected to the ground conductor to measure resistance, with cable of 05 m, as shown in Figure 1.

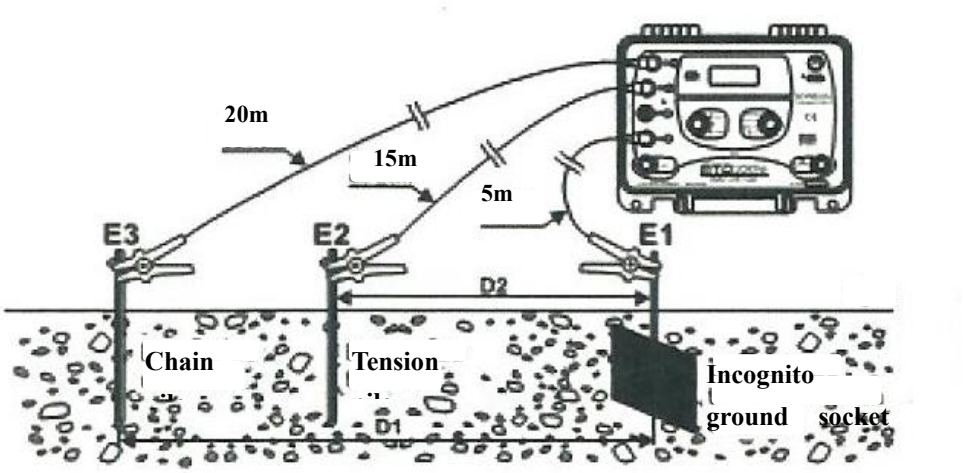


Figure1– Groundingresistancemeasurement: potentialdrop.
Fonte: https//www.eletricidade.net.

Analysis and Discussion of Results

During the grounding resistance analysis of the plant's electrical components, the day was sunny, with relative air humidity around 70% and ambient temperature ranging between 24° C and 36° C. However, the soil was generally moist. Position 01 on the function key on the terrometer was 20 Ω on the scale switch and holding down the Start key to find the resistance value.

The displacement from point E3 to point E2 is 20 meters, from point E2 to point E1, which is the electrode to be measured, 15 meters, from point E1 to the device, 5 meters. The electrode was implanted at a depth of 1.5 meters. 48 5/8 inch x 2.4 meter electrodes were implanted at a distance of 2.4 meters, interconnected by 70 mm bare copper cable to dissipate lightning to the ground. The grounding system was interconnected with a special GTDU connector, in a manhole, according to NBR 5419: 2019 and the fireman's technical standard 40/2017.

To determine the ground conditions for the grounding, the information that the soil is alkaline was used, which favors the grounding conditions. In this first measurement, the soil resistivity of 20.55 Ω near the distribution board was obtained, 12.63 Ω near the substation grounding; 22.85 Ω at the end of the containment concrete tank with an area of approximately 830 m^2 near the scale; 24.12 Ω, near the water tank; 9.46 Ω near the entrance cabin as shown in Figure 2.

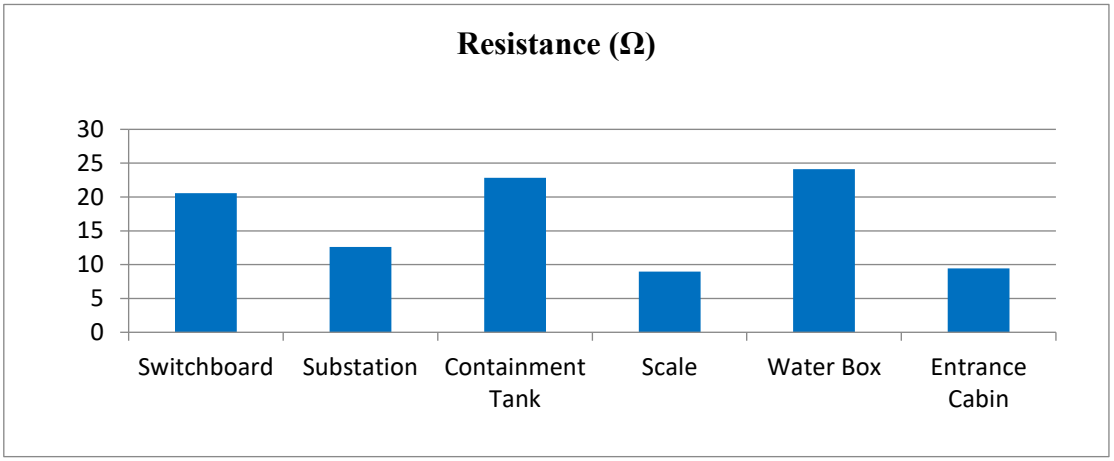


Figure2 -Soilresistancemeasurement

It can be observed in Figure 2 lower soil resistivity value near the scale installation region, allowing to conclude that this area would be the most suitable location for the installation of a simplified grounding, however there is no minimum soil resistivity value. conditioning the installation of the grounding to a certain location, which allows the installation of the grounding even near the water tank, where the highest ground resistivity value was found, since for the installation of a more complex grounding, with Use of more grounding electrodes Other variables, such as location, should be considered when choosing the installation location.

For the analyzed equipment, measurements were obtained at the respective points of resistance and voltages of the electric earthing, mixers, diesel tanks, water tank and scales, which are shown in Table 1.

Table 1 - Measurementofequipmentresistanceandvoltage

Place	Resistancemeasurement(Ω)	Voltagemeasurement(V)
Tank 01	0,39	0,1
Tank 02	0,31	0,1
Tank 03	0,35	0,1
Tank 04	0,79	0,0
Tank 05 - CAP	0,21	0,0
Tank 06	0,72	0,1
Tank 07 - RR2C	1,77	0,1
Tank 08	1,73	0,1
Tank 09	1,23	0,1
Tank 10	0,98	0,0
Tank 11	1,26	0,0
Tank 12	1,29	0,0
Tank 13	1,61	0,1
Tank 14	0,72	0,1
Misturador 01	0,01	0,0
Misturador 02	0,39	0,0

DieselTank	0,10	0,1
Water Box	0,80	0,0
Scale	1,67	0,1

All measurements made in this study are in accordance with the Standards: ABNT NBR 5419 - Protection of structures against lightning strikes and technical standard of fire brigade 40/2017, where the descriptive grounding memorial is evaluated for project approval.

The ohmic resistance values measured in the tanks, mixers, diesel tanks, water tank, scale, are in accordance with ABNT NBR 5419-3: 2015 recommendation in item 5.4.1, it is recommended that obtain the lowest possible grounding resistance, compatible with the electrode arrangement, topology and ground resistivity on site.

Figure 3 shows the values of the grounding resistance measurements for the points connected to the tanks, mixers, diesel tank, water tank and scales. It is observed that the measured values for resistance are low. As described above, it is of utmost importance to obtain low resistance for a substation, since the lower the resistance, the greater the absorption capacity of electric current by the ground, providing greater protection for theequipment..

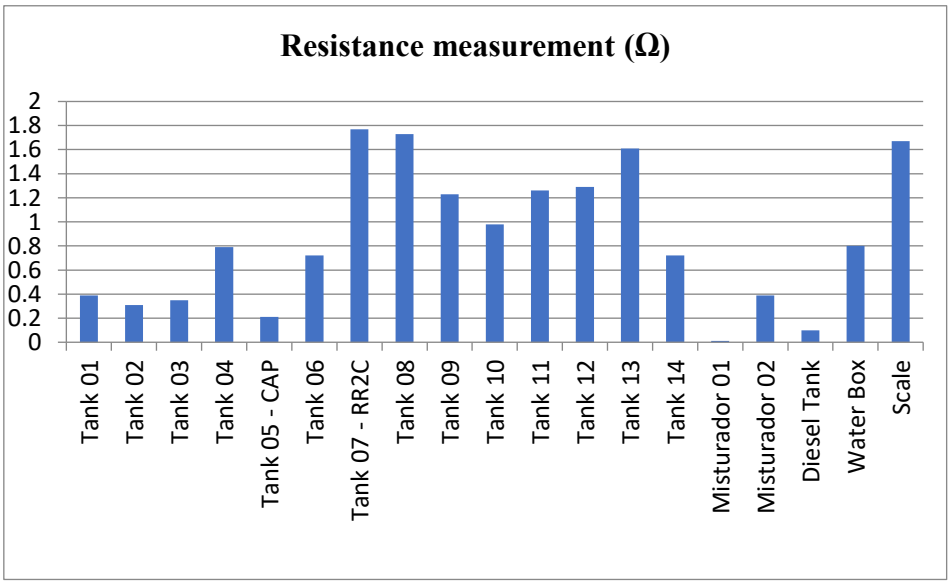


Figure 3 - Resistancemeasurement

Figure 4 shows the ground voltage measurement values of the points interconnected to the tanks, mixers, diesel tank, water tank and scales. The purpose of measuring voltage is to check for floating points, if they are found to be present, electrical grounding is the correction alternative to stabilize them.

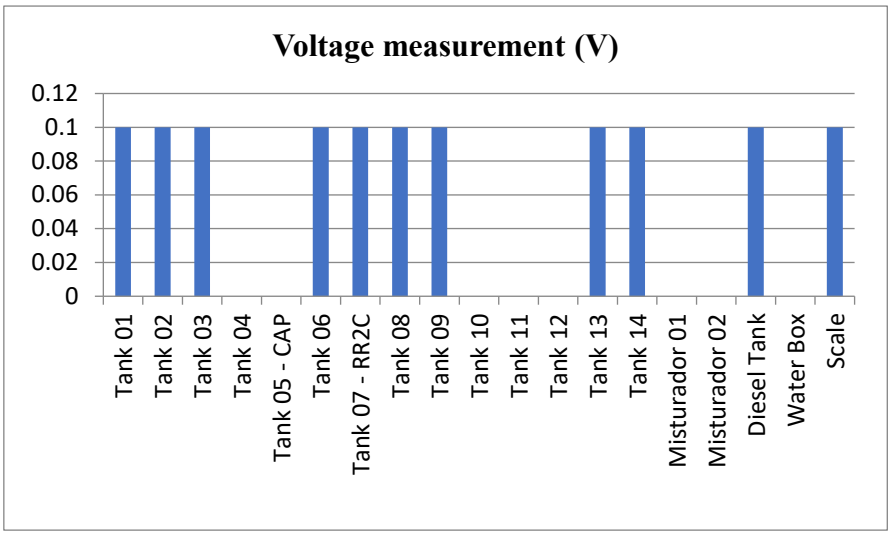


Figure4 - Voltagemeasurement

It is observed that the measured voltage values were equal to 0 and 0.1 V. Obtaining this value refers to the understanding of the Terrometer injecting a current of 1.2 A between the extreme points under test, being able to at the same time. time you inject this current, measure the voltage drop (V) between these points.
The substation grounding serves to stabilize the transformer voltage level when connected in single phase and to ensure the equipment protection. Upon completion of the grounding system, it was subjected to analysis for inspection and approval by the Fire Department.

Conclusion

It was possible to conclude that the conventional measuring method, with ohmic resistance of the electric grounding, in sheltered substation of 13.8 kV lowering, in a factory in the city of Manaus, proved to be effective for the grounding system. The measurements shown by the ohmic resistance meter are conditioning factors for the safety of living beings at electrical grounding sites.
In this study, it was observed that the reference values of the measurements are very close, remaining within the acceptable tolerable values, because the soil resistance may be different for each measured area, since the measured points were not close, being in this case 20 meters away, showing slight differences.
Another important contribution refers to the proper use of this measurement methodology, considering that the grounding still generates some doubts about its norms and procedures, among the people who do not work in the area and also among the electricians professionals. The method used minimizes the difficulties of understanding the theory and its practical applications, this material shows through the results presented greater simplicity in obtaining the data.
Therefore, after the revision of the manuals and norms that cover the theme about the lowered 13.8 kV sheltered substation grounding system, as well as a practical analysis in a grounding system, it was possible, through a process commonly employed, be expanded through ancillary learning materials related to electrical ground area.

References

[1]NBR 5410, ABNT - Associação Brasileira de Normas Técnicas. Instalações Elétricas de Baixa Tensão. Rio de Janeiro. 2008.

[2]NBR 5419, 2015 - Proteção de estruturas contra descargas atmosféricas.Rio de Janeiro.2005

[3]CAVALIN, Geraldo. Instalações Elétricas Prediais. São Paulo : Érica, 2006. 16ª.

[4]KINDERMANN & CAMPAGNOLO, Geraldo, Jorge Mário. Aterramento elétrico. Porto Alegre : SAGRA - D. C. LUZZA1T0, 2011. pp. 3.

[5]CREDER, Hélio.Instalações Elétricas. 15ª. Rio de Janeiro : LTC, 2007.

[6]Institute of Electrical and Electronics Engineers. IEEE81 (Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System). 2012.

[7]ABNT NBR 15749. "Medição de Resistencia de Aterramento e Potenciais na Superfície do Solo em Sistemas de Aterramento". Rio de Janeiro. 2009.

[8]Visacro Filho, Silvério. Aterramentos elétricos: conceitos básicos, técnicas de medição e instrumentação, filosofias de aterramento. São Paulo : Artliber, 2002.

[9]NR 10:2016, ABNT. Associação Brasileira de Normas Técnicas. Norma Regulamentadora - Segurança em Instalações e Serviços em Eletricidade. 2016. p. 2.

[10]Comunidade de Eletricidade.Disponível <https//www.eletricidade.net> Acesso em 19 ago. 2019; 03:30:00.

[11]RODRIGUES, Auro de Jesus. Metodologia científica. São Paulo : Avercamp, 2006.

[12]GIL, Antonio Carlos."Como elaborar projetos de pesquisa". São Paulo : Atlas, 2008. pp. 4.

[13]LAKATOS, Eva Maria."Fundamentos de metodologia científica". São Paulo : Atlas, 2010. 7.

Power Supply Modifying from 400 W to 600 W, Adding a 12v Circuit Voltage for Total 1200 W Power Operation of Machine ASPT Module Test

Élerson Luiz Batista Pisa
elerson.pisa@gmail.com
Centro Universitário FAMETRO - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Manoel Henrique Reis Nascimento
hreys@itegam.org.br
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

Companies are constantly seeking to implement continuous improvements in all sectors, seeking to build a relationship of reliability with their customers by improving the quality of their products. Given this scenario, this study aims to apply the power increase of a power supply to optimize a process. The implementation was made in a company of the industrial center of Manaus-AM. The proposal presented in this paper, points implementation of maintenance improvements, adaptation in the power supply and cost reduction.

Keywords: electric power; improvement; cost reduction.

Introduction

All electronic circuits need electrical power to function. However, this power is not always available in the form required for the electronic circuit, whether in a power outlet or even in a battery, most often operated with low continuous voltages [1].

Power supply is widely used because of its simplicity and cost. It features fast response, load and power variation used in various applications. It is abbreviated by the acronym PSU (Power Supply Unit), which

supplies the equipment with the required electrical voltage, having several output voltage values, INPUT (Voltage Input): 110/220 V and OUTPUT (Voltage Output): +3, 3 V, + 5.0 V, + 12 V, -5 V and -12 V. PSUs convert the utility's alternating input voltage (AC) to continuous voltages used by the electronics [2]. With this perspective, we will analyze the operation and the possibility of applying a change of load elevation, maintaining the same functionality that meets the needs and important factors such as practicality of maintenance and economy, aiming at reducing the cost of material purchase. In this case, it is evident that an adjustment can be made using the material in stock, taking into consideration the analysis and study of the change in the laboratory, where we will use digital multimeter to calibrate the desired stresses.

According to [3], most electrical and electronic circuits have inductive and capacitive loads that in the alternating voltage system inject and store energy in the grid, operating as reactive equipment that does not behave according to voltage. This device has the ability to supply and absorb electrical power.

However, the work presented is a power conversion to voltage PSU project, with adjustable output from 0 V to 12 V with the objective of transforming a power supply from 400 W to 600 W, resulting in a maximum output power at 1200 W module operation. After conversion, the PSU must work in parallel with another PSU to achieve the required power in the operation of the equipment. Converter types can be classified according to variable type (AC or DC) and the stage number can enable efficient conversion [4].

In general, electronics are present in various environments such as: homes, businesses and industries. Power supplies include converting alternating current to direct current, such as alternative energy processing, power amplifiers, household appliances, robotics, drive systems for electric and hybrid vehicles, as well as many other applications [5].

Thus, the number of PSUs used per module was reduced from 3 to 2, hoping that the results will be satisfactory to ensure efficiency in technical handling, facilitating the reading and interpretation of results, and the technical team can perform the work with ease. guarantee in the environment and enabling application in other process machines.

Theoretical Referential

The importance of electronics in the development of our society is evident, the prediction of important technological advances that will continue to influence the coming decades. Both today and in the future, any professional who wants to use, understand and modify the world we live in will need a thorough knowledge of the operational and scientific foundations of our modern technology. It is therefore necessary for today's student to be familiar with the wide variety of experimental techniques in order to learn how to buy and use these new technologies efficiently [6].

From the point of view of [6], it is necessary to learn how to design and build equipment that is not commercially produced, becomes indispensable for innovative scientific work. Today's existing methodologies and technology are changing from innovative to obsolete. An active professional has a hard time catching up with, and of course only those with good basic education can succeed in the long run. Assessments of the magnitude of physical phenomena require that they be made accurately and increasingly accurate due to modern technology.

According to [7], it is extremely relevant to read the instruction manual accurately before using any device. It is through this information contained in the manual that we get the correct information, what conditions the equipment can or cannot measure. Follow manufacturer's recommendations for calibration / calibration on measuring equipment constantly for use. In energized circuits care must be taken not to short circuit.
The largest PSU of heat generated in electronic components is semiconductor material. They are designed with encapsulations to withstand this heat, but have difficulty transferring this heat to the environment due to their limited capacity. Depending on its mode of operation heat is not uniformly generated in the semiconductor, it is produced by the current flowing in the component and transferring it to the environment before the temperature rises above its maximum limit [8].

1.1. Measuring instrument

The purpose in solving electrical measurement problems is the evaluation and the multimeter, being the main work tool of the technician in the areas involving electrical and electronic. In the analysis and calibration of the PSU voltages, this instrument helps to identify the root cause of the electrical circuit defects, obtaining data for analysis in order to conclude on the errors, making the necessary calibration according to the informed specification [9].

1.2. Structured Single Plug Tester (ASPT) Testing Machine

According to the ASPT 21797-01 [10] machine user manual, the system is controlled by a manager called Rackpc, a type of coupled industrial computer where it controls four modules that make up the machine. External connections are: a barcode reader, connected to the keyboard port of the PC and used to enter and send information, and a keyboard connection.

1.3. Chamber

A Chamber contains two modules and has a glass door to allow viewing through the LEDs, checking in the test of the active product. Each chamber has an independently controlled thermal environment. According to the manual, Chamber's temperature is factory set to operate at 75 °C.

1.4. Functional Test Module

Module connection descriptions will be covered, where PSU's will be allocated, focusing on this project implemented with the intuition of improvement. The module (Figure 01) is the metal structure that weighs approximately 55 kg without adapters and 65 kg with adapters. For 3.5” size hard disk (HDD) and 2.5” size (HDD) testing. The module also has electronic test boards and three 400 W PSUs with four slots each, being two 12 V DC slots and two 5 V DC slots. Modules are removable only from the front of the rack. The functional test module makes up, fixture (adapters), communication and electronic data cables, cooling coolers and management communication boards.

Figure 01 - Functional test module.
Source: Western Digital – Digitron, 2010.

1.5. The Module Bulkhead Card (MBH)

It is the main board of the module where it communicates all data information with the CBC (Chamber Backplane Card) and IDC (Intelligent Driver Controller), transmitting the communication with the main computer (Rackpc). The ultimate goal of this operation is to test the manufactured product. The MBH card receives power from all three PSUs and a data communication cable that sends readout information from the PSUs to the Disk Operating System (DOS) mode software or disk operating system.

1.6. PSU'sscheme

It is the numbered connection scheme of the PSU that connects to the MBH card for communication between them. A connection of the module PSUs as described in the user manual. This connection is made through the bus of a JP1, JP2, JP3 & JP4 connection to MBH card. Connects to PSU channels according to numbering indicator as shown in instruction manual.

PSUs provide voltage lines that monitor each voltage slot and detect appropriate voltage tolerance range in each slot and power on the IDCs, which communicate and control the test units that are monitored by the PC in the rack. This control / communication link is provided by the 'ATA4' card, a WD (Western Digital) designed card connected to an ISA slot on the PC. In the ASPT system, the ATA4 board provides two 40-way flat cable connections, one for each of the two modules in one chamber. These cables are routed through the rack and each plug into a connector on the front panel of a module. This connector is part of another board called a Module Buffer Board (MBB) located next to the module panel. MBB is also a WD project and provides buffering (data transmission) between ATA4 and IDC on the back of the module.

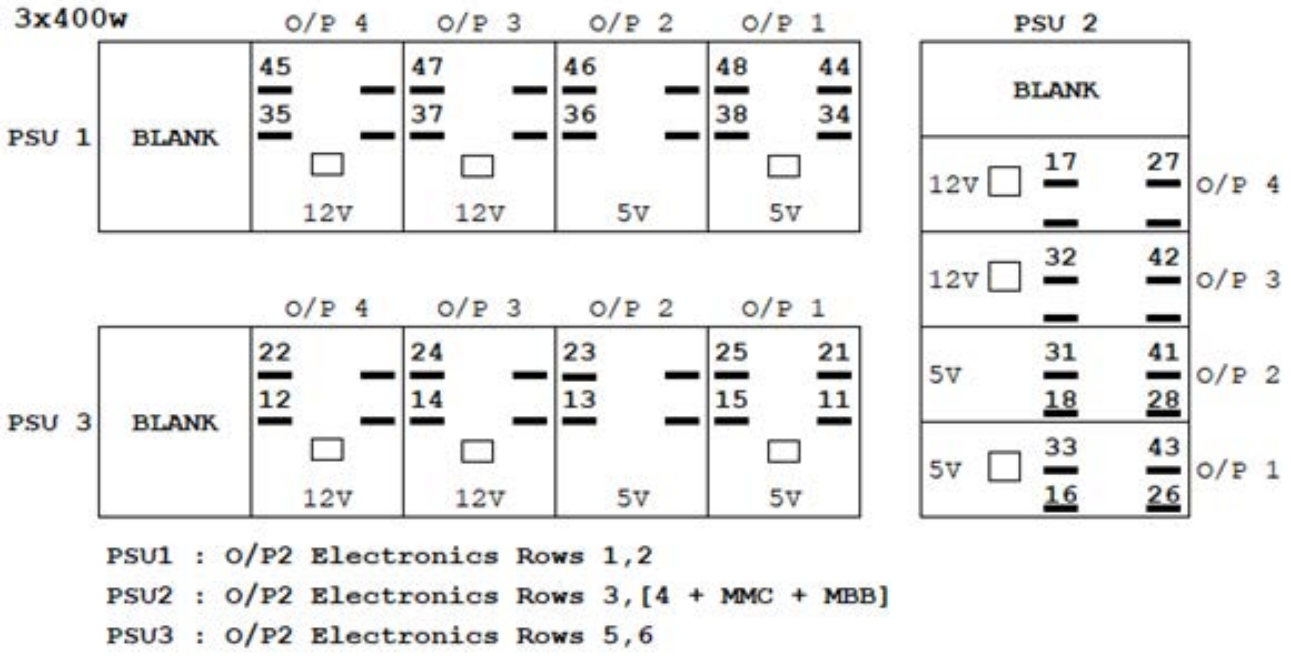


Figure 02 - Single-Plug Tester User Manual (PSU) wiring diagram.
Source: Western Digital – Digitron, 2010.

PSU1 connects IDCs 1 and 2, PSU2 connects IDCs 3,4 and the Module Management Card (MMC), PSU3 connects IDCs 5 and 6. PSU and module communication are via cable MMC board with O / P reference (Output voltage) from 1 to 4, being used for reading only in three slots of each PSU. In figure 03 is shown, for better visualization, how the three PSUs installed in the functional test module are interconnected, in particular, is the data cable connection for communication with the software.

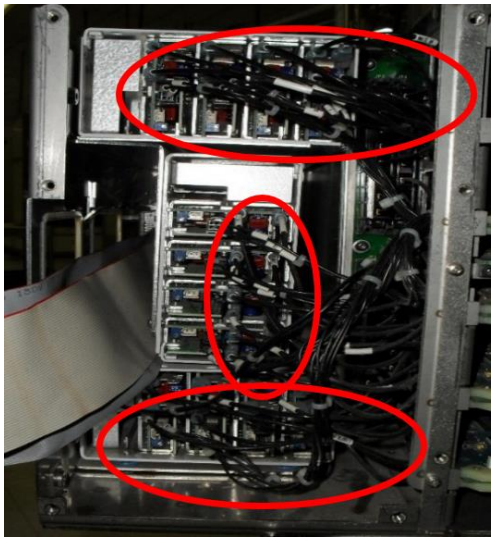


Figure 03 - Module with 3 PSU's (1200W).
Source: Western Digital – Digitron, 2010.

1.7. Data Cable Configuration

The data cable has 3 read connection ways on each PSU, below we can see the connection configuration:

PSU1 - Slot 1 Connects, PS1 (O / P1), Slot 3 Connects, PS1 (O / P3), Slot 4 Connects, PS1 (O / P4)
PSU2 - Slot 1 Connects, PS2 (O / P1), Slot 3 Connects, PS2 (O / P3), Slot 4 Connects, PS2 (O / P4)
PSU3 - Slot 1 Connects, PS3 (O / P1), Slot 3 Connects, PS3 (O / P3), Slot 4 Connects, PS3 (O / P4)

Module PSUs include an automatic calibration feature. However, the 5V and 12V PSUs must be set within + 1% -0% of the rated output voltages, 5V and 12V, respectively, before connecting the auto calibration cables.

Material and Methods

In this first moment, a bibliographic study regarding the hardware architecture was performed in the elaboration of the change related to the conversion of the power supply that has 12V and 5V power channels, as well as the manual calibration study made by the digital multimeter, which follows the systematic operating process where it will be applied to the company here called company X.

The focus of this project is to reduce the number of power supplies from three to two PSUs, model and characteristic of the power supply LAMBDA Alfa 400 W [11], has its specific power of 400 watts with 4 voltage slots for each PSU. The reference values on the slot outputs: + 12 V, + 12 V, + 5 V and + 5 V.

The study area for implementation is located in Campos Sales - Tarumã neighborhood, in the north of Manaus-AM. Easily accessible for transportation and customers at a Manaus industrial hub company, this is an assembly industry (HDD) where the process assembly flow goes from the preparation of the Front End PCB to the HDD pre-assembly in the Back End end sector. The company works with other types of machine industries, however, we will cover only what will be our object of study that will serve as the basis for design and implementation of the project.

Analysis and Discussion of Results

A 12 V voltage circuit was added that was extracted from another 4-slot 400 W power supply, which we have as a spare part, now having 5 voltage slots which reduced the number of PSUs used in the functional test module. from 3 to 2. The necessary manual calibration adjustments were made, using the digital multimeter to adjust the 12 V voltage in the slot (Figure 04).

Figure04 – Circuit of one + 12V slot.

1.8. The Conversion

In order to achieve the goal, there was a need to change the data cable connection as a PSU was removed. Initially the data cable had its configuration distributed to 3 PSUs, this connection was adapted and its distribution started to connect the two PSUs, resulting in a positive expectation.

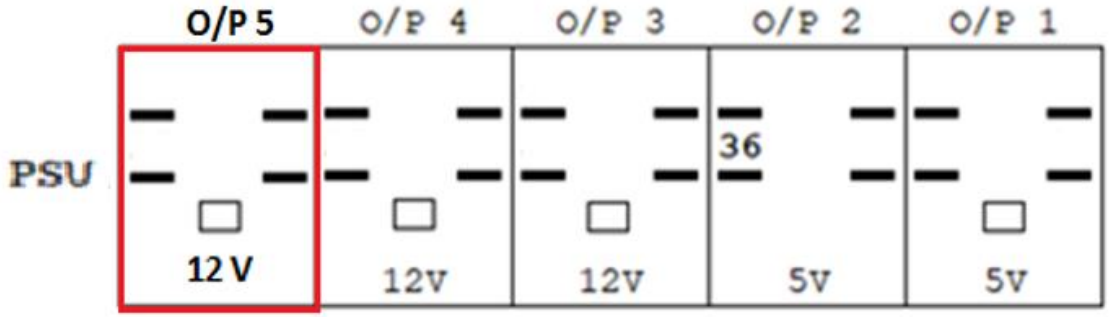


Figure 05 - 12 V Voltage Slot Scheme added at PSU.

In figure 06, follows the scheme of connection of the final project PSUs between the data cable to 2 power PSUs, the PSUs now distribute their connections for hardware / software monitoring. PSU 1 controls the binding and monitoring lines of the IDCs 1,2,3 boards and PSU2 controls the binding and monitoring lines of the IDCs 5,6, (4 + MMC + MBB). The connections are left: 15, 25, 34 and 44 and PS2 (OP1).

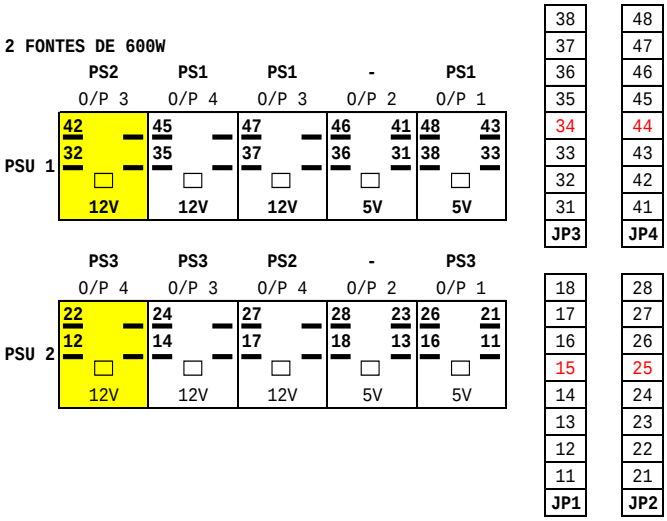


Figure 06 - Schematic of 2 converted power supplies.

Each power supply connection was verified by observing in the wiring diagram manual according to pinout 1 to 8, as it receives the MBH board on the connection bus JP1, JP2, JP3 & JP4. With the digital multimeter the slot voltages were checked and the results show what was expected, confirming that the voltages were the correct measurements. From this proposed modification, it was implemented in the functional test module, observed in the software the calibration readings, indicating that the PSU was calibrated correctly (figure 07).

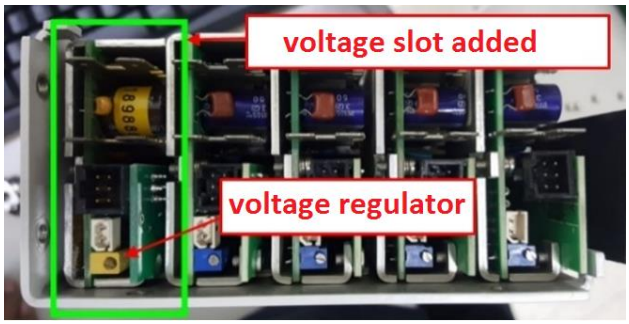


Figure 07 - PSU with five slots, 5V and 12V voltage slots.

In order for the machine to function properly when turning it on, all Chamber components (modules 1 and 2) must be in good working order including proper calibration of the PSU's in the functional test module, ie if any voltage is unregulated, it will not start the test program (DOS mode).

Being obtained a gain in reducing the temperature where the PSUs are. In the user manual one PSU operates from 0 to 70 °C, depreciation from 2.5% down to 50 °C and 70 °C, humidity from 5 to 95% without condensation, the three operating PSUs operate at a temperature of 37.9 °C, the change reduced the temperature to 33.9 °C. It had a lower temperature due to the three PSUs operating.

The usefulness of this conversion is exclusively for this equipment and helps in the speed and repair of the module, ensuring that there are no problems switching PSUs saving time in the production process, thus reducing the number of line stops. From this implementation, we seek alternatives to save on the purchase of similar material on the market with the power required for operation.

Conclusion

The major challenge for this work was to apply in practice the knowledge that was obtained during the undergraduate course in electrical engineering, developing the theoretical, scientific knowledge and skills acquired over time in the laboratory environment of the institution. The expectation that you could have applied the whole study, from idea to implementation, should be considered as a positive weight in working life, as through observations, analysis and diagnostics, practical tests and application, we were able to successfully convert the PSU.

Thus, a good working result of the functional test module was obtained in transforming the power supply from 400 W to 600 W. The results of the operation after conversion came from the study of the theoretical basis for functionality and practical application, where the idea of making the conversion was proposed, in which the original PSU makes available in the circuit configurations to be added a new voltage slot if necessary. , which was the case of our study. The management of the calibrations by the software showed data confirming the readings of the slots calibrated by the multimeter and confirming that the manual adjustment performed is correct.

Based on the existing structure and foreseeing as an improvement of application, the implementation was made with the benefit of reducing expenses on the purchase of the power supply, which also reduces the consumption of material used in the test module. product and increasing the amount of replacement and temperature reduction, which for the environment is important to reduce the heat generated by the operation of electronic equipment. Once satisfactory results and modification effectiveness have been confirmed, the stock material (SparePart) and the remaining PSUs of the modules used in the production process machines will also be implemented for 600 W power operation.

References

[1] BRAGA, Newton C. Power Supplies - Volume 1. 1 ed. NCB, Power Supplies - V. 1 São Paulo - Brazil - 2013, pp. 9-12.

[2] VENTORINI, Afonso, development of a fully power-controlled, microcontroller-controlled voltage and current switching power supply. Federal Office of Espirito Santo, Espirito Santo, 2007, pp. 20-23.

[3] BAETA, Guilherme Augusto Pereira. Power factor correction in distributed generation systems with alternative PSUs. 2017. Monograph (Undergraduate in Electrical Engineering) - Institute of Exact and Applied Sciences, Federal University of Ouro Preto, João Monlevade, 2017, pp. 783-968. 15-55.

[4] CRISPIM, Karina Souza. Study of back-to-back converter control for frequency conversion. 2018. 49 f. Monograph (Undergraduate in Electrical Engineering) - Institute of Exact and Applied Sciences, Federal University of Ouro Preto, João Monlevade, 2018, pp. 25-30. 1-46.

[5] FERRONI, Felipe Martins. Arduino microcontrolled sine voltage inverter. 2018. 77 f. Monograph (Undergraduate in Control and Automation Engineering) - Minas Gerais School, Federal University of Ouro Preto, Ouro Preto, 2018, pp. 25-30. 1-2.

[6] MAGON, Claudio José. Basic Concepts of Electronics: Theory and Practice. Available at: <http://granada.ifsc.usp.br/labApoio/images/apostilas/apostilaEletronica2018-v1.pdf>. Universityof São Paulo - USP InstituteofPhysicsof São Carlos - IFSC São Carlos, SP, 2018, pp. 1-318.

[7] VIANA, Joseanne Cristina, ARNOLD, Francisco, Development of an Automated Electrical Impedance Measurement System, www.scielo.br / rbef DOI: http://dx.doi.org/10.1590/1806-9126-RBEF- 2016-0183Rev. Bras. PhysicalEducation, 2017, vol. 39, no. 2, e2503.

[8] JR. Pedro Armando Da Silva, SOUZA, Pedro Paulo Corrêa, Tension PSUsReguladas, Fonte Ministry of Education Secretariat of Vocational and Technological Education Federal Institute of Education, Science and Technology of Santa Catarina Integrated Technical Course in Telecommunications, SANTA CATARINA, 2012, pp. 25-30. 3-32.

[9] PEIXOTO, Gustavo Henrique Braga. Development of an illuminance measurement system. 2019. 71 f. Monograph (Degree in Control and Automation Engineering) - Minas Gerais School, Federal University of Ouro Preto. Ouro Preto, 2019, pp. 24-52.

[10] MANUAL PROCEDURE, Setup, ASPT Menual 21797-01AUser Manual, Westem Digital – Digitron Manaus, 2010.

[11] https://www.datasheetarchive.com/LAMBDA%20alpha%20400w%20PSU-datasheet.html, date and time of access; 08.31.2019 at 17:56.

Water Pump Management Using Photovoltaic Plates in Santa Fe - Amazonas Community

Antônio Jackson Sabino da Silva
jacksonsabino123@gmail.com
Centro Universitário FAMETRO - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Antônio Estanislau Sanches
novo.sanches@gmail.com
Universidade do Estado do Amazonas – UEA - Brasil

Abstract

Electricity in today's world is one of the biggest concerns. Through clean sources, photovoltaic systems emerge as an alternative to this kind of problem.This work proposes the development of a photovoltaic system that will be applied to water pumping using a pump. Through the presented data, it will be possible to analyze if the photovoltaic energy is reliable and to propose solutions to the problem of residential water supply in the communities that do not have access to the electricity grid.

key words: photovoltaic systems; pump water; residential supply.

Introduction

We know that in riverside communities there are difficulties in water supply, which causes some problems in the living conditions of the population, such as the difficulty of bringing this resource to the residence, which is usually done through inadequate and even loaded containers. by women and children. Excessive physical effort in the water supply activity can cause damage to the physical health of people, as they may not have adequate physical conditions to perform the activity [1]. Looking for a way to alleviate these problems, it is possible to activate new technologies to improve the quality of life in the riverside community.

Second [2], Through the technological advances experienced in recent years by pumping technology in the

course of growthof water supply applications for communities in Brazil and around the world,are seeking to retrieve the most relevant information about the state of the art technology.

The photovoltaic effect was first observed by the French physicist Edmund Becquerel. In 1839, photovoltaic pumping, in turn, experienced its first applications in 1950 and commercially consolidated in the 1970s. More than 10,000,000 systems were installed. throughout Brazil, with its exponential growth over the years. The photovoltaic effect intensified the studies for the implementation of this clean and renewable energy, since its number increased significantly [2].

One reason for the growth of photovoltaic pumping applications is that their prices have dropped over the years as prices were very high and many opted for other technological means. With the reduction, it became feasible to use pumping that benefits the economy and quality of life of residents [2].

The plan of this work aims to carry out a study on photovoltaic energy to manage a water pump, knowing the main components of the system off-grid (Off-grid) and understanding a functionality of each within the system, and design a system of photovoltaic plate for water supply in the riverside community of Santa Fe - Amazonas. The main motivations for the realization of this project are life improvements for the riverine residents of the community.

To carry out this project we have the objective of designing a pump system using photovoltaic plates, for this it is necessary to dimension the place that will receive the water through the pump pipes, perform the sizing of the water pump design and perform the sizing of the photovoltaic plate.

2. Theoretical Referential

1.1. Solar Energy

Solar energy is the name given to any type of radiation capture from the sun and subsequent transformation into some form usable by man, is the source of almost all the energy resources of the earth. There are several ways to convert solar energy into electrical energy, and one of them is through the photovoltaic effect that occurs in devices that are called photovoltaic cells [3].

1.2. Photovoltaic Effects

The photovoltaic effect is to capture the energy coming from the sun and transform it into electrical energy through the photovoltaic cells, which uses a clean and inexhaustible source that is the sun, where everything occurs in a semiconductor material, one of these faces of semiconductor material. has a tendency to receive electrons and the other side a tendency to donate electrons. However this electron movement does not occur spontaneously, it is necessary to have an activation energy that comes from an external environment. This energy is nothing more than the energy contained in the photons of solar radiation, that is, that luminous radiation that is the light we see from the sun [3].

It was first observed by Edmundo Becquerel in 1839 who produced electric current by exposing two silver electrodes to light, and in 1877 was built the first photovoltaic cell which in turn had a low yield and consequently there was no development of it. Only in 1954 was the first article published on silicon photovoltaic cells, which had a yield of 4.5%. The definition of photovoltaic cell performance is the ratio of incident light power to available electrical power at the terminals. In 1956 the production of the

photovoltaic cell for silicon cells began, with a value obtained of approximately 24.4% [3].

Silicon is a matter of electricity semiconductors, as it has low electrical conductivity, thus using the doping process that serves to circumvent the conditions under which elements are mixed with silicon crystal, in the case of photovoltaic cells,silicon goes through two doping processes; one with Phosphorus (N-type silicon) and one with Boró (P-type silicon), each of these cells has a thin layer of N and P type material,as can be seen in figure 1 [3].

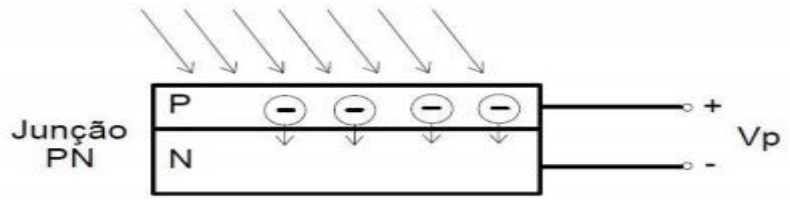


Figure 1. Simplified Scheme of a Photovoltaic Cell.

.

When light strikes the photovoltaic cell, an electric field forms between the P and N layers and the electrons are directed to flow from the P layer to the N layer. It is important to note that separately the layers are separately neutral [3].

Each cell with about 100 mm² generates in its terminals a voltage between 0.1 V and 1 V. Thus with low value the cells are assembled in series to reach voltage of 12 Volts. In direct current, depending on the application, the plates can be mounted either in series or in parallel [3].

1.3. Photovoltaic Solar Energy Applications

There are several solar photovoltaic applications, so any kind of electric charge can be supplied via photovoltaic solar energy that just depends on the correctly designed system, but will use the water pumping system to manage the pump where the system will be sized accordingly. with the data obtained by the pump in order to be able to apply Off Grid photovoltaic solar energy. Where Off Grid is the standalone or standalone system that generates off-grid photovoltaic solar energy. It is a solution for the direct supply of appliances or homes where this location does not have access to the mains or for economic and practical reasons, such as specific locations. For example; water pumping systems, where this energy is produced and stored in batteries that guarantee the supply in periods not exposed to the sun [3].

1.4. Bombs

Pumps are machines capable of transforming mechanical energy into hydraulic energy, where it receives electrical energy that causes the pump to move (Mechanical), thus converting it into hydraulic energy for fluid transport, which in turn is withdrawn from the pump. its origin to its destination. Its energy is taken up by the movement of the motor shaft where the electrons will move and create a flow of currents. Fluid is transmitted by increasing the pressure, speed or lift of the pump. For pump sizing realizations, it is necessary to obtain factors that will determine its operation, such as; Repression, Suction, Flow, Head Height and Power [4].

2.4.1 Repression

Settlement refers to the height of the pipe to the reservoir, measured from the water leaving the pump in the storage tank [4].

2.4.2 Suction

It is the calculated height from the water surface to the pump inlet. For example, in a well, the suction height and piping length will be similar as the pipes are vertical. But the catchment of a lake's water may have a pipe larger than the suction height [4].

2.4.3 Flow rate

It is the ratio between water volume and transport time, which can be measured by cubic meters per hour (m^3 / h), liters per hour (l / h) or liters per minute (l / min), remembering that 1 m^3 corresponds to at 1000 liters. So if a tank is 2000 liters, a pump running at a flow rate of 4 m^3 / h will fill it in about 30 minutes [4].

2.4.4 Height Manometric Total

To find the total head height, we add the suction height, the discharge height, the type of connections and piping, and the losses in compliance with the installation. The m.c.a. It is also the measure used here [5].

2.4.5 Power

Horsepower refers to the force of the pump and the measure employed is the horsepower (hp). 1 horsepower corresponds to 735.5 watts of power. Acronyms like 1/4 and 2/4 represent fractions of this power. For example, a 1/4 pump will have 25% 1 horsepower, or about 368 watts. The higher the power, the more energy is spent [4].

2.5 Drums

According to [3] Battery is a device that stores chemical energy and makes it available in the form of electrical energy, can be classified into rechargeable and non-rechargeable. A battery is a chemical-filled container that produces electrons, ie a device that creates electricity through chemical reactions. For off-grid systems, the use of batteries for energy storage systems becomes important to compensate for periods without sufficient solar radiation, for example at night or on cloudy days [6].

2.5.4 Battery For Use In Photovoltaic System

There are several types of batteries, but the most commonly used in photovoltaic systems are stationary batteries that are designed to withstand longer periods of discharge, which can suffer up to 80% without affecting their useful life, so they last much longer. They last around 5 years, with cases where they exceed 10 years, depending on the load cycles, ambient temperature and other factors that impact their useful life [7].

2.5.5 Inverters

The inverter is an electrical device where solar energy is captured by photovoltaic modules and is injected into the inverter from direct current, where the inverter will take the direct current and turn it into alternating current. It usually has 12, 24 or 48 volts input voltage and converts 127 or 220 volts into direct current [3].

2.5.6 Load Controllers

The charge controllers are between the panels and the batteries of the photovoltaic system, they are used to control the input voltage in them, thus avoiding overloads or discharges that could cause equipment damage, thus extending their useful life, are responsible for transferring as much as possible. of power from the photovoltaic array to the battery bank for proper charging [8].

3 METHODOLOGY

The research is of applied scientific character, defined by the application of scientific methods, to associate the theoretical approach with practical applications, that is, to find solutions to everyday problems in a basic and pure way [10]. The type of research will be descriptive in nature, with the objective of designing an Off Grid photovoltaic system to manage a water pump. Descriptive research aims to describe the characteristics of a population, phenomenon or an experience. For data collection, an intensive direct approach will be used, and for analysis and interpretation of the data will be quantitative, ie, this type of research is classified by many authors as a particular case of quantitative research [10].

Para elaboração, será feito um estudo bibliográfico referente a energia solar e a bomba de água, onde foi utilizada fontes secundarias, ou seja, por meio de livros, revistas e artigos científicos.

This study explores a photovoltaic energy project to manage a water pump, located in the Santa Fe - AM community. Santa Fe is a riverside community in the state of Amazonas, northern region of the country, which has an average of 200 inhabitants and is close to the municipality of Puini - AM. To carry out the project it will be necessary to evaluate the location that will be sized the plate and the pump, in turn the location does not have the presence of the electric grid, where it will be necessary to use stationary batteries that will store energy for when there is no sun she act. This system will consist of a photovoltaic arrangement, a charge controller, a battery bank, an inverter and a motor pump. Where the data obtained to perform the sizing was through a partnership with a confidential company that works in the area. The water will be captured through an artesian well and the water will be pumped to a reservoir to be sized for the amount of liters of water.A moto bomba a ser utilizado será a bomba submersa, onde a principal função da bomba é pressionar o fluido durante o processo de bombeamento, esse equipamento funciona dentro da água trabalhando em meio ao composto que será bombeado, ou seja, funcionam de forma permanente dentro da água. Segundo a [9], A escolha do melhor sistema de bombeamento de um poço artesiano depende da análise de vários fatores, onde se incluem: o diâmetro a profundidade do poço, a profundidade do nível de água e seu rebaixamento, a capacidade e duração do bombeamento, a qualidade da água, os custos iniciais e de manutenção, e a potência requerida.

4 RESULTS ANALYSIS AND DISCUSSION

For the pumping of water directed to the residential supply, the site dimensioned in this work was designed a photovoltaic system with analysis according to data obtained in the field, where the system consists of a photovoltaic arrangement, a charge controller, a battery bank, a inverter and a motorbike bomb. Water is collected through an artesian well where water is pumped to a water tank. Soon the design was implemented in the center of the community, where are located the two schools that are right in the center of the zone to be able to serve the riverside population, as shown in figure 2.

Figure 2. Community of Santa Fe - AM.

For the network system deployed for capture and distribution in local homes, the flow was successfully met. For the operation of the water supply system without interruption, preventive system maintenance will be scheduled.

In the Santa Fe riverside community, there are an average of 200 inhabitants. According to NBR 5626 we can consider that in popular or rural homes has an average consumption of 120 L / day per person, thus multiplying the average inhabitant x consumption will be 24,000 L / day or 24 m³ / day.

Foi estabelecido um reservatório com capacidade de 50 m³. A profundidade do poço é de 40 metros até se alcançar o lençol freático.

Knowing the amount of water to be pumped, a Single Phase 2.0 HP Sub15-20S4E14 220V Submersible Pump from SCHNEIDER was chosen, a multistage centrifugal pump, coupled to electric motors specially designed to operate in the water at great depths. and its groundwater pumping into tubular wells with an inner diameter from 4 ”at 220 volts. For this situation the pump flow rate is 4.5 m3 / h, 2hp power, stages 14, its 1 1/4 ”headpressure 60 m.c.a and the 79 mm rotor.

Table 1. Specification of selected pump.

MODEL	POWER (CV)	TENSION (V)	ELECTRIC CURRENT (A)
SUB15-20S4E14	2,0	220	6,69

Source: Own Authorship.

The electric power of the pump is given by the product of the current by the voltage:

$$P_b = V.I = 220\,V\,.6{,}69\,A = 1471{,}8\,VA$$

To perform the photovoltaic dimensioning it was necessary to calculate the energy of the pump and the period in which it remains in operation [3]. Thus knowing the volume (V) and the flow (Q) it is possible to calculate the required pump running time per day.

$$\Delta t = \frac{V}{Q} = \frac{24m^3}{4{,}5\,{}^{m^3}/_{h}} \cong 6\,horas$$

Knowing that the pump will need to run 6 hours a day, it is possible to calculate the energy (E_b)required for pump operation.

$$E_b = P_b.\Delta t = 1.471{,}8\,.\,6 = 8.830{,}8\,Wh/dia$$

From the energy required for the operation of the pump it is possible to design the photovoltaic panel.

Tabela 2. Especificação do painelsolar selecionada.

MODEL	MAXIMUM POWER (W)	MAXIMUM POWER VOLTAGE (V)	MAXIMUM POWER CURRENT (A)
JKM330PP-72	330	37,8	8,74

Source: Own Authorship.

The sizing of the photovoltaic system will be based on the monthly average daily radiation index of 4.5 h / day, measured by **SOLAR FINGER RESOURCE.** Latitude: -3.119 and Longitude: -60.0217.

Tabela 3. Daily Average Monthly

Month	**Radiation**(kWh/m²/dia)
January	4.23
February	4.20
March	4.19
April	4.16
May	4.17
June	4.39
July	4.77
August	5.19
September	5.22
October	5.05
November	4.73
December	4.28
Yearly	4.5

Fonte: **SOLAR FINGER RESOURCE -** https://solarfinger.com.br/radiacao-solar-no-brasil/.

The photovoltaic panel has the following specifications: it will consist of 13 modules JINK SOLAR 330Wp, organized in 13 rows in parallel, each row will be formed by 1 module in series, so we will have

to divide the daily pump consumption (E_b)by the average radiation shown in Table 2,which will have the total of 1962,7 KWh,value that the system will consume per hour. For daily consumption you will need a generation system producing 11776,00 Wh/dia.Monthly energy production(E_M)of the system will be:

$$E_M = (Radiation\ .30\ dias\ .Panel\ Power\ .0{,}83)/100$$

$$E_M = \frac{4{,}5\ .30\ .330\ .0{,}83}{100} = 36{,}98\ KWh/mês$$

The result of 36.98 KWh / month is per panel, so it must be multiplied by 13 to know the monthly energy of the system, reaching a total of 480.74 KWh / month.

For the sizing of the battery bank, extreme situations of scarcity of solar radiation were considered, such as on rainy days. The choice of batteries was made considering that it should have deep discharge capacity, with a long service life with development in the application in photovoltaic systems. Following this reasoning, we chose MOURA brand batteries.

Tabela 4. Especificação da bateria.

MODEl	CAPACITY (CN)	CAPACITY (CN)	Discharge Capacity
12MVA-9	105	12	80%

Source: Own Authorship.

The battery bank will consist of 12 batteries Moura - 12MC105, will be connected 6 blocks in parallel, each block will be formed by 2 batteries connected in series.

The inverter was chosen taking into consideration the total load power, the output waveform and the motor starting current. The inverter has to have its power in the range between 210W and 2944W.

The inverter used is manufactured by SWIPOWER SP2500L 2500W 12V 220V 60Hz pure sine wave with maximum efficiency, has 500W peak voltage is easy to install and operate, SWIPOWER SP2500L Pure Sine Wave inverters operate with high efficiency and are for off-grid systems. (No connection to the utility grid).

It operates with high efficiency and requires small installation space, so it is a better choice for space, cost and benefit. For project sizing purposes. Assume the continuous power of the inverter, not the peak power. Inverter Specifications shown below:

Tabela 5 - Specification of the selected inverter.

MODEL	NOMINAL POWER (W)	PEAK POWER (W)	INPUT VOLTAGE (V)	OUTPUT VOLTAGE (V)
SP2500L	2500	500	15,5	220 (+/ - 3%)

Source: Own Authorship.

The charge controllers are manufactured by the brand Y-SOLAR and were chosen according to the short circuit current.

Tabela. Especificação do controlador de carga selecionado.

MODEL	TENSÃO DO SISTEMA(V)	CORRENTE SUPORTADA(A)
Y-SOLAR	RBL-50A	50

Fonte: Autoria Própria.

It is recommended that the charge controllers support an input current of 148.53 (A), so 3 parallel 50 (A) controllers will be required to support the estimated total safety current of 150.00 (A). 1.7 (A).
Controller Features: PWM Technology, High Efficiency, Load Control Diversified. Protections: PV short circuit protection, PV polarity reversal protection, Battery overcharge protection, Discharge earth protection. Technical Specifications: Auto 12V / 24VDC Voltage, 30mA Self-Consumption, 14.4V / 28.8V Overload Protection, 13.5V / 27V Guaranteed Floating Charge, 13.2V / 26.4 Recover, 10.8V / 21.6V Discharge Protection, Work temperature -35.C ~ + 80.C e 2 Exits USB 5V/3A.

Tabela 7.Project investment.

EQUIPMENT	MODEL	QUANTITY	TOTAL (R$)
BOMB 2 CV	SUB15-20S4E14	1	2029,00
SOLAR PLATE 330 WP	JKM330PP-72	13	12348,70
DRUMS	12MC105	12	1642,80
INVERTER	SP2500L	1	1590,00
CONTROLLER	Y-SOLAR	3	477,00
			18087,50

Source: Own Authorship.

5. Conclusion

Photovoltaic pumping systems are an excellent alternative to water supply problems. With the importance of benefiting and bringing life improvements to the riverine residents. Despite the efficiency, it is necessary that the population has in mind the rational use in water consumption, thus avoiding waste.
Photovoltaic water pumping systems may have other applications, but these are advantageous for home supply. Since it is of utmost importance to use the technological means that provide us with improvement in quality of life.
Therefore, it is concluded that the project presented satisfactory results, besides supplying the residents' need to supply water to the Santa Fé riverside community - AM.

6. References

[1] BRITO, Priscila de Nazaré de Freitas, Supply Water Quality in Rural Lowland Flooded Amazon River Communities, Macapá,2013, pp. 19-50.

[2] CANÇADO, Jardel Costa Silva. Analysis of a Photovoltaic Pumping System,Ouro Preto, 2018 app. 22-36.

[3]SÁ, Daniel Augusto Pereira de. Photovoltaic Systems for Water Pumping, Rio de Janeiro, Novembro de 2010 pp. 1-65 paginas.

[4]VARON, Mauricio Pardo. STUDY OF A SUBMERSE CENTRIFUGAL PUMP (BCS) AS A FLOW METER, CAMPINAS, 2013 pp.5 - 126 páginas.

[5] SOARES, Prof. Homero, Máquinas Hidráulicas, Minas Gerais 2012, pp 8-29.

[6] OVELHA, Rui Miguel Rocha Val de. Project, Dimensioning and Installation of Photovoltaic Solution in a house off grid, 2017pp. 11-102.

[7] Engineering in Action Magazine Uni Toledo, Araçatuba, SP, v. 02, n. 01, p. 119-135, jan./ago. 2017.

[8] Brazilian Journal of Solar Energy Volume 1 Number 1 September 2010pp.41-52

[9]CARVALHO, Alisson Bruno Souza, The Feasibility of Implementing the Electric Power Generation System Through Photovoltaic Panels,2018 pp. 1-18.

[10] GIL, Antônio Carlos. Methods and techniques of social research. 6.ed. São Paulo: Atlas, 2019, pp. 8-12.

Headwather Recovery in Mindú Municipal Park: An Experience in Environmental Education

Carlos Santos de Almeida
carlos_almeida8@hotmail.com
Centro Universitário FAMETRO - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Ricardo Silva Parente
ricardosilvaparente@gmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Abstract

The main objective of the article was to highlight the importance of the spring to Mindu Municipal Park, as well as, propose solutions to the problems that were observed on the spot, the research aimed to demonstrate the activities aimed at spring recovery and revitalization of areas affected by degradation. The collections were performed three times a week over two months, from March to April 2018. Being possible to verify the conditions of the environment and how it was before the application of the Park's revitalization and maintenance activities. Being possible to delimit the first activities that will be applied to realize the restructuring and revitalization of the space. With the project initiative, more visitors were found in the Park, and with each step completed, awareness grew about the importance of environmental preservation. Therefore, encouraging visitors to participate in social and environmental activities is essential to sustain the site..

Keywords: environmental preservation; water body; forest park;

1. Introduction

Natural environments are fundamental for the development of tourism, and, no doubt, arouse fascination in people who seek contact with such spaces to recover their energy and relieve the stress of everyday life [1]. With 40.8 hectares of biodiversity, Mindu Municipal Park was created from a popular movement started in 1989, by the residents of the Parque Dez de Novembro neighborhoodas a way to protect the habitat of

the sauim (Bicolor Saguinus) [2].

The main body of water in the park, the iguapé do mindu, has been experiencing high levels of degradation over the years, where water quality is highly polluted. Water fulfills a fundamental function of connection, since, from the springs to the sea, through its hydrological cycle the water becomes various states of matter [3].

One way to protect the park's environment was the creation of protected areas that demand ecological studies on flora and fauna, land tenure, human occupation and economic activities in the area. Depending on the size of the area, the difficulty of access or the degree of human occupation, these studies may require a significant amount of time, labor and financial resources. [4].

Given the importance of environmental conservation, the main objective of the article was to highlight the importance of the spring to the Municipal Park of Mindu, as well as to propose solutions to the problems that were observed in loco, the research aimed to demonstrate the activities aimed at recovery of the spring. and revitalization of areas affected by degradation.

2. Theoretical Referential

2.1 Mindu Municipal Park

The Park located in the city of Manaus / AM, offers to its visitors the ecological knowledge, rich in biodiversity, adding mostly fauna and flora, and can be used not only for leisure but for various other activities that contemplate the use of nature, and through the parquet trails where The visitor can observe the characteristics of the place as the spring, thus having the opportunity to appreciate a specific water attraction. [5].

2.2Educação Ambiental

The Ecological Corridors translate into uninterrupted forest physical spaces, linking Conservation Units (CUs), conceived to human occupation, and land use in its most diverse ways, aiming at the well-being of the population with regard to quality of life, the protection of biological diversity, the ecological rescue of the territorial region, the improvement of the climate, the retention of rainwater and the protection of water resources [6].

Among the many factors with different degrees of importance for the creation and maintenance of these protected spaces are: the maintenance of essential ecological processes; the refuge for species that cannot reproduce and survive in managed landscapes; the continuity of natural evolution; strengthening opportunities for the development of local communities; scientific investigation; education; training; recreation; tourism and provision of environmental goods and services [7].

In this context, Environmental Education aims to teach current and next generations the importance of preserving the environment. The biggest intention is to try to create awareness ‘‘how to enjoy the resources offered by nature, thus creating a new model of behavior, seeking a balance between man and the environment’’[8].

The biggest challenge is to promote the change of habits, it is possible to transform behavior from the experience of seeing how harmful the action of the human being can be to nature. Recovering and keeping

springs alive and protected is a strategy for a future that has a better quality of life for the population aiming at environmental sustainability. Environmental awareness actions can be the beginning for recovery and revitalization for environmental sustainability, programs offered by SEMMA, make the population aim for a better quality of life while preserving the environment [9].

3. Methodology

3.1 Study Site

The research was carried out at Mindu Municipal Park, located at Perimetral Street, Parque 10 de Novembro neighborhood, South Central Manaus (Figure 1).

Figure 1. Mindu Municipal Park
Fonte: Google Earth, 2018.

The collections were performed three times a week over two months, from March to April 2018. The first collections allowed a survey of the initial conditions of the site, making it possible to plan the first activities of restructuring and revitalization of the space.

3.2 Data Processing

Study Approach Corroborates with Dray and Simonetti [5], of a qualitative nature destined to the restructuring of the spring in the Mindu Municipal Park, through actions carried out in loco, where it was verified the water quality, the animals that live there and if any form of illegal dumping occurs in the environment. The revitalization project had an exploratory-descriptive character, which is a strategy that allows a better understanding of the object of study and is characterized as being descriptive. deepening the knowledge on the subject.

4. Analysis and Discussion of Results

With the proposal of recovery of the spring was essential for the continued existence of the resident fauna

of the site, because the water works as an ecological drinking fountain, it is extremely necessary to preserve this good for fauna, flora and all biodiversity [10]. The planning actions that were worked on without loco have technical aspects are focused on the maintenance and conservation of the Mindu Municipal Park, which was created in 1943 in Manaus [1], where certain parameters of the situation were observed highlighting the predominance. Depending on the location, impacts can directly influence vegetation cover, as well as erosion in the soil [4].

Through technical visits, it was possible to characterize the environment, it was observed that the type of spring existing in the area is of the perennial type that have great tendency to erosive sprocess, to avoid these impacts the natural vegetation is very important.

According to the observed scenario (Figure 2), the canal was clogged due to accumulated residues such as foliage, dry branches, sand and even urban solid residues, due to the expansion and thickening of vegetation and other natural components when they accumulate in a large amount of water they may obstruct it. causing him to look for other means of exiting the ground, changing the river flow.

Figure 2. Spring of Mindú Park with dry branches that obstructed the passage of water.

The actions were performed with the help of a shovel, hoe and wheelbarrow, removing the objects from the area and all the sediment that prevented the flow of water, the result after a few weeks was satisfactory, because a small course of water was reappearing (Figure 3).

Figure 3. Clearance of the Nanuente of Mindu Municipal Park.

Following the course of the spring about 20 meters ahead, it was noted the accumulation of sand, which

causes siltation on the site. To prevent siltation from clogging the flow of water, they were carried out with the aid of tools to remove sand and make way for water to flow (Figure 4).

Figure 4. Siltation in the source of Mindu Park.

The purpose of removing the artery was due to the obstruction of the water channel. The canal sprouts elsewhere or closes at once. Therefore, from the sediment that obstructed the place where water sprouted (Figure 4), it was removed to keep the drinking fountain of the park active [11].

To prevent siltation, the presence of riparian forest is essential, that is, a natural protection against siltation. Without it, the erosion of the banks takes land into the river, making it muddy and making it difficult for sunlight to enter, also known as gallery forest, lowland forest, vegetation or riparian forest. Species were introduced in areas where siltation occurred.

For application there was the use of species arranged on the ground, called Heliconia (Heliconiaceae), whose common name is caeté or banana tree (Figure 5) that bloom from September to February, the naturally occurring region are the states of Amazonas and Acre, especially in moist secondary and primary forests, on riverbanks, roadside and places with soggy soils.

Figure 5. Plant species arranged on site.

Following the flow at the end of the spring there was an old maintenance dam without any maintenance, it

was observed that the site was abandoned and without any care. Before starting the restoration actions, it was necessary to evaluate the location, since it was an area closer to the Stream do Mindu, in this space were found different types of solid residues (Figure 6), due to the extension of the Stream do Mindu, these residues have been seeping through the aquifer that ends up being dumped in various neighborhoods of the city of Manaus.

According to Figure 6, the residues that were removed with the cleaning of the area were pet bottles, plastic bags, plastic packaging. Through waste bags were deposited all the waste that was in the area affected by pollution.

During the period of collection of this material, partnerships were made with the sustainable turn that always promotes the day of environmental awareness, is an event open to the public to carry out environmental activities, one of them being the cleaning of the streams of Manaus, and Mindu is one of the places where the event occurs and the cleaning of the park. On the parquet there is a collection station for recyclable materials, and the final destination of some solid residues removed during the cleaning of the spring.

Figure 6. Floating solid waste in Mindu stream.

The intent to rebuild the containment was to ensure that the residues would not be dammed in the watercourse near the source path, but not by ensuring that, as the waste is deposited, it cannot cause the obstruction again (Figure 7). After cleaning the area, the dam was rebuilt using sandbags inside.

Figure 7. Construction of Mindu Park Containment.

Near the ground, the 100 mm PVC pipe (Figure 8) was allocated, whose function is to clean the spring [7]. The pipe can be closed or open, and it is possible to control the flow of water without damaging the Mindu Park natural drinking fountain during the dry season, which occurs during the months of August, September, October and November, while the December to July are the flooding months of the rivers [12] [13].

Figure 8. Containment exhaust pipe.

In the containment (Figure 9) 66 polypropylene bags with sand inside were used, creating a microfilter so that the water that comes out of the nascent and does not mix with the polluted water of the Mindu stream. The seedlings collected on site were planted on site improving the structural aspect and fixation of the soil and also highlighting the scenic beauty of the site.

Figure 9. Implementation of sandbags and planting of seedlings in containment.

The main function of the spring in Mindu Park is the survival of the fauna (Figure 10) that inhabit the place, such as the Agouti (Dasyprocta), the Coral Snake (Micrurus Corallinus), the Spider (Araneae), the Alligator (Alligatoridae), the Green Iguana (Iguanaiguana), and the endemic species considered the official mascot of the Municipality of Manaus / AM since 2005, the Sauim-of-collar (Saguinusbicolorra) being one of the most threatened primates in the world. Currently considered to be critically endangered by the Ministry of the Environment criteria, the main threat to collar sauim is the destruction of its habitat due to deforestation and forest fragmentation.

Figure 10. Fauna that lives in Mindu Municipal Park [1] [5].

5. Conclusion

The actions taken to restore the existing spring inside Mindu Municipal Park have a positive influence on the site, as it is known that water eye is still the main responsible agent for the fauna to have a place to quench its thirst. . The justifications for site degradation outweigh the anthropic impacts, also due to the low social participation of volunteers for environmental education practices.

With the initiative of the project, it was found the presence of more visitors in the Park, and at each completed stage, as they observe the area being restored, in reflection form gains more importance the preservation of an environment that is in the midst of urban area, and that provides the balance of nature with its ecological corridor. Therefore, encouraging visitors to participate in social and environmental activities is essential for the support of the place.

6. References

[1] ALMEIDA, F., LEITE, J., ALVES, C., & DEUS, R. **Diagnóstico Ambiental Do Balneário Parque 10 De Novembro No Igarapé Mindú Em Manaus**, 2017.

[2] SEMMAS. **Dia D contra residuos solidos.**Disponivel em:< http://semmas.manaus.am.gov.br/dia-d-contra-os-residuos-solidos-ja-retirou-seis-toneladas-de-residuos-do-igarape-no-parque-municipal-do-mindu/> Acesso em 17 de set, 2018.

[3] MMA.**Água e deigualdades**. Disponivel em:<http://www.mma.gov.br/informma/item/9032-%C3%A1gua-e-desigualdades> Acesso em 22 de out, 2018.

[4] ABREU, M., & PINHEIRO, M. Participação da sociedade civil na gestão de unidades de conservação. Maretti, C.C.; Catapan, M.I.S.; Abreu, M.J.P.; Oliveira, J.E.D. **Áreas protegidas:** definições, tipos e conjuntos – reflexão conceitual e diretriz para para a gestão. Gestão de unidades de conservação:

compartilhando experiências de capacitação. www-Brasil/IPÊ – Instituto de Pesquisas Ecológicas. Organizadora: Maria Olatz Cases. WWF-Brasil, Brasília., p. 257-354, 2012.

[5] DRAY, W., & SIMONETTI, S. **As Trilhas Interpretativas Do Parque Do Mindu Em Manaus – Am:** Utilização E Conservação, 2012.

[6] AYRES, J. M., & al., e. **Os corredores ecológicos das florestas tropicais do Brasil.** Belém: Sociedade Civil Mamirauá, 2005.

[7] ARAÚJO. M.A.R. **Unidades de conservação no brasil: da república á gestão de classemundial**. Belo Horizonte: DEGRAC, p.272, 2007.

[8] VALENTIM, D. **Diagnóstico E Recuperação De Matas Ciliares Em Nascentes Da Cidade De Goioerê-PR:** Uma Experiência Em Educação Ambiental, 2014.

[9] CASTRO, A., NEVES, A., OLIVEIRA, A., SEIFERT, D., OLIVEIRA, H., DANGUY, J., CAVALCANTI, T. **Aplicação De Técnicas De Recuperação De Nascentes**, 2013.

[10] BARROS, J. **Plano de Manejo do Parque Municipal do Mindu. Manaus:** Prefeitura de Manaus. p. 121, 2008.

[11] BARROS, A., CHAVES, C., & PEREIRA, G. **Recuperação De Nascentes:** Formação De Multiplicadores Ambientais Em Área Degradada De Assentamento Rural, Eldorados Dos Carajás, Pará, 2017.

[12] SOUZA, J., & ALMEIDA, R. **Vazante E Enchente Na Amazônia Brasileira:** Impactos Ambientais, Sociais E Econômicos, 2010.

[13] ALMEIDA, G. **Recuperação Da Área Degradada Da Nascente Do Córrego Atrás Da Facto Vertente Do Ribeirão Taquaruçu Grande**. Estudo De Caso Recuperação De Área Degradada. PALMAS-TO, 2010.

Accident Prevention in Electrical Installations at Construction Sites in Manaus - Amazonas

Josielma Ladislau Batista
josielmaladislau@hotmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Ricardo Silva Parente
ricardosilvaparente@gmail.com
Galileo Institute of Technology and Education of the Amazon – ITEGAM - Brazil

Abstract

Electricity brings great benefits to the population, but when misused can pose a great danger especially with regard to safety.Safety is risk fre.Despite several safety standards and standards in place to ensure safety in work involving electricity, there are still many accidents that range from minor injuries to fatalities.The present work aims to propose preventive measures for the risks existing in building electrical installations, in order to guarantee the safety and health of workers who perform activities and services of electrical installations, by explaining the origin of the causes of accidents in buildings. electrical installations, workers' awareness of the importance of safety and the main risks in electrical services. Subsequent to this, preventive and corrective measures will be suggested to reduce work accidents in building electrical installations. In the development of this study, a direct observation field research was carried out in three construction sites of Manaus City, where relevant aspects related to work safety were observed, with works involving electricity.In partnership with the field research, bibliographical researches were carried out in order to strengthen the data collected in the sites of the researched works.According to the bibliographic survey and direct observation field research, the main consequences of not complying with the recommendations prescribed in NR1O and NBR 5410 are accidents and occupational diseases.Accidents are caused by unsafe acts and unsafe condition.The importance of DDS (Safety Dialogue) was pointed out to show the importance of equipment to workers, the percentage of personal protective equipment used at construction sites and the reasons that lead workers not to use PPE, among others. Through the lecture, it was possible to clarify to workers about the importance of using preventive measures so that they change their attitudes and there is a transformation and behavioral changes on

safety measures.Therefore, although companies have accident prevention measures, it is confirmed that the maximum of protective measures has their flaws. There is no work environment completely free of hazards and risks. Risks will always exist, even if in minimal proportions. Most workers have positive conceptions of improvements and benefits from the prevention of accidents in electricity.

Keywords: security measures; electricity; construction sites;

1. Introduction

The importance of electricity is so great that its absence can cause disruption to society, from small homes to large companies. Electricity work has been done for over a century. Over time, the way to accomplish it has undergone modifications to make it agile and safe.

Security is a risk waiver. Despite several existing safety standards and parameters to ensure safety in work involving electricity, there are still many accidents that cause from minor injuries to fatal victims. Electricity brings great benefits to the population, but when poorly employed can bring a great danger, and may cause various types of injuries: mild, medium and severe can cause even the death of people if the necessary care is not taken. Therefore, to prevent accidents, every electrical installation must be performed and maintained safely by a qualified professional and in the supervision of a legally authorised professional [1]. Every year, there are several hundred injured or dead workers due to the contact with energized conductors [2].

The reduction of accident rates involving services with electricity and improvement of the safety methods of the existing BT (low voltage) electrical installations, before repairs and renovations, disconnect the general key. For activities involving electricity in BT, two standards are consulted: ABNT NBR 5410 (low voltage electrical installations) and NR 10 (electricity services).

The objective of this work is to propose preventive measures for the risks existing in electrical installations in order to ensure the safety and health of workers working in electrical installations activities and services, through Explanation of the origin of the causes of accidents in electrical installations, awareness of workers about the importance of safety and the main risks existing in services with electricity. After that, preventive and corrective measures will be suggested to reduce occupational accidents in electrical installations.

2. Theoretical framework

2.1 Electrical installations

Electrical installations are the structures that deal with the transport of electricity from a generating source, its transformation and its use points [3]. Predictive electrical installations must be made by qualified professionals with experience in the type of service to be provided, because any error or slip can culminate in problems with accidents and even fires. [3].

2.2 Brazilian Association of Technical Standards

ABNT - Brazilian Association of Technical Standards - is the body responsible for technical standardization in Brazil. Brazilian Standards, providing inputs to Brazilian technological development. It is a private, non-profit and public utility entity founded in 1940.

2.2.1 NBR 5410:2004 – LowvoltageElectricalInstallations

In the 1.1 paragraph of NBR 5410:2004, it is said that this standard lays down the specific requirements for electrical installations at public influent sites in order to ensure their proper functioning, the safety of persons and domestic animals and the conservation of goods [4]. Low voltage electrical installations are regulated by ABNT standard NBR-5410.

2.2.2 NR 10 Regulatory norm 10

The regulatory norm N ° 10 is a standard of the Ministry of Labor and Employment that establishes the control measures, preventive systems, techniques and practices of services related to services performed in electrical installations and services with Electricity. [5].

The NR-10/2008 is supported and supported by some NRs such as: NR 6 (PPE-Personal protection equipment), NR9 (PPRA-Environmental Risk Prevention Program), NR 17 (ergonomics), NR23 (Fire protection), NR 26 (Safety signs) and NR 33 (safety and health in confined spaces) [6].

2.3 Main Electricity Risks

2.3.1 The Eletric Shock

Electric shock is the disturbance, of various nature and effects, manifested in the human or animal organism when it is traversed by an electric current [7]. The electric shock occurs when the body of a person allows the passage of electric current between two conductors energized from an electrical circuit orinterumconductorenergizedandumperfícieobjectomisobject.Istoé, when there is the difference of potential between one part of the body and another, the electric current will flow and with it arises the phenomenon of electric shock [8].

In most cases of accidents evolving electricity, the victims present burns, because the electric current reaches the body through the cutaneous coating. Due to the high resistance of the skin, the passage of the electric current produces structural alterations in the organism [9].

Accidents occur from the execution of unsafe acts or the existence of unsafe conditions, constituting these, the determinant causes in the occurrence of risks. For this, it is necessary to identify and evaluate the risks, through the techniques of risk analysis, evaluating all stages and elements of the work, rationalizing and developing sequences of operations.

2.3.2 Causesofelectricshock

Several factors considerably increase the chance of an electric shock, such as: the Wear of materials and equipment in the old electrical installations, lack of periodic maintenance and adequate in electrical installations; Inadequate implementation of electrical installations; Use of low-quality electrical materials; Development of electrical projects in an inadequate way without contemplating safety and quality required by the relevant technical standards, etc. [10].

2.4Electrical Risk control measures

The control measures can be interpreted as a set of strategic preventive actions in order to reduce or eliminate the risks, or still keep under control the possible undesirable events. The new NR-10 requires the control of electric risk, through preventive measures duly planned before its implantation in companies that perform interventions in electrical installations, or in its vicinity [11]. Despite the control measures covering the collective protection systems, the collective protection measures and the individual protection measures, the latter should always be adopted mainly when the adoption of the previous measures is not possible.

Also, during the realization of the work with electricity should be adopted appropriate safety signage, in the vicinity of the workplace aimed at the warning and identification of the type of work, as well as the responsible for the services. [7].

The main measure of protection for the worker is the use of PPE, and PPE means the equipment or devices of individual use and that possess CA (certificate of Approval) and CRF (Certificate of registration of the manufacturer), issued by the MTE (Ministry of Work and employment).

NR-10 refers to NR-6 the regulatory responsibility that specifically deals with PPE, thus maintaining its ethical integrity. With this it is up to the MTE to update and change the NR-6, so that it contemplates other EPIs inherent to the electrical hazards, according to the NR-10 [7].

2.5 Accident Preventions

Accident prevention should begin at the stage of the elaboration of an electrical project of any installation, through maintenance and use. Some measures to avoid or minimize accidents are: the proper sizing of the components, the use of insulation and electrical separation, the use of circuit protection devices, the use of grounding in the installations and detection devices Of leakage currents, the installation of lightning bolts and, also, appropriate operational procedures and defensive behaviors before the imminence or in the face of an electrical accident [12].

3. Methodology

This study is based on the methodology of direct observation field study. The phases of field research require, firstly, the realization of a bibliographic research on the topic prevention of accidents in electrical installations in construction sites of the city of Manaus. As for the methods employed, the research is classified as: bibliographic research, from sources based on materials published in books, published articles, dissertations and theses, legislation, which describe the safety and prevention of accidents in Electrical installations of BT (low voltage). It is documentary because they use documents considered normative, which are the NRs and ABNT NBR 5410 [13].

The research is classified as a descriptive research, since they study and describe preventive protection measures, the consequences of not observing the procedures and recommendations described in the NRs, NR10, NR 06, NR9, NR17, NR23, NR26, NR33, and ABNT NBR 5410, which indicates the most appropriate procedures for a low-voltage building electrical installation.

3.1 Study Area

The object of study of this research will be 3 construction sites, where one corresponds to building a commercial building of 4,638 m2 of area and two galleries of 2.520 m2 of area each, with a total of 200 people working in the places, where they are being held Activities related to civil engineering and electrical engineering.

The first stage of the research is to conduct a survey of information about electrical accidents in the workplace, i.e., construction site. The information obtained will allow the knowledge about the main risk situations of electrical accidents which employees are exposed, such as: Fall, electric shock, arc, confinements, magnetic field accidents, induction Electrical installations.

After the survey of information relevant to the risks caused by electrical accidents, it will be possible to present the appropriate procedures for the protection/prevention of these accidents.

Field visits will allow to identify the main consequences of non-compliance with the recommendations prescribed in the NRs cited at work and NBR 5410.

A lecture will be made on accident prevention in electrical installations to raise awareness of the preventive measures established by the NR10, NR6, NR9, NR17, NR23, NR26, NR33 that aim to prevent accidents and the life of Employees. Awareness of the importance of following the standards required for services with electricity.

4. Analysis and discussion of results

According to the bibliographical survey and direct Observation field research, the main consequences of not complying with the recommendations prescribed in NR1O and ABNT NBR 5410 are accidents and occupational diseases. Accidents are caused by unsafe acts and unsafe conditions. Therefore, the most appropriate procedures for a residential electrical installation were found.

In the works, it was found that the main unsafe acts of workers are: resistance to the use of some Ppe such as helmets, seat belts and gloves; False steps when climbing the scaffold, disobedience in the correct handling of tools, uses of the famous "technical adjustments", self-confidence, inappropriate postures, misfortunes and lack of attention. As for unsafe conditions, the main are: not providing PPE, inadequate tools and lack of training. In one of these works, training, lectures, provision of Ppe (personal protective equipment), tools in good conditions of use, requirement of the use of PPE, use of signaling in a correct way, among other conditions provided. However, in other works, some of these measures are absent. Such absent measures are: training, lectures and use of signalling properly.

The practice of unsafe acts or the existence of unsafe conditions in electricity services are responsible for the main accidents that occur, since the activity is conducive to dangerous situations. The activities performed in electrical installations expose the worker to the risks arising from the principle of electricity operation, mainly because such risks can be detected through a visual inspection, since they do not present Smell, color, noise or visible movements, that is, they do not provide easily detectable warnings [5]. The concern with the high numbers of accidents with electricity, caused mostly by ignorance of people or even by recklessness of professionals, was the great motivator for the creation of the Brazilian Association of Awareness for the Dangers of electricity. – ABRACOPEL, since unsafe acts can be conscious and

unconscious.

Based on direct observation, it was found that although many workers perform activities related directly to electricity, not everyone knows the recommendations described in NBR 5410 and NR 10, as shown in Figure 1.

Figure 1 – Knowledge of the workers of NBR 5410 and NR 10.

Although 90% of the workers know the norms described above, there are a total of 10% who are unaware. This quantitative is relevant for occupational safety and risk management, since they are exposed to hazards and risks of activity due to lack of knowledge, training, lectures or for being persons of foreign nationality. The probability of occurrence of accidents with collaborators with this profile is very expressive, because the behavioral deviations emitted by them in the accomplishment of the work configures an unconscious act and because it has this characteristic, can be practiced several During the execution of an activity, which compromises security and makes it critical. Once a fortuitous event occurs, it is not only the employee who suffers physical damage, the material and financial losses that will be suffered by both the employer and the employee. Of a total of 200 employees, this percentage corresponds to 20 workers who do not know the recommendations of the norms.

Based on a survey carried out in the three construction sites, it is possible to observe the occurrence of some accidents more frequently, as shown in Figure 2.

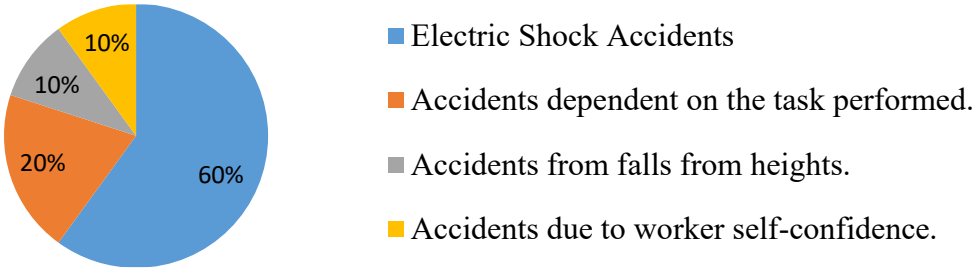


Figure 2 – Main accidents occurring with electricity.

As shown in Figure 2, it is observed that the most frequent accidents in construction sites are electric shocks with 60%, followed by 20% of accidents that depend on the activity performed as accidents due to stumps in materials, inadequate postures and slides in Activities in which there is the transport of materials and accidents caused by falls of objects on the collaborator in works involving the loosening of the upper parts of the construction work; 10% for jobs in heights and 10% by employee self-confidence. When comparing these data with Abracopel's 2018 data, it is observed that in Brazil the electric shock leads to the indices of

accidents with electricity, followed by other accidents not located in this study.

According to Abracopel's 2018 data, events with electric shock lead to the ranking of electrical accidents in the country, with 836 records, followed by overload fires, with 537 occurrences and accidents caused by atmospheric discharges, which totaled 51 episodes. These numbers add up to fatal, non-fatal cases. The most common causes attributed to accidents are the technical adjustments (popularly known as Gambiarras), the old electrical installations, the lack of maintenance and the use of the same socket to connect several equipments at the same time [2].

In the north, there was an evolution of accidents with electric shock electricity, where the number of deaths by electric shock between the years 2013 to 2018 increased according to data obtained by the Abracopel Yearbook in 2019 [2].

In 2018, Abracopel reported the occurrence of several electric shock deaths in the northern region. There were 68 cases of accidents, and the state of Pará was where the greatest number of accidents occurred with 21 fatal cases; The state of Amazonas and Rondônia had 11 cases; Tocantins 9 cases; Acre and Amapá with 7 cases and Roraima with 2 cases, with the smallest number of accidents [2].

In 2018, the numbers of accidents with electric shock involving electrician or autonomous technician were recorded 85 cases being 57 fatal. This number is reduced when compared with professional electricians who work in companies, because for these professionals to be hired is indispensable basic course of electrical installations, NR10, NR35, SEP among other courses with at least 40 hours, Qualification and professional habilitation. Companies provide Ppe for professionals to exercise their profession using all possible security measures. These safety measures are reflected in the non-occurrence of accidents with professional electrician in companies [2].

According to researches obtained through Abracopel, it was possible to realize that in the years of 2014 and 2017 the number of accidents of electrical origin and electric shocks had a significant increase, where there were 627 fatal accidents in Brazil. In 2015, it was the year that there was a slight drop in the accident index [2].

In the researches made with data obtained from Abracopel, it is possible to observe that there was an increase in ascending scale in the number of accidents of electrical origin since the year of 2013, when the research began. From 2013 to 2018, the following quantitative quantities were recorded: 2013 – 1038 cases, 2014 – 1223 cases, 2015 – 1248 cases, 2016 – 1319 cases, 2017 – 1387 cases and 2018 – 1424 cases. The recorded increases were as follows: 2013A 2014-185 cases, 2014 to 2015-25 cases, 2015 to 2016-71 cases, 2016 to 2017-68 cases and 2017 to 2018-37 cases. The highest and lowest indices recorded were 2013 to 2014, respectively, with 185 cases and 2014 to 2015 with 25 cases.

In the works under study, it was observed that companies provide PPE to all its employees, thus obeying item 6.3 of NR 6 on the obligation of the employer regarding its supply. The most commonly used EPIs are described in Figure 8.

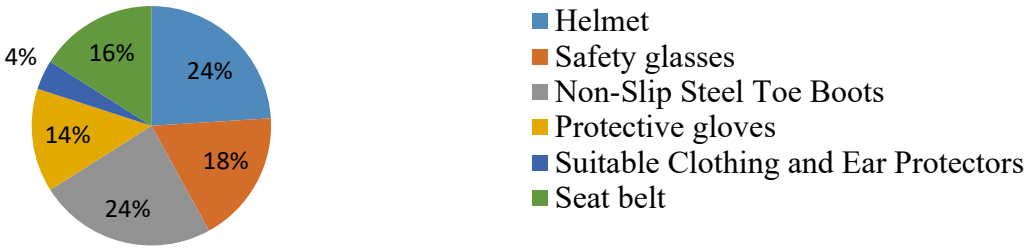


Figure 3 – Use of personal protective equipment

Although the company provides the appropriate protections equipment for the activities, the worker does not always use. As shown in Figure 3, the most useful equipment is the helmet and the toe-cap of non-slip steel. In the works, it was found that the other EPIs are less used in relation to these two. Some EPIs are used only in specific situations such as the seat belt. As for the garments, very few collaborators were seen wearing costumes considered EPIS by NR 06. Most workers used their own clothes to perform activities. Moreover, it was found the main reasons why workers do not like to make use of personal protective equipment. These reports are described in Figure 9. Among the reports described, it is verified that although companies provide PPE, there are workers who do not use the device, because they claim absence of this.

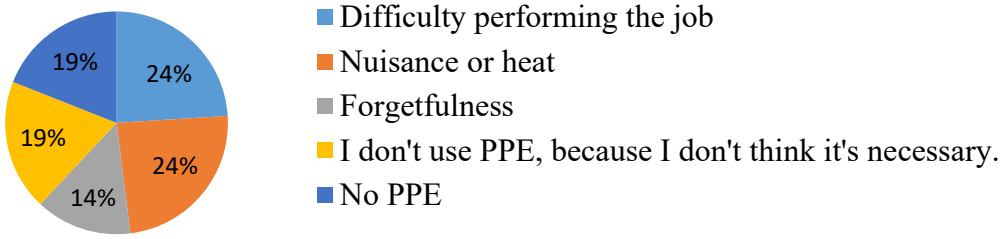


Figure 4 – Use of personal protective equipment in the works.

Data referring to Figure 4 were obtained in situations where the worker was questioned to use the Ppe provided to them. Complaints and non-use of PPE is frequent in construction sites. Based on this, it is important to supervise the work to assess the measures of securities being used.

From the data exposed in this context, observations were made to understand the profile of workers in the environment where they perform their work, so as to distinguish factors that contribute directly and indirectly to accidents. It is believed that by making the RPA, (Accident prevention meeting), with the workers of a work, through the lecture, the data of accidents were shown along with the NRs that deal with the safety standards, showing the common situations that provoked the Accidents with electricity. The dangers and risks arise from acts of choice of persons or, groups of people who often make decisions, without the proper possession of sufficient information regarding the potential consequences of certain actions.

In activities involving electricity, it is important to perform the DDS (daily safety dialogue), because the goal of DDS is to raise awareness about safety practices and to guide the correct practices, since the lack of Knowledge is still one of the main factors for the occurrence of occupational accidents. In the

construction sites in study, the DDS was performed every day.

Through the lecture, it was possible to clarify to the workers the importance of using preventive measures so that they change their attitudes and there is a transformation and behavioral changes on the necessary security measures to They develop their activities with the utmost security possible.

The power of hierarchy and the leadership exercised by a supervisor is of great importance. Leadership exerts great influence on the capacity of transformation, the imposition of habits and behaviors of workers. The guardians who require the electricians and their auxiliary habits and behaviors that seek the organization and actions to prevent accidents in the work [14].

For preventive and corrective measures, the safety engineering of the work states that when preventing hazards and risks, these must be controlled at the source, in the trajectory and last that is done in the worker. In order to meet this, in the construction sites, the use of EPCs (collective protection equipment) and PPE is verified. EPCs are used to prevent all people who develop some activity in the work. The most used are: signalling, scaffolding, ladders, first aid kit, lighting, protection barriers against luminosity, protection of the moving parts of machines, among others. The EPIs serve to protect only the individual. Figure 3 describes the main EPIs used in the construction sites under study. In construction sites, according to the risk it is not always possible to prevent at the source, since the site does not allow this or because the investment to treat risks at the source is more expensive than the value of the work.

5. Conclusion

Given the above, it confirms the importance of security when performing any activity, whether it is the electrical sector or any other. The electrical activity sector is one of the sectors with high hazard level.Hence the need to increasingly improve security measures.The prevention of accidents in low voltage electrical installations has to happen in a serious way and with the commitment and collaboration of all, so that we can preserve the life and integrity of all.

Workers should increasingly have the preventive notion through the correct use of equipment, procedures and safety standards. Companies in turn, besides having a preventive notion, also use the corrective notions. Preventive notions are to prevent an accident or incident. Corrective notions are to correct some erroneous safety procedure or measure.

It is also noted that these companies have measures to prevent accidents. However, to manage accident, always the maximum of protective measures has its flaws. There is no work environment entirely free from hazards and risks. Always the risks will exist, even if it is in minimal proportions. Most workers have positive conceptions of improvements and benefits of prevention.

Therefore, the awareness and sensitivity of all is the way to draw a working environment with the least possible accidents and productive, thus guaranteeing benefits for both the worker and the company.

6. References

[1] BRAZIL. Jorge DupratFigueiredo Foundation for Occupational Safety and medicine. Occupational Safety Engineering in the construction industry: temporary electrical installations in building sites. São Paulo: FUNDACENTRO, 2001.

[2] ABRACOPEL- Brazilian Association against the dangers of electricity, "statistics on electrical accidents". Available In: <www.mother.talk.with.br/number-of-accidents-with-electricity-bounce-in-2019 / ABRACOPEL- Brazilian Association Against the Dangers of Electricity>.Accessed 18 Mar.2019: at 15h: 17min.

[3] CREDER, Helium. Electrical installations.15th edition. Rio de Janeiro: LTC, 2013.

[4] BRAZILIAN ASSOCIATION OF TECHNICAL STANDARDS. NBR 5410 – Low voltage Electrical installations – March 2008.

[5] BARROS, Benjamim Ferreira de, et all. NR-10 regulatory standard for safety in electrical installations and services: Practical Guide to Analysis and application. 1st edition. São Paulo: Érica,2010.

[6] SOUZA, João José Barrico de; PEREIRA, Joaquim G. NR – 10 commented, aid Manual in the interpretation and application of the new NR-10. São Paulo: LTr, 2007.

[7] COTRIM, A. M. B. Electrical installations. Technical review and adaptation José AquilesBaessoGromoni and Hilton Moreno.5. Ed. São Paulo: Pearson Prentice Hall, 2009.

[8] MAMEDE FILHO, J. Industrial electricalinstallations. 9ed. Rio de Janeiro: LTC, 2017.

[9] CPNSP – Permanent Tripartite Commission for negotiating the electric sector in the state of São Paulo. Basic course of safety in installations and services in electricity.Training Manual. Funcoge: Rio de Janeiro, 2005.

[10] KINDERMANN, Geraldo. Electric shock. 2 ed. Porto Alegre: Sagra Luzzatto, 2000.

[11]BRAZIL, Ministry of Labor and Employment.Regulatory safety and occupational medicine standards.NR 10 Security in installations and services in electricity. Available in:<http://www.mte.gov.br>.AccessedMarch 29 2019 at20h:18 Min.

[12] SILVA, Mauricio Dias Paixão da.Accident prevention in electrical installations. Rio de Janeiro. April 2016.Available in:<http://monographs.poly.ufrj.br/monographs/monopoly10017749.pdf>. Accessed March 29, 2019 at 19h: 05min.

[13] GIL, Antônio Carlos. How to elaborate research projects.São Paulo: Atlas, 2011.

[14] COLTRE, Juliane Cristina. Safety and health at work: the prevention of accidents in civil construction. 2011. Available in:<http://www.repository.roca.utfpr.edu.br >. Accessed on 18 April.2019: at 15h: 17min

Articulation on Basic Sanitation in the City of Manaus, Collecting Nets Model for Lagoa Azul Community

Andressa Gaspar Freitas
andressagaspaar@hotmail.com
Centro Universitário FAMETRO - Brasil

Leonardo Olavo Braga Miranda
leonardoolavobraga@gmail.com
Centro Universitário FAMETRO - Brasil

Igor Bezerra de Lima
igorblima@hotmail.com
Departamento de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmailcom
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Igor Felipe Oliveira Bezerra
igorfelipe.dss@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

This article aims to demonstrate and articulate the situation of basic sanitation in the city of Manaus in the state of Amazonas. Through research, the precarious state of the sector in the region is now proven, the proposal for emergency measures such as the sewage collection system in the community of Lagoa Azul, is intended to demonstrate the absence of old management of the provision services for citizens' right to sanitation.

Keywords: Basic sanitation; Sanitary sewage; Water supply.;

1. Introduction

Basic sanitation is guaranteed to every citizen by law 11,445 of 2007, which establishes national guidelines for basic sanitation and the federal basic sanitation policy. These measures are more than rights, they are synonymous with quality of life. Brazil, a country with a huge amount of water resources, has been careless about them.

In the city of Manaus, the aggravation of the precarious sanitation situation is of various spheres, social, cultural, economic and political. Lack of awareness campaigns for the population, little zeal for the city and the environment, rubbish and irregular solid waste clumps in the open are common, the huge amount of waste in the streams from 2013 until June 2019 the city spending public resources approximately 70 million reais to remove 47,000 tons of rubble from the rivers, according to data from the Municipal Secretariat of Urban Cleaning (Semulsp) [1].

Demographic occupation has evolved, largely due to irregular and improper occupations, which are formed in a disorderly manner, with little or no infrastructure, which makes the process of urbanization of these housing complexes difficult.

Sometimes housing is built in high-risk locations such as slopes, slopes, regions near effluent emitters and / or contaminated streams, which undermines the health and well-being of the population living in these locations.

The lack of interest of the public power in this sector, demonstrates an outdated management more interested in treating and remedying the diseases of the population, to remedy the issuer and proliferator of problems.

This article aims to articulate the situation of basic sanitation in the city of Manaus, in order to describe the supply of drinking water to the population, examine the management of rainwater, evaluate the situation of collection and treatment of sewage, propose a sanitary sewage collection network for the community of Lagoa Azul, to elucidate the picture of vector proliferation and diseases.

2. Theoretical Foundation

Manaus developed on the banks of the Rio Negro, the second largest river in the world's water flow, and is still served by the waters of the Alter do Chão sandstone aquifer system currently considered the largest on the planet [2], and even with this availability there are still residents without access to the water distribution network.

According to the 2017 Diagnosis of Water and Sewage Services, conducted annually by the National Sanitation Information System (SNIS) [3], 89.26% of the capital has access to a drinking water network.

The water supply service is provided by the company Águas de Manaus, which started operating in 2018, supplying it through tubular wells and by capturing the surface drainage of the Negro river.

2.1.1 Surface Pickup

The withdrawal of waters from the Rio Negro is over 630.000.000,00 liters per day, which are sent to the treatment station, in order to undergo the water potabilization process, having its purpose defined by [4], as having for human consumption, the essential function of balancing raw water with physical, chemical, biological and radioactive limits.

Ordinance No. 2,914, of December 12, 2011 [5], applies to water intended for human consumption from an alternative water supply system and solution, defining legal responsibilities and parameters for abstraction, treatment, distribution and consumption.

Water treatment consists of a series of processes aimed at removing microorganisms, organic materials,

sediments and any other elements that may be harmful to health. Treatment technologies aim to reconcile the quality of treated water, the costs of implementation, operation and maintenance, and environmental sustainability.

Art. 13 of Ordinance 2914 (Brazil, 2011) [5] cites the competences of the person responsible for the system or collective alternative solution for water supply for human consumption, the main ones being: to guarantee the operation and maintenance of the installations in accordance with the relevant standards; maintain and control the quality of water produced and distributed through: operational control of the intake, adduction, treatment, confinement and distribution points; among others, the provision of reports and results for the public interest.

The distribution network in Manaus consists of 4 Water Treatment Stations (ETA'S). In the West, are located ETA 1 and ETA 2, responsible for supplying 80% of the city, ETA Mauazinho in the south of the capital, and ETA Ponta das Lajes is responsible for water distribution of the Water Program for Manaus (Proama), located in the East Zone.

According to [4], the water treatment plant must have three characteristics for the production of quality effluents: robustness, reliability and resilience. Robustness is the ability to meet demand, whether in flood or drought, reliability is the ability to meet the population at a given future time, and resilience to the regeneration that the body of water has when it suffers. interference or contamination.

The treatment plants in Manaus perform the water potabilization, performing the processes described in Table 1.

Table 1: Potabilization process of the company Água de Manaus.

PRE-ALKALINIZATION	**COAGULATION**	**Flocculation**	**DECANTATION AND FLOTATION**
Lime application to increase alkalinity and correct water acidity.	Lime application to increase alkalinity and correct water acidity.	Application of water to flocculate impurities, facilitating their removal.	Removal of impurities by physical forces.
FILTRATION	DISINFECTION	FLUORETATION	PF FINAL ADJUSTMENT
Retention of the finest impurities in a sand and anthracite filter.	Addition of chlorine, ensuring no microorganism.	Adding a small amount of fluoride to prevent tooth decay.	Second acidity correction for neutral water distribution.

Source: [3].

2.1.2 Underground abstraction

Manaus also has 41 other Groundwater Production Centers (CPAs) in operation. Secondly, [4] capturing groundwater has advantages, among which a significant reduction in implementation costs and a better quality of wastewater, most of the time neglecting most of the potabilization processes, and also presents greater resilience to pollution.

According to [6], due to the low rates of infiltration water in the lower layers and the biological, physical and chemical processes that occur in the soil of aquifer regions, they are naturally more protected from pollution.

Urban growth in Manaus occurs rapidly and several times irregularly, which makes the practice of opening clandestine artesian wells common.

The drilling of irregular wells, without the necessary procedures and studies, even in places vulnerable to pollution or already contaminated, compromises the entire quality of the aquifer, as stated [7], that wells built without ABNT technical standards compromise the environment. , mainly aquifers.

The Mineral Resources Research Company [8] stated that the Amazonian capital has approximately 15,000 groundwater abstraction points, of which 5,000 were duly registered by the Amazonas Environmental Protection Institute (IPAAM), 3,000 are deactivated due to abandonment, 7,000 are clandestine.

The situation is corroborated by [9], stating that in the capital there are thousands of low-yielding wells that draw water from the aquifer in shallow water tables, providing untreated water without monitoring and enforcement, and without any health protection. .

Commercial activities are virtually all sources of groundwater contamination, chemical leaks, industrial processes without the right measures and procedures, inefficient wastewater treatment, mining activities, solid waste management, indiscriminate use of pesticides. in agriculture, they represent the main sources of contamination.

For [10], improper productive activities can lead to soil pollution occasionally from groundwater and especially surface water, which generates problems that remain even after the end of the activity, also states that the management of these liabilities is fundamental to preserve spring and control possible consequences.

2.2 Health Exhaust

Once the water supply system is in place, there is a need for the collection, removal, treatment and final disposal of the wastewater, since these waters will be sources of pollution for the soil, groundwater and surface water, and still pooling. and constituting foci for the dissemination of diseases and vectors.

Sanitary sewage has several implications for society, showing a significant improvement in the population's quality of life, productivity, and e specially in the environment.

In his work [11] he states that the most important objectives of the sanitary sewage system are: improvement of local hygienic conditions and generating increased productivity; the conservation of natural and mineral resources, especially surface waters; sewage collection and remediation; the sanitary proper final disposal of the effluent; avoid creating outbreaks of pollution and contamination as well as aesthetic aspects of the region, for example, foul odors; the protection of downstream communities and settlements; preservation of areas for leisure and sports.

The system adopted in the city is that of sewage sewage, responsible exclusively for sewage without additional loads of rainwater. The model is defined by NBR 9648 [12] as being the set of conductors, installations and equipment for the purpose of collecting, transporting, storing and or treating sanitary sewage only, giving a convenient final disposal, continuously and hygienically safe. .

The Separator System has lower deployment costs, easier maintenance, and improvement in other systems such as drainage. For [11] the advantages of the system are the smaller plumbing, the segmentation of the implantation that allows the prioritization of emergency sections, the improvement in the removal of rainwater from the sewage.

Consisting of plumbing, being collectors, interceptors, emissaries, siphons and forced passages, accessory organs, such as manholes, inspection and cleaning pipes, cleaning terminals, crossing boxes, it also has lifting stations, treatment stations, and works final release and receiving body.

The diagnosis of water and sewage services in [13] reports that in the capital only 12.25% of the population has the sewage collection service. Approximately over 1,800,000 manauaras treat their own sewage or simply discharge it directly into the wild.

In the same way as water supply, the sewage service is performed by the company Águas de Manaus. The collection network has a length of over 500 kilometers, associated with 60 treatment stations and 51 pumping stations.

2.3 Drainage and Management af Low Water

Federal Law No. 11,445 / 2007, which deals with the National Policy of Basic Sanitation [13], in its article 3, provides that the drainage and management of rainwater, cleaning and preventive supervision of the respective urban networks is characterized as "Set of urban stormwater drainage activities, infrastructures and operating facilities, transportation, detention or retention for flood flow damping, treatment and final disposal of stormwater drained in urban areas".

According to [14], the drainage system must be understood as the set of infrastructure existing in a city to perform the collection, transportation and final release of surface water. It consists of a series of measures aimed at minimizing the risks to which populations are exposed, reducing the damage caused by flooding and flooding.

The drainage system should be considered as two systems: Initial System or (Micro Drainage), and System (Macro Drainage), which should be designed differentiated subcriterion, [15]. Figure 1 shows the scheme of micro and macrodrainage systems.

One of the main problems related to urban drainage in large cities concerns precipitation. Urbanization brings soil sealing, channeling of watercourses and impacts related to rainwater beyond the possibility of erosion, including increased flow, pollutant load and sewage that is often discharged into drainage rain.

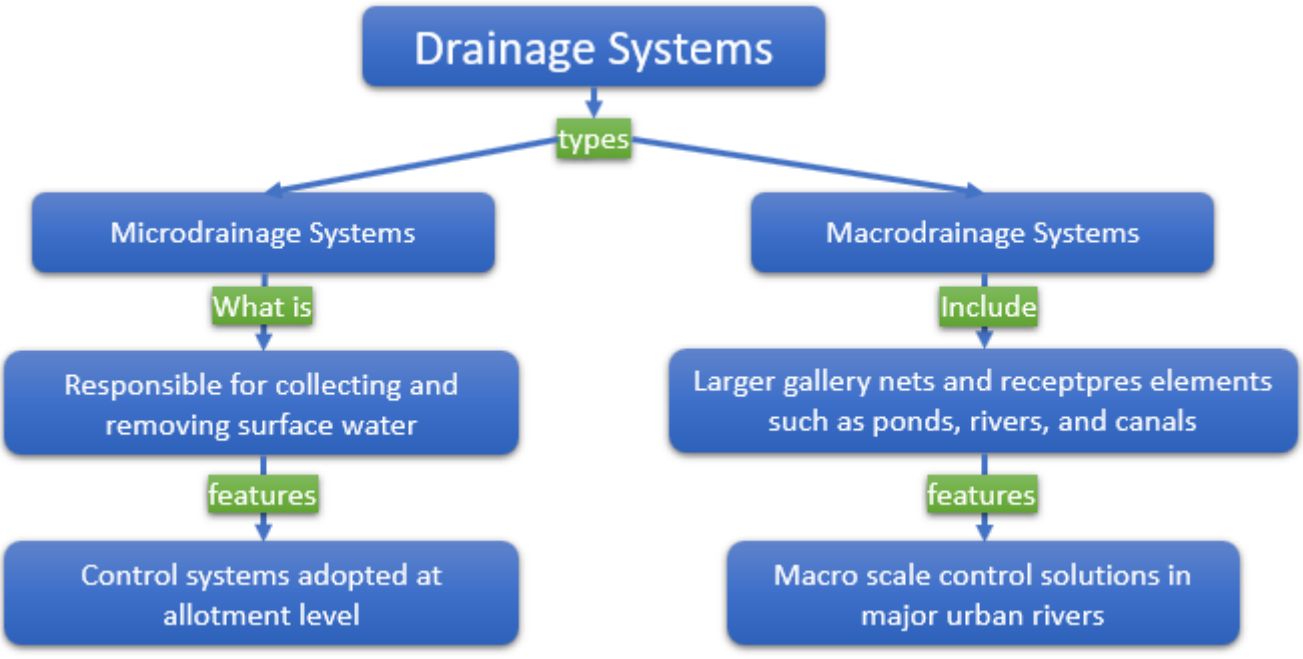


Figure 1: Micro and macrodrainage schemes.
Source: GPACC (2011).

In Brazil, most cities still suffer from flooding, flooding and flooding problems, generating a number of factors, among which two can be highlighted: the disordered occupation of natural stormwater run-off areas and the lack of a urban drainage that can prevent such flooding from occurring. The two factors listed depend directly on government action in the area of housing and sanitation.

According to [16], floods due to urbanization are those that occur in urban drainage due to heavy rainfall and soil sealing or obstruction to runoff, except for other conditions that do not have heavy rain as one of the causes. Problems such as urban flooding are motivated due to poor drainage systems, produced by runoff from stormwater and its excess that does not infiltrate soil already sealed due to misuse.

The existence of a network composed of surface drainage systems combined with underground drainage is a mechanism to control the problems arising from soil sealing in the urban perimeter of cities [17].

Rainwater management is understood as a drainage system that contains street paving, the implementation of surface and underground rainwater collection networks and the final destination of tributaries. It is one of the components of basic sanitation that aims to drain rainwater to prevent harm to human health [17].

The execution of the system services in the City of Manaus is the responsibility of the Municipal Secretariat of Infrastructure - SEMINF [18], which is responsible for developing the strategy for the implementation of infrastructure in the areas of basic sanitation, drainage, establishing priorities and defining implementation mechanisms. monitoring and evaluation.

In their work [19], they consider that the basic drainage system of a city should be structured respecting all legal, technical aspects, economic, social, environmental and institutional dimensions and a minimum physical composition with paving of streets, gutters and curbs, wolves' mouths, drainage galleries and ditches, it is noteworthy that all these elements must be interconnected and functioning properly or the risk of failure in the drainage system is high. In addition to these instruments, the characteristics of watersheds play a major role in the drainage process.

According to the report Geodiversity Commission of the Legislative Assembly of Amazonas [20], highlights that urban drainage in Manaus is precarious. Each time it rains, manauara faces a number of problems related to streams overflowing in virtually all areas of the city, resulting in flooding of streets, houses, manhole clogging and water contamination.

The importance of an adequate urban stormwater drainage and management service becomes significant for the city, where it will provide a series of benefits, such as: appreciation of existing properties in the benefited area, development of the road system; reduction of expenses with maintenance of public roads; rapid runoff of surface waters, ensuring safety and comfort for the population.

2.4 Vectors and Diseases

According to the World Health Organization [21], most of the diseases that spread in developing countries come from poor quality water.

Waterborne Diseases are those in which water acts as a vehicle for infectious agents. Pathogenic microorganisms reach the water through excreta from infected people or animals, causing problems mainly

in the intestinal tract. These diseases can be caused by bacteria, fungi, viruses, protozoa and helminths.

Parasites generally have two life stages: one within the host and one in the environment. While in the host's body, they have ideal conditions for their development, such as adequate temperature and humidity, and plenty of food.

When in the environment, on the contrary, they are threatened and die easily due to excessive light, oxygen, heat, and food shortages. The time that these microorganisms spend outside the host should be sufficient only to reach new organisms and continue their life cycle.

Sanitation and public health are directly linked, as many diseases such as cholera and diarrhea are related to low coverage of treated water supply, lack of a sewage treatment system, other diseases are linked to urban flooding such as dengue and leptospirosis, diseases present in areas with poor infrastructure.

One of the main functions of sanitation is to prevent the spread of these diseases, especially in children, as they are usually the most affected as they enjoy the flood to play forgetting the risk of disease contamination. The riverside families that live near contaminated streams are the ones that suffer the most. According to an IBGE survey [22], between 2016 and 2017, it highlights that 1,935 of the 5,570 municipalities (34.7%) of the municipalities reported epidemics or endemics linked to poor sanitation, with cases of diarrhea, leptospirosis, cholera, malaria and Hepatitis are the most common among the diseases.

Discussed at the 1st Amazonas Environmental Sanitation Seminar, held on October 7 and 8 in the city of Manaus. Deputy Josué Neto, thanked the commitment of the president of the National Health Foundation (FUNASA) [23], Ronaldo Nogueira, to solve the problems of state landfills and to take Amazonas from the precarious levels of sanitation currently existing.

The deputy points out that this is the first time the Federal Government has committed itself to sanitation in Amazonas. Formerly the Federal Government was not interested in Amazonas, with projects focused on sanitation and with this statement of commitment is an opportunity to improve the lives of the interior population.

Insufficient services identified in the sanitation sector are often linked to the most common health problems among the population, such as diarrhea and worms. According to Ronaldo Nogueira, studies show that for every $ 1 invested in sanitation, you save $ 4 in health.

Rita Castro, head of the Nucleus for the Control of Sexually Transmitted Infections and Viral Hepatitis of the Municipal Health Secretariat (Semsa) [24], explains that in Brazil the most common types of the disease are hepatitis A, which has oral-fecal transmission, one infected person to another healthy or through contaminated food or water. Semsa provides hepatitis A vaccine to children under two years of age, who are the most vulnerable to hepatitis A.

A survey by Instituto brasil [25], based on IBGE data, estimates that hospitalization expenses for gastrointestinal infections in SUS amount to R $ 95 million, and with the implementation of an adequate drainage system, these pantries tend to fall to R $ 72 million by 2035.

The most appropriate way to prevent most of these diseases is to take care of hygiene, cleanliness of the environment and food and one way to do so is through sanitation. Therefore, sanitation is fundamental in disease prevention. In addition, preventing solid waste in inappropriate places, for example, also prevents the proliferation of disease vectors such as mice and insects that are responsible for the spread of some diseases.

3. Methodology

The methodology of this paper was divided into 3 steps with different methods of investigation and research. Initially, through bibliographical research, among academic articles, authors, and legislations, the themes encompassed in the objectives can be defined, which clarified the definitions and scope of sanitation complaints.

Through qualitative and quantitative investigative research, among scientific articles, books, magazines, and the media, including news and documentaries, about the sanitation theme in the city of Manaus, we obtained insight into the present situation, notion of services provided, as well as future forecasts of the basic sanitation framework in the city of Manaus.

Using in loco investigations, digital tools, bibliographic research in books, scientific journals and rules governing the subject, and also through interviews with professionals from the sanitation professional community and residents of the Lagoa Azul community, it was possible to measure and discriminate the needs of the local population, noting the urgent sanitation conditions and the growing demand for such services.

The main descriptors sought in data collection were: basic sanitation; water supply; sanitary sewage; Rainwater Drainage and Management; Vectors and Diseases. Being divided into 3 steps, according to table 2.

Table 2: Work steps.

Step 1:	**Definition of sanitation services and infrastructure.**
Step 2:	Estimation of sanitation conditions
Step 3:	Demand from the Lagoa Azul community, sanitary sewerage project.

Source: Own authorship (2019).

4. Results and Discussions

In the city of Manaus there is a change in mentality towards sanitation, citizens are looking for their infrastructure rights, promoting a better quality of life, the competent bodies are gradually improving sanitation management, the solution adopted is the privatization of the sector. .

The company Águas de Manaus, is interested in providing quality services and make major investments in sanitation infrastructure, prioritizing the neediest segments such as sewage, declared publicly its goal to invest 800 million reais in infrastructure.

The completion of lagging ventures such as ETE TIMBIRAS demonstrates the interest in organizing the sector and improving the population's quality of life. The company says it is just the first step in declaring that it will expand the sewage collection network from 12.25% to 80% by 2030 [26].

Important awareness-raising projects have begun, including a culture of environment and resource preservation in the population, as well as the preservation of improvements and the adaptation of norms and procedures, which improves and brings the service provider body closer to the user population. .

Adapting the urban drainage system will provide a number of benefits to the city, such as the development of the road system, the reduction of expenses with maintenance of public roads, reduction in disease

expenses, rapid runoff of surface waters, providing a sense of security and safety. comfort for the population. Pungently, there is a huge water supply in the lightly and thoughtlessly exploited capital, and the intensification of enforcement and punishment must be intensified in order to protect not only the public interest, but the mineral wealth and health of the population. , training and retraining in supervisory bodies should be a priority for management.

With the increasing improvement of basic sanitation services, it will be latent the improvement in the population's health, the decrease of the cases of waterborne diseases, will make the health investments less expensive, being able to be directed to other deprived sectors of the capital like education and infrastructure. The efficient management of the organs, together with the population's awareness, will make the capital's economy grow exponentially, followed by the population's quality of life, increasing several other sectors, such as tourism, ecotourism, industry, commerce, education, among others. others, making Manaus a major attraction for new investors.

4.1 Collection Network, Model for the Lagoa Azul Community

Quick and practical solutions, such as setting up a collecting network, make a big difference in the quality of life in a community.

The elaboration of a collection network project for the Lagoa Azul community aims to demonstrate that with a small initial investment it can improve the daily life of the population.

Figure 2 shows the study area for the implementation of the collection network, the community currently has 1800 houses, approximately 8000 people, because it is an irregular occupation, comprises an area of high demographic density without any wastewater collection, being a shaky source of environmental pollution.

Figure 2: Blue Lagoon Community.
Source: [27].

The criteria and parameters used for the sizing of collecting networks were defined based on the standards of ABNT, NBR 9.649 [28].

To run economically, the network was divided into 3 collector bays each with its own treatment plant, taking advantage of all the differences in terrain quotas, thus excluding the need for pumping stations, since according to NETTO (1998) [11], the use of lifting stations is harmful to the system due to the solids present in the sewage.

The main dimensions are contained in table 3, the executive plan of the coleto network. shown in figure 3.

q (L / inhab day)	200	C	0,8	K1	1,2
Net length (m)		2281	specific mass H2O (N / m3)		9800
Project flow rates		Linear Contribution Rate			
Q start (L / s)	24,50	initial		0,0107	
Final Q (L / s)	47,61	final		0,0209	

stretch	Length (m)	Q PROJECT Inicial / Final	Terrain quota Montante / Jusante	D (mm)	Cota do coletor Amount / Downstream
BAÍA 1					
0	55	1,50	55	100	54,0
		1,50	54	100	53,0
1.1	55	1,50	54	100	53,0
		2,30	52	100	51,0
3	62	1,50	53	100	52,0
		1,50	52	100	51,0
1.2	80	2,71	52	100	51,0
1.1+3		5,26	47	100	46,0
1.3	80	3,57	47	100	46,0
		6,93	44	100	43,0
1.4	20	4,64	44	150	43,0
1.3+4		9,02	44	200	42,9

Initial Pop (Hab)	8000	Final Pop (Hab)	13600
K2	1,5	TI (L/s.m)	0,001

stretch	Length (m)	Q PROJECT Inicial / Final	Terrain quota Montante / Jusante	D (mm)	Terrain quota Montante / Jusante
BAÍA 2					
5.1	80	1,50	54	100	53,0
		1,67	54	100	52,6
5.2	82	1,74	54	100	53,0
		3,38	51	100	50,0
6	60	1,50	51	100	50,0
		1,50	51	100	49,7
5.3	60	3,03	51	100	50,0
5.2+6		5,89	47	100	46,0
7	60	1,50	49	100	48,0
		1,50	47	100	46,0
5.4	47	4,18	47	100	46,0
5.3+7		8,12	45	100	44,0
8	62	1,50	46	100	45,0
		1,50	45	100	44,0

Figure 3: Scales

Source: Own authorship (2019).

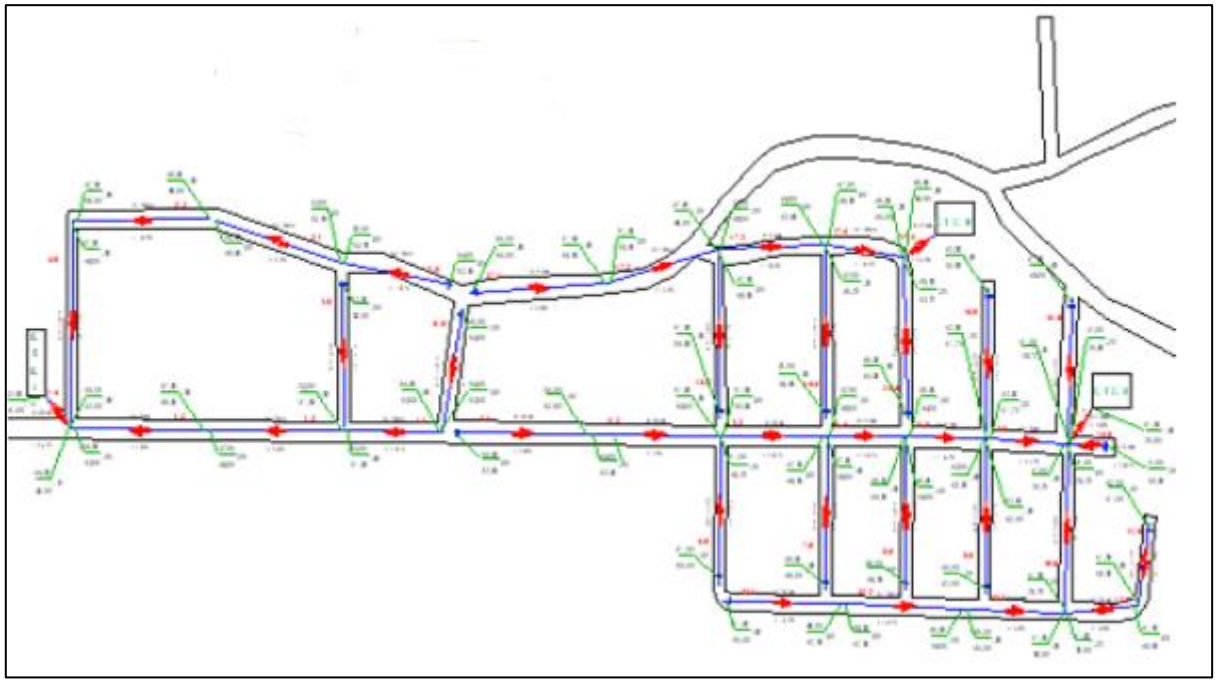


Figure 3 Community Lagoa Azul collecting network

Source: [3]

5. Final Considerations

Thus, in order to provide a continuous supply of safe water to the population in Manaus, existing standards for the production, treatment or distribution of drinking water must be respected. These standards

complement the general environmental protection measures. Therefore, the adoption of protective measures is part of these obligations.

The treatment of domestic sewage is also very important for the preservation of the environment. Sewage contaminates rivers, lakes, dams and seas with an excess of sediment and microorganisms that can cause various diseases.

It is urgent that the contamination of these watercourses by sanitary waste be reduced. Together with these sanitation measures, it will be necessary to intensify the environmental education, hygiene and sanitation programs, make the population aware in order to prevent them from diseases and to protect the environment. Given the information, it was concluded the importance of adapting the basic sanitation systems of the city of Manaus, in order to structure the implementation of new public policies, aimed at improving the quality of life of the local population, and the development of the region.

6. Bibliographical References

[1] Samara Maciel. Manaus joga 47 mil toneladas de lixo nos igarapés em 6 anos. Jornal Em Tempo Disponível em: https://d.emtempo.com.br/ciencia-e-tecnologia-meio-ambiente/166052/video-manaus-joga-47-mil-toneladas-de-lixo-nos-igarapes-em-6-anos. Acesso em 15 de Agosto de 2019.

[2] Correio Braziliense. Água que não acaba mais. Agência Nacional de Águas (ANA) Disponível em: https://www.ana.gov.br/noticias-antigas/agua-que-napso-acaba-mais.2019-03-14.4761862162. Acesso em 15 de Agosto de 2019.

[3] SISTEMA NACIONAL DE INFORMAÇÕES SOBRE SANEAMENTO. Diagnóstico dos Serviços de Água e Esgotos – 2017. Disponível em: http://www.snis.gov.br/diagnostico-agua-e-esgotos/diagnostico-ae-2017. Acesso em 15 de Agosto de 2019.

[4] LIBÂNIO, Marcelo. Fundamentos de qualidade e tratamento de água. Edição: 4ª; Edição. Lugar de publicação: Editora Átomo; 1 de janeiro de 2016 4ª ed.

[5] MINISTRO DE ESTADO DA SAÚDE. Portaria nº 2.914, de 12 de dezembro de 2011. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2011/prt2914_12_12_2011.html. Aceso em 26 de Agosto de 2019.

[6] MINISTÉRIO DO MEIO AMBIENTE. Águas Subterrâneas um recurso a ser conhecido e protegido. Disponível em: https://www.mma.gov.br/estruturas/167/_publicacao/167_publicacao28012009044356.pdf. Acesso em 10 de Agosto de 2019.

[7] OLIVEIRA, Josafá Ribeiro ; MELO, Claudio Franco; OLIVEIRA, Thiago Ribeiro; MELO, Claudio Franco Júnior. POÇO TUBULAR SEM CONTROLE COMPROMETE OS AQUÍFEROS SUBTERRÂNEOS. Acesso em 20 de Agosto de 2019. https://aguassubterraneas.abas.org/asubterraneas/article/download/23804/15869.

[8] D24AM. Manaus tem 7 mil poços clandestinos que apresentam risco de contaminação. Companhia de Pesquisa de Recursos Minerais. Disponível em: https://d24am.com/amazonas/manaus-tem-7-mil-pocos-clandestinos-que-apresentam-risco-de-contaminacao/. Acesso em 15 de Agosto de 2019.

[9] SILVA, Márcio Luiz da. Características das águas subterrâneas numa faixa norte- sul na cidade de Manaus (AM). Rem: Rev. Esc. Minas, Ouro Preto, v. 54, n. 2, p. 115- 120, Junho

2001.Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0370-44672001000200007&lng=en&nrm=iso. Acesso em 13 de Setembro de 2019.

[10] REBOLÇAS, Marcelo. Agência Nacional de Águas. Cuidando das águas: soluções para melhorar a qualidade dos recursos hídricos. Programa das Nações Unidas para o Meio Ambiente. 2. ed. -Brasília: ANA, 2013. Disponível em: https://capacitacao.ead.unesp.br/dspace/bitstream/ana/119/1/CuidandoDasAguas-Solucao2aEd.pdf . Acesso em 15 de Setembro de 2019.

[11] AZEVEDO NETTO, José Martiniano de. Manual de hidráulica; coordenação Roberto de Araujo; co-autores Miguel Fernandes y Fernandez, Acácio Eiji Ito. 8ª edição-São Paulo: Edgard Blucher, 1998.

[12] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. NBR 9648: Estudo de concepção de sistemas de esgoto sanitário. Rio de Janeiro. 1986.

[13] BRASIL. Lei nº. 11.445, de 05 de janeiro de 2007. Estabelece diretrizes nacionais para o saneamento básico. Disponível em: http://www.epsjv.fiocruz.br/sites/default/files/documentos/pagina/lei_11445-07.pdf. Acesso em 22 de Setembro de 2019.

[14] COLLISCHONN, W. TUCCI, C. E.M. 1998. Drenagem urbana e Controle de Erosão. VI Simpósio nacional de controle da erosão. 29/3 a ¼ 1998, Presidente Prudente, São Paulo.

[15] CETESB. Drenagem Urbana: manual de projeto. – 3. ed. – São Paulo: CETESB/ 3. Ed./ASCETESB, 1986. 464 P.: il, ; 22 cm.

[16] TUCCI, C. E. M. Inundações e Drenagem Urbana. In TUCCI, C. E. M.; BERTONI, J. C.(org.) Inundações Urbanas na América do Sul, ABRH, Porto Alegre, cap.3, 2003. pp.45- 129.

[17] PESQUISA NACIONAL DE SANEAMENTO BÁSICO (PNSB). Brasil. 2010. Disponívelem:<http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/pnsb2008/PNSB_2008.pdf.> Acesso em: 04 set 2013.

[18] PREFEITURA DE MANAUS. Bem-vindo a SEMINF. Disponível em http://seminf.manaus.am.gov.br/. Acesso em 14 de Setembro de 2019.

[19] PHILIPPI Jr. A. Saneamento, saúde e ambiente: Fundamentos para um desenvolvimento sustentável. Barueri, SP: Manoele, 2005- (coleção Ambiental; 2).

[20] Comissão de Geodiversidade da Ale-AM. Drenagem urbana é insuficiente aponta relatório da Comissão de Geodiversidade da Ale-AM. https://www.redetiradentes.com.br/drenagem-urbana-em-manaus-e-insuficiente-aponta-relatorio-da-comissao-de-geodiversidade-da-ale/. Aceso em 14 de Outubro de 2019.

[21] MORAES, Gina. AMAZONASATUAL. População de Manaus sofre com falta de saneamento básico. IBGE Disponível em: https://amazonasatual.com.br/populacao-de-manaus-sofre-com-falta-de-saneamento-basico/. Acesso em 15 de Setembro de 2019

[22] Divisão de Doenças de Transmissão Hídrica e Alimentar. DOENÇAS RELACIONADAS À ÁGUA OU DE TRANSMISSÃO HÍDRICA. Dezembro de 2009. Disponível em: http://www.saude.sp.gov.br/resources/cve-centro-de-vigilancia-epidemiologica/areas-de-vigilancia/doencas-transmitidas-por-agua-e-alimentos/doc/2009/2009dta_pergunta_resposta.pdf. Acesso em 16 de Setembro de 2019.

[23] FUNDAÇÃO NACIONAL DE SAÚDE. Funasa participa do I Seminário de Saneamento Ambiental do Amazonas. Disponível em: http://www.funasa.gov.br/web/guest/home/-

/asset_publisher/ihdKjCvMf50A/content/funasa-participa-do-i-seminario-de-saneamento-ambiental-do-amazonas?. Acesso em 12 de Outubro de 2019.

[24] G1 AMAZONAS. Manaus registra mais de 100 casos de hepatites este ano; campanha alerta para diagnóstico precoce. Disponível em: https://g1.globo.com/am/amazonas/noticia/2019/06/29/manaus-registra-mais-de-100-casos-de-hepatites-este-ano-campanha-alerta-para-diagnostico-precoce.ghtml. Acesso em 30 de Agosto de 2019.

[25] TRATA BRASIL. Saúde. Disponível em: http://www.tratabrasil.org.br/saneamento/principais-estatisticas/principais-areas-afetadas/saude. Acesso em 12 de outubro de 2019.

[26] G1 AMAZONAS. Índices de coleta de esgoto em Manaus devem melhorar nos próximos dois anos, diz Trata Brasil. Disponível em: https://g1.globo.com/am/amazonas/noticia/2019/09/02/indices-de-coleta-de-esgoto-em-manaus-devem-melhorar-nos-proximos-dois-anos-diz-trata-brasil. Acesso em 30 de Agosto de 2019.

[27] GOOGLE MAPS. Disponivel em:https://www.google.com/maps/place/UBS+N-56/@-2.968193,-60.008545,15z/data=!4m2!3m1!1s0x0:0xb0eb6d31404e451d?sa=X&ved=2ahUKEwj6p4-86qHlAhXnILkGHaLsAUQQ_BIwE3oECA0QCA. Acesso em 01 de Outubro de 2019.

[28] ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. NBR 9649: Projeto de redes coletoras de esgoto sanitrio. Rio de Janeiro. 1986.

Electric Energy Reuse of Plastic Injection Machine Motors for Lighting Circuit in a Manaus-Amazonas Industrial Pole Company

João Batista Lopes Gonçalves Junior
joaocbr500r@gmail.com
Centro Universitário FAMETRO – Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Jorge de Almeida Brito Junior
jorgebritojr@gmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

This work aims to reuse the electric energy used in three-phase induction motors of an industrial plastic injector for the lighting circuit of the same warehouse where the injectors are located, thus eliminating the need to use the energy of the electric company. Any resource that reuses electricity with better efficiency becomes essential today, making it a solution for industries that are thinking of saving the energy used in the productive processes in the manufacture of goods.This project uses a synchronous generator coupled to a three-phase induction motor of a plastic injector, which will reuse the electrical energy used of the induction motor to mechanically drive the synchronous generator, that will be able to generate enough electrical power in its coils for a 47-light shed lighting circuit, thus eliminating the need to use utility power, saving a portion of the energy usage costs on the monthly bill. This installation of the synchronous generator was performed on equipment of the company Moto Honda da Amazônia, which has a 24-hour operating regime for six days a week.

Keywords: three phase induction motor; plastic injection molding machine; synchronous generator; lighting;

1. Introduction

Electric energy becomes essential today in human life, both in economic, political, social, environmental and technological aspects. In short, energy is the ability to do work. Due to the growing demand of the

population, it is considered an important factor in production to boost the economic development of the country [1].

The consumption of electricity has been increasing more and more day by day, creating a big problem for the power generation companies, which to meet this need and generation costs, end up increasing the cost of Kilowatts / Hour, which reaches both In the population and industrial sectors, it is therefore necessary to use it rationally by both low-power and high-power consumer groups [2].

Some factors that interfere with the generation of electricity are climatic and environmental. In times of water scarcity, for example, hydroelectric plants have had limitations on power production, with low levels of water in dams, decreasing or even losing water pressure to move their turbines. In Brazil, its main source of electric energy is generated by the force of the river water current, so to preserve scarce natural resources, it is necessary to consciously use electric energy [3].

There is a lack of electricity supply to factories in the Manaus industrial hub, which can cause several negative impacts. One of them is the shutdown of the production line, especially for companies and small industries, as it is the only alternative source of energy for the production process, because they do not have a high power generator that meets this need. A standstill production line does not meet the goal of delivering to customers, which to alleviate the problem is necessary to approve overtime for employees who generate more spending on labor, equipment and logistics [4].

Amid this scenario all the reuse of electricity is necessary. Many industrialists use means and ideas that can save and make their production possible at the lowest possible cost of electricity. The project described here has as its purpose the reuse of electric energy from motors of plastic injection machines for lighting circuit.The project mentions how Electric Energy can be reused in an Industry that has high power motors in production equipment or any other type, which has a system with continuous rotation, through just a simple idea, which can reuse this energy, low-power circuits such as a warehouse lighting circuit.

2. Theoretical Referential

Increasing energy consumption has become increasingly necessary over time, as one of the main sources of energy generation comes from oil, a natural resource that over time becomes scarcer because it is not renewable. The main factors influencing the increase in electricity consumption and the unbridled increase in world population, production and manufacture of large-scale food and electronic goods and products, among others [5].

Faced with this scenario, any resource for generation, reuse of energy or use with better efficiency becomes essential today. With the advance of power generation technology through synchronous generators, there is an opportunity to reuse this already consumed energy.

The electrical energy generated by a synchronous generator and converted through mechanical rotation on the shaft. The generator rotor is driven by a prime mover machine, which produces a rotating magnetic field within the machine. This rotating magnetic field induces biphasic voltages in the generator stator windings [6].

Synchronous generators have two fundamental parts. A so-called fixed stator where windings and coils are located, known as armature windings. And another moving part we define as a rotor, where the field

winding is housed. It is called synchronous due to the equality between the electrical frequency and the angular frequency, ie the generator rotates at the speed of the magnetic field [6].

Whereas in the case of distribution grids, generators are usually operators in order to keep the active power constant regardless of the grid frequency. However in this work the rotation is continuous with constant mechanical torque.

For use in power plants where some type of fuel or drive is responsible for producing directly or indirectly the rotation of an axis to which an electric generator is coupled, turbo generators are usually used.

Due to their characteristics, especially those concerning generator optimization, driving machines are usually quite fast (1800 or 3600 RPM). These features have the benefit of being able to put as much power as possible in a smaller volume due to the high speed when coupled to any engine such as: Electric or combustion induction motors, plastic injection hydraulic pumps, among other equipment that has a rotation system of compatible speed.

Plastic injectors are equipment whose purpose is the production of plastic parts by injecting polymers (plastics) to high temperatures in prefabricated mould. And in this equipment the consumption of electric motor and 80% of the whole machine [4].

Many injection molding machines have all their operation based on a hydraulic system, i.e. the electric motor drives one or even more hydraulic pumps. The hydraulic oil pump in a plastic injector is a device that receives electrical potential energy through the rotation of a three-phase induction electric motor and transforms part of it into motion and pressure energy. And the pressure and flow of oil that carries out the opening and closing movements of mold, material injection and spindle movement. In this valve opening and closing system is the actuator, taking the oil flow or pressure to where it is needed according to the need of the injection cycle, the transmission is through increased pressure, increased speed, or combinations. between different energies. In other words, the hydraulic oil pump pumps hydraulic fluid, also known as hydraulic fluid, and at times when no pressure or flow is required, hydraulic fluid recirculation occurs [7].

As these plastic injector motors are working throughout the production process in a regime of up to 24 hours without breaks, and at this point it can be reused this energy of the motor in constant motion, coupled to a biphasic synchronous generated, which can generate power to supply luminaires scattered throughout the shed, As these plastic injector motors are working throughout the production process in a regime of up to 24 hours without breaks, and at this point it can be reused this engine energy in constant motion, excluding the need for electricity consumption made available by the dealership. Thus bringing savings to the company in the reuse of electricity in any equipment that has a rotation system that can be coupled to a synchronous generator.

To perform the installation it is necessary to lift the power and speed of the injector engine in relation to the synchronous generator, the speeds have to be close and the power of the electric motor three times higher than that of the generator so there is no overload of the Injector Motor. Every electric motor or generator has data supplied on a plate by the manufacturer fixed in the housing and also in manuals or datasheets, with more specific details of the equipment.

The ratio of the nominal output power of the generator must be greater than or equal to the power of the luminaires to not overload the generator, or in case of any increase in the structure of the shed there will be

no need for total change of the project.

The luminaires used in the shed are LED technology, which have low electricity consumption and with greater efficiency in lighting. Although the use of LED technology still has some challenges to be overcome, especially with regard to its high cost of initial investment, it has great advantages, such as the quality of its light and its energy efficiency [8].

For circuit control and safety and required a control panel with overload and short-circuit protection devices for generator safety in any overload.

In case of the need to disconnect the plastic injector, there is a need by the control Panel a design by-pass system for automatic feedback by the electric power utility. For lighting according to production needs.

When corrective or preventive maintenance of the synchronous generator is necessary for any inspections or exchanges of belts, bearings, coil insulation measurements, checking of couplings and retightening of terminals or even in case of exchange of Own generator, the automatic design by-pass system will also be used on the control Panel.

3. Methodology

The nature of this research is characterized as an experimental research, which determines an object of study, selects the variables that would be able to influence it, define the forms of control and observation of the effects that the variable produces in Material [9].It is characterized by the determination of a study object, the variables that could influence are defined, the forms of control and observation of the effects that is variable caused in the object are selected. So because this modality is sidewalk in experimental methods, it is more directed to the physical and natural sciences. Even if the margin of errors represents a relevant factor, its contribution is quite significant, given its application in practice. In the end, it is part of the practice, aiming at interfering in the reality itself.

The tests were performed in a mechatronics laboratory, in the company Moto Honda of Amazonia. This company was chosen by the vast sheds structure that have large quantities of luminaires and equipment with three-phase induction motors. Assays were performed as shown in Figure 1, with a Kohlbach biphasic synchronous generator, with a power of 2.2 KVA and rotation speed 3600 RPM, which was coupled its axis to that of a three phase induction motor with a power of 2.4 KVA only for testing , and rotation speed of 3800 RPM, compatible with the speed of the synchronous generator, which after energized and by is fixed to the generator,möglich realizar um movimento de medições no seu eixo, ocasionando na saída do gerador uma tensão de V = 220 VAC, aferida por um multímetro de fabricação Minipa de modelo ET-3200 em escala de tensão.According to the specifications and data provided by the manufacturer of the plate attached to the motor housing, it is possible to know the maximum operating current that the generator can withstand in its output, so that there is no possible overload or burning of the equipment of Generation.

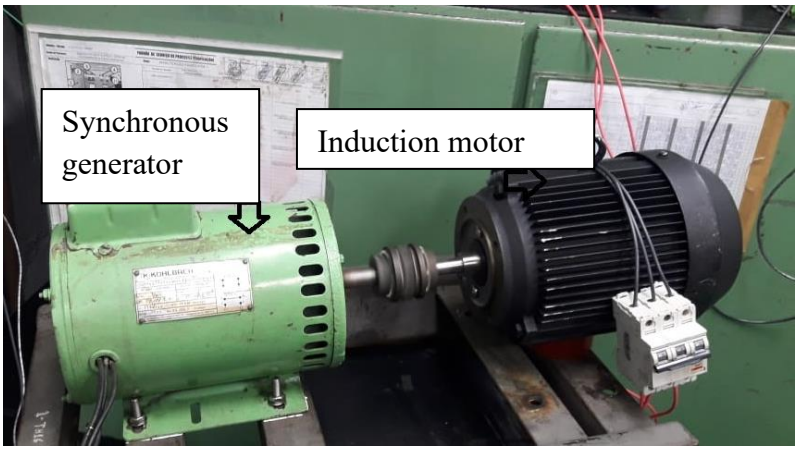


Figure 1. Test with synchronous generator and induction motor.

For eventual tests of the experiment were used the laboratory lighting lamps themselves represented by Figure 2, which have a quantity 7 luminaires, reaching a total of 14 LED bulbs, with 32 W of power and rated current of 0.145 A, That the installed joints reach a total of 2.3 A. These nominal current data of the lamps are also described in the Luminaire housing explained by the manufacturer.

Figure 2. Luminaires with test lab lamps.

It was necessary to remove the input power of the circuit breaker from the general frame of force of the laboratory lighting circuitry, where the interconnection of the generator output circuit was made in the circuit breaker itself, thus eliminating the power supply Electricity offered by the concessionaire.After this process the induction motor coupled to the generator is energized at a three-phase voltage of 220 VAC, which excites the coils of its rectifiers that will carry out measurements movements on its axis thus causing the mechanical drive of the synchronous generator.

While the generator performs rotational motion at a constant frequency, its output voltage will remain stable, and the 7 laboratory luminaires can be fed by its output voltage.

For better analysis, the same multimeter was used in the electric current scale to evaluate and observe whether the electric current will not exceed the nominal current of the generator for safety purposes.

The test was performed in a 24-hour regimen, analyzing whether it will not present oscillations of current and voltage outside the standards of the equipment nominals. After the 24 test hours, the voltage and electric current were measured again, which remained within the specified values, within the working range stipulated by the manufacturer, as well as the engine temperature, measured by the infrared thermometer

of the Fujitsu model TI30, which may not present a value greater than 60 °c in its display, which is the maximum operating temperature of the operating limits provided by the manufacturer.

The electrical diagram of the circuit is described in Figure 3. In it, with the selector switch S1 in the ON position it is possible to connect the panel of the control circuit. When the injector is in production process, its hydraulic motor mechanically actuated the generated synchronous, generating a voltage of 220 Vac in the coils of outputs of the generator.This voltage triggers a TR1 timer connected in parallel to the generator output, which makes a 3-minute count. After counting, the timer TR1 switches its closed and open contact, the contactor MS2 responsible for the power of the luminaires through the utility's electric power and off at the same time the TR1 timer switches the open contact by closing and Triggering the contactor MS1 responsible for the power of the luminaire through the electrical energy generated by the synchronous generator.

The electric command in Figure 3 serves as an automatic by-pass has a safety interlock system using normally closed auxiliary contacts of the contactors themselves so there is no possibility of double triggering.

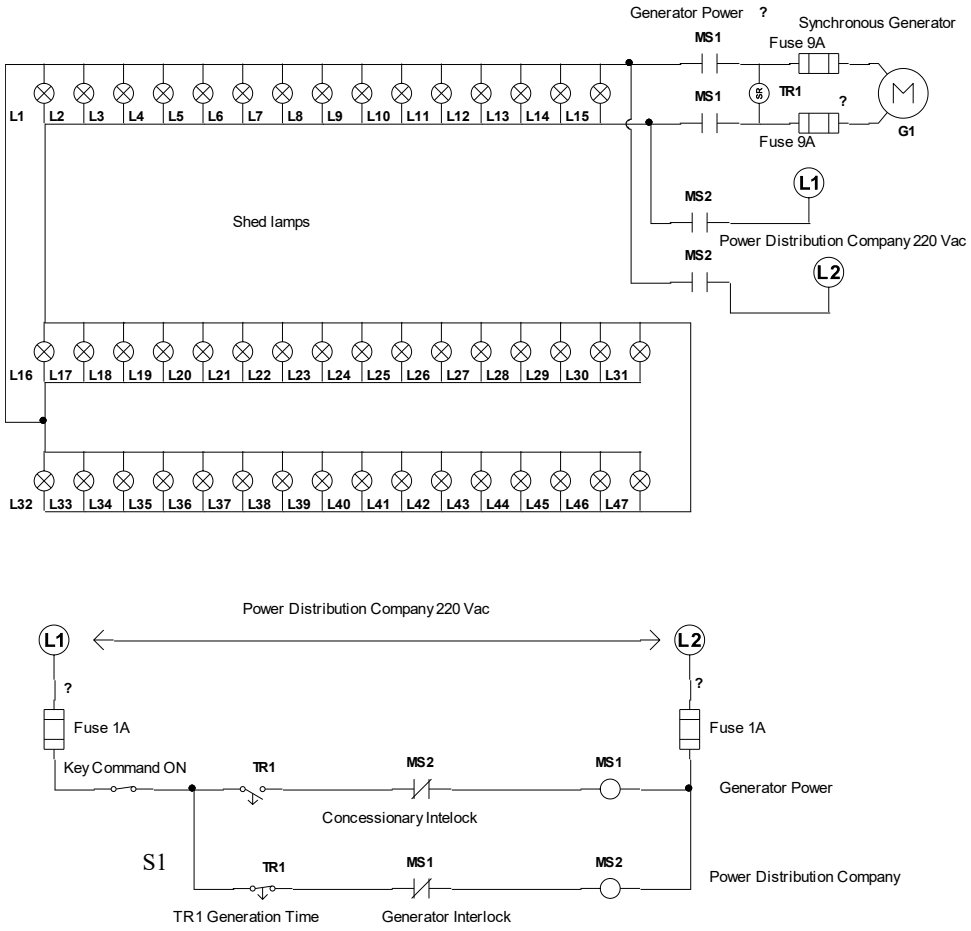


Figure 3. Electrical circuit diagram.

The entire circuit controller is protected by fuses, according to the nominal current of each circuit preventing any overload. To become more viable, the by-pass control Panel is powered by the utility's electric power, leaving the circuit independent of the operation of the plastic injector.

4. Analysis and discussion of results

With this experiment that was performed in the Mechatronic laboratory, it became easier to have a reference to perform the installation of the synchronous generator in the equipment, by itself knowing which material was used and what method to follow, thus executing the activity In the area, where the plastic injector is located and the luminaires installed in the shed.And through the simulation of the experiment it became more reliable to expect the result of coupling to a three-phase induction motor of a plastic injector by possessing a power of 75KW, well above the engine power that were made tests.

After coupled the synchronous generator next to the three-phase hydraulic injector engine of 1300 tons, with its control panel and by-Pass, the design has suppressed the need for electric power supply of the lighting circuit of a shed with 47 luminaires 32 W each, Even increasing the consumption of 160 W of three-phase motor power in the mechanical drive of the synchronous generator, the generated energy compensates, in relation to its modified working power after installation, leaving still a slack of 15 luminaires of the same Power supply, providing a total of 1,984 W of electric power for illumination.The shed has 13 plastic injectors and each consisting of 3 three phase induction motors, the project can encompass a greater amount of power generation, around 39 times the more. Figure 4 shows the luminaires that are present in the shed.

Figure 4. Shed Lighting Fixture.

In the experiment, it was observed that in a sample performed to analyze the tension, to each luminaire that was connected, there was a voltage drop of 0.1 V. Figure 5 exemplifies this voltage drop. For an initial value of voltage 227 V, when no luminaire is switched on, this voltage remains the same stable. When a 32 W luminaire is energized, there is a voltage drop of 0.1 V of the initial value. Therefore, the voltage becomes 226.9 V. When a second luminaire of 32 W is energized, again there is a voltage of 0.1 V, in which the voltage passes be 226.8 V and so on. In Figure 5, the luminaire actuation is exemplified by the range 32 W to 160 W, each time a luminaire and connected, there is a sum of powers, this same process occurs for the triggering of the other luminaires.

Tension(V)

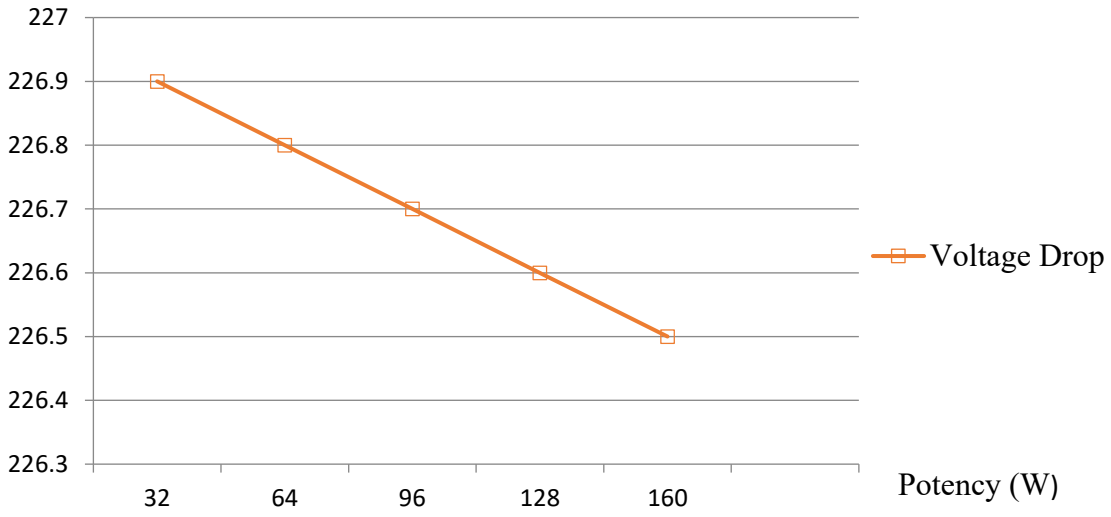


Figure 5. Voltage and power ratio.

This energy, being generated on a large scale, in another plastic injector existing in the factory, can be used in the other sheds, throughout the lighting circuit, implying an economy in the consumption of electricity coming from the concessionaire.

This project being installed in the factories of the industrial pole of Manaus will cause the concessionaires to provide a smaller amount of electricity that ultimately emits less CO2 in the atmosphere from thermoelectric plants due to lower consumption and demand of Electricity, being a great benefit to society and nature.The company can also hire more employees, increase wages, improve employee comfort in the factory premises, and also reduce inputs in its production process, bringing a benefit to society in the generation of jobs, quality of and ease of purchase of manufactured goods.

5. Conclusion

Based on what was presented in this article, we can consider that technological advancement contributes to a better generation of electricity, as well as a better reuse of that which was generated, even more in the scenario nowadays, with increases Unbridled electricity tariffs in the generation in KWh, which has a high cost, as well as in the industrial polo sector of Manaus, making it impossible for some companies to be able to perform their industrial and commercial activities.

In this way, the opportunity to take advantage of this technological advancement in order to save and supply the consumption of electricity, reusing that already used. Due to non-renewable resources each day become scarce and with high value of purchasing power. Electric energy demonstrates to be one of the most argued and disseminated subjects during this decade, because it affects all socio-economic aspects of a society, both industry and trade.

Therefore, after the feasibility of the installed project, the system of reuse of electric energy through a synchronous generator, in the three-phase motor of the hydraulic pump of plastic injector, can meet the need for an electrical installation consisting of 47 Luminaires of 32 W, each luminaire has 2 LED lamps of 16 W of power, in order to eliminate the mandatory need to use the electricity supply of the concessionaire during the production process, where the equipment is in the process of Operation.

The use of the generator coupled to the electric motor of the injector served as learning, that the electric energy used in the industrial process can be more efficient and productive, in the context of reducing the loss to the maximum of a productive process, thus combining All the employment of technology in LED lighting equipment and the technological advancement of synchronous generators existing on the market, thus adding to a greater economy in manufacturing.

6. Referência

[1] KAEHLER, Jose Wagner Maciel. **Comments on ANEEL's proposal to modify the manual for the preparation of the annual regulation to combat the waste of electricity from the concessionaires.** ANEEL, 2000.Available at: <http://www2.aneel.gov. br / applications / Audiencia_ Publica / audiencia_proton / 2000 / ap003 / Comment% E1rios% 20ANEEL.pdf>. Access on 14 Sep.2019.

[2] ACORONI, Junio Célio Pereira. **Energy Efficiency: Best Practices in Energy Saving in an Industrial Sector**. Academic Week Magazine, 2013. Available at: <// semanaacademica.org.br/system/files/artigos/artigo_junio.pdf>. Access on 13 Sep.2019.

[3] **Results Procel2014 Year 2013.** Available at: <http: // www. procelinphus. with. br / resultsprocel2014 / pdf-complete.pdf>. Access on 14 Sep.2019.

[4] **3 problems caused by power outages in your factory**. Available at: <https://www.ballufbrasil.com.br/3-problemas-gerados-pela-falta-de-energia-em-your-factory/>. Access on: 15 Apr.2019.

[5] Oak, Joaquim Francisco de. **Energy consumption, from antiquity to the present day - ARTICLE .Iluminates Energy Sector Development Institute**. Botafogo, Nov.2017. Available at: <https://www.ilumina.org.br/o-consumo-de-energia-da-antiguidade-aos-dias-de-hoje-artigo/>. Access on: 15 Apr. 2019.

[6] The Baptist, Julius Caesar. **Methodology for testing Synchronizer Generator Protection System Model using real-time digital simulator**. Belo Horizonte: [S.N], mar. 2015. Available at: <http://www.ppgee.ufmg.br/ synchronous generators / pdf>. Accessed on: 15 Apr. 2019.

[7] **Hydraulic Pumps**. Available at: <http://www.docent.ifrn.edu.br/bombas-hidraulicas/pdf> Access on: 17 Apr.2019.

[8] GIANELLI B F, SILVEIRA M C F, THAUMATURGO L R Y, ASTORGA O AM, SON M B M, **"The Employment of LED Technology in Public Lighting - Its Impacts on Energy Quality and the Environment,"** The 8th latinamericancongressonelectricitygenerationandtransmission - CLAGTEE, 2009.

[9] GIL, Antonio Carlos. **How to design research projects**. 4 ed. Sao Paulo: Atlas, 2008.

Mechanical Analysis of Asphalt Pavements with Alternative Materials in Manaus – Amazonas

Marcilio Silva Almeida
marcilio.thac@hotmail.com
Centro Universitário FAMETRO – Manaus, Amazonas - Brasil

Livia da Silva Oliveira
oliveira.livia@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Francisco Carlos Tavares Amorim
amorim.mao17@gmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Abstract

Pathologies in urban roads are common and recurring problems in the municipality of Manaus - AM, where defects have appeared early and successfully, especially the climatic condition of the differentiated region and the non-participation of the coarse aggregate in the asphaltic coating and sublayers. predominantly made of clay. Nevertheless, the Government often performs simple "hole-covering" operations to recover and restore such a structure, corroborating all the problems that trigger poor paving in the State Capital of Amazonas. Another challenge of the municipal administration is the disposal of construction waste, making it necessary to recycle it, highlighting the serious environmental problem caused by the extraction of the pebble. Aiming to contribute with alternatives the scarcity of stone material and the natural aggregate (pebble), substitute of gravel in the regional civil construction, it is proposed the use of construction and demolition waste (RCD). Asphalt concrete (AS) mixtures were made with recycled material, residual sand, portland cement, petroleum asphalt cement (CAP 50/70) and this binder modified with the addition of SBS (styrene and butadiene copolymer). Characterization tests were performed with aggregates, filler and petroleum asphalt cement (original and polymer), dosed by the Marshall method, and the asphalt mixtures were subjected to the Beam Fatigue Test at three different stress levels. The studies indicated satisfactory results of asphalt mixtures with the participation of RCD and SBS binder, compared to regional composites.

Keywords: asphalt pavement; construction waste; fatigue.

1. Introduction

Manaus' asphalt pavements have historically shown problems, stemming from several factors: vehicle growth, lack of maintenance, severe regional climate conditions such as high temperatures and high rainfall during most of the year, and above all, technically structured structures. inadequate, either by asphalt coating as a rule using hot machined asphalt sand, or by sublayers made up predominantly of clay material. Such asphalt mortar coatings have a significant and premature deterioration process, mainly due to the fact that regional asphalt mixtures do not present the coarse aggregate as their participant and the use of low support sublayers. The capital of the state of Amazonas has its rocky top at depths generally greater than 5m. Areas of interest for exploration of these mineral resources are more than 200 km to the north. They are, therefore, at great distances from the urban area of Manau, which results in high transportation costs. In this context, the solution commonly used in regional civil construction has been the replacement of stone material by pebble deposits, causing serious environmental damage, as well as the widespread use of hot-machined asphalt sand (AAUQ) coatings on clay sublayers, extreme case of the urban pavement of the Municipality of Manaus [1].

Proposing investigations to the above mentioned problems, the application of Construction and Demolition Waste (RCD) was studied, among other materials, aiming to provide not only alternative to the technical proposal (granular material for use in regional pavements) but also the environmental issue of the final disposal of these. waste produced by the construction industry [2][3].

Regarding the significant and anticipated deterioration process of the city pavements, mainly due to the fact that low-layered sublayers and regional asphalt mixtures do not contemplate the coarse aggregate as their participant, as well as the composition exhibiting an excess of fine aggregates and of binder with inadequate properties at in situ temperature. Thus, Manaus presents pavements, in general, with temperatures around 40 ° C [4], and it is increasingly necessary to use asphalt properties modifiers.

Polymer modified asphaltic binders provide excellent alternatives to address major pavement deficiencies, especially by improving properties such as thermal susceptibility, resistance to permanent deformation and thermal cracking. Among these modifiers, polymers of various types can be cited to improve binder performance [5]. Among the most used polymers in asphalt modification, the styrene-butadiene (SBS) block copolymers stand out, which improves the elastic characteristics of asphalt [6].

The modification of the asphalt composite participants for the region aims to solve the above problems, however, one must take into account the repeated load transmitted to the coating during vehicle traffic, intrinsic action the pavement fatigue life [7]. To estimate the fatigue life of asphalt mixtures, there are laboratory tests that seek to simulate the conditions of road application and those seeking a reasoned approach [8]. Most fatigue test results have been obtained through simple bending tests, in which stresses or deformations are repeatedly applied until the prismatic specimen breaks or is structurally compromised [9]. When it comes to the advantages of this type of test, we highlight the widespread use and the possibility of using the results directly in the sizing of pavements, in addition to allowing the options of testing under stress or controlled deformation [10].

In order to mechanically characterize the CA-type asphalt mixtures, by means of the four beam point fatigue test, at three different stress levels, and aiming to expose alternative solutions to the above-mentioned points, with regard to regional paving, bodies were fabricated. with the following composites: Asphalt Binder: Pure and Polymer Modified (SBS); Coarse aggregate: RCD (Construction and Demolition Waste) with two distinct particle sizes; Household: Residual Sand and Mineral Fertilizer: Portland Cement.

2. Theoretical Referential

2.1 Resíduos de Construção e Demolição (RCD)

In Brazil, it is estimated that 50% of solid waste comes from construction and demolition [11], and the proportions are equal for each of the two activities. Of this total RCD, around 65% is of mineral origin, 13% of wood, 8% of plastic and 14% of other materials [12]. Construction companies generate between 20% and 25% of waste, and self-construction works make up the remainder, making it even more difficult to control the final disposal of the RCD. In any case, the use of recycled aggregates as a substitute for natural aggregate represents a saving in Paving works, given the high cost of transportation from the consumer centers. In the United States, for example, a savings of 30% over simple graded gravel is measured [13].

In any case, the use of recycled aggregates as a substitute for natural aggregate represents a saving in Paving works, given the high cost of transportation from the consumer centers. In the United States, for example, a savings of 30% over simple graded gravel is measured [13]. The investigation of all these works has corroborated the feasibility of using the RCD in exchange for the rolled pebble and gravel, according to technical criteria linked to the behavior evidenced in the research. Composites with RCD, according to the researches examined, showed successively better results, either in terms of stability, tensile strength or susceptibility to permanent deformation.

2.2 Vida de Fadiga

Fatigue is the process of structural deterioration that a material undergoes when subjected to a state of repeated stress and strain, and may not reach the ultimate strength of the material, resulting in cracking after a sufficient number of loading repetitions. In other words, fatigue is the loss of resistance that a material suffers when repeatedly asked for bending or traction [10]. In the fatigue test, the material is subjected to the request at which irreversible evolution occurs to a final stage of rupture or an arbitrary limit of deformation [19]. With the objective of estimating the fatigue of asphalt mixtures, there are laboratory tests that try to simulate the conditions of request of a highway and those that seek a reasoned approach [20]. Laboratory equipment for repeated load testing allows the application of cyclic loading to the material under stress and controlled deformation. In both tests there is a reduction of the initial stiffness of the material to a level that can be pre-set in order to define the end of the test. The great advantage of the DC test is that it allows better observation of fatigue crack propagation [21].

3 Methodology

3.1 Materials

The materials used in this work are easily found in the region and the methods followed were those recommended by the National Department of Transport Infrastructure - DNIT [19], Brazilian Association of Technical Standards - ABNT [22], American Society for Testingand Materials - ASTM [23] and EuropeanCommittee for Standardization - EN [24].

3.1.1 Petroleum Asphalt (CAP) and Polymer Cement

Two types of asphalt were analyzed in this research: petroleum asphalt cement (CAP 50/70), which will be called here only CAP, representing the asphalt commonly applied in the rolling layer of that city, supplied by the Isaac Sabbá Refinery (REMAN).), as well as the same binder modified by the styrene, butadiene and styrene (SBS) copolymer. A set of equipment was used consisting of a mechanical stirrer with shear propeller coupled to a thermometer and a heating blanket. The CAP 50/70 was first heated and then passed through a 5 liter Becker and directed into the heating blanket. SBS granules were then incorporated into the asphalt Becker at a ratio of 2% of the heated binder mass contained in said Becker. During the two hours of mixing of these components, the heating temperature was controlled in the range of 150 ± 5 ° C at a rotation of 300 rpm and then the modified CAP (CAPSBS) was obtained. Both binders were characterized in the local refinery's Product Development laboratory, following standard ASTM instructions [23] and meeting the requirements of the National Oil, Gas and Energy Agency - ANP [25]. The tests performed were: Penetration, Softening Point, Trichlorethylene Solubility, Flash Point, Ductility at 25 ° C, Relative Density at 25 ° C, SayboltFurole Viscosity Brookfield Viscosity (135 ° C, 150 ° C and 177 ° C), Rotational Thin Film Heat and Air Greenhouse (RTFOT) Aging, as well as post-aging tests such as Mass Variation, Retained Penetration and Softening Point Variation. With these characteristics it was possible to have a prospection of the changes caused to the asphalt with the inclusion of the polymer.

3.1.2 Mineral Material

As an alternative material in the condition of coarse aggregate, we used the Construction and Demolition Waste (RCD), coming from the crushing of beams and pillars, ie, reinforced concrete for structural purposes only (Figures 1 and 2). The composition was performed in two particle sizes, a coarse called RCD 1, because it is similar to the definition of Brita 1 (material with a maximum diameter of 19.0 mm) and a fine called RCD 0, similar to the definition of Brita 0 (material with a maximum diameter of 12.5 mm), the purpose of this mixture of particle size was to search for a well graded particle size curve (Figures 3 and 4). As a material traditionally used in Manaus, was the Manaus sand (Figure 5), material constituent of the mixtures under study.

Figure 1. Construction and Demolition Waste Storage - RCD

Figure 2. RCD block crushing and sieve separation

Figure 3. RCD Material 1 - Large Aggregate

Figure 4. RCD Material 0 - Large Aggregate.

The samples were characterized according to DNIT [19], by the following tests: Los Angeles Abrasion, Adhesiveness, Absorption, Shape Index, Apparent Relative Density, Real Density, Effective Density, Particle Size Analysis, Loose and Compacted Specific Mass, Mass Grain Specific and Sand Equivalent. Also included in the asphalt mixtures were: Portland cement (CP II – Z – 32) as filler (inert mineral material in relation to the other components of the finely divided mixture, passing at least 65% in the 0.075 mm aperture screen square mesh), being characterized by Particle Size Analysis and Real Density.

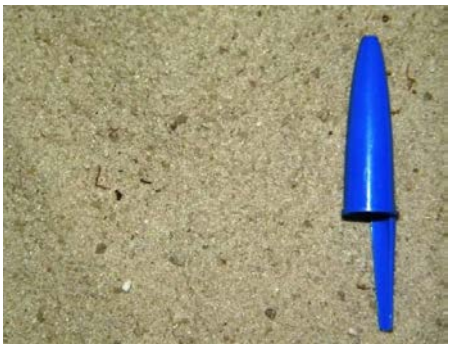


Figure 5. Manaus Sand Material - Kid Aggregate

3.2 Methods

The materials specified above were dosed according to the Marshall methodology, being asphalt concrete - CA, with CAP 50/70 and CAP 50/70 modified by SBS copolymer. The design content for both types of mixtures (RCD + CAP and RCD + CAPSBS) is determined. After obtaining the design content, the

prismatic specimens were molded (Figure 6) for the stress controlled fatigue test (TC) by three stress values (0 kN, 0.7 kN and 1 kN) using the Four Point BendingApparatus equipment manufactured by IPC Global.

Figure 6. Fatigue test specimen

3.2.1 Mineral Dosage

Manauara reality is the dosing of this coating only with fine aggregates, filler and asphalt cement, or at most asphalt concrete (CA) with gravel, which in this work will be replaced by alternative coarse material. The mineral particle size of the resulting CA-type blends fell within the C (Rolling Layer) range alluding to DNIT 031/2006 - ES using Marshall dosing parameters.

3.2.2 Project Content Determination

The optimal binder content of asphalt mixtures was defined by the DNIT's 3rd Federal Road District (3rd DRF) method [19], which is based on the Void Volume (Vv) and Bitumen-Void Ratio (RBV) values. and according to the specification of the Marshall Dosing Method [26]: Vv from 3% to 5% and RBV from 75% to 82%. This method consists of determining these parameters for five groups of cylindrical specimens (101.5mm in diameter and 63.5 ± 0.5mm in height), each group having three specimens made with the same binder content. The preparation and compacting temperatures of the mixtures are obtained.

3.2.3 Confecção das Misturas Asfálticas em Molde Prismático

Concerning the production of the asphalt mix beams, removable “L” shaped metal molds were made, measuring 402 mm in length and 164 mm in height, with a 5 mm thick plate (Figure 7). 50 mm high, 400 mm long, 50 mm wide (Figure 8) and a socket with the Marshall compression standard (Figure 8), all beams were compacted at 75 strokes per face with manual compression, equivalent to a pressure of 7 to 14 kgf / cm². And with the so-called “optimum” content, the specimens were produced to perform the beam fatigue test. Therefore, it was necessary to make beams from asphalt mixes according to EN 12697-24 / 2004, whose recommendation is a minimum height of the beams of 3 (three) times the maximum diameter of the aggregate. The maximum diameter of the coarse aggregate used was 2.4 cm, ie a minimum height of 7.2 cm. However, the maximum space available on the mechanical test equipment is 6.4 cm, therefore, the minimum height adopted. There were no problems with the minimum width and length required.

Figure7 Removable L-shaped mold.

Figure 8. Mix Compaction Set

Figure 9. Inserting Asphalt Mix into Mold

Figure 10. Beams ready for Fatigue Testing

In Table 1 below, the geometric characteristics of the beams produced are discriminated, the values correspond to the arithmetic means of four measurements collected in the PC and inserted in the software that performs the test.

Table 1. Geometric characteristics of the beams.

Mixture	Indication	Altura (mm)	Height (mm)	Width (mm)
RCD+CAP	1	63,8	400,0	50,0 mm
RCD+CAPSBS	2	63,9	400,0	50,0 mm

3.2.4 Ensaio de Fadiga em Quatro Pontos de Viga

The main characteristics of the four-point bending test [24] are listed:

a) The two inner and two outer supports are symmetrically opposed to the center of the specimen.

b) The test may be performed with Controlled Deformation (DC) and Controlled Stress (TC).

c) The semi-sinusoidal loads were applied to the two inner supports in the vertical direction, while the vertical position of the external supports was fixed, Figure 11.

The equipment used to perform this experiment was the Power Point BendingApparatus, manufactured by IPC Global, which is a hydraulic or pneumatic loading machine that allows to control a very specific system and allows testing of a diverse range of specimens from small metal samples. , asphalt, fibers, plastics and similar materials, up to very large components or assemblies [21].

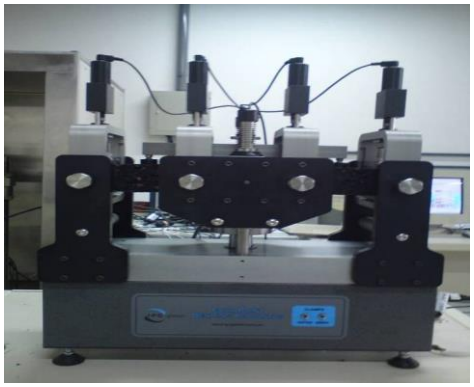


Figure 11. Four point flexion test scheme

Regarding the beam fatigue test, which was used the four-point bending equipment, the following criteria were followed:

a) Testing by controlled voltage (TC), with loading voltages of 0,3 kN, 0,7 kN and 1 kN allowed;
b) Constant test temperature of 25 ° C;
c) Test performance frequency of 10 Hz, the standard stipulates frequencies between 0.1 Hz and 50 Hz, as the frequency of 20 Hz, for example, simulates a heavy vehicle at a speed of 133 km / h on the floor. Due to this, the frequency of 10 Hz was adopted;
d) Loading range in the order of 250 µm / m;
e) Maximum number of 1,000,000 cycles;
f) Initial stiffness module calibrated in cycle number 100;
g) End of the test by obtaining complete Fatigue (rupture) or acquiring 50% of its initial stiffness modulus (stress / strain ratio).

4. Analysis and Discussion of Results

4.1 Characterization of Asphalt Binders

Table 2 lists the results of the characteristics of petroleum asphalt cements, standardized by the ANP [25]. The importance of these results is highlighted, as they directly influence the behavior of asphalt mixtures.

Table 2. Characterization of Asphalt Binders

Características	Method	Unity	Results	
			CAP 50/70	CAPSBS
Penetration	D5-06	0,1 mm	69	39,5
Softening point	D36/D36M-09	grau C	49,7	52,5
SayboltFurol Viscosity a 135 ºC	E102/E102M-09	s	283	300,78
Brookfield Viscosity a 135 ºC	D4402-06	cp	539	870
SayboltFurol Viscosity a 150 ºC	E102/E102M-09	s	140,7	149,38
Brookfield Viscosity a 150 ºC	D4402-06	cp	279,8	401,36
SayboltFurol Viscosity a 177 ºC	E102/E102M-09	s	50,8	56,97

Brookfield Viscosity a 177 ºC	D4402-06	cp	96,8	158,64
Ductility	D113- 07	cm	> 100	41,5
Flash point	D92-10	grau C	318	324
Solubility in trichlorethylene	D2042- 09	% massa	99,9	99,7
RTFOT % mass change	D2872- 04	%	0,04	0,075
RTFOT softening point increase	D36/D36M-09	grau C	7,1	9,3
RTFOT retained penetration	D5-06	%	63	27,1
Relative density 20/4 ºC	D70-09	N/A	0,998	0,994

The reduction of conventional binder penetration (CAP 50/70) is clear by adding the SBS copolymer. This result indicates increased consistency, also observed by the softening point gain (temperature required for a standard sphere to pass through a binder sample). Therefore, the increase in flow resistance is justified by the SayboltFurol and Brookfield viscosity tests. It is also emphasized the properties after aging in RTFOT greenhouse, which is observed the increase of the consistency of both asphalts, pointed by the increase in the softening point. Note that this last test is very important because it simulates the hardening of the binder in the process of machining and transport of asphalt mixtures.

4.2 Characterization of Aggregates

Listed in Table 3 and Figure 12 are the results of particle size analysis by sieving, characterization of coarse aggregates and fine, and it should be emphasized that the Portland cement presented real relative density equal to 3.16.

Figure 12 shows the particle size curve of the aggregates. It should be noted that this characteristic is one of the most important for the behavior of asphalt mixtures, influencing the stiffness, stability, workability and permanent deformation. suitable for paving, so it is necessary to verify some characteristics, whose results are presented in Table 3.

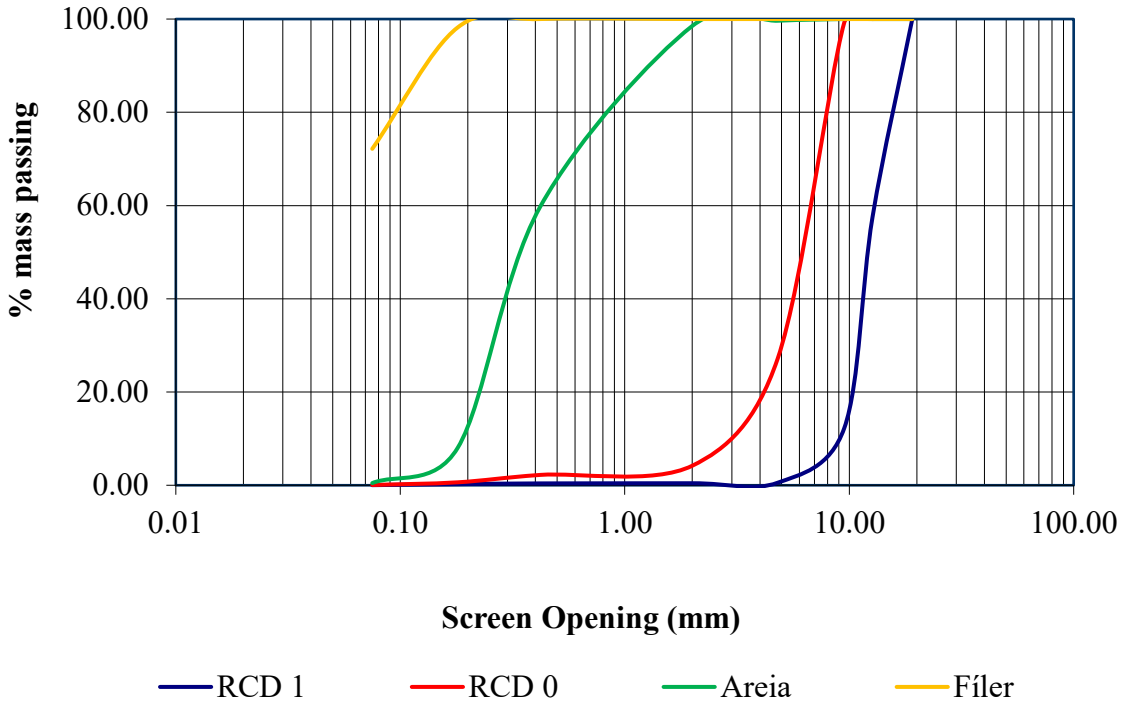


Figure 12. Aggregate Particle Size Curves

After particle size analysis, which is very important in the dosing process of an asphalt mixture, the importance of the particle shape that directly influences the workability and shear strength of the asphalt mixtures is also highlighted, that is, in general the greater the irregularity. of the larger aggregates is the interlocking of these particles in the compacted mixtures.

Table 3. Characterization of aggregates

Test	Method	RCD 1	RCD 0	Sand
Abrasion Los Angeles (%)	ME 035/98	47,34	46,81	-
Adhesiveness	ME 078	Positiva	Positiva	-
Absorption (%)	C 127 e ME 194	7,122	7,122	-
Apparently density		2,403	2,403	-
Real density		2,617	2,617	0,522
Effective density		2,165	2,165	-
Effective density (%)	D 2419	-	-	91,40
Shape Index	ABNT 6954/89	Cúbica	Cúbica	-
Loose Specific Mass (g/cm^3)	C 29	1,231	1,285	1,720
Compacted Specific Mass (g/cm^3)		1,340	1,291	1,936
Grain Specific Mass (g/cm^3)	ME 084/95	-	-	2,632

RCD 1 and RCD 0 were found to be classified as cubic, which may contribute to better performance in asphalt coatings [22]. A caliper was used to measure its dimensions (length, width and thickness) and thus obtain its classification. work on the asphalt mixture according to the granulometry obtained to form a set in it. RCD 1 and RCD 0 work on the asphalt mixture according to the particle size obtained to form a set in it. Another noteworthy feature is Abrasion Resistance, which aims to simulate the actions of transport and application of aggregates. The RCD obtained low Wear Resistance, which did not disqualify it for this work. Aiming to participate in asphalt mixtures, it is also emphasized in Table 3 the high value of Los Angeles abrasion for the RCD, extrapolating the acceptable maximum of 45%. However, for construction waste this value is acceptable, considering higher values found in the literature relative to those obtained in this research.

The high absorption of the recyclable aggregates was observed, attributing a high consumption of asphalt in the mixture, which can be explained by the sharp overall porosity found by the RCD. Large aggregates showed positive adhesiveness, which is essential, since the aggregate that does not confer this characteristic will be easily disconnected from the asphalt film, causing pavement wear, a common pathology in Manaus coatings [27].

4.3 Mineral Dosage

Based on the maximum and minimum ranges established by DNIT [19], Figure 13 presents the granulometry of the mixture, while Table 4 shows the participating aggregates and their corresponding percentages in this research.

Table 4. Aggregate mineral dosage and filler

Material	CA RCD/CAP (%)	CA RCD/CAPSBS(%)
RCD 1	30,5	30,5
RCD 0	35,0	35,0
Residual sand	31,0	31,0
Cement	3,50	3,50

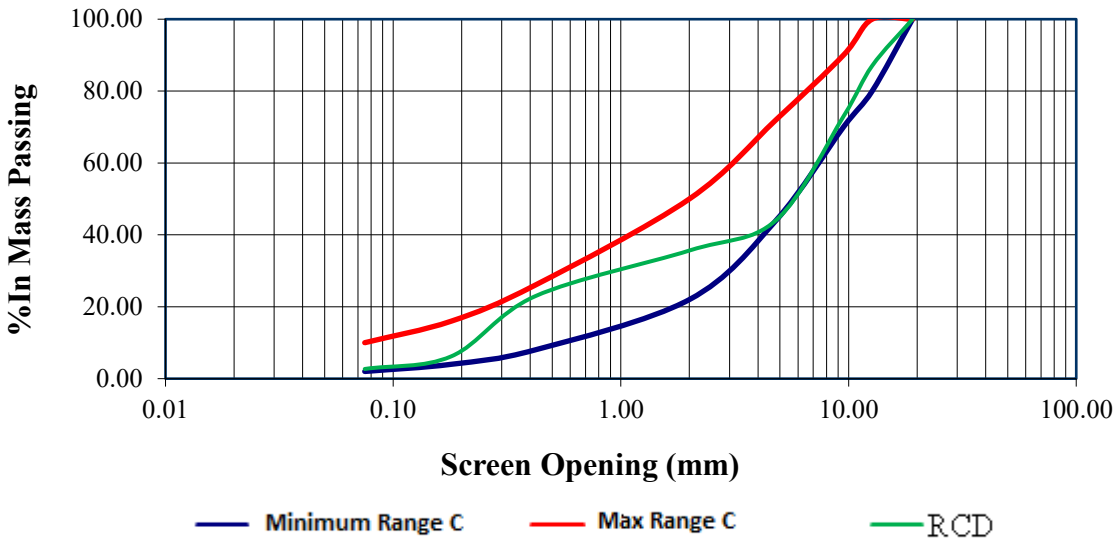


Figura 13. Enquadramento das misturas – Faixa C, Norma DNIT 031/2006-ES

4.4 Project Content

Design levels were defined by graphical process according to physical parameters and particle size analysis [19] [26]. It is noteworthy that: RCD + CAP refers to asphalt mix with traditional binder (CAP 50/70) and asphalt mix with modified SBS copolymer binder (RCD + CAPSBS).

Table 5. Mix Parameters

Mixture	Project Content de CAP (%)	Vv (%)	RBV (%)
RCD+CAP	6,91	4,00	78,40
RCD+CAPSBS	6,05	3,85	76,58

By observing the binder design content for all mixtures analyzed, there is a slight decrease in binder consumption for mixtures produced with CAPSBS compared to mixtures made with standard CAP. All Vv and RBV parameters fall within their respective standards (Table 5).

4.5 Fatigue Determination by Four Point Bending Apparatus Equipment

The fatigue test is characterized by the reduction in the strength of a material under repeated loading when compared to the resistance under application of a single load [24]. frequency, were set such that the number of cycles for the test did not last very long, over 24 hours. The initial module value is calculated at the start of the test by performing 100 cycles for its determination . Information about the Stiffness Module after the Fatigue Test is observed in the mixtures made for this research in Table 6 and Figure 14.

Table 6. Rigidity Module Results for Different Tensions

Mixture	Amplitude µm/m	Tension (kN)	Nr of Cycles	Stiffness Module (MPa)
RCD+CAP	250	0,3 kN	685.342	5.004, 67
RCD+CAPSBS			737.871	5.643,90
RCD+CAP	250	0,7 kN	498.573	5.647,23
RCD+CAPSBS			554.856	5.921,65
RCD+CAP	250	1,0 kN	239.184	6.089,51
RCD+CAPSBS			303.763	6.341,73

No specimen (beam) was tested under the same conditions as the previous one, the mix and tension were changed. Knowing that the modulus of stiffness is the relationship between stress and strain, higher stresses bring larger modules, in some cases this behavior was not observed. The composite beams with RCD (CA) were able to break clearly, observing even the ruptured coarse aggregate.

In Figure 15 it is possible to verify that with the increase of the deformation, there was a gain of the Stiffness Module, highlighting that the asphalt mixture constituted with RCD and SBS obtained the highest values of this last property, which also showed the lowest deformation values. In his work, [28] also obtained increasing linear representation, which composed asphalt mixtures that went through the aging process, whose asphalt binder was modified with recycled tire rubber.

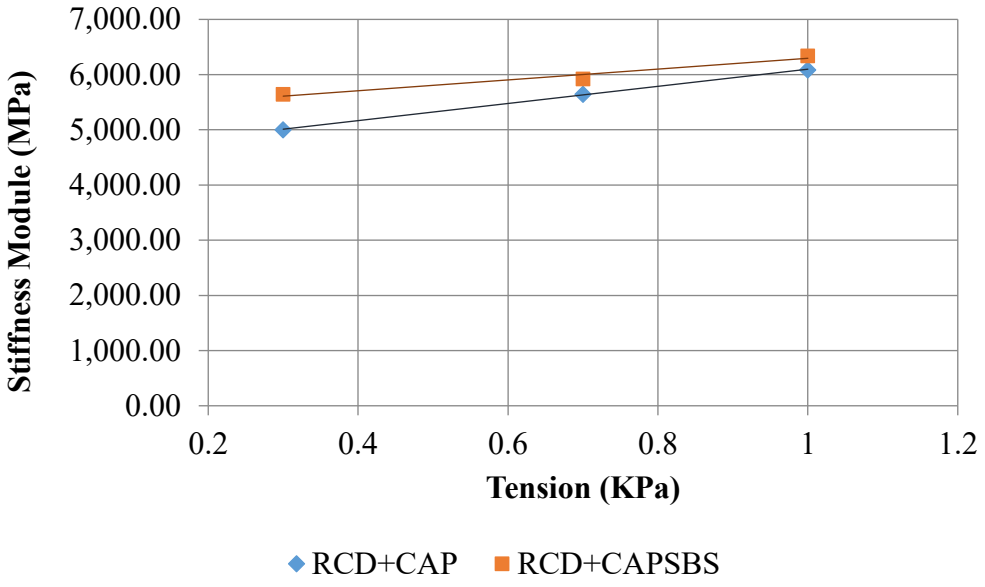


Figure 14. Rigidity x Stress Module Chart of Tested Asphalt Mixtures

The use of the SBS copolymer in the CAP provided an increase in the Stiffness Module, confirming previous studies regarding the efficiency of this particle polymer in mechanically tested asphalt composites in other parameters [17] [18]. When comparing the values presented for the mixtures with conventional PAC, it is clear that the deformations were higher than those with the modified ligand.

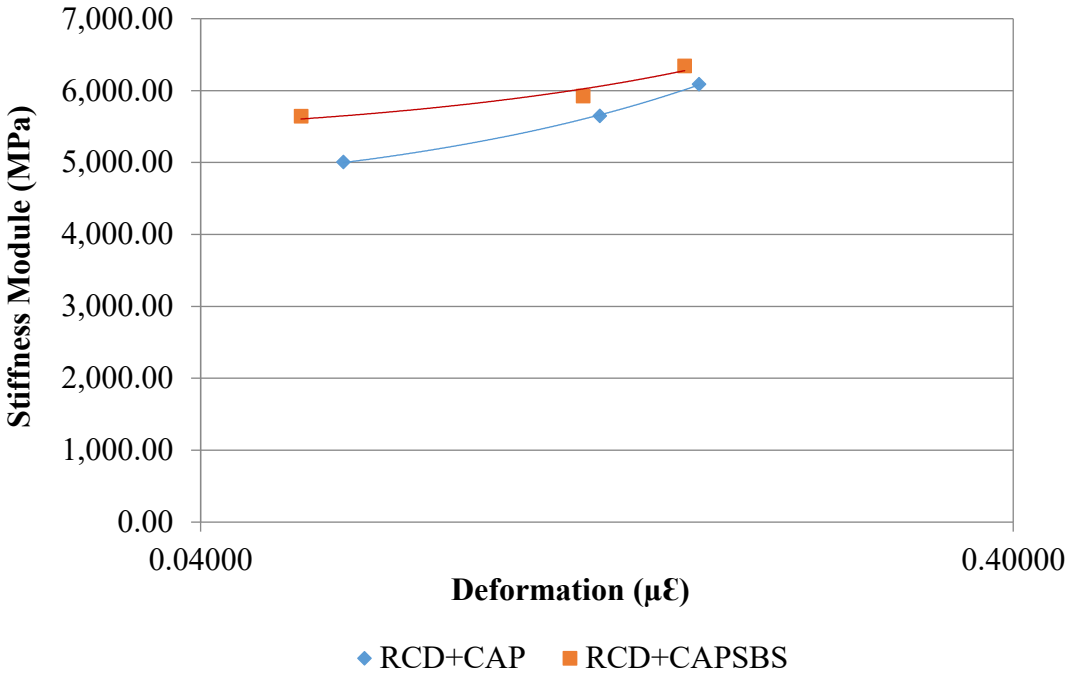


Figure 15. Stiffness vs. Deformation Module Graph of Tested Asphalt Mixtures

5 Conclusion

Aiming to contribute to the execution of alternative and viable asphalt composites for application in Manaus urban roads, specimens (beam type) were made in order to be mechanically characterized. It is understood that, with this research, we obtained:

a) Consumption savings of asphalt binder, as the 2% insertion of SBS into the CAP generated a slight decrease in its volume with the use of recycled aggregate.
b) Concerning the Fatigue Assay, there was an increase in specimen life within each type of mixture after incorporation of the SBS copolymer.
c) RCD + CAPSBS-containing mixtures had a longer Fatigue period than RCD + CAP-mixtures at all stress levels.
d) The RCD (Construction and Demolition Waste) aggregate, commonly called recycled, is an alternative to asphalt coatings used in urban roads in the city of Manaus, since it presents satisfactory results when compared to the materials commonly used in regional paving, besides comply with the prerequisites outlined by the standards.

6 References

[1] PALMA, K.A.L. *Gênese e Distribuição das Silicificações nos Paleossolos e Rochas Sedimentares Aflorantes em Manaus.* Dissertação de Mestrado no Programa de Pós-Graduação em Geociências, Instituto de Ciências Exatas, Universidade Federal do Amazonas, 2014.

[2] CRISÓSTOMO, P.H.S.; SOUZA, R.J.Q.; FERREIRA, M.R.P.; D'ANTONA, D.M.G.; FROTA, C.A.. *A Influência da Cal de Carbureto nos Parâmetros Físicos da Dosagem Marshall*. 05-026. In: 5º

Congresso de Infraestrutura de Transportes, 2010, São Paulo, SP. Anais do 5º. Congresso de Infraestrutura de Transportes. São Paulo, SP : ANDIT, 2011.

[3] CONSELHO NACIONAL DO MEIO AMBIENTE. Resolução CONAMA No. 307, de 5 de julho de 2002. Disponível em: <http://www.mma.gov.br/port/conama/res/res02/ res30702.html>. Acesso em: 30 de junho de 2012.

[4] PICANÇO, H. M; CARTAXO, E. F; PEREIRA, P. S. H; FROTA, C. A. *Refletividade, radiação solar e temperadtura em diferentes tipos de revestimentos das vias urbanas no município de Manaus (AM).* In: Congresso de Infraestruturas de Transportes, 5, São paulo, 2011, Anais... São Paulo: ANDIT, 2011.

[5] PAIVA, B.A. *Análise do Ligante Asfáltico Modificado com Poliestireno de Copos Descartáveis.* Universidade Federal Tecnológica do Paraná, 2017.

[6] SILVA, A.M. *Avaliação do Desempenho Mecânico de Misturas Asfálticas Projetadas com CAP Hima e Cap 60/85-E Aplicadas na Restauração de um Trecho da Rodovia SC-114.* Dissertação de Mestrado em Engenharia Civil, Universidade Federal de Santa Catarina, Florianópolis, 2018.

[7] BARROS, L.M. *Deformação Permanente de Misturas Asfálticas: Avaliação do Desempenho conforme critério de FlowNumber de Misturas Quentes e Mornas.* Dissertação do Mestrado em Engenharia Civil, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2017.

[8] BOEIRA, F.D., PINHEIRO, G.S., SPECHT, L.P., DRUZIAN, E.L., JUST, M.L., BABADOPULOS, F.L.A.L., NASCIMENTO, L.A.H., PEREIRA, D.S.. *Projeto e implementação de ensaio de fadiga por tração-compressão direta (uniaxial) para avaliação de dano em misturas asfálticas.* Revista Matéria, Vol. 23, Nº 3, ISSN 1517-7076, Rio de Janeiro, Outubro - 2018.

[9] SILVA, J.A.A.*Utilização do Politereftalato de Etileno (PET) em Misturas Asfálticas.*Tese de Doutorado em Engenharia de Processos, Centro de Ciências e Tecnologia, Universidade Federal de Campina Grande, 2015.

[10] LAPAV – Laboratório de Pavimentação da Escola de Engenharia. *Análise de Fadiga de Misturas Asfálticas através do Ensaio de Flexão em Viga Quatro Pontos.*Relatório Final de Pesquisa RDT - CONCEPA / ANTT. Universidade Federal do Rio Grande do Sul, Porto Alegre, 2014.

[11] FILHO, N.M. *Resíduos de Construção Civil na cidade de Londrina: Análise da Política de Gerenciamento de Resíduos da Construção Civil adotada pelo Município e Estudo de Caso utilizando uma Proposta de Reciclagem baseada na Técnica de Estabilização por Solidificação à base de Cimento Portland.* Tese de Doutorado em Arquitetura em Urbanismo da Universidade de São Paulo, São Carlos, 2015.

[12] MELO, D.M. *Estudo do Resíduo de Construção e Demolição oriundo do Município de Manaus-AM em Misturas Asfálticas*. Dissertação de Mestrado. Universidade Federal do Amazonas - UFAM. 238 pg. 2010.

[13] RUTZEN, D. *Agregados reciclados para uso em pavimentação: efeitos da adição de cal em resíduo de construção e demolição.* Universidade Federal do Rio Grande do Sul, Porto Alegre, 2015.

[14] FROTA, C.A.; NUNES, F.R.G.; SANTOS, M.G.R.; CANTANHEDE, B.P. *Utilização de Agregados de Resíduos da Construção Civil como Substituto do Agregado Natural para Estabilização do Solo*

*Argiloso Superficial de Manaus.*In: Congresso Brasileiro de Geotecnia Ambiental, V, 2003, Porto Alegre. Anais (CD-ROM), Rio de Janeiro: ABMS, 2003.

[15] FROTA, C.A.; NUNES, F.R.G.; MENTA, C.O. *Utilização de Entulho Reciclado em Misturas Asfálticas para a Região de Manaus-Am.*In: Reunião de Pavimentação Urbana, 12, 2003, Aracaju. Anais (CD-ROM). Rio de Janeiro: ABPv, 2003.

[16] FROTA, C.A.; ALENCAR, C.L.S.; SILVA, C.P.L. *Influência do Tipo de Agregado na Qualidade Técnica de Misturas Asfálticas.* In: Reunião Anual de Pavimentação, 35, 2004, Rio de Janeiro. Anais (CD-ROM). Rio de Janeiro: ABPv, 2004.

[17] BERTOLDO, R. A. ; SOUZA, R. J. Q. ; CUNHA, T. M. F. ; FROTA, C. A.. *Influência do polímero SBS na resistência à tração de misturas asfálticas utilizando areia de resíduos de construção e areia residual para o Município de Manaus-Am*. 04-040. In: 4o Congresso de Infraestrutura de Transportes, 2010, São Paulo, SP. Anais do 4o. Congresso de Infraestrutura de Transportes. São Paulo, SP.

[18] OLIVEIRA, B. C.; BERTOLDO, R. A.; SOUZA, R. J. Q.; GUIMARAES, D. M. D.; FROTA, C. A.. *Utilização de resíduos de construção (RCD) e ligante modificado com SBS em misturas asfálticas para a cidade de Manaus-Am*. In: 40a. Reunião Anual de Pavimentação, 2010, Rio de Janeiro, RJ. Anais da 40a. Reunião Anual de Pavimentação. Rio de Janeiro, RJ : ABPV, 2010.

[19] DNIT – Departamento Nacional de Infraestrutura dos Transportes. 031/06-ES - *Pavimentos flexíveis: concreto asfáltico*. Rio de Janeiro, 2006.

_____. *Pavimentação Asfáltica: Ensaio de Fadiga por Compressão Diametral a Tensão Conrolada*. Rio de Janeiro, 2017.

[20] BERNUCCI, L.B.; MOTTA, L.M.G.; CERATTI, J.A.P.; SOARES, J.B. *Pavimentação Asfáltica: formação básica para engenheiros.* 1ª ed. Rio de Janeiro: ABEDA, 2008.

[21] CRISÓSTOMO, P.H.S.; CAVALCANTE, D.G.; SOUZA, R.J.Q.; VALENÇA, P.M.A.; FROTA, C.A.. *Análise de Vida de Fadiga em Viga utilizando Misturas Asfálticas Confeccionadas com Resíduo de Construção e Demolição e Ligante Asfáltico Modificado por Polímero*. In: 6º Congresso de Infraestrutura de Transportes, 2012, São Paulo, SP. Anais do 6º. Congresso de Infraestrutura de Transportes. São Paulo, SP : ANDIT, 2012.

[22] ABNT NBR 6954/1989 *Agregado graúdo - Determinação do índice de forma pelo método do paquímetro.*

[23] ASTM – American Society of Testing and Materials. C29 / C29M – 09 – *Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.*

_____. D 5- *Standard test method for penetration of bituminous materials*. USA, 1997.

_____. D 36 - *Softening point of bitumen: ring-and-ball apparatus*. USA, 1995.

_____. D70 - 091 *Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)*.

_____. D 113- *Ductility of bituminous materials.* USA, 1999.

_____. D 2041-00: *Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures*. American Association of State Highway and Transportation Officials. Philadelphia, Pennsylvania, 2000.

_____. D2419 - 09 *Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate*.

_____. D 2872 - *Effect of heat and air on a moving film of asphalt (rolling thin-film oven test)*. USA, 1997.

_____. D 4402 - *Viscosity determination of asphalt at elevated temperatures using a rotational viscometer.* USA, 2002.

_____.E 206-72: *Standard Definitions of Terms Relating to Fatigue Testing and Statistical Analysis of Fatigue Data.*USA, 1979.

[24] EN 12697-24, 2004. *"Bituminous mixtures. Test methods for hot mix asphalt, Part 24: Resistance to fatigue".*European Committee for Standardization, Brussels.

[25] AGÊNCIA NACIONAL DO PETRÓLEO, GÁS NATURAL E BIOCOMBUSTÍVEIS (2005). Resolução No. 19, de 11 de julho de 2005. ANP, Rio de Janeiro, 2005.

[26] DNER - Departamento Nacional de Estradas de Rodagem. "DNER ME 043/95: *Misturas betuminosas a quente - Ensaio Marshall.*" Rio de Janeiro, 1995.

_____. EM 367/97: *Material de enchimento para misturas betuminosas*. Rio de Janeiro, 1997.

_____. ME 004/94: *Material Betuminoso: determinação da viscosidade Saybolt-Furol a alta temperatura método da película delgada.* Rio de Janeiro, 1994.

_____. ME 035-98 - *Agregado graúdo: determinação da abrasão Los Angeles*, Rio de Janeiro, 1998.

_____. ME 078/94 - *Agregado graúdo - adesividade a ligante betuminoso,* Rio de Janeiro, 1994.

_____. ME 083/98 - *Agregado – analise granulométrica,* Rio de Janeiro. 1998.

_____. ME 085/94: *Material finamente pulverizado: Determinação da massa específica real.* Rio de Janeiro, 1994.

[27] CAVALCANTE, D.G., CRISÓSTOMO, P.H.S., SILVA, L.C.P., SOUZA, R.J.Q., GUIMARÃES, D.M.D., FROTA, C.A. *Levantamento Visual das Patologias na cidade de Manaus-AM.* Revista Teoria e Prática da Engenharia Civil, Brasil. 2012.

[28] ZATARIN, A. P. M. *Viabilidade da Pavimentação com Asfalto-Borracha*. Revista Gestão & Sustentabilidade Ambiental, v. 5, n. 2, p. 649-674, 2016.

[29] CABRAL, A. E. B. *Modelagem de propriedades mecânicas e de durabilidades de concretos produzidos com agregados reciclados, considerando-se a variabilidade da composição do RCD*. 2007. 280p. Tese (Doutorado em Ciências da Engenharia Ambiental) – Escola de Engenharia de São Carlos, São Carlos.

Application of MASP to Paper Waste Control in a Manaus X Institution

Dalyla Mendes de Rezende (dalylamendes.ufam@gmail.com)
Jonas Gomes da Silva (jgsilva@ufam.edu.br)
Eureka Laboratory
Department of Industrial Engineering, Federal University of Amazon (UFAM)
Manaus, Amazon, Brazil

David Barbosa de Alencar (david002870@hotmail.com)
Instituto de Tecnologia e Educação Galileo da Amazônia (ITEGAM)
Manaus, Amazon, Brazil

Abstract

The paper analyzes the reduction of waste of A4 paper used in prints in the finance section of a department of Institution X. The research is a case study in which the collection and analysis of data follow the steps of the Method Analysis and Problem Solving (MASP) in conjunction with the tools: Brainstorming, Check Sheet, Cause and Effect Diagram, Pareto Chart and 5W1H. After analyzing the data, it is concluded that operator error, faulty printer tray and sudden change of document content account for 77.52% of paper waste in the department. In the end, for each of these cases, it is proposed an action plan that together with other proposals, total seven actions of improvements for the managers of the department in question.

Keywords: Reduction of Waste; MASP; PDCA;

1. Introduction

Waste reduction is a common goal for all organizations and adding this philosophy process in the company's routine is relevant. Overproduction, downtime, transportation waste from the processing itself and producing defective products are some examples. Eliminating these wastes increases the operations' efficiency by a wide margin [1]. The use of quality tools for problem-solving such as these are implemented in all types of companies and organizations.

According to [2], the Problem Analysis and Solution Method (MASP) is an excellent problem analysis tool in which problems are prioritized and solved. This method consists of taking corrective and preventive actions to eliminate not only the problems, but also the causes of nonconformities, and is divided into eight steps: Problem Identification, Observation, Analysis, Action Plan, Action, Verification, Standardization and Conclusion [3].

The Institution X, thus designated in respect of the information security policy, is an Organization that stands out on the national scene for its performance in the Amazon region in support of numerous federal, state and municipal agencies. Its organizational structure has a several departments subdivided into sections. For this study was chosen the finance section of one of the departments of the organization, which is responsible for managing the burdens arising from missions carried out by the employees of this department

outside the headquarters, Manaus, capital of Amazon, Brazil.

This department has a printer located in the finance section and is connected to the internal computer network, receiving print orders from five computers. Most of the print volume is for the preparation of Administrative Management Processes (PAG) for each employee's financial rights, and a smaller portion is for general document prints.

The printer is available through a contract signed between this institution and a local company, which establishes a franchise of 48,000 annual impressions. The warehouse supplies A4 on demand.

It was then realized that the paper franchise is overestimated, because at the end of 12 months does not reach 48,000 impressions, which makes the analysis of waste impracticable, masking it within the franchise. Another relevant factor is the absence of an adequate study of print demand, as well as the monitoring and control of these prints, which are often unnecessary, leading to the excessive consumption of A4 paper. Thus, it is necessary to find out the root causes of this waste, as well as adopt measures that can prevent its recurrence to generate savings at the end of each month and consequently enable a balanced contractual renewal for each department.

This research is relevant for the following reasons:

a) The more paper is produced, the more trees are cut down, the more water is spent in the production process and more waste and landfill space are taken up. According to [4], an institution that encourages conscious consumption, paper production is among the most water-consuming industrial processes. The production of one kilogram of paper consumes 540 liters of water, and for each ton of paper 12 trees are felled;

b) Avoiding paper waste can save the organization significant financial resources; and

c) Given the search for knowledge through research and the application of a method for solving a problem little known in the Federal Organs, this work is relevant to the academic environment.

Thus, the main objective of this paper is to analyze the reduction of A4 paper waste in the finance section of an Institution X department, by applying the first four steps of the Problem Analysis and Solution Method (MASP) together with other basic quality tools.

2. Theoretical Referential

2.1 Examples of waste

We live in a society used to waste, from the waste of energy resources such as water, electricity, and gas, to the unfulfilled use of what we buy to eat [5].

Wastewater is a very serious social and environmental problem, as only 3% of all water available on Earth is fit for consumption. The idea of wasting water is not only associated with household habits, such as indiscriminate use of the shower and the poorly closed tap, but this also occurs largely in agriculture and industry [6].

Electricity loss and waste rates in Brazil correspond to 40 million Kilowatts. Industries, households, and commerce waste 22 million Kilo Watts; Power utilities due to distribution problems and technical losses account for 18 million Kilo Watts [7].

Natural gas is wasted by burning it. Among the many reasons for natural gas flaring in Brazil, we can

mention the following: problems in the compression systems, scheduled maintenance, commissioning of new production units and long-term testing [8].

When a portion of food is wasted, all the resources involved in the process, such as water, land, and energy, are also wasted. Besides, the treatment of food waste also has a significant impact on the environment, as landfilling of waste generates methane, a potent greenhouse gas [9].

2.2 The PDCA Cycle

Walter A. Shewhart developed PDCA as a statistical process control cycle that can be continuously repeated over any process or problem originally in the 1930s at Bell Laboratories in the USA. However, the method only popularized in the 1950s by quality expert W. E. Deming, becoming known worldwide when applying it to quality concepts in works developed in Japan [10].

The PDCA (Plan - Do - Check - Action) cycle is a method that aims to control and achieve effective and reliable results in the activities of an organization, being an efficient way to present an improvement in the process [11]. The ideas proposed by this method were used in the process of quality improvement on production lines, but its application was soon expanded to improve team-based collaboration [12].

The first step of the PDCA cycle is planning where objectives are defined. In the second step, data is collected and problems are recognized. In the third step, the problems are examined and analyzed. Finally, in the next step, the failures in the processes to eliminate the problems to reach the objectives will be observed, otherwise, they should be improved and the steps restarted [13].

At PDCA, once an improvement is achieved, it becomes the standard to be challenged with new plans for further improvement. The completion of the cycle will flow at the beginning of the next cycle, and so on [14]. The results of the use of the PDCA cycle in recent times are quite satisfactory and have proven its usefulness in budget cuts by assisting in the decision-making process, since discussions are based on objectivity, ie, less about assumptions and more about objective numbers [15].

2.3 MASP

2.3.1 MASP Definitions

The Problem Analysis and Solution Method (MASP) is the name given in Brazil by QC-Story, the Japanese problem-solving method [16]. It is a systematic way of using facts and data to solve problems. The fundamental difference between structured problem solving and other methods is root cause determination because if it is not eliminated the problem will occur again, causing loss of resources used in its investigation [17].

QC-Story originated from the Komatsu factory in Japan as a tool for easier reporting. As more groups began writing their reports in the format used by QC-Story, it was noted that the procedures served as an excellent guideline for their activities, and through it, people would be able to deliver better reports and get better results. Thus, QC-Story was then adopted as a method of problem-solving [18].

The basis of QC Story is two: PDCA as a concept and scientific methodology as a philosophy. Decisions that are often made based on common sense in QC-Story and MASP are based on facts and data, thus demonstrating the great importance of this method [19]. Also, MASP is based on obtaining data that justifies or proves facts previously raised and that are proven to cause problems. Some quality tooling

techniques are used as deployment aids during their deployment, namely: Stratification, Verification Sheet, Pareto Chart, Cause, and Effect Diagram, Brainstorming, and 5W1H [2].

2.3.2 MASP Steps

According to [19] the eight steps of MASP are as follows:

1) Problem identification: Clearly define the problem and recognize its importance; through the survey of its history and its consequences;

2) Note: Investigate the specific characteristics of the problem with a broad view and from various points of view by dividing the problem into smaller parts that are easier to solve;

3) Analysis: Find out the root causes, once identified ensure effectiveness in solving the problem, avoiding waste of resources;

4) Action Plan: Design a plan to block the root causes;

5) Action: Block the root causes, aiming the reappearance of the problem;

6) Verification: Verify if the block was effective;

7) Standardization: Avoid the reappearance of the problem;

8) Conclusion: Review the entire problem-solving process and record it for future work.

For better understanding, Chart 1 demonstrates MASP distributed within the PDCA.

Cycle	MASP Steps	Objective
P	**Problem Identification**	Clearly define the problem and recognize its importance
	Note	Investigate the specific characteristics of the problem with a broad and multi-point view
	Analyze	Discover the root causes
	Action plan	Design a plan to block the root causes
D	**Action**	Block the root causes
C	**Verification**	Check if the lock was effective
A	**Standardization**	Prevent against reappearance of the problem
	Conclusion	Recap the entire problem solving process for future work

Chart 1 - MASP steps and correlation with PDCA cycle

Source: Adapted from [2]

With the MASP steps defined, it is important to emphasize that quality tools act as the resource to be used in the method, act as tools for collecting, processing and arranging the information. What solves the problems is not the tools but the method [20].

2.2.3 MASP Application Cases

MASP is a scientific and effective solving-problems tool. Its use provides organizations with a management process focused on corrective and preventive actions to detect problems and propose actions focusing on continuous improvement [21].

Below is the cases found in articles about the use of MASP.

a) Case Study of the Application of MASP in a Paper Industry: MASP reduced whole losses in a paper mill, as these directly affect productivity. The application of MASP in this work made it possible to solve the problem through simple actions without costing the company, generating a reduction in whole losses in the first month of implementation [22].

b) Process Management and Improvement in a Public Pharmaceutical Industry: Drug Development Project Management Case Study: This research aimed to clarify the causes of the large number of redevelopment projects of a public pharmaceutical industry in Rio de Janeiro, as well as how to propose corrective actions by applying MASP. The main causes of the problems raised were found and four actions were traced using the 5W1H tool, aiming at the correction of the problems and the consequent reduction of the recurrence of redevelopments [23].

c) Implementation of Problem Analysis and Solution (MASP) Methodology for Loss Reduction in Manufacturing Companies: The MASP methodology was implemented in a Lavras - MG manufacturing industry, which produces irrigation machines, whose problem was the high number of defects parts from its suppliers. With the results found, it was noticed the need for supplier control which implied the installation of a system that verified the nonconformities of the parts. With the application of MASP, it was possible to observe a reduction in the rate of defective or out of specification parts, thus reducing the production lead-time of this company [24].

d) Application of the methodology of analysis and problem-solving - MASP in the logistics of a large retail chain: With the aid of the MASP tool, 11 problems were identified in the logistics of a Hypermarket belonging to a Large Retail Network, located in João Pessoa-PB. The most relevant problem is the excess inventory, treated through the eight stages of MASP, with the help of other quality tools already established in the specialized literature [25].

3. Data Collection and Analysis Methodology

The development of this research is exploratory, which according to [26] occurs when there is a few accumulated and systematized knowledge. In this type of research, the problem in question gains clarity through interviews with experienced people and bibliographic surveys [27].

The method used was the case study, which consists of an in-depth study of one or a few objects in a broad and detailed manner [27].

The location chosen for this research was the finance section of Institution X, composed of eight employees. The research steps carried out from March to June 2018 (Chart 2) are described bellow:

a) Bibliographic survey: all the foundations for MASP application were reached through this survey, which gathered ideas and methods from several authors found in scientific articles and books;

b) Problem identification:

b1) for the first stage of MASP, a questionnaire consisting of five questions was applied. Questions were elaborated that sought to identify the main problems existing in the study place, as presented in Chart 3;

b2) through a spreadsheet provided by the contract inspector, data regarding actual print consumption as well as costs between May 2017 and April 2018 were collected;

Steps	March	April	May	June
Bibliographic research	19	13	-	-
Identification of problems	-	16 - 18	-	-
Observation	-	23 - 25	-	-
Analysis	-	27	-	6
Action planning	-	-	-	7 – 12
End of research	-	-	-	20 - 25

Chart 2 - Research Steps

Source: Own elaboration

1.	What are the main problems in the finance section?
2.	Since when do problems occur?
3.	How often do they occur? Sort By: D – Daily; W – Weekly; M - Monthly
4.	Have you heard of the Analysis and Problem Solving Methodology - MASP?

Chart 3 - Questionnaire applied to collaborators

Source: Own elaboration

c) Observation of the problem:

c1) observation of the most relevant problem in loco. The conditions under which the problem occurs were ascertained and their specific characteristics were raised through the 5W1H;

c2) Figure 1 represents the data collected in the second part of the problem identification step;

d) Problem analysis:

d1) a brainstorming was performed on April 27 with the eight collaborators of this study, to survey the variables that influence the problem. An Ishikawa diagram was created to verify the causes;

d2) the causes were described for better understanding;

d3) a Verification Sheet was prepared to quantify the frequency of occurrence of the causes identified in the Ishikawa Diagram over a month. The people involved in this process were instructed in completing the form correctly and emphasized the importance and purpose of data collection;

d4) with the data collected from the verification sheet, the use of Pareto Chart was admitted, whose principle says that 20% of vital causes are responsible for 80% of problems in an organization;

e) Action planning: the action plan was prepared using the 5W1H tool to block the main causes of paper waste, identified in the previous step. The eight employees were involved through a Brainstorming held on June 8, at which time the actions to be taken, the responsible, the deadline and the place where it would be applied were decided;

f) Conclusion of the research: after applying the first four stages of the MASP, the research was completed, highlighting the main lessons learned, suggestions for improvements, limitations of the study and recommendations for future work.

It is noteworthy that this research used spreadsheets and text editor.

4. Results and discussions

4.1 Basic section profile

The finance section has eight male employees, six of them aged 25 to 30 and two aged 50 to 55. All employees are career-oriented, being the two with the largest age in the process of transfer to retirement.

4.2 Problem Identification

As a result of question 1 of the questionnaire applied to the research collaborators, which dealt with the main problems existing in the finance section, there were a total of eight problems (Figure 1).

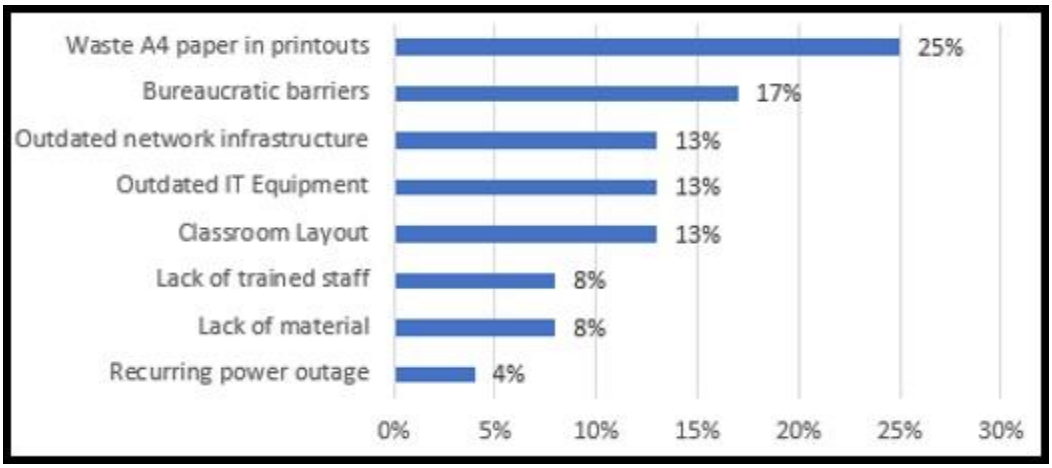


Figure 1 - Problems identified in the investigated department

Source: Own elaboration

As shown by Figure 1, Waste A4 paper used in printing is the main problem point out by 25% of employee opinions. Another important information obtained from the application of the questionnaire is that this problem occurs daily. Thus, the waste of A4 paper used in printing was chosen as the most relevant problem to be addressed by MASP. Other problems identified were bureaucratic barriers (17%), outdated network infrastructure (13%), outdated IT equipment (13%), classroom layout (13%), lack of trained staff (8%), etc.

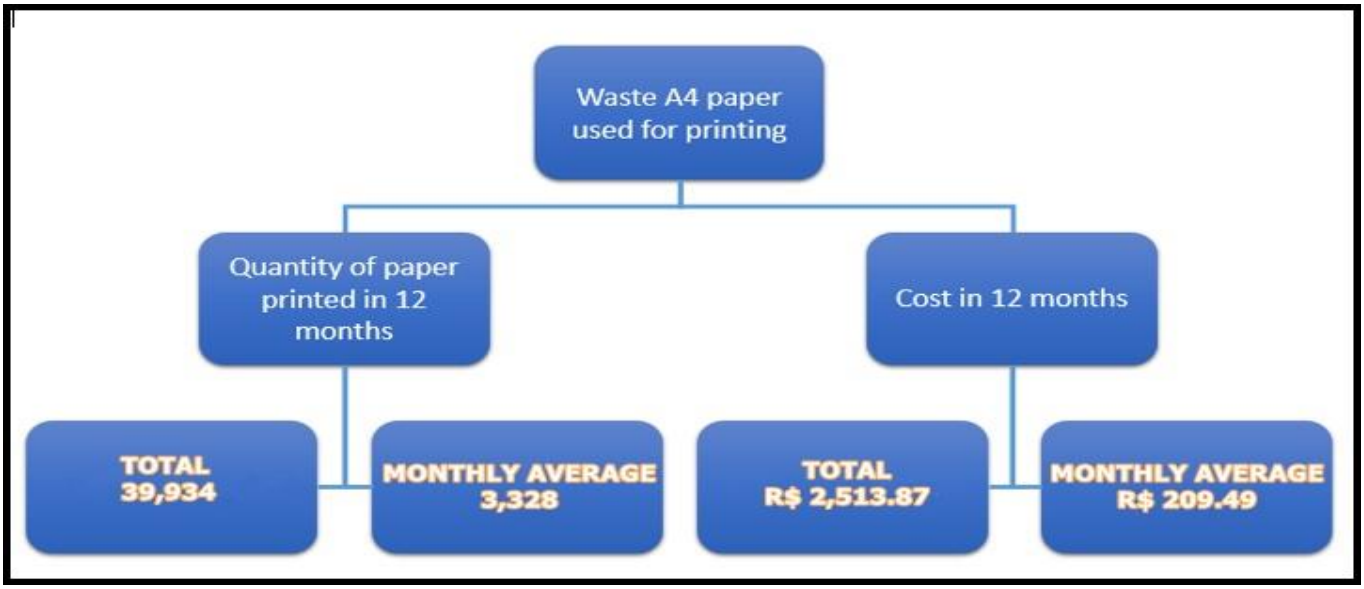


Figure 2 - Number of impressions and costs in one printer (May 2017 to April 2018)

Source: Own authorship

Figure 2 shows tabulated print quantity and cost one of the 50 printers contracted by the institution. The data indicate that in 12 months (from May 2017 to April 2018), the department used only 39,934 impressions of the 48,000 contracted. As this is an annual service contract, the value of the contract is not changed over the 12 months, even when the impressions are not used in full.

The cost (in R$) shown in Figure 2 is the sum of the amount paid for the printer contract and the paper supplied by the warehouse, as the print contract does not include the supply of A4 paper.

5W1H	Question	Answers obtained to characterize the problem
What?	What is the problem?	Waste A4 paper used for printing.
Why?	Why does it occur?	High number of unnecessary printouts, leading to excessive A4 paper consumption.
Where?	Where is it?	On the printer located in the finance section of a department of Institution X.
Who?	Who are the stakeholders?	Military in the finance section.
When?	When does it occur?	It occurs during office hours, in the morning and afternoon shifts.
How?	How it happens?	Lack of a demand study and enforcement control of the number of impressions.

Chart 4 - Problem characterization by using 5W1H

Source: Own elaboration

4.3 Observation of problems

The conditions under which the problem occurs and its specific characteristics raised through 5W1H are presented in Chart 4 and Figure 3 shows the relationship between the accumulated average monthly deductible (by franchise) and the accumulated real impression consumption between May 2017 and April 2018.

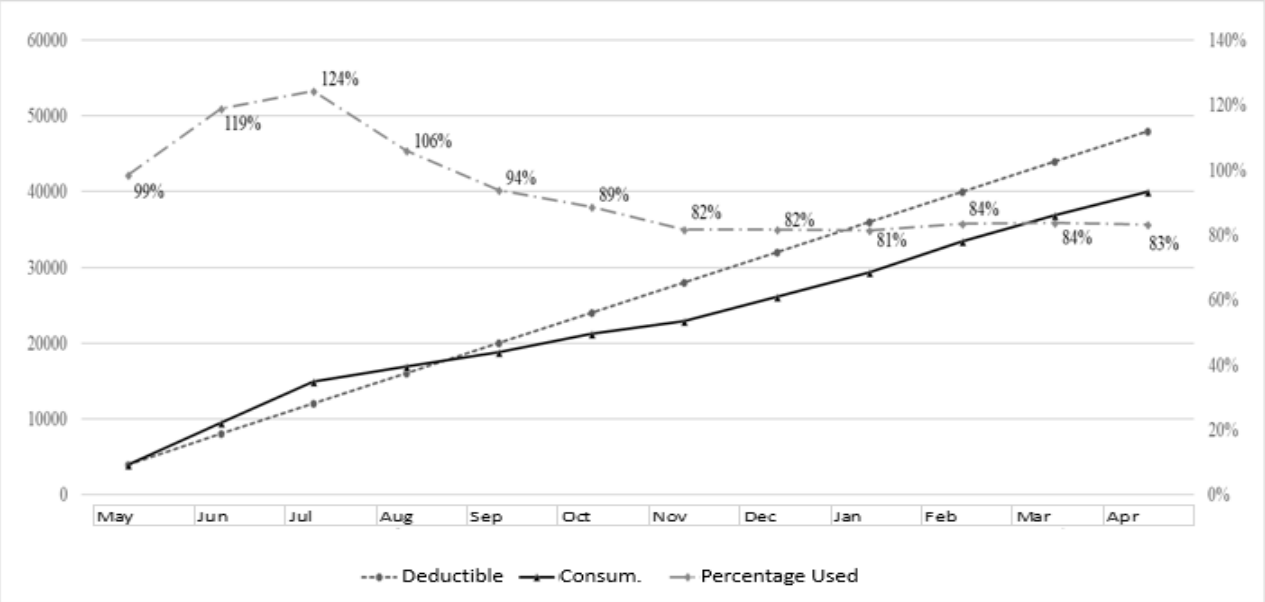


Figure 3 - Cumulative average monthly franchise and cumulative real impression consumption

Source: Own Preparation

Since the annual deductible by the franchise is 48,000 impressions, so the monthly average is 4,000. In Figure 3, the dotted line refers to this monthly average accumulated each month (Deductible), the continuous line refers to the actual accumulated consumption and the dash-dotted line refers to the percentage used, that is, the relationship between the accumulated actual consumption and the accumulated average monthly deductible.

It is noted that over the course of 12 months, 83% of total contracted impressions were used, it means 39,934 of the 48,000 impressions. In monetary terms, the unused resource was R$ 291.26 out of the R$ 1,733.28 paid annually. As a result, the contracted printing franchise is overestimated, and it covers both print demand and waste. It is noteworthy that this study is limited to only one printer out of 50 hired by Institution X.

4.4 Cause Analysis

After Brainstorming process with collaborators, a Cause and Effect Diagram (Figure 4) was constructed assuming that the only way to solve a problem is to know its causes well. Around eight causes of the problem were identified and described in Chart 5 for a better understanding,

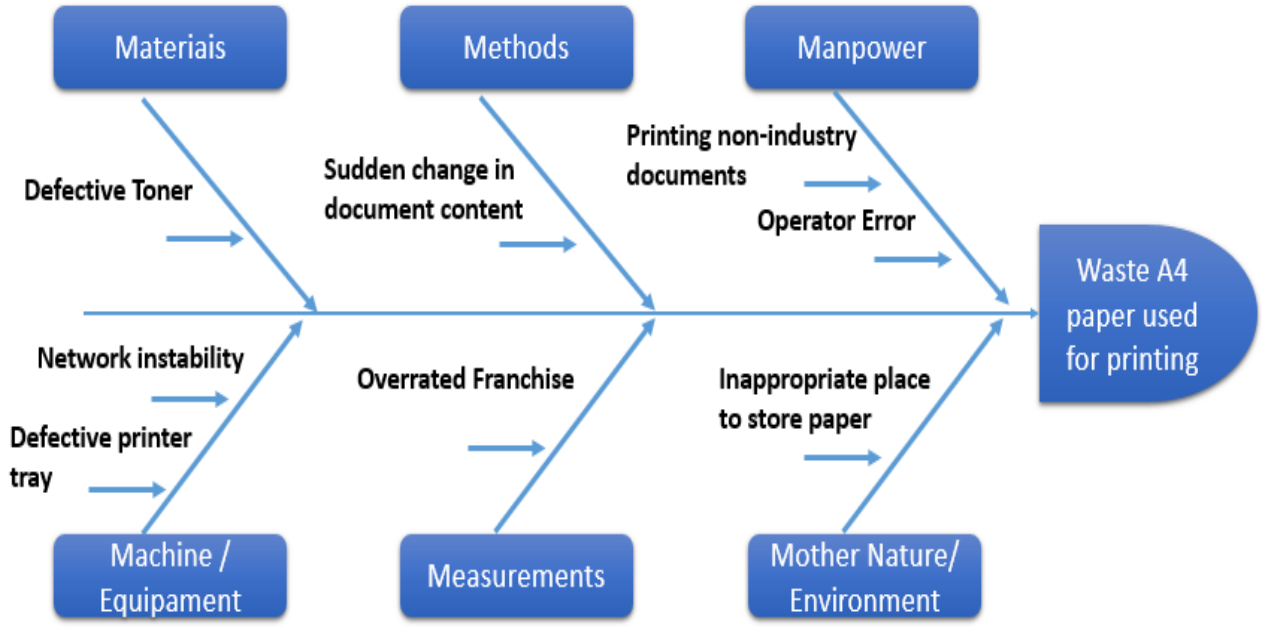


Figure 4 - Cause and Effect Diagram on A4 Paper Waste
Source: Own Preparation, Adapted from [21]

With the causes defined and described, the employees filled out the Verification Sheet to quantify their frequency of occurrence for 1 month. Chart 6 shows the Verification Sheet template delivered to employees. Then, the data regarding the frequency of occurrence of paper waste causes were verified, making clearer the relationship between the causes and the problem studied.

To find out the priority causes to be treated, it was allowed to use the Pareto Chart. Figure 5 shows the cumulative frequency and relative frequency for each cause analyzed, where those with the highest score should be treated as a priority. This makes clear the three vital causes of paper waste: operator error,

defective printer tray, and sudden change in the document content. These account for 77.52% of paper waste and if resolved, much of the problem will be effectively eliminated. The other four cases represent 22.49% of the problem and are therefore considered trivial.

Cause	Description
Operator Error	Inexperience and inattention when commanding an impression. Due to the numerous documents with varying formatting, the layout needs to be adjusted in advance, which is sometimes overlooked and new printing is required.
Instability in the internal computer network	Makes the printer unavailable by making print commands "queue". Operators send more print commands as there is no clear indication of the offline printer. When the network returns to normal there are several repeated prints, and these copies are rendered unusable.
Defective Toners	They cause scratches and smudges on prints.
Inadequate place to pack paper reams	The reams of paper are packed in a wooden cabinet that shows wear, with an incidence of moisture and mold, causing roughness, stains and consequently the paper waste. Besides, printer operation is impaired when receiving a wet paper.
Defective printer tray	Wrinkles the paper inside the printer.
Printing of documents unrelated to the department.	There is no effective way to control impressions, and it is common to see personal printed material such as copies of school documentation or work.
Sudden change of document content.	The same multi-page document printed more than once due to changes in content, caused by bureaucratic and/or administrative adjustments.
Overrated Franchise	There is no effective demand for study.

Chart 5 - Description of the main causes of paper waste

Source: Own authorship

Check sheet	
Date:	
Causes	**Frequency**
Operator error	
Network instability	
Defective Toner	
Inappropriate place to store paper	
Defective printer tray	
Printing non-departmental documents	
Sudden change of document content	

Chart 6 - Verification Sheet

Source: Own Preparation

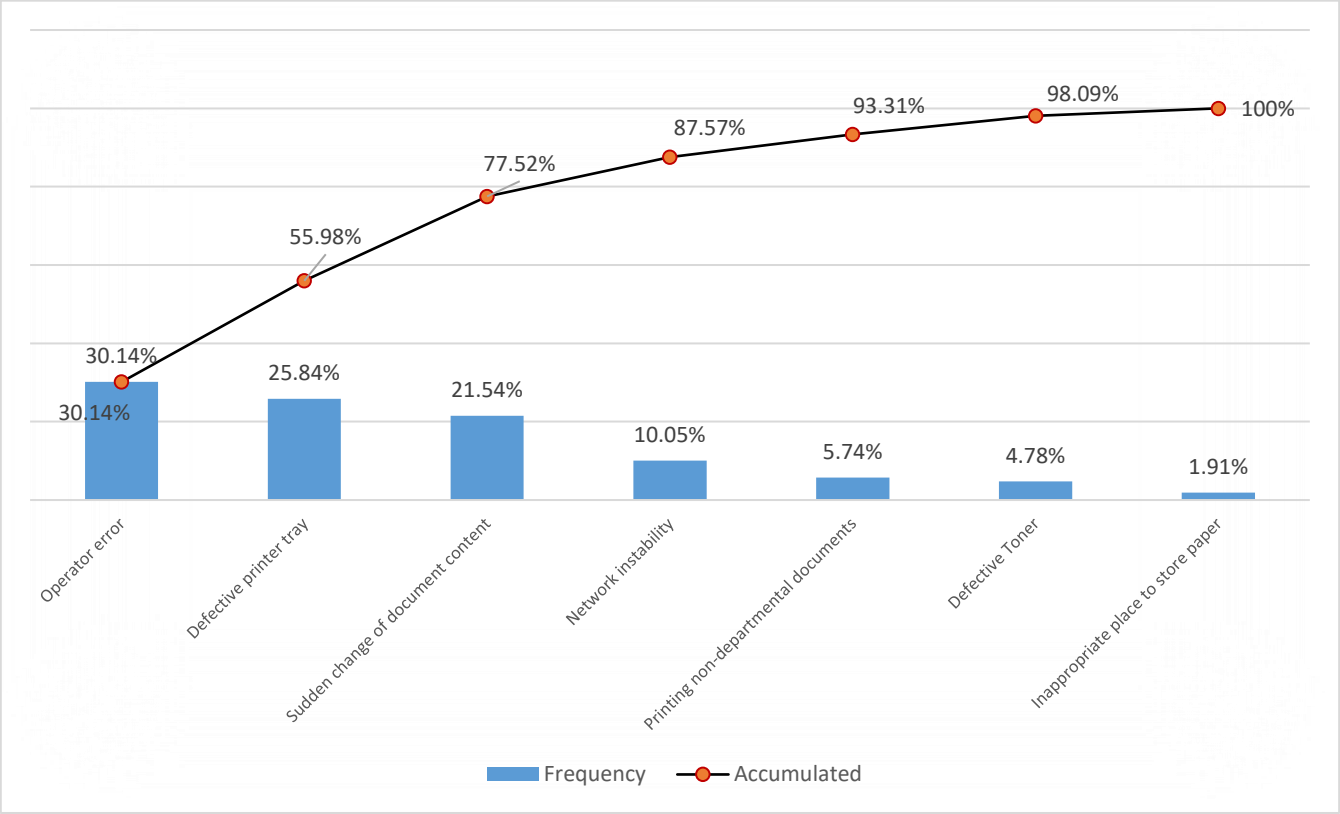


Figure 5 - Analysis of the causes of paper waste A4

Source: Own Preparation

4.5 Action Plan

The next step was to build with the employees an action plan for each cause selected as priority. Charts 6, 7 and 8 were prepared using the 5W1H tool for the three vital causes. This step completes the entire MASP planning process, which configures phase P of the PDCA cycle.

Question	Actions to minimize operator error
What should be done?	Make operators aware of the importance of avoiding paper waste in printouts by presenting a standard procedure for performing each print correctly.
Why is it necessary to do?	It is the most relevant cause.
Where should it be done?	In the department auditorium and the finance section.
Who are responsible?	Employees of the finance section.
When should it be done?	July 2018.
How will it be done?	Lectures and instructions for correct printing procedures.

Chart 6 - 5W1H to minimize operator error.

Source: Own elaboration

Question	Actions for Defective Printer Tray
What should be done?	Perform preventive and corrective maintenance on the printer within the specifications of the manual. Make the obligation on the printing contract stated by the contractor.
Why is it necessary to do?	Printing failures due to printer malfunctions affect the finance section's work, making the printer unavailable indefinitely.
Where should it be done?	In the printer of the finance section.
Who are responsible?	Contract supervisor and contractor.
When should it be done?	July 2018.
How will it be done?	Closer contact of the finance section with the contract supervisor who will request the presence of a company representative for proper maintenance, as well as assisting in drafting a future contract.

Chart 7 - 5W1H to minimize waste from the defective printer tray.

Source: Own elaboration

Question	Actions for the sudden change in the content of the documents.
What should be done?	Create standard templates for the documents that are most in the section, restricting changes to the document content only.
Why is it necessary to do?	Each operator makes documents individually, both in formatting and textual body.
Where should it be done?	Finance section
Who are responsible?	Employees of the finance section.
When should it be done?	July 2018
How will it be done?	Meeting to adjust and standardize all documents, as well as inform the other sections of the department about the new standards.

Chart 8 - 5W1H to minimize waste due to sudden change in document content.

Source: Own elaboration

5. Conclusion

The paper analyzes the reduction of A4 paper waste in the finance section of an Institution X department by applying the first four steps of the Problem Analysis and Solution Method (MASP) in conjunction with other basic quality tools.

When it comes to the relationship between MASP and PDCA, it is worth mentioning the importance of step P of this cycle, which is related to the first four stages of MASP developed in this study. This allows the identification of the problem in the study place and better clarity on the actions to be taken to solve it.

The main causes of waste A4 paper used in printing were discovered through the Pareto chart since only with data collection it is not possible to identify the bottleneck. Using the 5W1H tool countermeasures have been developed to minimize the problem to eliminate the three vital causes: operator error, defective printer tray and sudden change of document content.

The application of this methodology will allow the execution of simple actions in the organization, reducing costs and providing a management process where problems are treated scientifically and effectively.

In addition to the measures presented in the action plan stage, the following are suggestions for improvements:

• The need for efficient paper consumption control by conducting a demand study to measure the real need of the finance section for the renewal or acquisition of a new printing contract;

• Replacing the printed version with the electronic equivalent will also reduce the amount of paper used, avoiding unnecessary printing;

• Disposal of discarded leaves for recycling;

• Extend improvement actions to the entire Institution X with the involvement of all employees, as it has 50 printers and this study was limited to only one. Reducing paper waste will bring environmental benefits and will reduce costs for the organization;

The limitations of the work are defined by the difficulty in measuring data since the institution did not have a structured data collection and due to the confidentiality of information, some data could not be plotted. Thus, the opinions of the employees involved through brainstorming meetings, questionnaire application and the use of check sheets were fundamental for this study.

For future works, it is recommended to develop the other stages of MASP regarding action follow-up, verification, standardization and conclusion, not seen in this study.

6. Acknowledgement

To the Institution X manager that authorized the research and also to the UFAM`s Department of Industrial Engineering members of examining board that evaluated the article and gave suggestions for improvement, Dr. Gabriela de Mattos Veroneze and MSc. Nadja Vanessa Miranda Lins.

7. References

[1] OHNO, Taiichi. Toyota Production System: Beyond Large-Scale. Porto Alegre: Bookman,1997.

[2] CAMPOS, V. F. TQC: Controle da Qualidade Total (no estilo japonês). 8. ed. Belo Horizonte: INDG, 2004.

[3] CARPINETTI, L. C. R. Gestão da qualidade: Conceitos e técnicas. São Paulo: Atlas, 2. Ed. 2012.

[4] AKATU. Painel Florestal - Produção de folha de papel A4 necessita de 10 litros de água. Disponível em: <https://www.akatu.org.br/akatu-na-midia/painel-florestal-producao-de-folha-de-papel-a4-necessita-de-10-litros-de-agua/>. Acesso em: 10 abr. 2018.

[5] SANTOS, J., CAMARGO, M., PINTO, M., COSTA, S. A responsabilidade social no controle do desperdício de alimentos em um hospital. In. SIMPÓSIO DE EXCELÊNCIA EM GESTÃO E TECNOLOGIA. Rio de Janeiro, 2007.

[6] SILVA, Gleisan Lopes. Promovendo educação ambiental, por meio de da conscientização do consumo de água nas escolas do município de São Bernardo. 2017. 49 f. Monografia (Graduação) – Curso de Ciências Naturais/Química, Universidade Federal do Maranhão - Campus São Bernardo - UFMA. São

Bernardo, 2017.
[7] ANEEL, Agência Nacional de Energia Elétrica. Banco de Informações de Geração –BIG. Disponível em: <http://www.aneel.gov.br>. Acesso em: 06 maio. 2018.
[8] LOUREIRO, Gustavo Leandro. Queima de gás. 2012. 89 f. Monografia (Graduação) - Curso de Engenharia de Petróleo, Universidade Federal Fluminense - UFF. Niterói, 2012.
[9] TEIXEIRA, Ana Catarina Ferreira. Impacto de uma ação de redução do desperdício alimentar ao nível do consumidor num serviço de alimentação do ensino superior português. 2017. 108 f. Dissertação (Mestrado em Ciências do Consumo e Nutrição) - Faculdade de Ciências, Universidade do Porto. Porto. 2017.
[10] WALTON, Mary. The Deming Management Method: The Bestselling Classic for Quality Management. Penguin, 1988.
[11] MARÇAL, L. L., SILVA, A. C. A., COSTA, N. N. Aplicação do MASP, utilizando o Ciclo PDCA na solução de Problemas no fluxo de Informações entre o PPCP e o Almoxarifado de uma fábrica de refrigerantes para o Abastecimento de tampas Plásticas e rolhas metálicas. ENEGEP 2008.
[12] MARUTA, Rikio. The creation and management of organizational knowledge. Knowledge-Based Systems, v. 67, p. 26-34. Japão: Elsevier, 2014.
[13] KHOLIF, A. M., HASSAN, D. S. A. KHORSHID, M. A., ELSHERPIENY, E. A., OLAFADEHAN, O. A. 2017. Implementation of model for improvement (PDCA-cycle) in dairy laboratories. Journal of Food Safety. Wiley Periodicals, Inc. Giza, 2018.
[14] MASAAKI, Imai. Kaizen: The key to Japan's competitive success. New York, ltd: McGraw-Hill, 1986.
[15] SIMONS, Ellen. 'Paradise by the Dashboard Light': Working with a Simple PDCA Cycle at Avans University of Applied Sciences. Netherlands: Liber Quarterly, v. 21, n. 2, 2012.
[16] RIBEIRO NETO, A.F. Aplicação do método de análise e solução de problemas-MASP. Especialize. Revista on-line v.15. Jan.2013.
[17] ROONEY, J.; HOPEN, D. On the trial to a solution: part 2 – what is in? what is out? Defining your problem. The Journal for Quality and Participation, v.27, n.4, p.34-37, 2004.
[18] SUGIURA, YAMADA. The QC Storyline: A guide to solving problems and communicating the results. Tokyo: Asian Productivity Organization, 1995.
[19] CAMPOS, V. F. Gerenciamento da rotina do trabalho do dia a dia. 9.ed. Nova Lima: Falconi, 2013.
[20] GOMES, L. G. S. G. Reavaliação e melhoria dos processos de beneficiamento de não tecidos com base em reclamações de clientes. Revista Produção Online, UFSC. Florianopolis, v. 6, n. 2, 2006.
[21] ISHIKAWA, Kaoru. Controle de qualidade total à maneira japonesa. In: Controle de qualidade total à maneira japonesa. 1993.
[22] TZASKOS, D.,GALLARDO, G. Estudo de Caso da Aplicação do MASP em uma Indústria de Papel. Revista Qualidade Emergente, UFPR. Curitiba, v7, n. 2, p. 01-14, 2016.
[23] LIMA, Ana Carolina Felizardo. Gestão e melhoria de processos em uma indústria farmacêutica pública: estudo de caso da gestão de projetos de desenvolvimento de medicamentos. 2016. 115 F. Dissertação (Mestrado em Sistemas de Gestão) - Universidade Federal Fluminense – UFF. Niterói, 2017.
[24] ANDRADE, R. S., RODRIGUES, A. Implementação da Metodologia de Análise e Solução de Problemas (MASP) PARA Redução de Perdas em Empresas Manufatureiras. Revista da Universidade Vale

do Rio Verde. Betim, v. 15, n. 1, p. 73-82, 2017.
[25] SANTOS, M. C.; GONÇALVES, A. T. P. Aplicação da metodologia de análise e solução de problemas – MASP na logística de uma grande rede varejista. GEPROS. Gestão da Produção, Operações e Sistemas. Bauru, v. 11, n. 4, p. 21-44, 2016.
[26] VERGARA, SYLVIA CONSTANT. Projetos e relatórios de pesquisa em Administração. 5.ed. São Paulo: Atlas, 2004.
[27] GIL, ANTONIO CARLOS. Como elaborar projetos de pesquisa. 4. ed. São Paulo: Atlas, 2008.

The Connection Between Cooperativism And Decent Work

Caroline Jacques, Max Richard Verginio, Dimas de Oliveira Estevam

Abstract

Cooperativism is based on the principles of cooperatives. They are applied, in practice, the cooperative values of free association and democracy for its members and are based on the fundamental rights. However, in the last two decades, in Brazil, the cooperatives began to hire workers on a low wage salary in a continuous and accelerated process. Taking into consideration that the hiring of workers by the cooperativism was not considered by its founding members, the formal hiring generated by cooperatives, all around the world, has increased. It is important to mention that the fundamental working rights notions started to exist due to the emergence of the concept of Decent Work. This concept was formalized by the International Labor Organization (ILO) in 1999, with the aim of promoting quality work opportunities, under the conditions of human freedom, equity, security and dignity. They are considered essential conditions for overcoming poverty, reducing social inequalities, guaranteeing democratic governance and sustainable development. In the research carried out in Brazil about this subject, it was identified that the employment opportunities generated by the cooperatives are closer to the concept of Decent Work when compared to those generated by the private sector. Thus, the present article aims to identify the connection between cooperativism and Decent Work through a bibliometric revision of literature. The methodological process used in the research was the bibliometric approach by applying co-word analysis. From the results obtained, it was not possible to establish a direct connection between cooperativism and Decent Work. Nevertheless, the connection was identified indirectly in the articles that focused on this theme. Even though, the focus was on the associated membership and not on the hired employees.

Keywords: Cooperativism, decent work, Bibliometry.

1 INTRODUCTION

This article is part of an ongoing research which is being conducted by the Interdisciplinary Research Group on Socioeconomic Development, Family Farming and Rural Education (GIDAFEC / UNESC / CNPq) that is part of the Graduate Program in Socioeconomic Development (PPGDS) of the Universidade do Extremo Sul Catarinense (UNESC), based in Criciúma (SC). GIDAFEC conducts research on family farming and cooperativism, mainly involving aspects of collective production, decent work, gender inequality in labor, innovation, among others.

Research on cooperativism normally uses concepts of the double dimension of the cooperative and the double quality of the associate. The first one refers to the economic and social aspect, and the second one to the associate, who is both owner and user of the cooperative. The present study seeks to analyze another characteristic of current cooperativism, increasingly present in the activities performed by cooperatives: the salaried worker.

The data observed in the Annual Report on Social Information (RAIS), in recent research, indicates that there is a significant increase in employment in cooperatives in Brazil. Especially in sectors such as credit, health insurance, hospital services and rural energy services, among others. Even in critical periods, when the national macroeconomic scenario was marked by a downturn in the economy, the job creation balance in cooperatives were positive from 2002 to 2017. However, in the crisis of 2008 and 2015, job creation balance declined but were not negative as it was for private companies. That is, when analyzing the total generation of jobs in establishments of a legal nature equal to cooperative throughout the national territory.

It is important to point out that RAIS (Annual Report on Social Information) is the official employment control agency in Brazil. Registration controlled by RAIS covers only formal employment contracts, which are governed by the Consolidation of Labor Laws (CLT). Based on these records, it has been observed over the last decades that cooperatives have hired salaried workers in increasing and significant numbers. In a way, the hiring of workers by cooperatives was not considered by their founders of the cooperative movement; although it is currently a recurring phenomenon worldwide.

Within the hiring of salary workers by cooperatives, it is necessary to analyze the quality of the work generated. In order to carry out this research, the study was based on the concept of decent work formalized by the International Labor Organization (ILO) in 1999; whose objective is to promote opportunities for quality work, considering the conditions of freedom, equity, security and human dignity, which are are believed to be essential for overcoming poverty, the reduction of social inequalities, ensuring democractic governance and sustainable development.

It was found in the literature published in Brazil on this theme that the employment generated by the cooperatives are closer to the concept of Decent Work, when compared to the employment generated by the private companies. Therefore, the present article has as objective to identify the relationship between cooperativism and decent work in the scientific productions carried out in Brazil.

In addition to this introductory section, the article presents briefly the concepts of cooperativism and decent work followed by the methodology section. In order to reach the objective proposed a bibliometric analysis of publications on “cooperativism and decent work” was applied. After the methodology section, the results of the research are presented, followed by the final considerations.

2 LITERATURE REVIEW

Cooperativism is a secular movement and its modern format is based on the experiences of Rochdale pioneers in Manchester, England, in the beginning of 1844. The production scale, legal requirements, marketing competition demanded that the cooperatives as a social and economic movement, established principles that allowed cooperatives to maintain themselves in the market, without degenerating their bases. Since the beginning of cooperativism, it has in its identity the valorization of human dignity in the social and economic domain.

In order to connect the normative issues present in the cooperatives, with the fundamentals of human rights, Schneider (2017) makes this connection between cooperativism and human rights, with the following arguments: “cooperativism is the result of a consciousness will and collective action. It is an

organization to solve, in a balanced and fair way, the great challenges of survival in the area which is conflicting and full of contradictory interests, as it is the economic system." (SCHNEIDER, 2017, p. 156).

The arguments on the employment of workers in cooperatives by the author above is related to the professionalization of management and the complexity of the services provided. In an increasing competitive market context, cooperatives are subject to the same regulations as other organizations, whether public or private. With the advent of increasingly complex regulations, the transaction cost of cooperatives has risen, making their operation impractical without hiring technical professionals. Even if the cooperative does not aim to generate profit, and the cost of social participation rises above the benefits achieved, it is unlikely that members will remain associated with a cooperative. Given that, the hiring of salaried workforce is related to providing greater efficiency in managing the costs of cooperatives, adapting their operating logic to the market.

When cooperatives are oriented to market efficiency, according to Bialoskorski Neto (2012), there are two possible forms of orientation for maximizing the welfare of members, through the provision of services or oriented towards the generation of financial surpluses and, later, redistribution between the associates at the end of the period. The orientation to the services provided has a short-term characteristic, while the generation of excedents, the benefits to the associates are not immediate. The author analyzes agricultural cooperatives in Brazil and concludes that the predominant characteristics are of the first type, that is, oriented to short term services. Moreover, the data collected shows the dimension of this type of management, in the state of São Paulo, the research showed that 72.73% of agricultural cooperatives capitalize the leftovers and do not distribute the economic results in cash to its members (BIALOSKORSKI NETO, 2012).

Cooperatives, whether oriented by short-term or long-term goals, produce positive results for its members. These results are partly related to the principles of cooperativism, which cooperatives must pursue. However, only a few results addressing the effects of these principles on workers hired by cooperatives were found. That is, those in which the relationship with the cooperative is not constituted as an associate, but as a salaried worker. If the results are positive for the members, little is known about the possible advantages to the workers hired by the cooperatives.

In order to measure the quality of work generated by cooperatives in Brazil, the application of the concept of decent work, coined by the International Labor Organization (ILO) in 1999 seems appropriate. The concept is directly related to the minimum working conditions necessary to achieve workers' human rights (ILO, 1999; JACQUES et al. 2016, p. 168). In a more practical way, decent work can be defined as productive service, adequately paid, exercised under conditions of freedom, fairness and security, without any form of discrimination, capable of guaranteeing a decent life for workers, whether men, women, immigrants, or anyone belonging to ethnic minorities (JACQUES et al. 2016).

In an article published by the International Co-operative Alliance (ICA), the organization warns about the risks in the alignment changes in macroeconomic policy, which are focused on monetary policies, pricing policies, fiscal austerity and labor flexibilization. This macroeconomic stance goes against the UN 2030 Sustainable Development Agenda, which advocates full employment. However, among the ICA's proposals for governments are the active promotion of the cooperative model for the creation of wealth and

quality jobs at local, national and international levels, as well as changing the conditions of access to social protection policies beyond labor status, and strengthening of dialogue with unions (ICA, 2018).

The close relationship between cooperativism and the fundamental rights of the human beings can be identified, especially when it comes to labor. Moreover, the UN's 2030 agenda defines quality work as one of its objectives. Even though it makes no mention whether cooperativism is closer or not to the Agenda. ICA, the most representative body in the international sphere of cooperativism, stands in favor of the agenda goals at the UN and also demonstrates how cooperatives would be able to contribute positively to the future of work on a global scale.

According to the literature review in recent years, publications of scientific articles have grown significantly. Therefore, the importance of using tools aimed at analyzing large numbers of databases and bibliometric is one of them. Authors like Zupic; Cater, (2015), point out at least two main ways for the use of bibliometric research, to help new researchers to quickly understand the structure of a given scientific field and, or to introduce quantitative analysis in literature reviews.

However, among the risks that the researcher may encounter, in searching for concepts in scientific database search systems is finding studies that are not related to the area under research. That may lead to a larger sample in other areas, which may contribute very little for the ongoing research. As an example, recently a bibliometric analysis for the concepts of "cooperatives and sustainability" in the Web of Science database identified 792 works. Among the results found, 25.2% corresponded to environmental sciences and ecology, 15.7% to engineering. , 8.2% on Computer Science (BRIDI; MEDEIROS, 2018, p. 82).

Another way bibliometric analysis is being applied in Brazil is through studies that search through every publication of an electronic journal. Francisco (2011) made a bibliometric analysis of 240 articles from 2002 to 2010, from the REA-Eletrônica Business Administration Journal. The author complements his analysis with geoanalysis techniques and social networks in order to find the main influences on the journal or the most frequent concepts in the texts.

These are examples of how it is possible to work with bibliometric analysis using a large amount of information to identify the state of the art on the publications of a given theme. In this sense, the following presents the methodology to achieve the objectives outlined in the article.

3 METHODOLOGY

In order to achieve the research objectives, the methodological approach adopted in was searching through secondary sources in electronic available databases. The bibliographic sources for the research were selected in scientific bases. To assist in the treatment and cleaning of the data, the R language was used as an appropriate tool for the article object. The procedure applied was co-word analysis, which compares the terms that occur in the keywords, titles, abstracts, and even the body of the article.

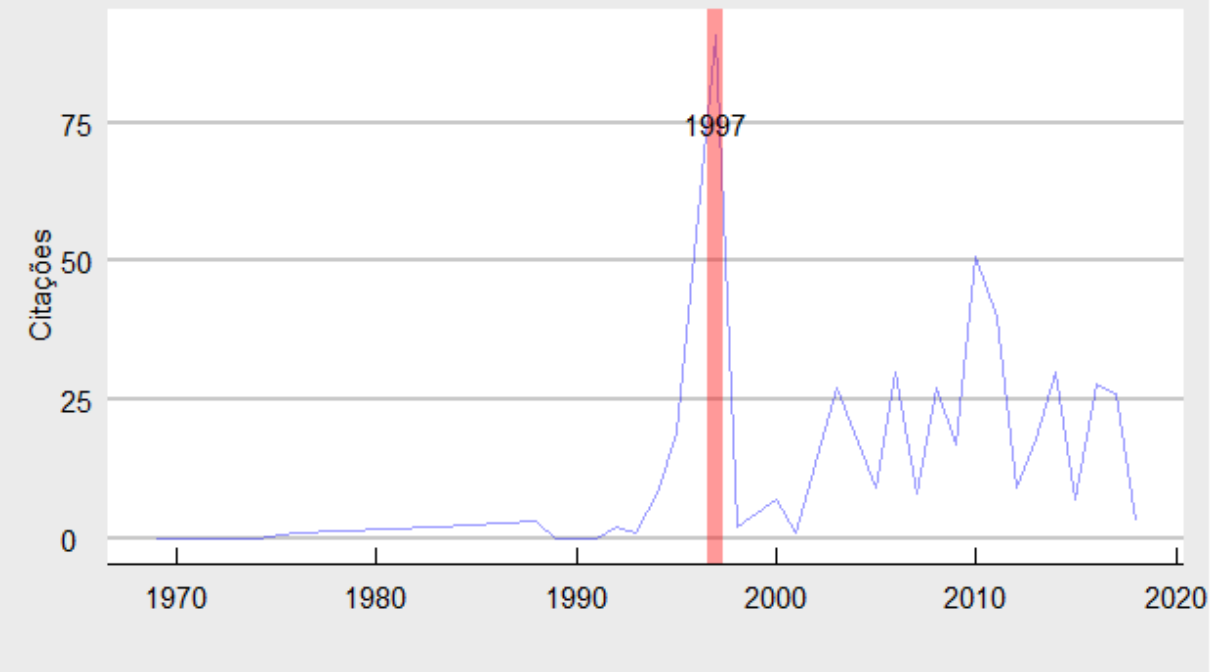
The data was analyzed using script prepared for bibliometric research in R language, with the aid of the Biliometrix package (ARIA; CUCCURULLO, 2017, p. 959). Bibliometrix which is a package for automating the stages of data analysis and data visualization.

4 DISCUSSION OF THE RESULTS

The data source used was Scopus, due to the worldwide reach of the journals that are available in this system. This database makes it possible to import a large amount of information into the bibtex file format. The keywords used in the search were "*cooperativismo*" or "cooperativism" in order to limit the search results. By using the concepts of cooperativism, the objective is to reach studies which are related to cooperativism.

The descriptive analysis identified 168 scientific articles, 101 publication sources, 265 different keywords registered by the system and 481 keywords registered by the authors. The first publication found in the search is dated 1968, and the last one, 2018, with an average of 2.78 citations.

Figure 1 Citation rate per year

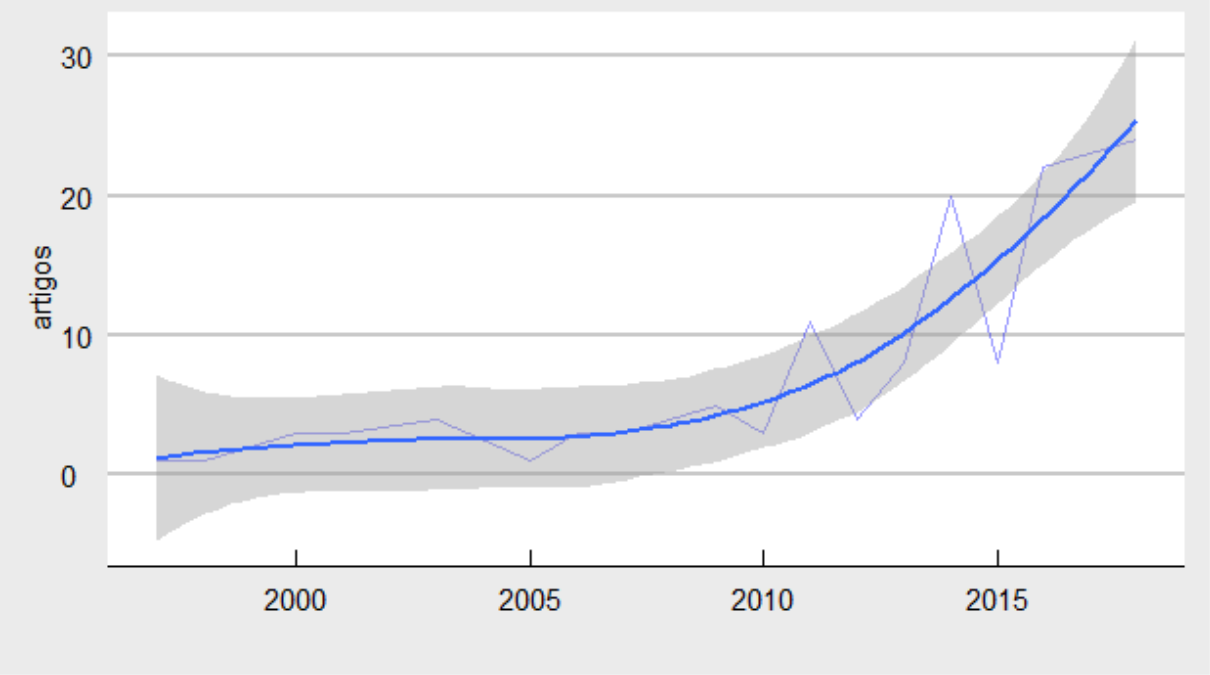


Source*:*

Scopus, prepared by the authors of the article.

Regarding the authorship, it was found in the research 268 authors, 302 appearances, 68 published individually, and 84 articles published by individual authors, and another 200 authors did not publish individually. The average article found was 0.627 articles per author, 1.6 authors per article, 1.8 co-author per article, summarizing a collaboration index of 2.38.

Figure 2: Scientific production on cooperativism by year 1997 to 2018

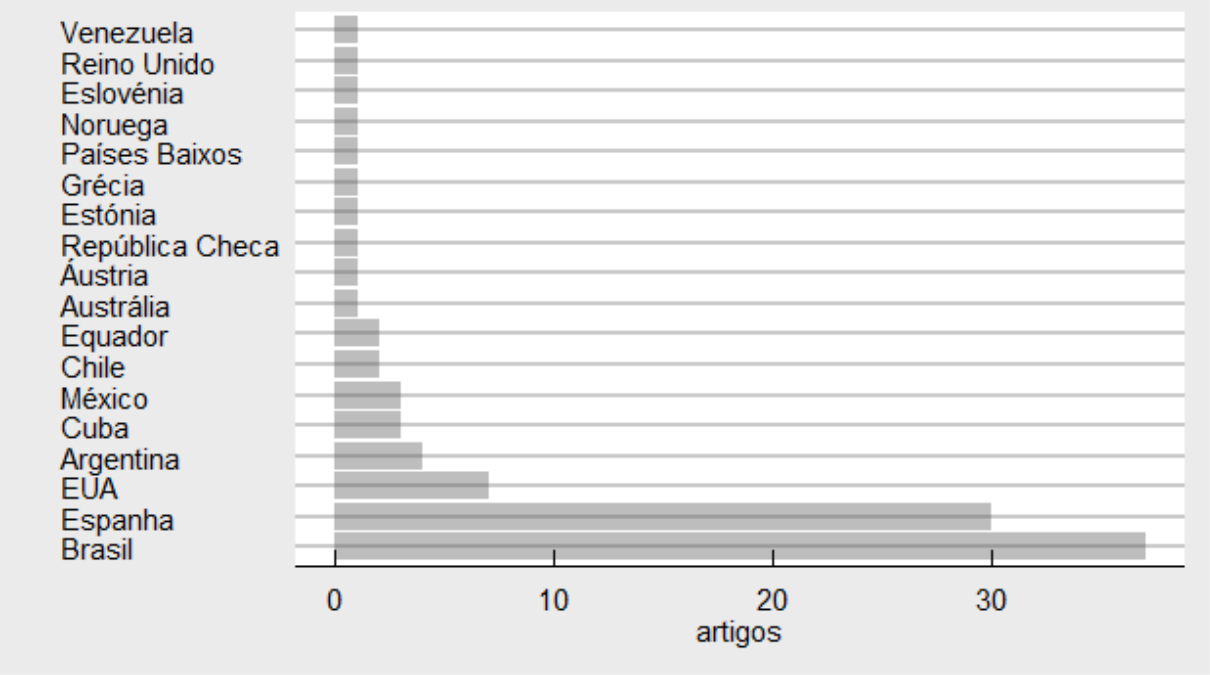


Source: *Scopus, prepared by the authors of the article.*

The first three decades analyzed, the production was sporadic, with intervals of eight years without publications. The academic production began to be constant, only from 1988, but limited to one or two articles per year. Except for 1995, when there were four publications. This pattern in publications continued until 1999, when there was an increase in the average for three annual publications from 2000 to 2007. From 2008, a cycle of increasing publications on the theme of cooperativism begins. In 2017 there were twenty-four publications, if considered the last six years, the average of publications were eighteen per year, using the keyword "*cooperativismo*" and or "cooperativism".

The countries that presented the largest academic production on this theme were Brazil, with thirty-seven articles and Spain, with thirty-one articles. Argentina and the United States had 6 publications each. The intra-country (SCP) collaboration rate for Brazil is thirty-three, for Spain thirty-one, and inter-country collaboration (MCP) is four for Brazil and zero for Spain. This indicates low level of collaboration or relationship between research countries on the subject. The forms of collaboration or research networks are related to local researchers, with little or no link between international researchers.

Figura 3: Most productive countries



Fonte: *Scopus*, prepared by the authors of the article.

Although Brazil leads regarding the number of publications, articles published in the United States had the highest number of citations, one hundred and fifteen, with an average of 19.16 citations per article. Spain, with seventy-three citations, has an average of 2.34 citations per article. United States, which is third in publication, has forty-six citations from an article. Next comes Brazil, which has thirty-seven citations, with an average of one citation per article. Brazil and Spain are the countries that publish the most about the subject, however, the articles, when published by the United States, have a wider range, given the number of citations they receive.

There are two types of keywords in the Scopus database, the first one are the keywords registered by the authors, and secondly those that are added by the system operators. They aim to contribute to the academic scientific search, which are sought by the researchers. It is, therefore, a kind of categorization of the keywords of the authors.

It implies that authors themselves would have difficulty identifying the keywords that best rank their work. For example, in the following table the authors classified forty papers as “cooperativism”, twenty-seven as “cooperatives” and eleven as “social economy”; however, the system keywords are not concentrated, with five keywords in “ Cooperative sector ”, four in“ Agricultural cooperative ”and three in“ Agricultural history ”. A limitation of these indicators is that not all articles have the keywords registered, neither by the authors nor by the system operators. Among the articles, 16.2% had not registered keywords, while 78.6% of the articles had no system keywords.

The Co-word analysis tool visually represents the cluster of keywords, which are considered themes, where density and centrality are used to classify and map in a two-dimensional diagram. The thematic map is intuitive and can be analyzed according to four quadrants.

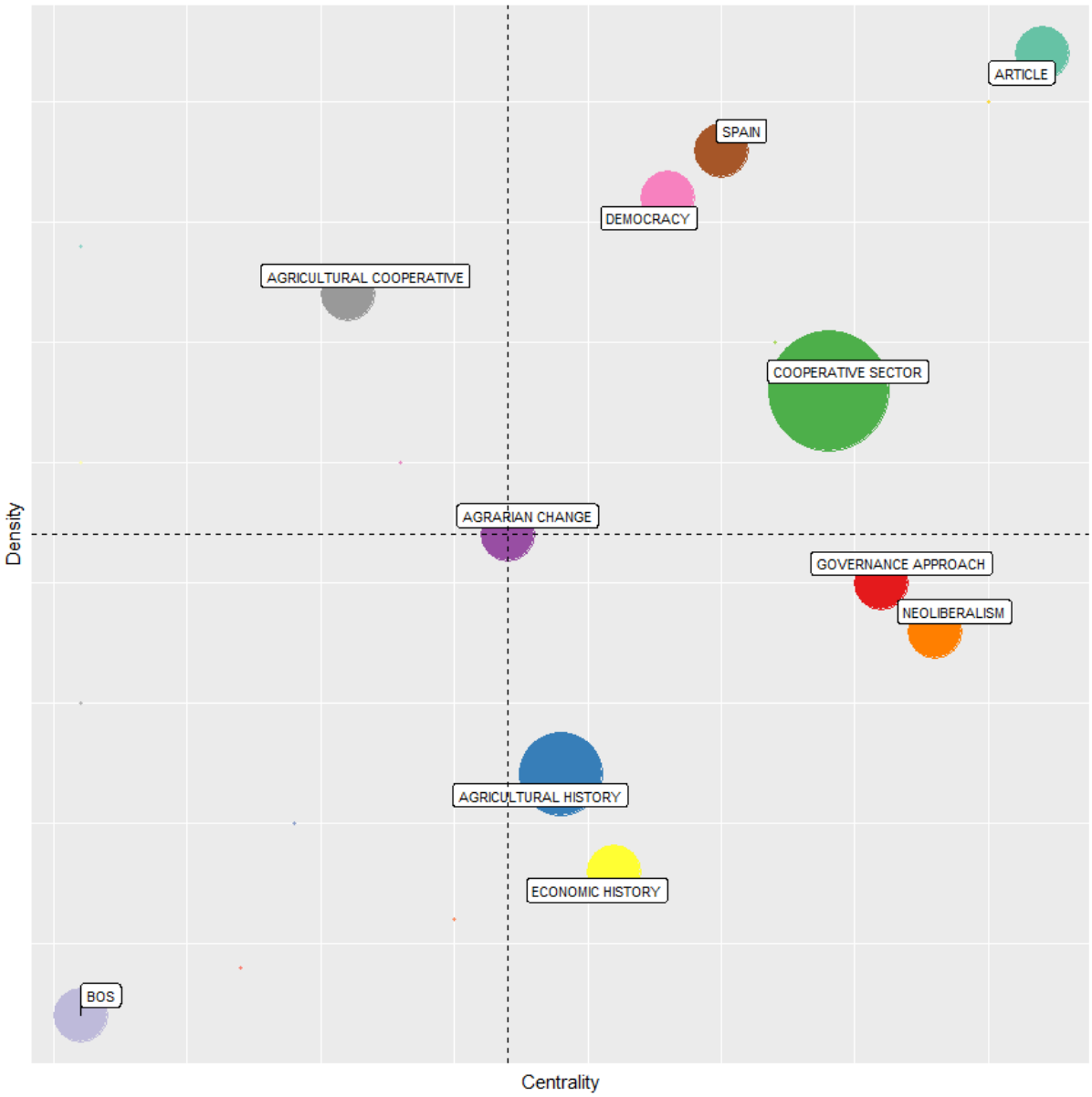
Table 1: thematic map analysis

	Quadrant	**Clustering**
(1)	quadrant top right	motor-themes
(2)	quadrant bottom right	basic themes
(3)	quadrant bottom left	emerging or declining themes
(4)	quadrant top left	highly developed themes

Source: Bibliometrix – 2019.

According to the keyword analysis, the topics that are driving themes listed in the first quadrant are Democracy and the Cooperative Sector, as well as their relationship with Spain. In the second quadrant are considered basic themes: governance, neoliberalism, economic history and the history of agriculture. In the third quadrant there were no classified themes and in the fourth quadrant, which represents very specialized themes, cooperative agriculture. One theme could not be classified because it was right in the middle, among the four quadrants, which refers to agrarian changes.

Figure 4: thematic map



Source: *Scopus*, created by the authors of the article.

Bibliometrics approach offers an interesting tool for academic use, especially when the researcher is entering new research topics. The most appropriate instrument for analysis is defined in accordance to each situation. Therefore, in this sense, having knowledge about emerging ways of mapping the production of scientific knowledge can lead to new directions, promoting quality increments in scientific production. A necessary tool, I believe, mainly because time for scientific production is short and those who are new to research needs to gain knowledge about a certain field of research.

5 FINAL CONSIDERATIONS

Cooperativism has a history of academic publications. The theme is present in research and publications in high impact journals. In the last 10 years, there was an exponential increase of scientific

publications at the international level. It also occurred the increase of interest in cooperativism. Brazil has a key role in the scientific production on this theme. As well as Spain, due to the recognition of the Mondragon complex, which is a source of inspiration for cooperatives around the world.

Among the themes identified in the thematic map, appears prominently farming history, economic history and the cooperative sector . They are forms of approaching the research on cooperativism, which gives some hints about the strong connection that the cooperative sector has with or without the establishment of the economical and farming mindset at the moment.

There was no evidence of a direct connection between cooperativism and Decent Work in the articles researched. However, it was found an indirect connection as it was possible to identify a few articles that focused on the connection between cooperativism and human rights. However, the focus was on the workers associated to the cooperative. Thus, this connection would be through the approximation of the objects of research. Therefore, the analysis of employment generation in cooperatives based on decent work can be considered a good theme for future research.

Acknowledgment

This article is part of the research of the Internal Promotion Announcement of the University of Far South Catarinense (UNESC): Public Notice No. 118/2018 (Selection Process Research Group Program 2018-2020) and Public Notice No. 120-2018 (Institutional Scholarship Program of Scientific Initiation - PIBIC / Unesc - PROCAD - Academic Dean's Office).

6 REFERENCES

ACI, I. C. A. The challenges of the future of work : how cooperatives can be part of the solution. , v. 32, n. May, p. 30–32, 2018. Disponível em: <https://www.ica.coop/sites/default/files/publication-files/prworkersday-2018the-challenges-of-the-future-of-work-how-cooperatives-can-be-part-of-the-solutionen.pdf>. .

ARIA, M.; CUCCURULLO, C. bibliometrix : An R-tool for comprehensive science mapping analysis. **Journal of Informetrics**, v. 11, n. 4, p. 959–975, 2017. Elsevier Ltd. Disponível em: <http://dx.doi.org/10.1016/j.joi.2017.08.007>. .

BIALOSKORSKI NETO, S. **Economia e Gestão De Organizações Cooperativas**. 2º ed. São Paulo: Atlas, 2012.

BRIDI, A. P. P.; MEDEIROS, F. S. B. Cooperativas e sustentabilidade sob o prisma acadêmico. **Saber Humano**, p. 70–91, 2018. Disponível em: <https://saberhumano.emnuvens.com.br/sh/article/view/266/325>. .

BYRNE, K.; HEALY, S. Cooperative Subjects: Toward a Post-Fantasmatic Enjoyment of the Economy. **Rethinking Marxism**, v. 18, n. 2, p. 241–258, 2006. Disponível em: <http://www.tandfonline.com/doi/abs/10.1080/08935690600578919>. .

VAN DOORN, N. Platform labor: on the gendered and racialized exploitation of low-income service work in the 'on-demand' economy. **Information, Communication & Society**, v. 20, n. 6, p. 898–914, 2017. Disponível em: <https://www.tandfonline.com/doi/full/10.1080/1369118X.2017.1294194>. .

FRANCISCO, E. de R. RAE-eletrônica: Exploração do acervo à luz da bibliometria, geoanálise e redes sociais. **Revista de Administração de Empresas**, p. 280–306, 2011. Disponível em: <http://www.scielo.br/pdf/rae/v51n3/v51n3a08.pdf>. .

HEYNEN, N. Cooking up Non-violent Civil-disobedient Direct Action for the Hungry: 'Food Not Bombs' and the Resurgence of Radical Democracy in the US. (P. Routledge, Org.)**Urban Studies**, v. 47, n. 6, p. 1225–1240, 2010. Disponível em: <http://journals.sagepub.com/doi/10.1177/0042098009360223>. .

JACQUES, C. DA G.; SANTOS, M. J. N. DOS; ORCHARD, M. S. E. Responsabilidade Social das Empresas, Trabalho Decente e Acordos Marco Internacionais: um estudo de caso do setor têxtil. **Política e Sociedade**, v. 15, n. 33, p. 160–193, 2016.

LEIDNER, D. E.; FULLER, M. Improving student learning of conceptual information: GSS supported collaborative learning vs. individual constructive learning. **Decision Support Systems**, v. 20, n. 2, p. 149–163, 1997. Disponível em: <http://linkinghub.elsevier.com/retrieve/pii/S0167923697000043>. .

OIT, O. I. D. T. Trabajo Decente. **Oficina Internacional del Trabajo**, p. 1, 1999. Ginebra, Suiza. Disponível em: <https://www.ilo.org/public/libdoc/ilo/P/09651/09651%281999-87%29.pdf>. .

SCHNEIDER, J. O. **Democracia, participação e autonomia cooperativa**. São Leopoldo: Unisinos, 1991.

SCHNEIDER, J. O. Cooperativismo e direitos humanos. **Perspectiva Econômica**, v. 13, n. 2, p. 147–157, 2017. São Leopoldo. Disponível em: <http://revistas.unisinos.br/index.php/perspectiva_economica/article/view/pe.2017.132.05/6354>. .

SOARES, S. V.; PICOLLI, I. R. A.; CASAGRANDE, J. L. Pesquisa Bibliográfica, Pesquisa Bibliométrica, Artigo de Revisão e Ensaio Teórico em Administração e Contabilidade. **Administração: Ensino e Pesquisa**, v. 19, n. 2, p. 308–339, 2018. Disponível em: <https://raep.emnuvens.com.br/raep/article/view/970>. .

ZUPIC, I.; CATER, T. Bibliometric Methods in Management and Organization. **Organizational Reserch Methods**, v. 18, n. 3, p. 429–472, 2015.

Decision Theory under Uncertainty Mean-Variance Approach

Kamalou-Dine Adissa Akinocho
Zhejiang University of Science & Technology
School of Science

Abstract

In this paper, we mainly consider the theory and analysis of Decision under uncertainty which is making the foundations of all finance and portfolio theories. Decision makers face choices among a number of risky alternatives which is represented by lotteries. This paper develops alternative theories for choices under risk which expected utility theory which is derived from reasonable axioms about rational behavior in risky environment. An alternative theory of choice is developed, in which value is assigned to gains and losses rather than to final assets. All risky alternatives can be summarized by two numbers – mean u and variance σ^2 *called Mean-Variance Theory (MVT). This implies that typical mean-variance utility function* $v\ (\mu,\sigma) = \mu - \frac{\gamma}{2}\sigma^2$ *which is increasing in* μ *and decreasing in* σ*.The results show that, investors have different mean variance utility functions but the main results regarding optimal portfolio of risky assets do not depend on the specific utility functions of investors.*

Keywords: Uncertainty, decision, aversion, lotteries

JEL Classification: ECON 851

1. Introduction

Financial literature widely discusses the investment decisions of companies. This field has seen a surge of research with both theoretical and experimental advances. The study of the relationship between the decision under uncertainly and investment level is the most common way of analyzing the problems of over- and under risk. However, the study of Decision Theory under Uncertainty risk Mean-Variance Approach in financial distress is a topic that still requires more in-depth study. According to previous study, it identifies the existence of financial constraints as a key variable. This Implies that almost every decision we ever make in our lives, involves uncertainty. Uncertainty is then meant to represent "non probabilized" uncertainty –situations in which the decision makers is not given a probabilistic information about the external events that might affect the outcome of a decision–, as opposed to risk which is "probabilized" uncertainty. We assume that decision maker faces a choice among a number of risky alternatives which is represented by lotteries.

We will thus concentrate on situations in which to provide the application of decision theory to the problem of investment and making under uncertainty to the financial markets. The main contribution of this work is to find whether there is a conclusive correlation between the decision makings under uncertainty in the context of the financial, and to conduct a Mean-Variance Portfolio Analysis on over risky returns. In our

research we present decisions under uncertainty, where Choice under uncertainty characterized as the maximization of expected utility. We develop the notion of MeanVariance Theory (MVT) as one representation of preference over risky.

The paper proceeds as follows. We start with a rather didactic section in which we present some definition lotteries to decision under uncertainly following some example.

In the three sections coming we develop alternative theories for choices under risk: Expected Utility Theory, Mean-Variance Theory, and Prospect Theory. We then discuss in Section 6 Mean Variance Portfolio Analysis and Capital Asset Pricing Model (CAPM) to end this section.

2. Theory

This survey is concerned with introduction to some of the most important definitions and examples used within the decision Theory under Uncertainty.

Almost every decision we ever make in our lives, involves uncertainty, i.e. the outcome of our choices cannot be predicted with absolute certainty. These decisions include not only financial investment choices, but career choices, marriage, and college major. Decision theory under uncertainty makes the foundations of all finance and portfolio theories. We assume that decision maker faces a choice among a number of risky alternatives. Each risky alternative may result in one of a number of possible outcomes, but which outcome will actually occur is uncertain at the time of decision making. We represent these risky alternatives by lotteries.

Definitions and examples

These definitions that we are going to tell, we help us understand the notion of lotteries and how it uses by following examples to explain the development alternative theories for choices under risk. By contrast, uncertainty represents a situation in which no probabilistic information is available to the decision maker.

What is a lottery?

A lottery is a probability distribution defined on a set of payoffs. It can be discrete, in which case it is described by the list of payoffs $x_1; x_2; :::; x_N$ and the probabilities of these payoffs $p_1; p_2; :::; p_N$. The number of outcomes in a discrete lottery can be finite $N < 1$, or infinite. A lottery can also be continuous, in which case the set of payoffs is usually a subset of real numbers (x C R) and the distribution is described with a probability density function *(pdf)* $f(x)$ or the cumulative distribution function *(cdf)* F(x) $=\int_{-\infty}^{x} f(t)dt$.

Lotteries can also be a mix of discrete and continuous, but we will not deal with such lotteries in this thesis. We use the notation $\mathcal{L}$ to denote the space of all possible lotteries.

Just like in the case of any probability distribution of a random variable, we require that

[Discrete] : $p_i \geq 0 \quad \forall i, \sum_i p_i = 1$

[Continuous] : $f(x) \geq 0 \quad \forall x, \int_{-\infty}^{\infty} f(x)dx = 1$

Just like with any random variables, we might want to compute the mean and variance of a lottery, and also the covariance between any two lotteries.

In general, lotteries can have any kind of abstract outcomes, not only monetary payoffs. For example, when you play basketball, you can win, loose, end with overtime or have an injury. These outcomes are not stated in monetary terms. For simplicity of analysis, we assume that these outcomes can be represented in terms of money, so a win is for example equivalent to +$500, and a loss is equivalent to -$400.

Moreover, money lotteries are all we need for the study of financial decisions, where outcomes are naturally represented with monetary returns. Also note that sure outcomes can also be viewed as lotteries that have one outcome occurring with probability 1.

Example 1: A discrete lottery A, with two outcomes, $1000 and $500, each achieved with equal probabilities.

$$A = \begin{cases} \$1000 \text{ w.p. } 1/2 \\ \$500 \text{ w.p. } 1/2 \end{cases}$$

The expected value and the variance of this lottery are:

$E(A) = 1000 \times 0.5 + 500 \times 0.5 = \$750$

$Var(A) = (1000 - 750)^2 \times 0.5 + (500 - 750)^2 \times 0.5 = 62.500$

This example is not supposed to be realistic but to show how to determine The expected value and the variance of discrete lottery.

Let consider A; B $\in \mathcal{L}$ be lotteries and $\in [0; 1]$. Then $C = \lambda A + (1 - \lambda) B$ denotes a compound lottery where with probability the lottery A is played and with probability (1-) the lottery B is played. If the lotteries are discrete, then the probability of outcome i in C is $P_i^C = P_i^A + (1 -)P_i^B$, and when the lotteries are continuous, the probability density of C is $f_C(x) = f_A(x) + (1 -) f_B(x)$.

To be clear of our example the main challenge of decision theory is to define preference over lotteries that will allow comparison of different lotteries. For example, consider a

lottery D, which pays $750 with probability 1. Which lottery is better, A or D? This question is equivalent to asking "would you be willing to pay $750 for lottery A? More generally, how much are you willing to pay for lottery A? This is the fundamental question of asset pricing. Most people will say that they would pay less than $750 for lottery A.

In general, most people are not willing to pay the mean of a lottery to buy that lottery.

This suggests that things other than the mean of a lottery are also important. Nevertheless, until recently (mid-20th century), the only theory of preferences over risky alternatives was the mean theory - i.e. the value of a lottery is given by its mean payoff. The next example illustrates the first challenge to the mean theory. It is known as the "St. Petersburg Paradox", analyzed by the Swiss mathematician Daniel Bernoulli in 1738. Let take another example.

Example 2**:** We consider the lottery A, based on the following gamble.

A fair coin is tossed repeatedly, until "tails" first appears. This ends the game. Let the number of times the coin is tossed until "tails" appears be k. The lottery pays $\$2^{k-1}$. Thus, if you toss the coin once, and "tails" appear, then you are paid $2^{1-1} = 1$. If it takes 5 tosses until the coin shows "tails", then you are paid $2^{5-1} = 2^4$

= \$16. Thus, the possible payoffs of this lottery are 2^{k-1}, k = 1; 2; …, and the probabilities are $(1/2)^k$, k = 1; 2;… The expected value of this lottery is: $E(A) = \sum_{k=1}^{\infty} 2^{k-1} \left(\frac{1}{2}\right)^k = \frac{1}{2}\sum_{k=0}^{\infty} 2^k \left(\frac{1}{2}\right)^k = \frac{1}{2}\sum_{k=0}^{\infty} 1 = \frac{1}{2} \infty = \infty.$ Once again, the question is, how much are you willing to pay for this lottery? Despite the fact that the expected payoff of this lottery is , there is not a single person who would pay \$ to play this lottery.

In fact, most people are willing to pay no more than a few dollars to play this lottery. Indeed, this game can give you a high payoff of more than a million dollars, if you toss the coin 21 times before "tails" first appears (your payoff in this case is 2^{20} = \$1 048 576). But this happens with very low probability $\left(\frac{1}{2}\right)^{21}$ = 0.000000476837, or once in more than 2 million plays. Example 2 (St. Petersburg Paradox) demonstrates once again that, in general, the value of a lottery is not equal to the expected value of its payoff. Nevertheless, until middle of the 20th century, the expected value was the well-accepted theory of decisions under risk.

In the next three sections we develop alternative theories for choices under risk: (i) Expected Utility Theory, (ii) Mean-Variance Theory (MVT), and (iii) Prospect Theory. We start with the main-stream theory in economics - the Expected Utility Theory (EUT).

3. Expected Utility Theory (EUT)

Expected utility theory has dominated the analysis of decision making under risk.

According to the last examples, the motivation for the development of EUT is Example 2 (St. Petersburg Paradox). Bernoulli realized that twice the money is not always "twice as good". If a person has only a small amount of money, say \$1000, then doubling it increases his utility by more than say doubling the wealth of someone who has 10 million dollars. Put in another way, the marginal utility from money is diminishing - the more money you have, the smaller is the gain from additional \$1. This idea of diminishing marginal utility from money is equivalent to risk aversion in EUT, and will be formalized later. For now, Bernoulli's intuition is that instead of computing the expected payoff of a lottery, we need to compute the expected utility of a lottery. The strength of EUT is that it is not only intuitively appealing, but can be derived from more fundamental axioms about preferences.

3.1. Axiomatic foundations of Expected Utility Theory

Savage (1954) book is still considered today to be one of the major achievements in decision theory. With a scarcity of input, he delivers the classic subjective expected utility representation of preferences. Savage thus ties together the idea of subjective probability advocated by Ramsey and de Finetti with the idea of expected utility derived (with given probabilities) by von Neumann and Morgenstern.

The starting point for any decision theory under risk is lotteries, and the assumption that people have some preferences over the space of all lotteries. We assume that there exists a weak preference relation $\succsim$ on L, such that for two lotteries A, $B \in \mathcal{L}$, the notation A$\succsim$B means that "lottery A is at least as good as lottery

B". From the weak preference relation, we can derive the strict preference relation and the indifference relation as follows. The strict preference relation $\succ$ on L means that A $\succ$ B if A $\succsim$ B but not B$\succsim$A. We read A~ B as "lottery A is strictly better than lottery B". The indifference relation~ on L means A ~ B if A $\succsim$ B and B $\succsim$A. We read A ~ B as "lottery A is as good as (or equivalent to) lottery B".

Next, we make some assumptions (axioms) about the preference relation$\succsim$, that will allow representing it with a utility functional and enable practical usage. We describe Savage's core axioms. The most important one is often referred to as the "sure thing principle".

A preference relation $\succsim$on $\mathcal{L}$ is called rational if it satisfies the following two axioms:

A1. Completeness: A preference relation $\succsim$ on $\mathcal{L}$ is complete if for any two lotteries $A, B \in \mathcal{L}$, either $A \succsim B$ or $B \succsim A$ or both. Completeness means that the decision maker is able to choose among risky alternatives.

A2. Transitivity: A preference relation $\succsim$on $\mathcal{L}$ is transitive if for any three lotteries $A, B, C \in \mathcal{L}$, we have $A \succsim B$ and $B \succsim C \rightarrow A \succsim C$

The transitivity assumption is a natural consistency of preferences. We can show that if transitivity is violated for some individual, i.e. his preferences are A $\succsim$B and B$\succsim$C and C $\succ$ A, then we can easily extract all his wealth by offering him to trade B for C, A for B, C for A, and repeat many times, and each time he gets C for A he pays some amount (because C is strictly better than A).

The next assumption is technical, and is needed in order to ensure representation of preferences with utility.

A3. Continuity: The weak preference relation$\succsim$on $\mathcal{L}$ is continuous if for any lotteries A, B, C $\in \mathcal{L}$ with A $\succsim$ B $\succsim$C, there exists a probability p $\in$ [0; 1] such that $B \sim pA + (1 - p) C$

The right hand side is the compound lottery, where with probability p lottery A is played and with probability $1 - p$ lottery C is played. Here the term continuity means that any lottery "in between" two other lotteries (here B is in between A and C) is equivalent to some mixture of the two lotteries. What it also means is that there are no "jumps" in preferences due to small changes in probabilities.

For example, suppose that A is "basketball game with friends", and B is "staying at home", and C is a "knee injury", and I prefer playing basketball over staying at home: A$\succ$ B. Then, when I add a small enough probability of a knee injury to the basketball game, I would not suddenly change my mind and decide to stay at home. That is, B does not become better than $pA + (1- p)C$ for small enough $(1- p)$. This axiom is reasonable because most people do go out to work, shopping, movies, despite the small risk of getting into accident.

Let $\succsim$ on $\mathcal{L}$ be a weak preference relation on the space of lotteries. If $\succsim$ satisfies the axioms A1, A2 and A3, then there exists a continuous utility functional $U: \mathcal{L} \rightarrow R$ such that $U(A) \geq U(B)$ if and only if $A \succsim B$ for any lotteries $A, B \in \mathcal{L}$. This also implies that, for any lotteries, U (A) > U (B) if and only if $A \succ B$ and $U(A) = U(B)$ if and only if $A \sim B$.

We say that a utility functional $U: \mathcal{L} \rightarrow R$ has expected utility form if there exists a utility function $u : R \rightarrow R$, such that for every lottery L$\in \mathcal{L}$, $U(L) = E[u(x)]$

In words, the utility of a lottery is equal to the expected utility of its payoffs. Specifically, for discrete lottery

$$U(L) = E[u(x)] = \sum_i u(xi)\, pi$$

and for continuous lottery (with pdf *f (x))*

$U(L) = E[u(x)] = \int_{-\infty}^{\infty} u(x)\, f(x)\, dx$

The utility function *u* is sometimes called "von Neumann-Morgenstern" (vNM) utility function, after the mathematician John von Neumann (1903 .1957) and the economist Oskar Morgenstern (1902 - 1977) who provided the axiomatic foundations for the EUT. These two are also the founders of Game Theory. We can conclude by this tendency the advantage of EUT is that it is derived from reasonable axioms about rational behavior in risky environment. Observe that a key advantage of the EUT is that in order to know the preferences over risky alternatives, all we need to know is the preferences over sure outcomes, given by the vNM utility function $u: R \rightarrow R$. In all applications, we make the standard assumption that *u* is increasing, which means that more money is better (formally monotonicity assumption).

A4. Independence of irrelevant alternatives. A, B $\epsilon \mathcal{L}$ two lotteries with $A \succ B$, and let ϵ (0;1]. Then for any lottery $C \epsilon \mathcal{L}$, it must be $\lambda A + (1-\lambda) C \succ \lambda B + (1-\lambda) C$

The independence axiom means that the ranking of two lotteries does not change if you mix each of them with a third lottery. Preferences that satisfy the independence axiom, in addition to completeness, transitivity and continuity, can be represented with expected utility form.

The certainty equivalent (CE) of a lottery L is the non-random payoff CE which is equivalent to playing the lottery: CE ~ L. If preferences can be represented by expected utility, then certainty equivalent is defined by $u(CE) = E[u(x)]$.

Suppose that the preference relation $\overset{>}{\sim}$ on $\mathcal{L}$ has expected utility representation with vNM utility function *u*, then, $v(x) = a + bu(x)$ is another vNM utility function representing the same preferences as *u*.

We need to show that for any two lotteries $A, B \epsilon \mathcal{L}$. To do that we need to know first

$E_A[u(x)] \geq E_B[u(x)] \leftrightarrow E_A[v(x)] \geq E_B[v(x)]$

Where the subscripts *A* and *B* indicate that we are computing the expected values using the probability distributions *A* and *B*. Note that we can write:

$E_A[v(x)] = E_A[a + bu(x)] = a + bE_A[u(x)]$ *first*

$E_B[v(x)] = E_B[a + bu(x)] = a + bE_B[u(x)]$ *second*

Subtracting the second from the first:

$E_A[v(x)] - E_B[v(x)] = b\{E_A[u(x)] - E_B[u(x)]\}$

All expectations are numbers, and since b > 0 we have:

$E_A[v(x)] - E_B[v(x)] \geq 0 \leftrightarrow E_A[u(x)] - E_B[u(x)] \geq 0$

3.2. Risk Aversion

We have seen in example 1 a lottery that pays $1000 or $500 with equal probabilities,

$$A = \begin{cases} \$1000 \text{ w.p. } 1/2 \\ \$500 \text{ w.p. } 1/2 \end{cases}$$

The expected value of this lottery was found to be $E(A) = \$750$, and we mentioned that most people would not pay $750 for this lottery. In general, most people prefer the mean of a lottery for sure, over the lottery itself. This behavior is called risk aversion.

We call a person risk-averse if he prefers the expected value of every lottery $L \in \mathcal{L}$ over the lottery itself, i.e. $E(L) \succ L$. If preferences over lotteries can be represented with expected utility form, then risk aversion means $u[E(x)] > E[u(x)]$.

A person is risk-seeking if he prefers every lottery over its expected value, $L \succ E(L)$. A person is risk-neutral if he is indifferent between lotteries and their expected return, $L \sim E(L)$. Once again, if preferences over lotteries can be represented with expected utility form, then risk-seeking means $E[u(x)] > u[E(x)]$, and risk-neutral means $u[E(x)] = E[u(x)]$. Let ;ore detail, a person described by EUT is:

(i) risk-averse if and only if his vNM utility function u is strictly concave, (ii) risk-seeking if and only if his vNM utility function u is strictly convex,

(iii) risk-neutral if and only if his vNM utility function u is linear.

This is simple principle to understand. We need to show that $u[E(x)] > E[u(x)]$ for any lottery, any tangent line to the graph of a strictly concave function, lies above the graph of the function. Figure1.1 illustrates this graphically. In particular, the figure shows a tangent line $g(x)$ at the point $(\mu; u(\mu))$, where $\mu \equiv E(x)$ is the mean of a lottery.

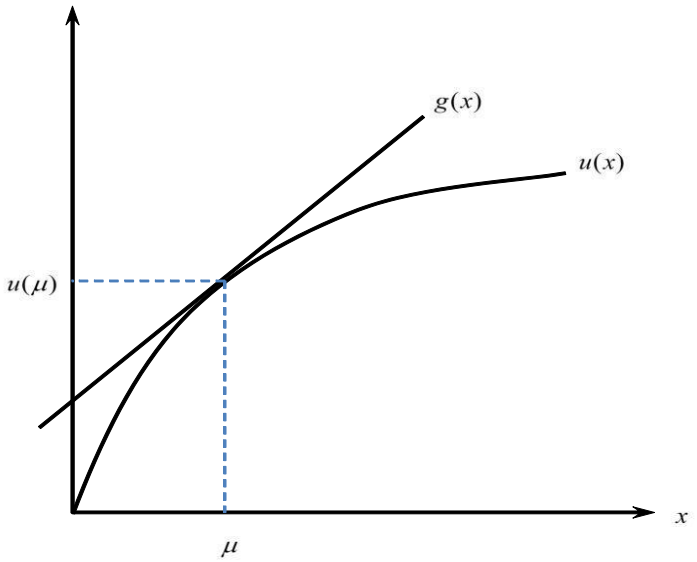


Figure1: Strictly concave u and a tangent line at $(\mu, u(\mu))$

The equation of the tangent line is $g(x) = u(\mu) + u'(\mu)(x - \mu)$, and since it lies above $u(x)$ for all x with the exception of $x = \mu$, we have $\forall x \neq \mu$ $g(x) > u(x)$

$u(\mu) + u'(\mu)(x - \mu) > u(x)$

Taking expectation $u(\mu) + u'(\mu)[E(x) - \mu)] > E[u(x)]$ $u(\mu) + u'(\mu)[\mu - \mu)] > E[u(x)]$ and finally we obtain $u[E(x)] > E[u(x)]$.

3.3. Measuring risk aversion

We have established that risk-averse individuals, whose preferences can be represented with expected utility functional, must have concave vNM utility function u. Some question is asking here according to this section which utility functions are suitable? Different individuals might have different degree of risk aversion, so how do we capture these differences with the utility function? The next definition introduces two ways of measuring the degree of risk aversion.

Given a twice differentiable vNM utility function $u: R \rightarrow R$.,

The Arrow-Pratt coefficient of absolute risk aversion at x is defined

$$ARA: = -\frac{u''(x)}{u'(x)}$$

The Arrow-Pratt coefficient of relative risk aversion at x is defined

$$RRA: = -\frac{u''(x)}{u'(x)}x$$

Intuitively, the "more concave" the utility function is, the greater should be the degree of risk aversion. Therefore, both measures have the second derivative, which is supposed to capture the degree of concavity. The minus in front makes both measures positive numbers (since the second derivative is negative for strictly concave functions).

The both have $u'(x)$ in the denominator to eliminate the effect of multiplication by a positive constant.

The different between two measures is the absolute risk aversion is relevant for choices involving absolute gains and losses from current wealth, while the relative risk aversion is relevant for choices involving percentage (or fractional) gains or losses of current wealth.

What we need to know here is the Arrow-Pratt measures of degree of risk aversion allow us to establish whether one individual is more risk-averse than another individual. That is, individual 2 is more risk averse than individual 1 if for every x we have $ARA_2(x) > ARA_1(x)$ or $RRA_2(x) > RRA_1(x)$ for $x > 0$. There are several other, equivalent ways, of making the same comparison across individuals. As we know about risk-averse, another risk called risk premium RP is important to know in this section.

A risk premium RP for a given lottery is the amount that an individual is willing to pay out of the expected payoff in order to avoid playing the lottery, and instead receives its mean with certainty: $u[E(x) - RP] = E[u(x)]$

Notice that on the left side we have utility from certainty equivalent. That is, the risk premium is just the difference between the mean of a lottery and its certainty equivalent, i.e. $RP = E(x) - CE$. Therefore, an individual is more risk-averse if the risk premium he is willing to pay for avoiding any lottery is higher.

Yet another equivalent way to compare individuals according to their degree of riskaversion is by letting the more risk-averse vNM utility function be "more concave". In other words, the vNM utility function u_2 is more risk averse than u_1 if u_2 is obtained through an increasing and concave transformation of u_1. $u_2(x) = \upsilon(u_1(x))$ for some increasing and concave function $\upsilon(.)$.

The different definitions of risk aversion and of more risk aversion help us prove some testable predictions about the behavior of risk-averse individuals. For example, even risk averse individuals will invest some of their wealth in risky assets, provided that the return of the risky assets is high enough. However, the amount invested in risky assets is smaller for more risk-averse individuals.

4. Mean-Variance Theory

According to the previous section expected utility theory has several advantages. First, it is derived from precise axioms about human behavior, so users of the theory know exactly what assumptions about

preferences make the EUT valid. Second, the expected utility theory helped us understand why people are usually unwilling to pay for a lottery the expected value of its payoffs - a behavior known as risk aversion. EUT explains why people buy insurance, while at the same time invest in risky assets. We have seen applications of EUT to optimal investment and demand for insurance. Notice however that in choosing optimal investment in risky asset, we assumed that the entire distribution of returns is known.

In a more realistic setting, of choosing optimal portfolio with many risky assets, we would need to know (or estimate) the joint distribution of all asset returns - a monumental task.

This is why in 1952 Harry Markowitz introduced a theory of portfolio selection based on the simplifying assumption that all risky alternatives can be summarized by two numbers – mean u and variance σ^2 - the Mean-Variance Theory (MVT).

In the next section we will learn the details of Markowitz portfolio selection theory, but in this section we discuss the assumptions behind the mean-variance analysis. In particular, how good is the key assumption of the MVT, that in evaluating risky alternatives people only care about the mean and variance of the returns? We also ask, under what assumptions the MVT is as valid as the EUT.

We say that a utility functional $u: \mathcal{L} \to R$ has mean-variance form if there exists a utility function $u: R \times R_+ \to R$, such that for every lottery $L \in \mathcal{L}$ $U(L) = u(\mu, \sigma^2)$ Where

$\mu = E(L)$ and $\sigma^2 = Var(L)$, and such u is called the mean-variance utility function. Equivalently, the mean-variance utility function can be written as $u(\mu, \sigma)$, i.e. as a function of mean and standard deviation, instead of variance.

In other words, the utility derived from any lottery depends only on the mean and variance of that lottery. Notice the notation $u: R \times R_+ \to R$ which means that the meanvariance utility function u *maps* elements from the two dimensional Euclidian space into real numbers.

The second dimension is restricted to non-negative real numbers because variance cannot be negative. Thus, the mean-variance utility function maps vectors (μ, σ^2) into numbers. The mean-variance utility function is therefore very different from the vNM utility function that maps single numbers (quantities of money or payoffs) into real numbers. But there are some similarities between the mean-variance utility functions and the vNM utility functions. Similar to monotonicity (more is better) of the vNM utility function u, which requires that it is an increasing function, the mean-variance utility is assumed to be increasing in the mean μ. A lottery with higher mean is better, ceteris paribus (for the same variance). We will always assume that u is strictly monotone.

Using mean-variance utility, one can define risk aversion in the standard way, just like in EUT, where risk-averse individual is one who prefers the mean of any lottery over the lottery itself. A mean-variance utility function $u: R \times R_+ \to R$ is called risk-averse if $u(\mu, 0) \geq u(\mu, \sigma)$ for all σ and all $\mu > o$ Similarly, an individual is risk-seeking if $\sigma > 0 \to u(\mu, 0) < u(\mu, \sigma)$ while risk-neutrality means that $u(\mu, 0) = u(\mu, \sigma)\ \forall \sigma$.

The next definition is a bit stronger assumption than risk aversion.

A mean-variance utility function $u: R \times R_+ \to R$ is called variance-averse if $u(\mu, \sigma_1) \geq u(\mu, \sigma_2)$ for all μ and all $\sigma_1 < \sigma_2$. It is strictly variance-averse if $\sigma_1 < \sigma_2 \to u(\mu, \sigma_1) \geq u(\mu, \sigma_2)$.

The applications of the mean-variance theory are vast, especially to the portfolio analysis.

We now turn to the critique of the mean-variance theory.

4.1. Critique of the mean-variance theory

One problem that is very obvious is that the mean-variance theory cannot always be applied to all lotteries. Mean-variance representation is not grounded in such axioms, and it is not immediately clear what kind of preferences can be represented with mean variance utility.

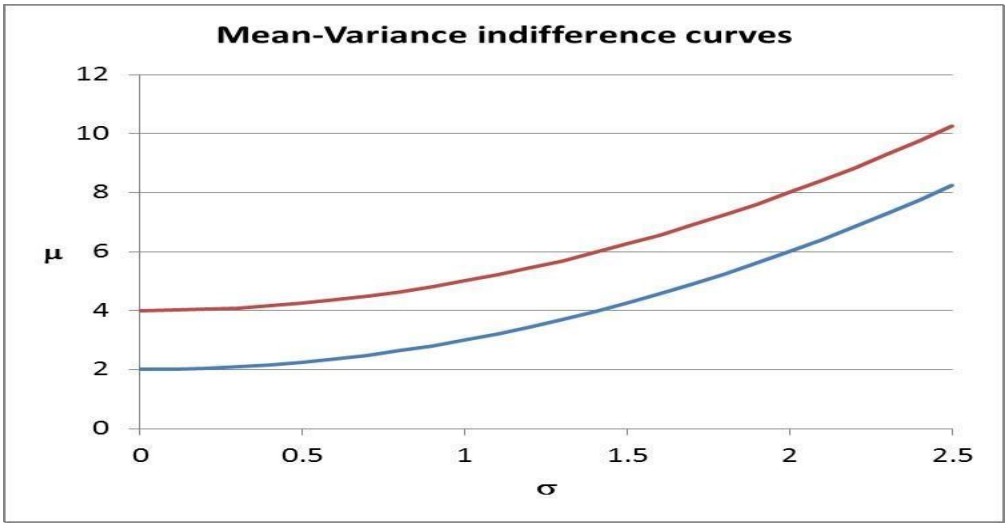


Figure 2: Mean-variance indifference curves.

4.2. Validity of the mean-variance theory

We discuss three cases when the mean-variance theory arises as a special case of the expected utility theory:

1. Quadratic vNM utility function:

Let $\succsim$ be a preference relation on $\mathcal{L}$ which can be described by expected utility with vNM utility function u. If u is quadratic, then there exists a mean-variance utility function $v(\mu, \sigma)$ which also describes $\succsim$.

2. Normally distributed payoffs:

Let $\succsim$ be a preference relation on $\mathcal{L}$ which can be described by expected utility with vNM utility function u. Suppose that payoffs are normally distributed, i.e. $x \sim N(\mu, \sigma^2)$, with pdf

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right], -\infty < x < \infty$$

Then, there exists a mean-variance utility function $v(\mu, \sigma^2)$ which describes $\succsim$ for all normal lotteries.

3. Small risks

Suppose that you have initial wealth w, to which we add a small risk z, with $E(z)=0$ and Var (z) $=\sigma^2$, so the total wealth is random: $w + z$. We can always make the assumption that $\mu_z = 0$, because if the risk was y with $\mu_y \neq 0$, we could write the resulting wealth as $w + \mu_y + y - \mu_y$, and then redefine

the initial wealth as $w^{+}\mu_y$ and the mean-zero risk $z = y^{-}\mu_y$. Therefore, the mean and variance of the final wealth are:

$E(w + z) = w + E(z) = w = \mu$

$Var(w + z) = Var(z) = \sigma^2$

To summarize, in this section we introduced the widely used in practice Mean-Variance Theory. Its main advantage is simplicity, and the main drawback is that it violates the First Order Stochastic Dominance. However, we have shown that under certain special cases, the MVT is equivalent to the EUT: (i) when vNM is quadratic, (ii) when payoffs have normal distribution or any distribution completely determined by mean and variance, (iii) when risks are small.

5. Prospect Theory

Recall that Expected Utility Theory is grounded in axioms of what is considered rational behavior. In that sense, the EUT is prescriptive - it prescribes how people should (or supposed to) behave when choosing among risky alternatives. But does the EUT do a good job describing how people actually behave? In many situations the EUT does describe actual behavior pretty well. Nevertheless, there are plenty of experimental and real world examples where the EUT fails. The development of Prospect Theory (Daniel Kahneman and Amos Tversky 1979), and the Cumulative Prospect Theory (Daniel Kahneman and Amos Tversky 1992) is an attempt to improve on the EUT in order to explain actual behavior with risky alternatives. Thus, Prospect Theory is descriptive attempts to describe actual behavior.

5.1. Motivation

The key ingredients of the different version of Prospect Theory are: framing, and probability weighting. Framing refers to the way the particular choices are formulated (framed), and the reference for gains and losses. Probability weighting is the observed tendency of people to consistently inflate low probabilities, and deflate high probabilities.

Example 3 (Framing).

Imagine that your country is preparing for the outbreak of a deadly virus, which is expected to kill 600 if no cure is found. You need to choose between two programs: A, B. With program A, 200 people will be saved. With program B there is a 1/3 probability of saving all 600 people, and 2/3 probability of not saving anyone.

Thus, when the choice is framed in terms of numbers of people saved, the two alternatives are:

$$A = \{+200 \quad w.p.\ 1\,, \qquad B = \begin{cases} +600 & \text{w.p. } 1/3 \\ 0 & \text{w.p. } 2/3 \end{cases}$$

The majority (72%) of doctors who participated in this experiment chose A over B. This is indeed what the EUT predicts that risk-averse individuals should choose. The mean of B is 200, so risk-averse individuals should prefer the mean of this lottery (i.e. program A) over the lottery itself. In a different experiment, with another group of doctors, the participants had to choose between programs C and D. If program C is adopted, 400 people will die with certainty, and if program D is adopted, there is 1/3 probability that nobody will die, and 2/3 probability that 600 will die.

Thus, framed in terms of people dead, the two alternatives are:

$$C = \{-400 \quad w.p.\ 1\,, \qquad D = \begin{cases} 0 & \text{w.p. } 1/3 \\ -600 & \text{w.p. } 2/3 \end{cases}$$

The majority of doctors who participated in this experiment (78%) chose D over C. Here the EUT predicts that risk-averse individuals should again choose the mean of a lottery over the lottery. The mean of D is -400, so the EUT predicts that risk-averse individuals will choose C over D, which is the opposite from what the majority of participants chose. Thus, it seemed like the participants in this experiment were risk-seeking.

Notice that A is the same as C, while B is exactly the same program as D. The difference is in the way these programs are framed. A and B are framed in terms of lives saved (gains) and C and D are framed in terms of numbers of dead (losses). Thus, Kahneman and Tversky modified the original vNM utility function so that it is consistent with riskaverse behavior for gains (concave), and risk-seeking behavior for losses (convex).

Figure 3 describes such utility function, which we call value function, and denote by $v{:}R \rightarrow R$ As in EUT, we will always assume that the value function v is monotone increasing.

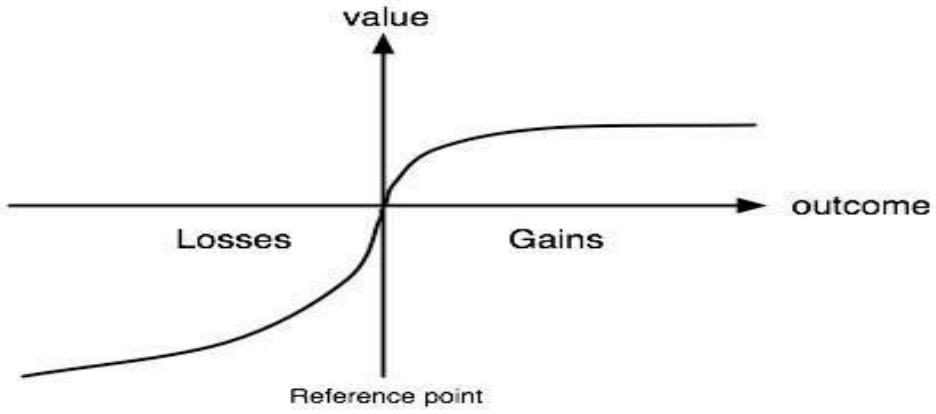


Figure 3: Prospect theory value function.

Notice that the vNM utility function $u{:}R \rightarrow R$ in EUT, was not restricted to be concave or convex, and it potentially could have the shape of the Prospect Theory value function in figure 1.3. However, the EUT is usually applied to final wealth, which is usually positive.

The prospect theory however abstracts from wealth, and focuses on gains and losses. But nevertheless, the above value function seems more like a refinement of the EUT, rather than an altogether new theory.

To summarize there are many versions of Prospect Theory (PT) today, but they all share the properties of (i) framing, and (ii) probability weighting.

 Original Prospect Theory 1979.

For any lottery $A \epsilon \mathcal{L}$, with outcomes $x1 < x2 < \ldots < xn$ and probabilities $P_1; P_2; \ldots ; Pn,$ and given the individual's value function $v{:}\ R \rightarrow R$ and his weighting function $w{:}\ [0;\ 1] \rightarrow [0;\ 1],$ the Prospect Theory utility from the lottery A is given by

$$_{PT}(A) = \sum_{i=1}^{n} w\,(p_i)v\,(x_i)$$

This looks similar to EUT, except that the vNM utility function *u* is replaced by the prospect theory value function *v*, and instead of the actual probabilities of outcomesp_i, the individual uses the weights$w\,(p_i)$.

Therefore, the original prospect theory was modified, and in 1992 Kahneman and Tversky developed the so called Cumulative Prospect Theory (CPT).

 Cumulative Prospect Theory 1992.

For any lottery $A \in \mathcal{L}$, with outcomes $x1 < x2 < \ldots < xn$ and probabilities $P_1; P_2; \ldots ; Pn$, and given the individual's value function $v: R \rightarrow R$ and his weighting function $w: [0; 1] \rightarrow [0; 1]$, the Cumulative Prospect Theory utility from the lottery A is given by

$$_{CPT}(A) = \sum_{i=1}^{n} [w\,(F_i) - w\,(F_{i-1})]v\,(x_i)$$

This seems like a very similar definition to the original Prospect Theory, and indeed in many cases the resulting utility from a lottery is very similar (PT (A) is similar to CPT (A)). The prospect theory (PT or CPT) is more general than the EUT, and seem to be able to resolve some inconsistencies of EUT with empirical and experimental evidence. The disadvantage of the CPT is its complexity, which makes it difficult to apply in practice.

The next section presents the modern portfolio theory, which is based on the assumption that people choose among risky alternative according to the MVT, i.e. all we need to compare lotteries or financial assets is the mean and variance of their returns.

6. Mean Variance Portfolio Analysis and Capital Asset Pricing Model (CAPM)

We begin our analysis with simplifying assumptions. There are only two periods, and preferences over risky returns are represented with Mean-Variance Theory (MVT).That is, we assume that the mean-variance utility function is $v(\mu, \sigma)$, where μ is the mean return and $\sigma^2$is the variance of the return.

6.1. Mean-Variance Portfolio Analysis

Suppose that there are n assets indexed by $i = 1, 2 \ldots n$. The price of an asset *i* in the first period is q_i and in the second period the asset pays dividend D_i' and has the priceq_i'. Thus, the total value of the asset in the second period is $A_i' = D_i' + q_i'$. The gross return on the asset is$R_i = A_i'/q_i$, and the net return is $r_i = R_i - 1$.

In our analysis we focus primarily on the net returns, since most of the examples we will encounter present data on net returns. From the point of view of the investor, who makes portfolio decisions in the first period, the return on a given asset,r_i, is a random variable, with mean (expected value) and variance.

Let [Mean] : $\mu_i = E(r_i)$

[Variance]: $\sigma_i^2 = Var(r_i)$

And [Standard deviation] : $\sigma_i = \sqrt{Var(r_i)}$

The standard deviation (or variance) tells us how volatile the asset returns are. An asset that guarantees a particular return r_f with certainty, is called a risk-free asset, and we have $E(r_f) = r_f$, and $Var(r_f) = 0$. For any two assets, *i* and *j*, we will also be interested in the degree of comovement of their returns (r_i and r_f), which is measured with covariance or correlation: [Covariance] : $\sigma_{ij} = Cov(r_i, r_f)$ or [Correlation]

: $\rho_{ij} = \frac{Cov(r_i, r_f)}{\sigma_i \sigma_j}$.

We can see almost terms and formulas we use in this survey are from statistic. The mean and variance (or standard deviation) is the only two features of any asset (or portfolio of assets) that investors care about. Thus, any asset can be represented as a point in the mean-variance space, as figure illustrates.

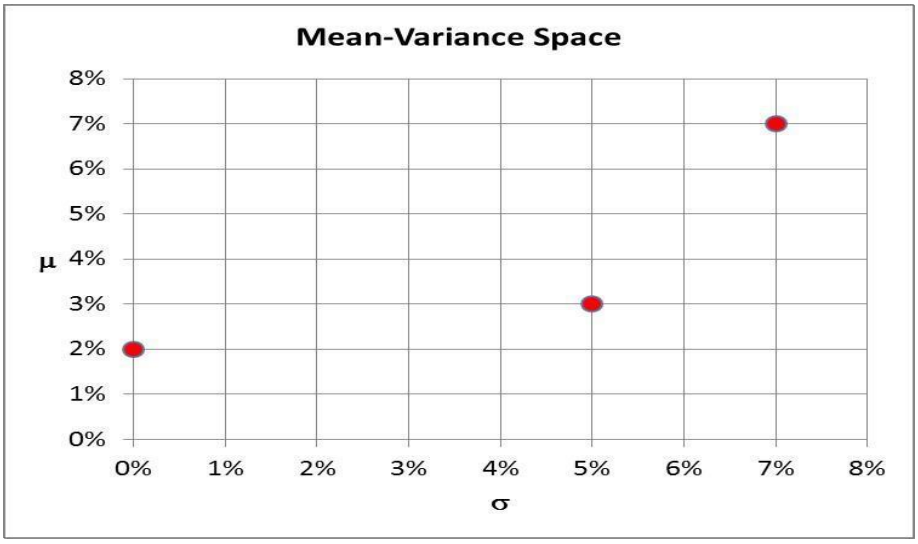


Figure 4: Mean-variance space.

The figure shows 4 assets: a risk-free asset with mean return of 2% and variance of zero, a risky asset with mean return of 3% and standard deviation of 5%, and another risky asset with mean return of 7% and standard deviation of 7%.The mean returns, variances and covariances are usually estimated based on historical data. Although figure 4 is called the mean-variance space, we prefer to use σ (standard deviation) on the *x*-axis instead of σ^2(variance), because standard deviations have the same units as the data, while the units of variance are the original units squared.

6.1.1. Portfolios with two risky assets

Suppose an investor divides some amount of his wealth, *w*, between two assets *i* and *j*, such that a fraction $\lambda \epsilon$ [0; 1] is invested in *i* and the rest $1-\lambda$ is invested in *j*. The net return on a portfolio is: $r_\lambda = \lambda r_i + (1-\lambda) r_j$

Since the returns $r_i$and r_j are random variables, the return on the portfolior_λ is also a random variable. Thus, any portfolio composed of risky assets can be viewed as just another risky asset, with random return r_λ, and with mean and variance as follows:

$$\mu_\lambda = E(\lambda\, r_i + (1-\lambda)\, r_j) = \lambda\mu_i + (1-\lambda)\,\mu_j$$

$$\sigma_\lambda^2 = Var(\lambda\, r_i + (1-\lambda)\, r_j) = \lambda^2\sigma_i^2 + (1-\lambda)^2\sigma_j^2 + 2\lambda(1-\lambda)\rho_{ij}\sigma_i\sigma_j$$

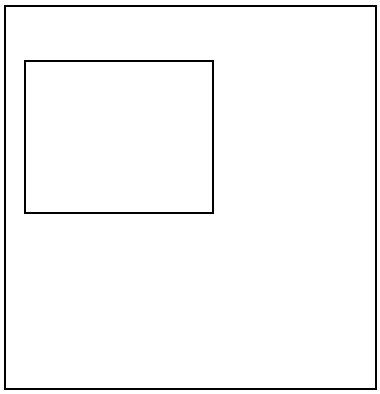
$$\sigma_\lambda = \sqrt{[Var(\lambda\, r_i + (1-\lambda)\, r_j)]}$$

The mean return on the portfolio depends on the mean returns of the com-posing assets (μ_i andμ_j), as well as the asset sharesλ and$(1-\lambda)$. Thus, the mean return is a weighted average of the mean returns on individual assets. The variance of the portfolio return depends on the variances of returns of the composing assets σ_i^2 andσ_j^2 on the asset shares λ and $1-\lambda$ and on the covariance (or correlation) of the asset returns.

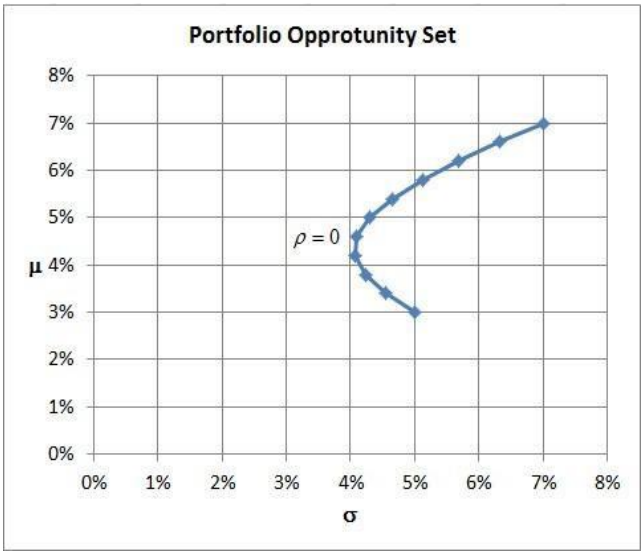
Therefore, even an investor who cares only about mean and variance of his portfolio (MVT investor), will still need information about the correlations of assets in his portfolio.

We assume that asset returns are exogenous to investors, and investors can only choose the portfolio share (or portfolio weight) of each asset,$\lambda \in [0; 1]$, (and$1-\lambda$) in this case. By varying $\lambda \in [0; 1]$, the investors can create infinitely many portfolios, even if there are only two assets available. The set of all possible portfolios can be presented graphically, in the mean-variance space, as the mean-variance opportunity set. For any two assets with returns r_i andr_f , the mean-variance opportunity set, is the set of all mean and standard deviations of returns on portfolios created from investing a share $\lambda \in [0; 1]$in asset *i* and share $1-\lambda$ in asset *j*. Mathematically, the mean-variance opportunity set is defined as follows:

$$OS_{ij} = \left\{(\mu_\lambda, \sigma_\lambda) \epsilon R \times R_+ / \lambda \in [0; 1],\ \mu_\lambda = \lambda\mu_i + (1-\lambda)\,\mu_j,\ \sigma_\lambda = \sqrt{[Var(\lambda\, r_i + (1-\lambda)\, r_j)]}\right\}$$



	Asset i	Asset j
μ	3%	7%
σ	5%	7%
ρ_{ij}	0	



Two assets

Figure 5: Mean-variance opportunity set for two assets.

Each point on the graph represents a portfolio created with a particularλ.

For example, the point (*3%, 5%)* is created from$\lambda = 1$, which means that the portfolio consists entirely of asset *i*. Similarly, the point (*7%, 7%)* is the portfolio corresponding to$\lambda = 0$, which means that the entire investment is in asset *j*. All the other points on the graph represent portfolios with$0 < \lambda < 1$, i.e. portfolios containing positive shares of both assets. What we need to know here is the standard deviation ("risk") of asset *i* is 5%, and when combined with a more risky asset j, with standard deviation of 7%, we are able to create a portfolio with around 4% standard deviation! This is a stunning feature, which is called the diversification effect. This terms means the reduction in portfolio risk (variance) that results from combining assets with certain statistical (probabilistic) features. For example:

"You are invested equally in a company that produces suntan lotion and a company that produces umbrellas. If the summer turns out to be sunny, the first company does well and the second poorly. In contrast, if the summer turns out to be rainy, the first company does poorly and the second does well. In other words, their returns are negatively correlated. By investing in both of them, instead of only one of them, obviously you reduce your portfolio risk a lot. Let see what happen with n risky assets.

6.1.2. Portfolios with n risky assets

Suppose there are n > 2 risky assets with random returns $r_1, r_2, \ldots . r_n$ and $\lambda_1, \lambda_2, \ldots . \lambda_n$the portfolio shares (weights) of some fund allocated to these assets. The shares must add up to 1, which is like a "budget constraint": $\sum_{i=1}^{n} \lambda_i$

The return on a portfolio with given shares is $\lambda_1, \lambda_2, \ldots . \lambda_n$

$$r_\lambda = \lambda_1 r_1 + \lambda_2 r_2 + \cdots . + \lambda_n r_n = \sum_{i=1}^{n} \lambda_i r_i$$

As before, the return on a portfolio is random, and has mean and variance

$$\mu_\lambda = \lambda_1\mu_1 + \lambda_2\mu_2 + \cdots . + \lambda_n \mu_n = \sum_{i=1}^{n} \lambda_i \mu_n$$

$$\sigma_\lambda^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} \lambda_i\lambda_j Cov(r_i, r_j)$$

Recall that variance of a random variable can be defined as the covariance of that random variable with itself. Therefore, the double summation terms for $i = j$ captures the individual variance terms of every returnr_i, multiplied by λ_i^2.

The notation becomes much easier if we express the above in matrix form. Moreover, matrix notation makes programming with Mat lab straightforward. The means of all asset returns can be expressed with the *n*-by-*1* vector μ

$$\mu = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_n \end{bmatrix}_{n\times 1}$$

The covariance matrix of all individual assets is n-by-n matrix $\sum$:

$$\sum = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \cdots & \sigma_{1n} \\ \sigma_{21} & \sigma_2^2 & \cdots & \sigma_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{n1} & \sigma_{n2} & \cdots & \sigma_n^2 \end{bmatrix}_{n\times n}$$

Thus, the *ij*th element is $\sigma_{ij} = Cov(r_i, r_j)$, and the elements on the diagonal are the individual variances.

We introduce two more notations: the vector of portfolio weights and a vector of 1-s:

$$\lambda = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_n \end{bmatrix}_{n\times 1} , \quad I_n = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$$

With these notations, we can write the budget constraint $[BC]$ as:

$[BC]: \lambda' 1_n = 1$

The portfolio mean is: $\mu_\lambda = \lambda'\mu$ And the portfolio variance as: $\sigma_\lambda^2 = \lambda' \sum \lambda$

With more than 2 assets, the mean-variance opportunity set is not a curve, we have seen that combining two assets in a portfolio, creates an opportunity set which is a curve. Even with 3 assets, one can create portfolios with pairs of assets, and that will give three curves. But in addition to pairs, any portfolio consisting of two assets can be considered as another asset, which can be combined with individual assets in yet new portfolios. This is why the opportunity set is connected, i.e. does not have "holes".

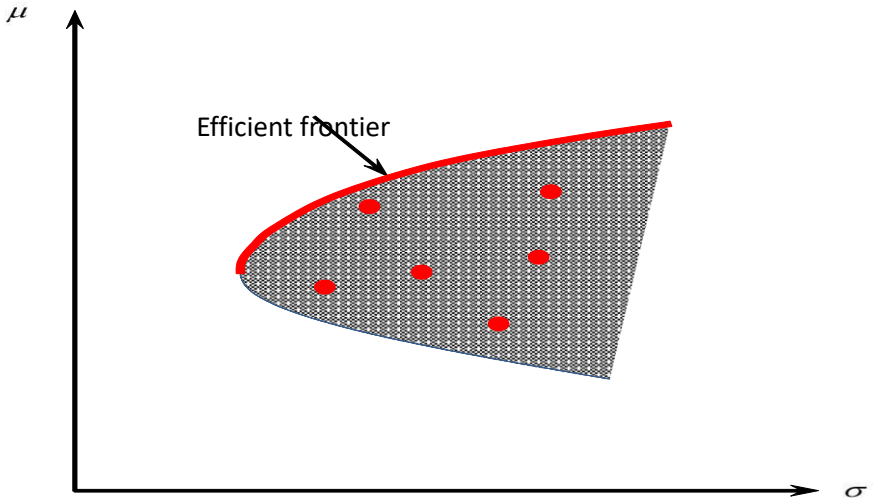


Figure 6: Mean-variance opportunity set, n > 2 assets.

Imagine that you choose portfolios that give you minimum variance of return for any level of mean return. These portfolios would be on the left boundary of the opportunity set, and are called the minimum-variance frontier. However, only the increasing part of the minimum-variance frontier constitutes the efficient frontier, because any portfolio below thee efficient frontier is dominated by some portfolio on the efficient frontier.

In other words, for any portfolio under the efficient frontier, there is another portfolio on the efficient frontier which has higher return and lower variance. Any investor should choose portfolios on the efficient frontier only.

To summarize, in this section we illustrated the shape of the mean-variance opportunity set, and concluded that any MVT investor, with monotone and variance averse utility function, will choose a portfolio on the efficient frontier only. However, we will show in the next section, that investors can in general do much better than the efficient frontier, if there exists a risk-free asset. In reality, there are such assets, for example government bonds or treasury bills that have a guaranteed return over one period.

6.1.3. Adding a risk-free asset

Suppose that in addition to the n risky assets with random returns $r_1, r_2, \dots . r_n$, we also have a risk-free asset with guaranteed return r_f.

Let the portfolio share in the risk-free asset be λ_0, and the shares in other risky assets be as before $\lambda = [\lambda_1, \lambda_2, \dots . \lambda_n]'$. The "budget constraint" on the weights is $\lambda_0 + \sum_{i=1}^{n} \lambda_i =$

1

Notice that the sum of weights on risky assets is $\sum_{i=1}^{n} \lambda_i = 1 - \lambda_0$. Let see an example:

The portfolio $\lambda_0 = 0.4,\ \lambda = [0.1, 0.2,\ 0.3]'$ consists of 40% investment in risk-free asset,

and 10%, 20% and 30% investment in risky assets 1, 2 and 3. Thus, 60% of the portfolio is invested in risky assets. If we refer to the portfolio of the risky assets as a separate portfolio, then the weights have to add up to 100%, and this is achieved by dividing λ by the sum of its weights:

$$\frac{\lambda}{\sum_{i=1}^{n}\lambda_i} = \frac{\lambda}{1-\lambda_0} = \left[\frac{0.1}{0.6}, \frac{0.2}{0.6}, \frac{0.3}{0.6}\right]'$$

Consider a portfolio which combines a fraction λ_0 invested in the risk-free asset with $1-\lambda_0$ invested in some portfolio *p* consisting of the other n risky assets only. Notice that if $\lambda_0 < 0$, the investor borrows money at the risk-free return. The return on this new portfolio is:

$$r = \lambda_0 r_f + (1-\lambda_0) r_p$$

With mean and variance:

$$\mu_r = \lambda_0 r_f + (1-\lambda_0)\mu_p$$

And

$$\sigma_r^2 = (1-\lambda_0)^2\sigma_p^2, \quad \sigma_r = (1-\lambda_0)\sigma_p$$

Thus, combinations of the risk-free asset with any other portfolio of risky assets are located on the line that connects the risk free asset and this other portfolio *p*.

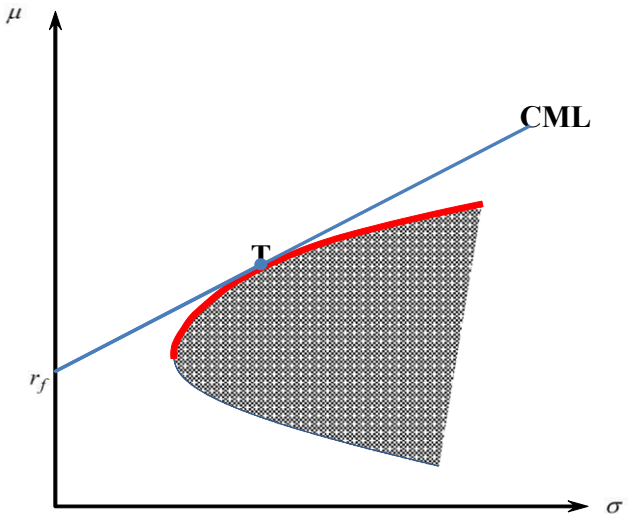


Figure 5: Capital Market Line (CML)

We see on figure 5 that the best investment opportunities are created when we combine the risk-free asset with the tangent portfolio on the efficiency frontier (portfolio T).

The line that connects the risk-free portfolio with the tangent portfolio is called the Capital Market Line (CML). The slope of the capital market line is called the Sharpe ratio (SR), and is equal

$$SR = \frac{\mu_T - r_f}{\sigma_T}$$

The Sharpe ratio gives the tradeoff between risk and return, i.e. the excess return that investors can get over the risk-free asset, for every additional unit of risk (the standard deviation). For example, suppose that μ_T = 7%, r_f = 2%, σ_T = 10%. Then, the Sharpe ratio is

$SR = \frac{\mu_T - r_f}{\sigma_T} = \frac{7-2}{10} = 0.5$, This means that an increase in risk of a portfolio (standard deviation) by 1% is compensated with a 0.5% higher expected return.

Notice that with the risk-free asset, investors have better set of portfolios to choose from (CML) than the efficient frontier, because the CML lies above the efficient frontier, and coincides with the efficient frontier only at the tangent portfolio. All investors will therefore choose some portfolios on the CML.

Those who desire less risk, will invest a greater proportion of their wealth in the riskfree asset (λ_0 is greater). These conservative investors will choose portfolios on the CML that are close to r_f. In other words, all investors should choose portfolios on the Capital Market Line.

In order to make optimal investment choices, we now need to find the tangent portfolio (which is the same as finding the Capital Market Line).

As you can see, finding the optimal portfolios analytically (the CML) is a tedious task, even with only two risky assets. With more than 3 risky assets, it is a mission impossible, and requires the use of computer optimization software.

6.2. Capital Asset Pricing Model (CAPM)

In the previous section we derived optimal portfolios for investors whose preferences are described by Mean-Variance Theory (MVT). Without a risk-free asset, we showed that investors will choose portfolios from the efficient frontier of the opportunity set.

Under the assumption that there is a risk-free asset, and that investors can borrow and lend at the risk-free rate r_f. We showed that all MVT investors will choose portfolios from the Capital Market Line (CML) which is the highest slope line connecting the riskfree asset with the mean-variance opportunity set. Thus, the CML is the set of optimal portfolios such that any investor with MVT preferences will choose from. The implication is that all investors hold the same portfolio of risky assets, called the tangent portfolio T, and the only difference between investors is the fraction $\lambda_0$invested in riskfree asset versus the fraction invested in the tangent portfolio T.

Since all investors hold the same portfolio of risky assets, shares of risky assets $\lambda_1, \lambda_2, \dots . \lambda_n$in the tangent portfolio are common to all investors. For example, if IBM stock represents 0.1% of investor A portfolio of risky assets, it also represents 0.1% of investor B portfolio of risky assets. Suppose there are I investors. The market share of asset i, out of the total market value of all risky assets is:

$$\frac{\sum_{j=1}^{I} \lambda_i \, \omega_i}{\sum_j^I \sum_{i=1}^{n} \lambda_i \, \omega_i} = \frac{\omega_i \sum_{j=1}^{I} \lambda_i}{\sum_{j=1}^{I} \omega_i \sum_{i=1}^{n} \lambda_i} = \frac{\lambda_i W}{W} = \lambda_i$$

Where ω_i is investor j wealth (money) invested in the market for risky assets (say the stock market), and $\sum_{j=1}^{I} \omega_i$= W is the total value of all the risky-assets. Therefore, since all the investors hold all the risky assets, the individual share of asset i in the tangent portfolio is also the market share of asset *i*, and the tangent portfolio T in equilibrium is also the Market portfolio M. Thus, in this section we will refer to the tangent portfolio as the market portfolio.

6.2.1 Deriving the CAPM

The starting point is the result that all investors hold the same market portfolio M of risky assets (which is the same as the tangent portfolio T). The market portfolio contains positive shares of all existing assets. Next we examine the effect of slightly changing the share of some security *i*. Consider mixing a small fraction ω of some security *i* with $1 - \omega$ of the market portfolio.

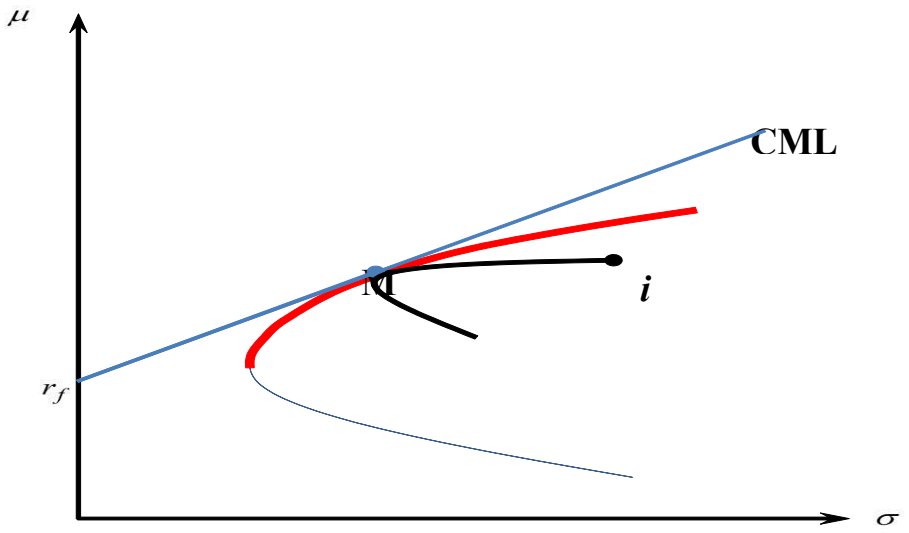


Figure 6: Market portfolio mixed with asset i.

When $\omega = 0$the *i*-curve coincides with the market portfolio. For$0 < \omega \leq 1$, the combination is between M and *i*. Values of $\omega < 0$ mean that we are selling some of the existing holdings of asset *i* in the market portfolio.

The return on portfolios that combineω of asset *i* and$1 - \omega$ of the market portfolio is:

$r_p = \omega r_i + (1 - \omega)r_M$

With mean and variance:

$\mu_p = \omega\mu_i + (1 - \omega)\mu_M$ And $\sigma_p^2 = \omega^2\sigma_i^2 + (1 - \omega)^2\sigma_M^2 + 2\omega(1 - \omega)Cov(r_i, r_M)$

6.2.2. CAPM in practice

We studied optimal portfolio selection under the assumption that all investors care about is the mean and variance of the return to their investment. In other words, we assumed that preferences are described by the Mean-Variance Theory (MVT). This is not the same as assuming that there is only one investor, or that all investors are identical.

In our examples we assumed that the mean-variance utility of individual *i* is:

$\mu^i(\mu, \sigma) = \mu - \frac{\gamma_i}{2}\sigma^2$

Thus, there could be unlimited number of investors, which differ by their varianceaversion (or risk aversion) parameterγ_i. Despite the differences in preferences among individual investors, we arrived at a striking conclusion - the Two-Fund Separation Theorem, which implies that all investors will invest in two funds only: the risk-free asset and market portfolio. The only difference between investors' portfolios is the fraction of their financial wealth invested in the risk-free asset,λ_0, more variance-averse investors will hold a larger portion of their financial wealth in the risk-free asset. But nevertheless, all investors will hold the same market portfolio of risky assets - M.

Moreover, we showed that all assets (and all portfolios for that matter), must lie on the same Security Market Line. As follow this equation: $\mu_i - r_f = \beta_i(\mu_M - r_f)$

The expected excess return on asset *i* (or any portfolio) is proportional to its Beta:

$$\beta_i = \frac{Cov(r_i, r_M)}{Var(r_M)} = \rho_{iM}\frac{\sigma_i}{\sigma_M}$$

The term $\mu_i - r_f$ is the expected excess returns on asset *i*, and $\beta_i(\mu_M - r_f)$ is the predicted excess return by the CAMP (SML). Asset i has mean return higher than the one predicted by the SML (positive Alpha), while asset j has mean return lower than the predicted by SML (negative Alpha).

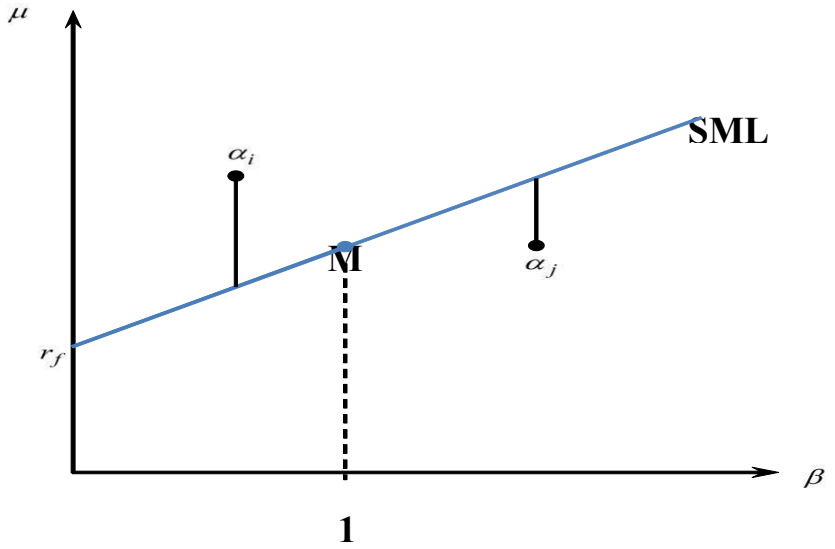


Figure 7: The Alpha of an asset (or portfolio).

Our first instinct tells us that positive Alpha of an asset (or portfolio) is an indicator that the asset outperformed the market, and had average return above what the theory (CAPM) predicts.

Similarly, a negative Alpha indicates that an asset (or portfolio) underperforming, and delivering returns below the levels required by its Beta risk. A very appealing (but dangerous!) investment strategy of buying assets with positive Alpha and short selling assets with negative Alpha.

One explanation for observing non-zero Alphas is that different investors tend to specialize in different subsets of assets. If a hedge fund specializes in particular industries, its tangent portfolio will consist of that industry's securities.

The derivation of the CAPM shows that if the tangent portfolio consists of a group of assets, then all the assets that make up the tangent portfolio, or any combination of these assets, must have Alpha of zero.

The practical implication of this is that all investors need to choose whether to actively manage their portfolio (be active investors) or be passive. Active investors will choose their own tangent portfolio, while passive investors will simply invest in some mutual fund (index fund). One needs to remember that μ and $\sum$ are not given, and active investors must estimate the mean returns and covariance's based on historical data, and sometimes make predictions based on firm-specific factors, industry-specific factors and macroeconomic forecasts. Thus, being active investor entails a cost, and it can be shown theoretically that only the most efficient and informed investors will be active in equilibrium.

7. Conclusion

This paper presents the theory of decision under uncertainty which develop alternative theories for choices under risk. To summarize, the prospect theory (PT or CPT) is more general than the EUT, and seem to be

able to resolve some inconsistencies of EUT with empirical and experimental evidence. The disadvantage of the CPT is its complexity, which makes it difficult to apply in practice. Of the three theories, the CPT is by far the most complicated, while the MVT is the simplest.

The result show the modern portfolio theory, which is based on the assumption that people choose among risky alternative according to the MVT. All we need to compare lotteries or financial assets is the mean and variance of their returns.

References

Abdellaoui, M., A. Baillon, L. Placido, and P. Wakker (2009): "The Rich Domain of Uncertainty," Discussion paper, Erasmus School of Economics, Erasmus University.

Ahn, D., S. Choi, D. Gale, and S. Kariv (2009): "Estimating Ambiguity Aversion in a Portfolio Choice Experiment," Working paper.

Akay, A., P. Martinsson, H. Medhin, and S. Trautmann (2009): "Attitudes toward
Uncertainty among the Poor: Evidence from Rural Ethiopia," discussion paper 4225, IZA.

Al Najjar, N., and J. Weinstein (2009): "The Ambiguity Aversion Literature: a Critical assessment," Economics and Philosophy, In press.

Amarante, M. (2009): "Foundations of neo-Bayesian statistics," Journal of Economic Theory, 144, 5.

Andersen, S., J. Fountain, G. Harrison, and E. Rutstr¨om (2009): "Estimating Aversion to Uncertainty," mimeo.

Anscombe, F., and R. Aumann (1963): "A definition of subjective probability," Annals of Mathematical Statistics, 34, 199–205.

Arrow, K., and L. Hurwicz (1972): "An optimality criterion for decision making under ignorance," in Uncertainty and Expectations in Economics, ed. by C. Carter, and J. Ford, pp. 1–11. B. Blackwell.

Bewley, T. (1986): "Knightian decision theory: Part I," Discussion Paper 807, Cowles Foundation.

Borghans, L., B. Golsteyn, J. Heckman, and H. Meijers (2009): "Gender Differences in Risk Aversion and Ambiguity Aversion," discussion paper 3985, IZA.

Bossaerts, P., P. Ghirardato, S. Guarnaschelli, and W. Zame (2009): "Ambiguity in Asset Markets: Theory and Experiment," Review of Financial Studies, In press.

Burks, S., J. Carpenter, L. Gotte, and A. Rustichini (2008): "Cognitivesk ills explain economic prefrences, strategic behavior, and job attachment," Discussion paper 3609, IZA.

Cabantous, L. (2007): "Ambiguity aversion in the field of insurance: insurer's attitude to imprecise and conflicting probability estimates," Theory and Decision, 62, 219–240.

Camerer, C., and H. Kunreuther (1989): "The effects of financial incentives in experiments: a review of capital-labor-production framework," Journal of Risk and Uncertainty, 19, 7–42.
Camerer, C., and M. Weber (1992): "Recent developments in modeling preferences: uncertainty and ambiguity," Journal of Risk and Uncertainty, 5, 325–370.

Chakravarty, S., and J. Roy (2009): "Recursive expected utility and the separation of attitudes towards risk and ambiguity: an experimental study," Theory and Decision, 66(3), 199–228.

Chateauneuf, A. (1994): "Modeling attitudes towards uncertainty and risk through the use of Choquet integral," Annals of Operations Research, 52, 3–20.

Chateauneuf, A., M. Cohen, and I. Meilijson (2004): "Four notions of mean preserving increase in risk, risk attitudes and applications to the Rank- dependent Expected Utility model," Journal of Mathematical Economics, 40, 547–571.
Chateauneuf, A., J. Eichberger, and S. Grant (2007): "Choice under uncertainty with the best and worst in Mind: Neo-additive capacities," Journal of Economic Theory, 137, 538– 567.

Chateauneuf, A., and J. Faro (2009): "Ambiguity through confidence functions," Journal of Mathematical Economics, In press.

Chateauneuf, A., and J.-M. Tallon (2002): "Diversification, convex preferences and nonempty core in the Choquet expected utility model," Economic Theory, 19(3), 509–523.

Chew, S., and J. Sagi (2006): "Event Exchangeability: Small Worlds Probabilistic Sophistication without Continuity or Monotonicity," Econometrica, 74, 771–786.

(2008): "Small Worlds: Modeling Attitudes toward Sources of Uncertainty," Journal of Economic Theory, 139, 1-24.

Chow, C., and R. Sarin (2002): "Known, unknown and unknowable uncertainties," Theory and Decision, 52, 127–138.

Cohen, M., and J.-Y. Jaffray (1980): "Rational behavior under complete ignorance," Econometrica, 48(5), 1281–1299.

Cohen, M., J.-Y. Jaffray, and T. Said (1985): "Individual behavior under risk and under uncertainty : an experimental study," Theory and Decision, 18, 203–228.

(1987): "Experimental comparison of individual behavior under risk and under uncertainty for gains and for losses," Organizational Behavior and Human Decision Processes, 39, 1–22.

Cohen, M., J.-M. Tallon, and J.-C. Vergnaud (2009): "An experimental investigation of mprecision attitude and its relation with risk attitude and impatience," mimeo, Universit´e Paris I.

Curley, S., and F. Yates (1985): "The center and range of the probability interval as factors affecting ambiguity preferences," Organizational Behavior and Human Decision Processes, 36, 272–287.

Dekel, E., B. Lipman, and A. Rustichini (2001): "Representing preferences with a unique subjective state space," Econometrica, 69, 891–934.

Di Mauro, C., and A. Maffioletti (2004): "Attitudes to risk and attitudes to uncertainty: experimental evidence," Applied Economics, 36, 357–372.

Dominiak, A., P. D¨urschz, and J.-P. Lefort (2009): "A Dynamic Ellsberg Urn Experiment," Discussion Paper Series 487, University of Heidelberg.

Dow, J., and S. Werlang (1994): "Learning under Knightian uncertainty: the law of large numbers for non-additive probabilities," mimeo, London School of Business.

Du, N., and D. Budescu (2005): "The Effects of Imprecise Probabilities and Outcomes in Evaluating Investment Options," Management Science, 51, 1791– 1803.

A methodology proposal to develop a research project for innovation system

Dr. Jonas Gomes da Silva (jgsilva@ufam.edu.br)
Eureka Laboratory
Department of Industrial Engineering - Faculty of Technology
Federal University of Amazon (UFAM)
Manaus – Amazon – Brazil

Abstract

Around the world many students or professionals interested in innovation system field dream to have a master, doctor or post doctorate experience in a top university. However, it is noted that are difficulties to identify a top university and propose a good research for a potential supervisor. So, the aim is to propose a methodology to help readers to write a research project concerning innovation system in order to submit into top universities selection process. In order to do so, a basic conceptual methodology with 8 steps and guidance will be presented by using a real case entitled as "The Best UK Universities Management Practices to Foster Local Entrepreneurship and Innovation", a basic post doctorate project that the author submmited and was approved in 2018 by the Directors of The Manchester Institute of Innovation Research at Alliance Manchester Business School in the University of Manchester. It was concluded that there is no a universal standard to write a research project concerning to innovation system field or even other field, each university or fund/grand foundation develops its own model. So the conceptual methodology doesn't want to replace other methodologies, but only guide those candidates that wish to write a proposal and follow the orientations given in this article.

Keywords: Research project; Innovation System; University;

1. Introduction

In a knowledge society, professionals with a quality post-secondary education are more employable, earn higher wages, and cope better with economic crisis. In this sense, higher education contributes both individuals and society, since a solid post-secondary education is a prerequisite for a country's ability to innovate and for its healthy long-term growth (adapted from WORLD BANK, 2018). Here Higher Education means Education institutions that support students beyond the secondary school level, specifically colleges, universities, graduate schools, and professional schools, often supporting applied and pure research (adapted from IEG, 2017 page 164).

Nowadays, nations must innovate and produce new technologies and/or services to speed up their competitiveness and adapt technologies to face local challenges. As a result, the role of universities in supporting and producing these outcomes is critical through the: provision of services to develop job-relevant skills aligned with demand in the economy; promotion of skills to complement the development

of competitive advantage; focus on research, learning, innovation, production and adaptation of technologies into local development; and dissemination of best management practices to society (adapted from DARVAS et. Al., 2017, page xiii).

Around the world there are thousand universities, the correct total number of such institutions is not well known, but according to Statista (2018), a germany online portal of statistics, in June of 2018, there were around 21,709 universities in 25 countries and the ten countries with the highest number of universities were: India (3944; 18.17%), USA (3257; 15%), China (2208;10.17%), Indonesia (2110; 9.72%), Brazil (1394; 6.42%), Russia Federation (1172; 5.4%), Japan (980; 4.5%), Mexico (916; 4.2%), France (620; 2.86%) and Iran (607; 2.8%). And according to the 2019 edition of Education at a Glance (OCDE, 2019 page 231 to 235): a) the number of foreign students engaged in tertiary education programmes wordwide has expanded massively in past few decades, rising from 2 million in 1998 to 5.3 million in 2017. In OCDE area, there were 3.7 million international of foreign students in 2017, 6% more than 2016; b) students become more mobile as they reach more advanced levels of education. International students account for only 3% of total enrollment in short-cycle tertiary programmes and 4% of total enrolment in bachelor`s programmes, but they represent 22% of enrollment in doctoral programmes; c) international enrolment is much higher doctoral level in the OCDE area (Figure 1), particularly in France, Luxembourg, the Netherlands New Zeland, Switzerland and United Kingdom, where 40% or more tertiary students come from abroad.

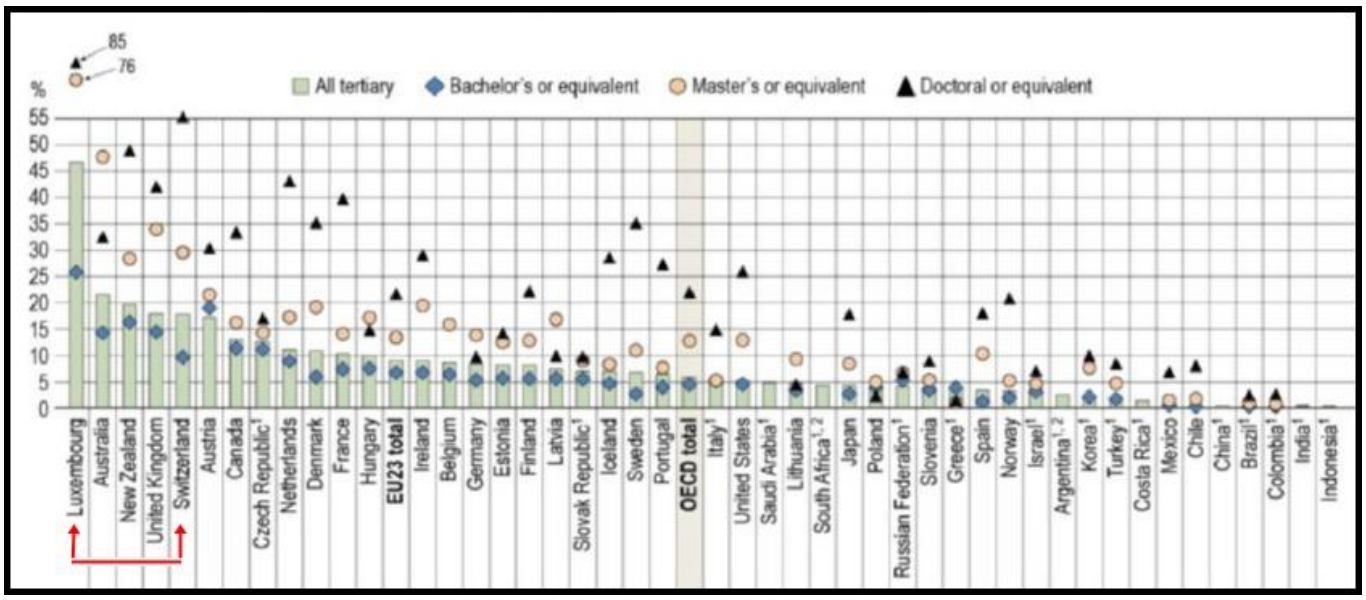


Figure 1 – International student enrollment as a percentage of total enrolment in tertiary level in 2016
Source: OECD (2019), Figure B6.3 (Year of Reference 2016).

The numbers shown above points out that thousands of people around the world are trying to update their knowledge, skills and networking through universities experiences. And when a student, researcher or other professional wish to study abroad to advance (master, doctor or post doctorate) the knowledge on innovation system issues, he face difficulties to develop a good research project in order to send to potential professors of top universities.

Basically, a research project is a detailed proposal that the candidate wish to undertake. Some universities departments require the candidate to submit a research project/proposal for master, doctor or post doctorate

process. Sometimes the universities have their own models, but independent of the model, it is important to prepare one even if it isn´t a formal requirement of the course. So the main question of this research is "How to build a good research project about innovation system in order to send to top universities selection process?"

So the main aim of this paper is to propose a methodology with basic orientations to help readers to write a research project concerning innovation system in order to submit into top universities selection process.

2. Conceptual Methodology for an effective research project

The research is descriptive with action research method and qualitative approach. Basically, the conceptual methodology is built from the experience of the author during The Manchester University selection process for the Academic Research Visit. Basically, the conceptual methodology has 8 steps as is described on Figure 2 bellow:

2. 1 Step 1: Theme

The theme is the essence of your research. It should be easy to memorize and call the attention or the curiosity of the potential supervisor.

It is recommended to select a theme that the candidate is very interested to investigate, something unique written in at most two lines.

Before decide for the theme, try to make a brainstorming and write five proposals and ask for advices from professors or tutors that have experience in the field. They`ll be able to give opinion on the importance of the theme for the academy and other stakeholders of the society. In short, the candidate should review some classes taken, consider a topic that enjoy to read and talk, think about your field that admires or aspire to be, and try to research current events in order to find topics that are calling a lot of attention and need further investigation.

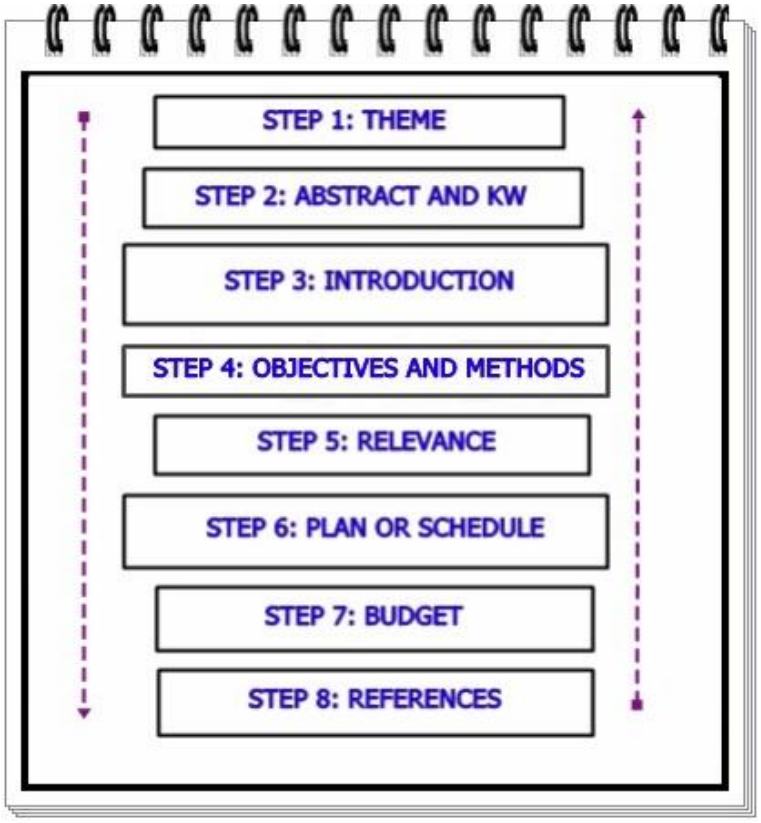


Figure 2 – Methodology to write a Research project

Source: Own Author

2.2 The step 2: Abstract (or Resume) and Key Words

An abstract or resume is a short version of your project. Since the candidate will submit the project for university selection process, it is recommended to check the university norms, but normally this part has

100 to 250 words and is important to write about the main aim of the research, the methodology to collect and analyze the data and the expected results.

The abstract is important because help the potential supervisor or reviewer to: a) decide to read; b) understand the essence of the proposal; c) remember key findings about the subject. The candidate can write the abstract and refine it as the research progresses over time.

The amount of keywords depends of journals, normally it is required 4 to 8 keywords or short phrases. The candidate can choose them by considering using Google Scholar or another scientific search engine.

2.3 The step 3: Introduction

The introduction is the chance to show to the potential supervisor or reviewer that your proposal is valuable. If the candidate wants to write about innovation system and submit into a top university abroad, then some tips are: (a) write the main topics of the introduction; (b) these topics could follow a broad view of the theme and then narrow down; (c); state the research problem; (d) explain the reason why that country and university was selected, if possible try to insert information from university official documents such as strategic planning, professors articles, books, etc; (e) and summarize relevant literature about the theme or topic; (d) use facts, statistics from international and reliable sources.

In this methodology, the literature review was put in this section, since the candidate is just writing a proposal plan to be read for potential supervisors or reviewers selected by University contacted.

2.4 The step 4: The main objectives and methods

It is recommended the maximum of three objectives. The objectives of the proposal plan should be clear, brief, meaningful and interesting. They provide the directions that the candidate desire to go and should reflect a logical sequence that realistically permit to investigate the problem proposed.

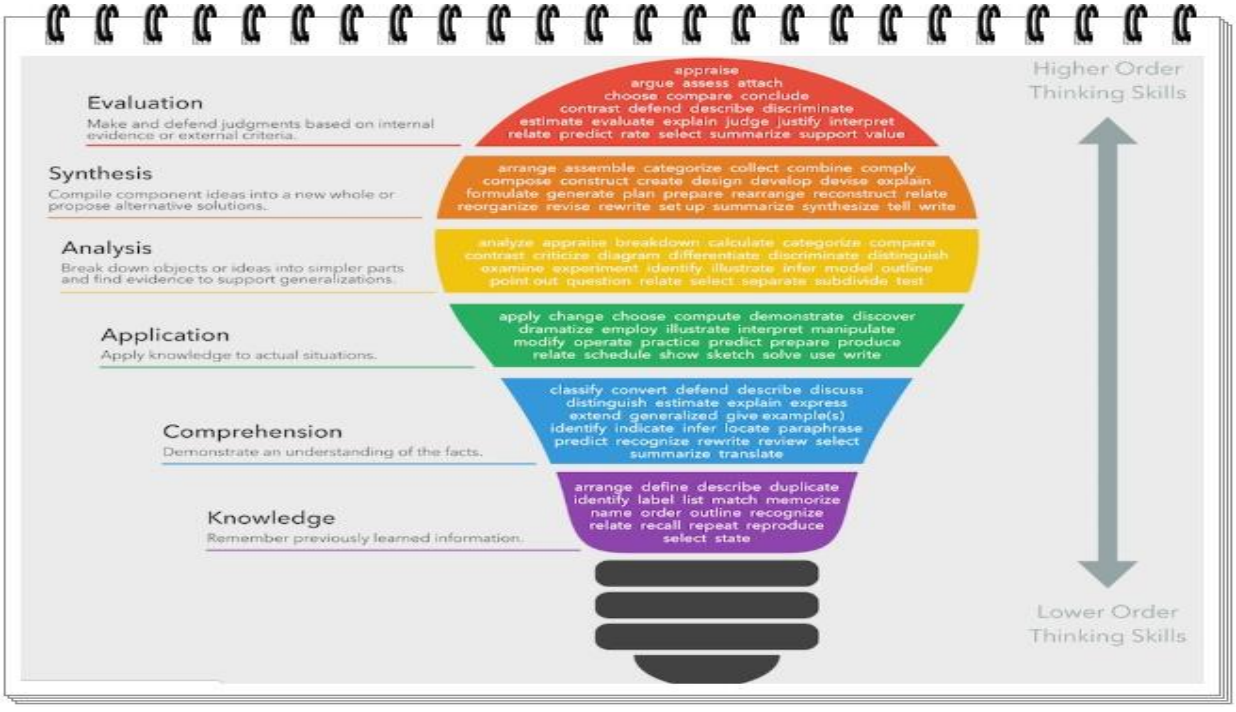


Figure 3 – Bloom`s Taxonomy Verbs

Source: Fractus Learning < https://www.fractuslearning.com/blooms-taxonomy-verbs-free-chart/>

It is recommended to use action verbs such as to investigate, to identify, to study, to compare, to determine, etc. Since innovation system is also focused on educational, training and learning processes, a basic source to consult are Bloom et al. (1956) and Anderson et al. (2001). Basically, Bloom et al. (1956) developed a taxonomy to promote higher forms of thinking in education that was reviewed by Anderson et al. (2001), in the first case is possible to identify the main verbs used when writing objectives for Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation, as shown in Figure 3.

Concerning with the methods, the proposal should make clear on how the results will be attained. Basically, the candidate can write about the type of the research and how will collect and investigate the data. The primary and secondary sources that will be used as well as the main methods to carry out the research. There are several methods used in qualitative and quantitative approaches, such as surveys with sampling method, interviews, focus group, case study, observation, experiment, content analysis, thematic analysis, etc.

It is important to focus on the objectives and/or main research question and when the proposed project be approved, it is recommended during writing process to cite relevant sources to compare different methodologies used to study the problem.

2.5 The step 5: Relevance

The relevance of the proposal shows how significant is to the academy and other stakeholders. So look into the problem and try to visualize for example the value of the study not only for the academic point of view, but to the industry, entrepreneurs, research institutes, government, etc.

2.6 The step 6: Plan or Schedule

The plan or schedule shows the main activities that will be carry out during the period of the research. If the plan is for master project the period is two years, for doctor project is 3 or 4 years depending on the University aimed, for post doctorate project, the period is one year. If the candidate doesn't know when exactly will start the research, the time horizon can be written as Month1, Month 2…. Month N. Otherwise, it is possible to write the month as January until December for the year aimed. It is very important to be realistic about the activities, how long each will be taken, as well as the resources that will be necessary. As much activity put it means that more resource and attention will be demanded.

It is recommended to leave time for editing and correcting, one tip is to use the PDCA method to write the research project: activities to Plan (individually, with the professor or team), to Do, to Check and Act (to register good results or make a corrective or new activities, etc).

2.7 The step 7: Budget

The Budget focused on how much will cost to realize the research project. Normally, a candidate write a research project for a fund/grant agency or a foundation in order to get a scholarship, but due high competition, it is very hard to be approved. So, the candidate should be prepared for a situation that demands the calculation of many resources that will be demanded without the scholarship.

A good budget shows to the potential professor or reviewer that candidate have thought about your research in detail. Some tips are: a) look at the plan or schedule; b) identify each cost item, including the cost that

you will need before going to abroad; c) in a spreadsheet put each cost with the respective month; d) use the value of the coin of the destiny country; e) try to talk with researchers that are living or lived in that country in order to identify the approximate cost of some itens.

With the budget the candidate also can study the types of grant provided by that country and/or university, the rules and value. This is important since the candidate could try to submit a proposal before or after arrive abroad. Also, with the research project and budget, the candidate can search for local or national government support, as well as a company support through Research and Development grant.

2.8 The step 8: References

Each nation has a national norm to write correctly a research project and also References. The candidate can should try to identify the norms of the aimed country in order to put the references according with them. However, if is not possible to do so, use your country`s norms and latter adjust them when arrive in the university aimed.

3. How to identify Top Universities

There are several organizations that rank the universities around the world. Some of them are:

3.1 QS Top Universities

The QS Top Universities (Figure 4) is a medium-sized company with over 250 staff working around the world <https://www.topuniversities.com/>. They have a diverse on line database that permit the user to access not only the ranking, but events, free test preparation, guidance on choosing the university, scholarships, etc.

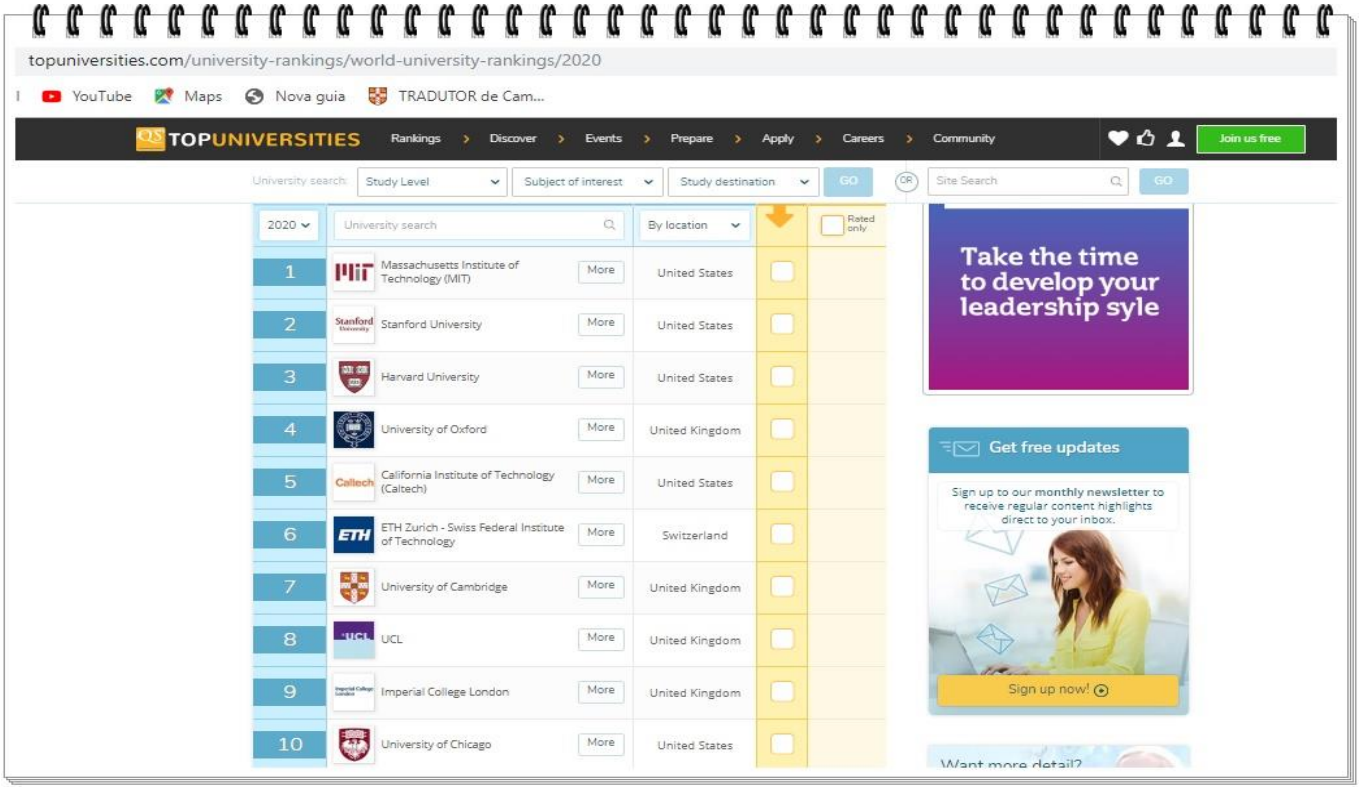


Figure 4: QS Top Universities site

3.2 The Time Higher University Ranking

The Time Higher University Ranking (Figure 5) is an American organization < https://www.timeshighereducation.com/> that is a leading provider of higher education data for world research institutions. In partnership with Elsevier every year they rank universities by using 13 performance indicators, also they organize events and provide useful information to students on where to study, advices, subjects and how to find a University.

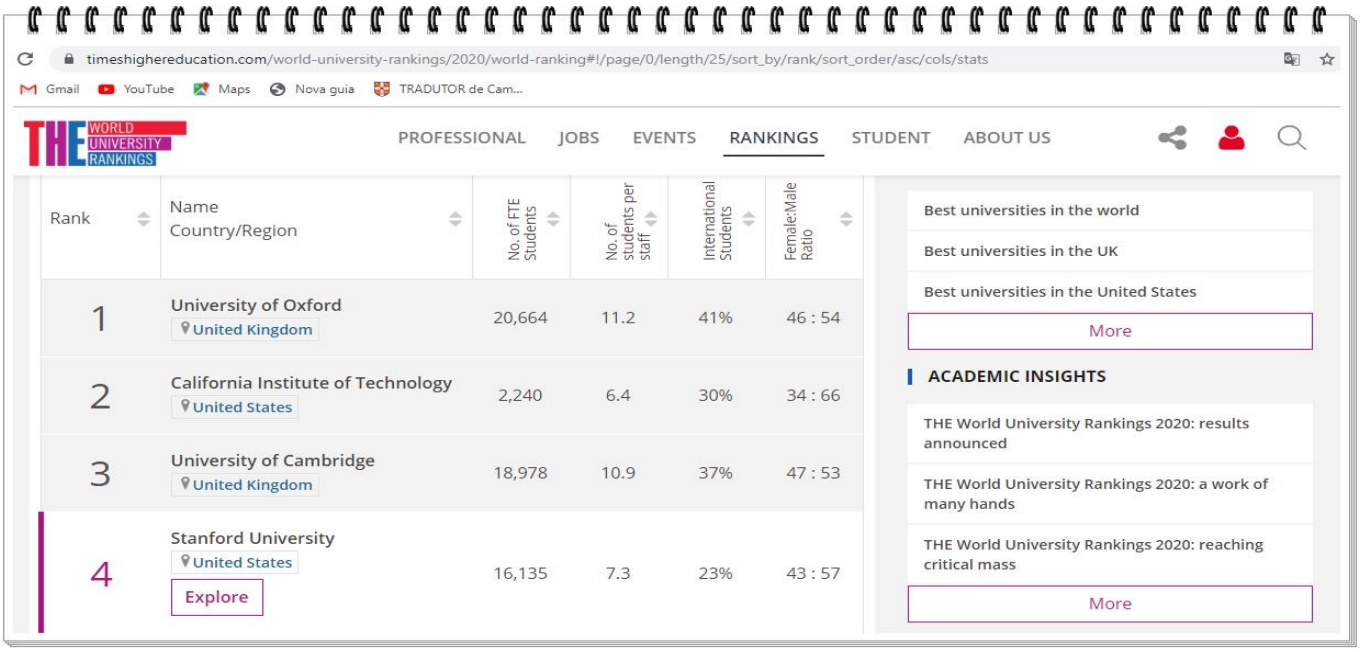


Figure 5 – The Times Higher Education site

3.3 The Reuters Most Innovative Universities

The Reuters (Figure 6) also produce a rank with the 100 most innovative universities <https://www.reuters.com/innovative-universities-2018/methodology>. According with them, all these universities produce original research, create useful technology and stimulate the global economy.

Figure 6 – Reuters site

4. An example of a Research project for Post Doctorate

In order to show the application of the conceptual methodology, this section present main parts of a Post Doctorate research project submitted and approved in 2018 by the Directors of Manchester Institute of Innovation Research.

4.1 Theme

Best UK Universities Management Practices to Foster Local Entrepreneurship and Innovation.

4.2 Resume or Abstract

We're facing global economy recovery and countries able to build up, in long term, dynamic local innovation systems, probably will have more chance to overcome the challenges, creating more jobs and prosperity. In such scenario, universities play an important role, since their scientific, technological and entrepreneur innovation abilities contribute for regional or local innovation systems. Although several innovation system approaches have been developed, few researches were urdertaken to develop models that contribute for universities to achieve world class innovation performance level, taking into consideration the best common management practices identified from an international perspective. Thus, the main aim of this research is to investigate the best UK Universities common management practices used to foster local entrepreneurship and innovation, in order to propose a model to help other universities to achieve them in a long term. In order to do so, innovation systems approaches, models, awards and interview with experts will be used to develop a cross-sectional survey for the data collection and analysis process. The UK Top Universities will be selected through recognized international assessment and The University of Manchester will be the basis of the research. Through interview with experts, researchers, top managers, Deans, NGO leaders and application of a self assessment questionnaire and a cross sectional analysis process, the best common management practices will be identified and used as base to propose a conceptual model with valuable guidance on how to use it to foster local entrepreneurship and innovation.

Key words: Innovation System; University; Best Management Practices: Entrepreneurship

4.3 Introduction

4.3.1 Global Economy and Innovation System

According to the World Economic Outlook Report (a report published twice a year, presenting International Monetary Fund staff economists' analyses of global economic developments) released on april, 2018:

a) world growth strengthened in 2017 to 3.8 percent, with a notable rebound in global trade. It was driven by an investment recovery in advanced economies, continued strong growth in emerging Asia, a notable upswing in emerging Europe, and signs of recovery in several commodity exporters;

b) prospects remain favorable in emerging Asia and Europe, but are challenging in Latin America, the Middle East and sub-Saharan Africa, where — despite some recovery — the medium term outlook for commodity exporters remains generally subdued, with a need for further economic diversification and adjustment to lower commodity prices. More than one-quarter of emerging market and developing

economies are projected to grow by less than advanced economies in per capita terms over the next five years, and hence fall further behind in terms of living standards.

Such scenarios may show that we are facing a global economy recovery and countries able to build up, in a long term, dynamic local innovation systems, probably will have more chance to overcome the challenges, creating more jobs and prosperity.

The concept of "innovation" refers to the search for, development, adaptation, imitation and adoption of technologies that are new to a specific context (DOSI, 1988). An innovation system is therefore a network of organizations within an economic system that are directly involved in the creation, diffusion and use of scientific and technological knowledge, as well as the organizations responsible for the coordination and support of these processes.

According with Skillern (2008) Social entrepreneurship is an innovative, social value- creating activity that can occur within or across the nonprofit, government, or business sectors, primarily to create social value, rather than personal or shareholder wealth.

According with SEO (2006), the concept of Innovation System (IS) is based upon the interactive model of innovation, the key feature of the concept is that an economy's ability to generate innovations does not only depend on how individual actors perform, but rather on how they interact as parts of a system.

4.3.2 Innovation System Approaches

Several types of innovation system approaches have been developed over the time, either focusing on territories as their point of departure or specific technologies/sectors. Among them, are: a) National System of Innovation (NSI); b) Regional Innovation System (RIS); c) Technological Systems Approaches (TSA); d) Socio Technical System Approach; e) Local Innovation System**.**

Althouth several researches have been made on above approaches (Freeman, 1987; Hughes 1983, 1987, 1990; Mayntz and Hughes, 1988; LaPorte, 1991; Summerton,1994; Coutard, 1999; Carlsson, B. and R. Stankiewicz, 1991; Lundvall, 1992; Nelson, 1993; Nelson and Rosenberg, 1993; Wong, 1995; Edquist, 1997; Cooke, 1992, 1998, 2001; Asheim & Isaksen, 2001; OECD, 2002; Geels, 2004; Lester, 2005; Hekkert, Suurs et al, 2007; Reamer, Reynolds and Mills, 2008; Oster, S. M. 2012, etc), few were urdertaken toward **University System Innovation Approach** and there is a special need to understand on how Top Universities are working together with local organizations, in order foster their entrepreneurship and innovation.

4.3.3 Why UK and The University of Manchester?

UK selection was made by using National System Innovation (NSI) approaches. NSI is the most mentioned approach, not only in academic field, but among governmental policy makers. For instance, in the last ten years, well recognized international organizations have developed and improved models to evaluate countries by using NIS or Global Innovation perspectives (Tables 1, 2 and 3), and in all cases, UK appears among 20 best countries in terms of Innovation Performance.

The last result (Table 3) is interesting because this year the Global Innovation Index (GII) ranks the innovation performance of 130 countries around the world with the theme "Energizing the World with innovation". According with the organizers, the GII 2018 analyses the energy innovation landscape of the next decade and identifies possible breakthroughs in fields such as energy production, storage, distribution,

and consumption. It also looks at how breakthrough innovation occurs at the grassroots level and describes how small-scale renewable systems are on the rise.

Table 1 – The most innovative countries (2009)

Country	**Score**	**Rank**	**Region**
Singapore	2.50	1	SEAO
South Korea	2.26	2	SEAO
Switzerland	2.23	3	EUR
Iceland	2.17	4	EUR
Ireland	1.88	5	EUR
Hong Kong	1.88	6	SEAO
Finland	1.87	7	EUR
USA	1.80	8	NAC
Japan	1.79	9	SEAO
Sweden	1.64	10	EUR
….			
United Kingdom	**1.42**	**15**	**EUR**
…			
Brazil	- 0.59	72	LCN

Source: BCG, National Association of Manufacturers, and The Manufacturing Institute, innovation indexes, 2008.

Table 2 – The Most Innovative Countries (2014)

Country	Score	Rank	Region
South Korea	92.10	1	SEAO
Sweden	90.80	2	EUR
USA	90.69	3	NAC
Japan	90.41	4	SEAO
Germany	88.23	5	EUR
Denmark	86.97	6	EUR
Singapore	86.07	7	SEAO
Switzerland	86.02	8	EUR
Finland	85.86	9	EUR
Taiwan	83.52	10	SEAO
….	...	...	...
United Kingdom	**80.01**	**16**	**EUR**
….	...	...	...
Brazil	54.41	45	LCN

Source: Bloomberg, IMF, World Bank, OECD, U.S. Patent and Trademark Office,WIPO (2014)

Table 3 – The Most Innovative Countries (2018)

Country	Score(0-100)	Rank	Region
Switzerland	68.40	1	EUR
Netherlands	63.32	2	EUR
Sweden	63.08	3	EUR
United Kingdom	**60.13**	**4**	**EUR**
Singapore	59.83	5	SEAO
USA	59.81	6	NAC
Finland	59.63	7	EUR
Denmark	58.39	8	EUR
Germany	58.03	9	EUR
Ireland	57.19	10	EUR
…..	….	...	….
Brazil	33.44	64	LCN

Source: The Global Innovation Index 2018

According with GII 2018 report (p. 19), the U.K moved to 4th place this year gaining three positions in Innovation Input Sub-Index and keeps its 6th spot in Innovation Output Sub-Index. The pillar where the U.K. improves its rank is Business sophistication (12th), especially due to the gains in Knowledge absorption (24th). At the sub-pillar level, other significant increases are in Knowledge diffusion (16th), Investment (8th), and Creative goods and services (2nd). Despite these important gains, the U.K. loses between two and five positions in Institutions (14th), Human capital and research (8th), and Infrastructure (7th). Items such as ease of getting credit, expenditure on education, and ICT services imports and exports lose the most positions. The U.K. maintains its 1st spot in quality of scientific publications, government's online service, and e-participation; it loses its 1st spot in ICT and business model creation. Thanks to its historic universities and the quality of its scientific publications, the U.K. is still the 5th world economy in quality of innovation.

When we compare the factors developed by the three (Table 1, 2 and 3) methodologies, it was found that (Table 4):

R&D tax credit and funding, regulation, education, infrastructure quality, business surrounding; IP generation, publication & knowledge transfer and high tech exports are the common factors founding among them, reason by which it is believed that Universities can play important roles to develop such factors in partnership with Government, Industries, Business sectors, especially in the "knowledge-based" economies of modern industrial and industrializing states as sources of trained "knowledge workers" and ideas flowing from both basic and more applied research activities (David and Bhaven, 2006).

Table 4 – Comparative factors from methodologies used to build the tables 1, 2 and 3

Factors score used	Methodology (Table 1)	Methodology (Table 2)	Methodology (Table 3)
Input – R&D tax credit	**X**	**X**	**X**
Input – Taxation level	X	-	-
Input – Gov. R&D fund	**X**	**X**	**X**
Input – Education policy	X	-	-
Input – Trade policy	X	-	X
Input – Regulation	**X**	**X**	**X**
Input - IP policy	X	-	-
Input – Immigration policy	X	-	-
Input – Infrastructure policy	X	-	-
Input – State of education	**X**	**X**	**X**
Input – value add by manufacturing	-	X	-
Input – Work force quality	X	-	X
Input – Infrastructure quality	**X**	**X**	**X**
Input – Business surrounding	**X**	**X**	**X**
Input – Political environment	-	X	X
Input – Tertiary education	-	X	X
Input – Ecological Sustainability	-	X	X
Input – Investment	-	X	X
Output – R&D investments	X		
Output – IP generation	**X**	**X**	**X**
Output – Publication & knowledge transfer	**X**	**X**	**X**
Output–Innovation/Patent Trade	X	X	-
Output – High tech export	**X**	**X**	**X**
Output – Labor productivity	X	-	X
Output – Market capitalization	X	-	-
Output – Employment growth	X	-	-
Output – Investment	X	-	-
Output – Knowledge creation	-	-	X
Output – Knowledge impact	-	-	X
Output – Business migration	X	-	-
Output – Economic growth	X	-	-
Output – Creative goods/services	-	X	X
Output – On line creative	-	X	X
Total	24	16	20

Source: Author

Finally, the reasons by which The University of Manchester was chosen are presented below:
The University has a long term strategic plan with the vision to be one of the leading universities in the world by 2020. In order to so, the vision has three core goals (world class research, outstanding learning and student experience, and social responsibility) guided by three main principles and values (Knowledge, Wisdom and Humanity) that inspired the proponent of this project;
This year the University was ranked 29st in the world according to the QS World University Ranking and it was ranked 34st by the Shangai Jiao Tong Academic Ranking of World Universities, an improvement of 4 positions when compared with 2011 (38st), the year that the strategic planning was launched;
The University put priority (strategy 5 – an international institution) on research collaborations, international business engagement, diversified student population, student experience and transnational education as the ways to enhance its international reputation. So, there is interest from Amazon Federal University managers to construct and promote long term partnership with The Manchester University;
The University strengthens cooperation with both the public and private sectors of the local communities;
The University has the Innovation, Management and Policy (IMP) division, one of the largest research groups for innovation management and policy. One of its groups includes the Manchester Institute of Innovation Research (MIOIR), which is believed to be the best basis to develop the research.

4.4 Main objectives and Methods

The main objectives are:
a) To investigate the best common management practices adopted by UK top universities concerning with their strategies to foster local communities entrepreneurship and innovation;
b) To propose a model to help other universities to improve their local communities entrepreneurship and innovation;
c) To contribute for new partnerships among industry, academia, government local entrepreneurs.
To reach the above objectives, innovation systems approaches, models, awards and interview with experts will be used to develop a cross-sectional survey for the data collection and analysis process. The UK Top Universities will be selected through recognized international assessment and The University of Manchester will be the basis of the research. Through interview with experts, researchers, top managers, Deans, NGO leaders, application of a self assessment questionnaire and a cross sectional analysis process, the best common management practices will be identified and used as base to propose a conceptual model with valuable guidance to foster local entrepreneurship and innovation.

4.5 Relevance

a) It will serve as benchmark for universities Deans interested in continuously improve their management process toward world class innovation level of excellence;
b) It will provide academic discussion and reflection on how universities are innovating their processes in a more collective and entrepreneurship way;
c) Also, it will provide several suggestions for future researchers on topics found as needing further investigations;

d) It will serve as a bridge to approximate UK and Brazil organizations such as Universities, Governmental Agencies, Industries interested in realizing international experience exchange and partnerships on innovation;

e) Local entrepreneurs will improve their understanding about how work better with universities in order to foster their innovation process, products and services;

f) It is hoped to encourage university students to pursue their own entrepreneurial business initiatives.

4.6 Part of the Plan or Schedule

The PDCA methodology will be used to implement the proposed plan showed by Table 5 (it is shown part of the plan).

The main actions and methods will be discussed with the supervisor during the update meetings.

Table 5 – Part of research plan

Action	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
To update the Research Plan with the supervisor	X		X		X		X		X		X	
To study Alliance Manchester Business School and Innovation Management and Policy Division programs and projects toward local innovation and entrepreneurship	X	X										
To review the literature in order to identify and analyze models that evaluate University Best Strategic Management Practices to Foster Local Entrepreneurship and Innovation	X	X										
To select UK top innovative Universities by using national and international ranking criteria		X	X									
To develop a survey to evaluate University management practices to foster local entrepreneurship and innovation.		X										
To development and update a Web Page to open the project for Students, Scientific, Government and Business communities, as well as to collect data and share results.			X	X	X	X	X	X	X	X	X	X
To realize the Pilot Test with a sample of the selected Universities.				X								
To improve the survey and Web Page				X	X							
To collect data through web page, interviews and visits into Universities, Governmental and Business leaders that deals with local entrepreneurship and innovation.						X	X					
To analyze data and discuss with participants.							X	X				
To construct the model and a manual to guide managers on how to achieve best universities practices.									X			
To improve the model through participants contributions.									X	X		
To create a Database containing main information of people contacted during the project;							X	X	X	X	X	X
To support the IMP Entrepreneurship Programs or give orientation to Master and Doctor Students.	X	X	X	X	X	X	X	X	X	X	X	X

Source: Author

4.7 The Budget

The budget is show on Figure 7.

4.8 The references

The references will be show together with the references of this paper.

ACADEMIC RESEARCH VISITOR AT THE MANCHESTER INSTITUTE OF INNOVATION RESEARCH															
ALLIANCE MANCHESTER BUSINESS SCHOOL - UNIVERSITY OF MANCHESTER - UNITED KINGDOM															
ACADEMIC AREA: BEST UK UNIVERSITIES MANAGEMENT PRACTICES TO FOSTER LOCAL ENTREPRENEURSHIP & INNOVATION															
Duration: 12 months - July/15/19 to July 15/2020															
1 POUND =	5,2	Reais	March, 22th	STIMATED BUDGET IN POUNDS STERLING - VERSION 3 - APRIL 2d, 2019											
TOTAL COST	£31.525,0	Jonas Investment	£15.651,4	Partner 1 Investiment	SOLINOX - Fábio Magalhães -	Partner 2 Investiment		Partner 3 Investiment		Partner 4 Investiment		Partner 5 Investiment		Partner 6 Investiment	
ISTO TOTAL EM RE	R$ 163.930	Investimento Jonas	R$ 81.387	Investimento do	R$ 25.000	Investimento do	R$ 0	Investimento do	R$ 0	Investimento do	R$ 0	Investimento do	R$ 0	Investimento do	R$ 0
COST ITEM	Jonas investment	Partners investmen	Previous-trip	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Passport Update process (tax and	£78,3	£0,0	£78,3	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
VISA costs	£392,3	£0,0	£392,3	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
Round Trip	£0,0	£865,4	£865,4	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
Equipments (Notebook, camera,	£480,8	£576,9	£480,8	£576,9	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
Consumer material for research (paper, ink,	£0,0	£576,9	£0,0	£96,2	£0,0	£96,2	£0,0	£96,2	£0,0	£96,2	£0,0	£96,2	£0,0	£96,2	£0,0
Clothes	£600,0	£0,0	£0,0	£300,0	£0,0	£0,0	£0,0	£0,0	£300,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
House renting	£0,0	£7.800,0	£0,0	£1.200,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0	£600,0
House materials	£1.500,0	£0,0	£0,0	£1.000,0	£0,0	£0,0	£0,0	£0,0	£500,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
Bench fee (annum) paid to University	£0,0	£5.000,0	£0,0	£5.000,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0	£0,0
Property Tax	£2.160,0	£0,0	£0,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0	£180,0
Food	£4.800,0	£0,0	£0,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0	£400,0
Health Insurance	£2.400,0	£0,0	£0,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0	£200,0
Gas and light	£960,0	£0,0	£0,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0	£80,0
Water service	£360,0	£0,0	£0,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0	£30,0

Figure 7 – Part of the Budget

Source: Author

5. Conclusion

The aim of this article is to propose a methodology to help readers to write a research project concerning innovation system in order to submit into top universities selection process. In order to do so, a conceptual methodology with 8 steps was presented by using real case of success, focused on a post doctorate project called "The Best UK Universities Management Practices to Foster Local Entrepreneurship and Innovation", which was submitted and approved in 2018 by the Directors of The Manchester Institute of Innovation Research at Alliance Manchester Business School in the University of Manchester.

After this experience it was concluded that there is no a universal standard to write a research project concerning to innovation system field or even other field, each university or fund/grand foundation develops its own model. So the conceptual methodology doesn't want to replace other methodologies, but only to serve as a guide to those candidates that wish to write a proposal and follow the orientations given in this article.

Further research should be done to compare the research methodologies used by the top universities in order to find common topics and propose valuable guidance for the readers.

6. Acknowledgement

To professors and staff of The Manchester University that kindly answered all my doubts and contributed with valuable guidance for Post Doctorate: Dr. Luis Araújo, Dr. Silvia Massini, Dr. Jonatan Pinkse, Dr. Lucas Cordeiro, Manager MSc. Debora Cox, Administrative Assistant Holly Croslley.

7. References

[1] Altbach, Philip G. 2013. "Advancing the National and Global Knowledge Economy: The Role of Research Universities in Developing Countries." Studies in Higher Education 38 (3): 316–330.

[2] Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., Wittrock, M.C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*. New York: Pearson, Allyn & Bacon.

[3] Asheim, B. & Isaksen, A. (1996), Location, Agglomeration and Innovation: Towards Regional Innovation Systems in Norway , STEP Report R-13, Oslo.

[4] Asheim, B. & Isaksen, A. (2001), Regional Innovation Systems: the Integration of Local Sticky and Global Ubiquitous Knowledge, Journal of Technology Transfer.

[5] Bloom, B.S. (Ed.). Engelhart, M.D., Furst, E.J., Hill, W.H., Krathwohl, D.R. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.* New York: David McKay Co Inc.

[6] Bloom, D. E., D. Canning, K. J. Chan, and D. L. Luca. 2014. "Higher Education and Economic Growth in Africa." International Journal of African Higher Education 1 (1): 22-57.

[7] Bloomberg, International Monetary Fund, World Bank, Organisation for Economic Co-operation and Development, United Nations Educational, Scientific and Cultural Organization, U.S. Patent and Trademark Office, World Bank, World Intellectual Property Organization: Most Innovative in the World 2014: Countries, January 7, 2014. Accessed on March 1st http://www.bloomberg.com/visual-data/best-andworst/most-innovative-in-the-world-2014-countries.

[8] Boston Consulting Group, The Manufacturing Institute, National Association of Manufacturers. The Innovation Imperative in Manufacturing, 1999:Boston, USA.

[9] Carlsson, B., Stankiewicz, R., 1991. On the nature, function and composition of technological systems. Journal of Evolutionary Economics 1, 93–118.

[10] Carlsson, B. and Stankiewicz, R. (1995): "On the nature, function and composition of technological systems". In: Carlsson, B. (ed.):Technological Systems and Economic Performance: The Case of Factory Automation. Kluwer Academic Publishers. Dordrecht, pp. 21-56.

[11] Cooke, P. (1992), "Regional innovation systems: competitive regulation in the new Europe", Geoforum 23, pp. 365-382.

[12] Cooke, P. and Morgan, K. (1998) The Associational Economy: Firms, Regions and Innovation, Oxford

University Press, Oxford.

[13] Cooke, P. (2002), Knowledge Economies: Clusters, Learning and Co-operative Advantage, London, Routledge.

[14] Cornell University, INSEAD, and WIPO (2015): The Global Innovation Index 2015: Effective Innovation Policies for Development, Ithaca, Geneva.

[15] Cornell University, INSEAD, and WIPO (2018): The Global Innovation Index 2018: Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva.

[16] Darvas, Peter, Shang Gao, Yijun Shen, and Bilal Bawany. 2017. Sharing Higher Education's Promise beyond the Few in Sub-Saharan Africa. Directions in Development. Washington, DC: World Bank. doi:10.1596/978-1-4648-1050-3. License: Creative Commons Attribution CC BY 3.0 IGO

[17] David C. M., Bhaven N. S., 2006. Universities in National. The Oxford Handbook of Innovation. DOI: 10.1093/oxfordhb/9780199286805.003.0008.

[18] De Brito Cruz, C. and L. de Mello (2006), Boosting Innovation Performance in Brazil. OECD Economics Department Working Paper No. 532

[19] Edquist, C. and Johnson, B. (1997), Institutions and Organizations in Systems of Innovation. In: Edquist, C. (ed): Systems of Innovation: Technologies, Institutions and Organizations. Pinter Publishers. London, pp. 41-63.

[20] George, E., and N. Augustine. 2009. "Higher Education and Economic Development in Africa: The Case of Cameroon." Educational Research and Reviews 4 (5): 231.

[21] Hughes, T. P. (1983): Networks of Power: Electrification in Western Society, 1880-1930. The Johns Hopkins University Press. Baltimore.

[22] Forbes, 2012. The Most Entrepreneurial Colleges, accessed 2014 August 15th, on http://www.forbes.com/sites/michaelnoer/2012/08/01/t

he-most-entrepreneurial-colleges/

[23] Freeman, C. (1995),The National System of Innovation in Historical Perspective, Cambridge Journal of Economics, 19, 5-24

[24] Geels, F.W., Understanding System Innovations: a critical literature review and a conceptual synthesis, in System Innovation and the Transition to Sustainability. Theory, Evidence and Policy, B. Elzen, F. Geels, and K. Green, Editors. 2004, Edward Elgar: Cheltenham, Northampton. p. 19-47.

[25] Geels, F.W., From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy, 2004. 33(6-7): p. 897-920.

[26] Hekkert, M., R. Suurs, S. Negro, S. Kuhlmann, and R. Smits, Functions of innovation systems: A new approach for analysing technological change. Technological forecasting and Social Change, 2007.74(4): p. 413-432.

[27] Independent Evaluation Group (IEG). 2017. *Higher Education for Development: An Evaluation of the World Bank Group`s (English)*. World Bank Education Overview. Washington, D.C.: World Bank Group. International Monetary Fund. 2018. World Economic Outlook: Cyclical Upswing, Structural Change. Washington, DC, April.

[28] La Porte, T.R. (Ed.), 1991. Social Responses to Large Technical Systems: Control or Anticipation. Kluwer academic Publishers, Dordrecht, NL.

[29] Lester, R. K., 2005. Universities, Innovation, and the Competitiveness of Local Economies – A summary report from the Local Innovation Systems Project–Phase I. Industrial Performance Center, MIT. Lundvall, B.-Å. (1992): Introduction. In: Lundvall, B. Å. (ed.): National Systems of Innovation toward a Theory of Innovation and Interactive Learning. Pinter Publishers. London, pp. 1-19.

[30] Mayntz, R., Hughes, T.P. (Eds.), 1988. The Development of Large Technical Systems. Campus Verlag, Frankfurt.

[31] Nelson, R. R. (1992): "National Innovation Systems: A Retrospective on a Study". Industrial and Corporate Change, no. 2, pp.347-374.

[32] OECD (2019). Education at Glance 2019: OECD Indicators, OECD Publishing, Paris.

[33] OECD (2002). Benchmarking Science-Ind. Relationships. Paris.

[34] OECD (2013) ,Singapore: innovation profile, in OECD,Innovation in Southeast Asia, OECD Publishing.

[35] Reamer, A., Reynolds, E. B., and Mills, K. G (2008). Clusters and Competitiveness: A New Federal Role for Stimulating Regional Economics. Blueprint for American Prosperity, Metropolitan Policy Program, Brookings, USA.

[36] Seo J. H. "Region Innovation System and Industrial Cluster: Its concept, Policy Issues and Implementation Strategies" presented on National Workshop on Sub-National Innovation Systems and Technology Capacity Bulding Policies to Enhance Competitiveness of SMEs, 27-30 October 2006, Beijing, China.

[37] Oster, S. M. (2012). Competitive Strategy in the Nonprofit Sector. *Oxford Handbook of Managerial Economics*.

[38] Skillern, J. C. W., 2008. Putting Entrepreneurship in the Social Sector. Interview made by Sean Silverthorne in 04 Feb 2008. Accessed 26 August 2014 link http://hbswk.hbs.edu/item/5782.html

[39] Statista. Estimated number of Universities around the worldwide as of July 2018. Retrieved from October 10, 2019, from <https://www.statista.com/statistics/918403/number-of-universities-worldwide-by-country/>.

[40] Stengos, T., and A. Aurangzeb. 2008. "An Empirical Investigation of the Relationship between Education and Growth in Pakistan." International Economic Journal 22 (3): 345–359.

[41] Summerton, J. (Ed.), 1994. Changing Large Technical Systems. Westview Press, Boulder/San Francisco/Oxford.

[42] Wong, P.K. (1995), National Innovation System: The Case of Singapore, Seoul: Science and Technology Policy Institute (STEPI).

[43] Wong, Po K., (1999): National Innovation Systems for Rapid Technological Catch-up: An analytical framework and a competitive analysis of Korea, Taiwan and Singapore. Paper presented at the DRUID Summer Conference on National Innovation.

[44] Whalley, J., and X. Zhao. 2010. "The Contribution of Human Capital to China's Economic Growth." NBER Working Paper 16592, National Bureau for Economic Research, Cambridge, MA

[45] World Bank. 2018. *World Bank Education Overview: Higher Education (English)*. World Bank Education Overview. Washington, D.C.: World Bank Group.

The Welfare State and The Market Economy: The Austrian experience as a Social Market Economy (SME)

Rafat Fazeli[1], Reza Fazeli (Corresponding Author)[2]

Abstract

This paper concentrates on the recent development of the welfare state and social wage in Austria. Our empirical review is concerned with the net benefits or net social wage received by the Austrian working population. Net social wage is defined as the difference between the social benefits received and taxes paid by the working class. This measurement will enable us to find out whether the working population has received a net gain (or net social wage) and whether this net gain has expanded over time. The paper offers a study of the trends of the "social wage" in France in the last decades before the Great Recession. It addresses two major questions. The first question is whether the expansion of social expenditures has posed any drag on capital accumulation and economic growth in this country. The second question is whether the increasing ideological challenges from the right and the competitive pressures of globalization have led to the retrenchment of the French welfare states in the recent decades.

Keywords: *Welfare State, Social Wage, Economic Growth, Government Expenditures, Taxes*

JEL classification: *B55, C88, E01, E24, E69, H50, H53*

This study[3] concentrates on the development of the welfare state and social wage in the last decades before the Great Recession of 2008. The Great Recession may have caused some disruption on the trends of social expenditures. Given that welfare expenses constitute a large proportion of all state expenditures, reducing government spending means a reduction in welfare programs expenditures. On the other hand, social protection programs, in particular unemployment insurance benefits and minimum income support, has significantly reduced the harsh effect of the crisis on millions of individuals. Austria has a small, yet open, economy with exports of goods and services accounting for 47 percent of the gross domestic product (GDP). Austria is one of the 14 richest countries in the world in terms of GDP (Gross domestic product) per capita; it has a well-developed social market economy, and a high standard of living (IMF 2010). The GDP (purchasing power parity) was around $323.1 billion in 2009, down from a slightly higher $335.2 billion in 2008. The per capita GDP (PPP value) of the country was about $39,400 in 2009 (Economy Watch 2010). This number has increased to $55,510 in 2018 (World Bank 2018). The economy is built on a strong infrastructure with well-developed industry, banking, transportation, services, and commercial facilities. While the majority of Austria's industrial and commercial enterprises are small, there are a

[1] California State University, Fullerton,
[2] California State University, Fullerton, rf.fazeli@gmail.com
[3] We would like to thank Professor Anwar Shaikh who has been the forerunner for the research on social wage and has offered very helpful comments for our research on social wage and the welfare state.

number of large industrial employers having thousands of people on their payroll, mainly in iron and steel works and chemical plants.

The industry accounts for slightly above 25 percent of gross domestic product with an average growth rate of nearly 3 percent. (Statista 2019 and Encyclopedia of the Nations 2010) Though forming a relatively small component of the GDP, 1.7 percent in 2009 and 1.2 percent in 2017 (Statista 2019), agriculture still plays a vital role in the Austrian economy, producing about 80 percent of the domestic food consumption of the country and contributing to some export earnings with processed food items.

Historically, her trading partner has been Germany, making it vulnerable to rapid changes in the German economy. However, as a member state of the European Union, it has gained closer ties to other EU economies, reducing its economic dependence on Germany. In addition, membership in the EU has drawn an influx of foreign investment to Austria, leading to a higher growth rate of GDP. Growth in GDP accelerated in recent years and reached 3.3% of growth rate in 2006. With a GDP of $55,510 (PPP value) ranked 18th in the world in 2018 (International Monetary Fund 2018), she was the fourth richest country within the European Union, with Luxembourg, Ireland, and Netherlands leading the list.

Austria is among the countries with one of the highest contribution of knowledge in the economy, the service sector accounting for 65.8 percent of GDP in 2009. (Encyclopedia of the Nations 2010 and Economy Watch 2010) Austrian labor force has become increasingly diversified in the recent decades. Between 1985 and 2001, over 254,000 foreigners were naturalized in the country. Austria's proportion of foreign-born residents in 2001 was even higher than that of the United States, reaching a level of 12.5 percent. (Jandl, Michael and Albert Kraler 2003)

Austria is among the countries whose state spends a high proportion of GDP as the government expenditures. In 2015, this ratio for Austria was 51 percent. This ratio was 57 percent for Finland that had the highest general government spending as a percentage of GDP. The second in the rank was France with 56.8 percent of GDP (OECD 2015). Our study shows that during the period of this empirical study, 1990-2006, both state expenditures and social wage have remained stable relative to GDP with a noticeable increase up to around 1995 and a slight decline thereafter. The state Expenditures have stayed at about 50 percent of GDP from 1990 to 2006, while social wage expenditures have remained at about 30 percent of GDP in this period. (See Figure 1) Social Expenditures, which has a more limited coverage than social wage, has been about 27 percent of GDP in the period of this study and recent years. Austria has been allocating a higher percentage of GDP on social expenditures, compared to all Continental social market economies, except for France. France's share of social expenditures in GDP has been around 32 percent in recent years, which is higher than all OECD countries, even higher than Northern Social Market Economies such as Sweden, Norway, and Finland.

Austria provides a comprehensive system of social security and welfare schemes. The population is either covered through the principle of insurance, which provides coverage for all gainfully employed persons and their dependents; or "public welfare benefits made available by the federal, provincial and municipal authorities to all citizens in need, who are not covered by the insurance system." One of the outstanding features of the Austrian welfare state is its provision of long-term care for the population. "All persons in need of (nursing) care are eligible for long-term care benefits. The amount of long-term care

benefits will depend exclusively on the extent of care needed. Long-term care benefits are funded from tax revenue." (Austria .org 2019)

As reflected in Figure 1, the initial increase of more than 5 percent of GDP can be explained mainly by the economic slow-down during the period of 1992 to 1996.

Figure 1. Social Wage & State Expenditures as a Percentage of GDP Austria

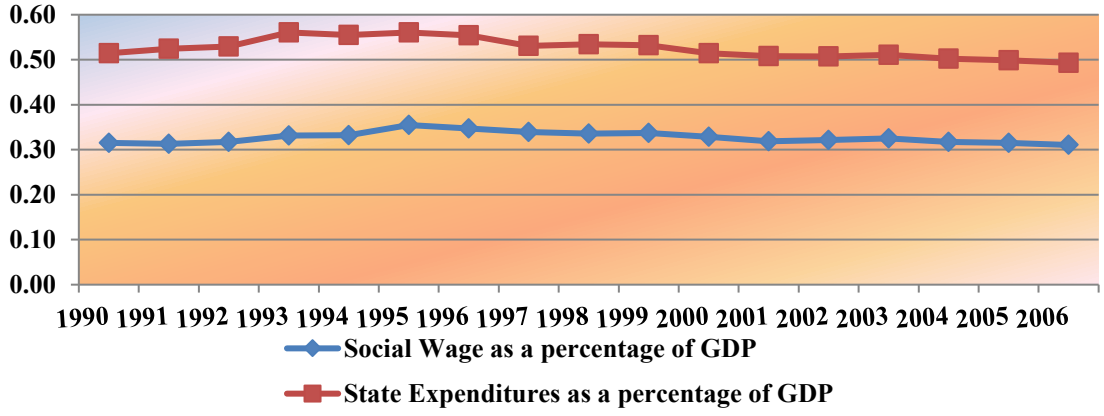
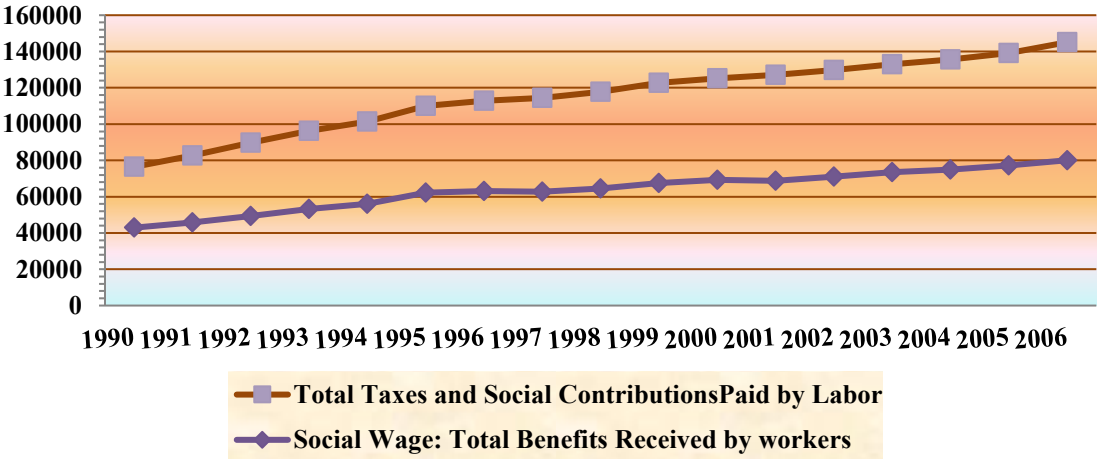


Figure 2. Social Wages Received and Taxes Paid by the Working Population Austria

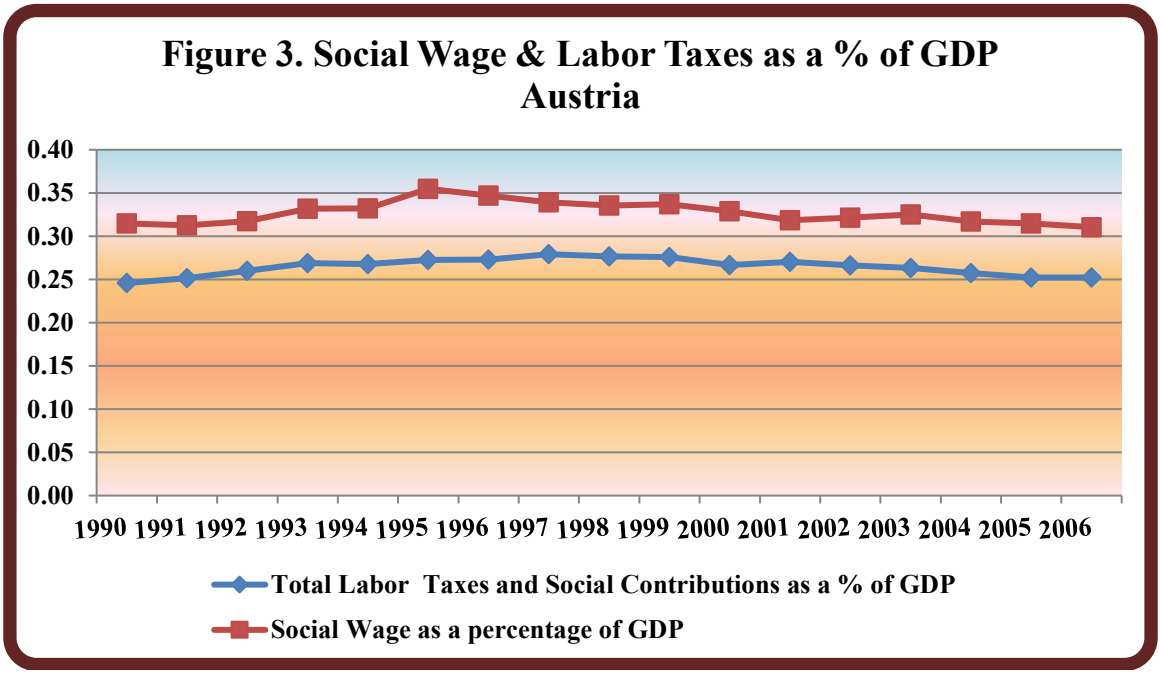


While in prior two decades, Austria had enjoyed higher economic growth and lower unemployment than many European countries, this trend did not continue during the first halve of the 1990s. In 1990, the economic upswing in Austria continued. Real GDP grew by 4.6 percent. In the course of this year, foreign demand, particularly from Germany replaced domestic demand as the driving force of the upswing. Despite the high rate of economic activity and large employment gains, unemployment increased as a result of the huge inflow of foreign labor from the Eastern European countries. Inflation was modest in 1990. The early 1990s recession led to a decline of annual GDP growth, from 4.2 percent in 1990 to 0.4 percent in

1994. Economic slowdown and rising unemployment (See Figure 8) required a higher level of social and state expenditure. Thus, as Figure 2 shows, the share of both social and state expenditures in GDP increased in this period.

Since 1995, however, due to positive merchandise export and higher investment rate due to the membership in the European Union, the economy experienced fairly constant growth, with annual GDP growth rates for 1998, 1999, and 2000 of 3.3 percent, 2.8 percent, and 2.7 percent respectively. (See Austria 2010)

Figure 2 shows that social wage and the taxes paid by labor have increased between 1990 and 2006 in a relatively slow rate-somewhat faster between 1990 and 1995 and slower afterwards. (Figure 2) The gap between social wage and labor taxes has increased in the more recent years. (Figure 3) But the significance of this change can be evaluated better when we look at Figure 3, demonstrating these values as a proportion of GDP. This figure shows that social wage and labor taxes relative to GDP have both increased with a mild increase in their gap between 1990 and 1995 (social wage ratio from 30 percent to 35 percent and labor tax ratio 25 percent to 27 percent), implying that the net social wage has increased slightly over this period. Both social wage ratio and labor tax ratio have declined to their initial values in the subsequent years in Austria. The net social wage ratio has declined to 6 percent of GDP in 2006. (See also Figure 5 for the trend of the net social wage ratio.) This been smaller than that of Germany, and definitely much less than the net social wage ratio in the United Kingdom, the most egalitarian liberal market economy, 11 percent in 1993 and close to 10 percent again in 2003.



These numbers do not, however, indicate a lower role for the welfare state in Austria. The ratio of social wage to GDP has varied between 30 percent and 35 percent of GDP. (See Figure 3) This is a significant share of GDP and larger than those of Germany (ranging from 28 percent to 33 percent) and the United Kingdom (ranging from 22 percent to 27 percent). The prominent role of the social wage in the life of the working population becomes even more evident when we look at share of social wage in the

labor income. This ratio has varied between 59 percent and 64 percent and shows a high degree of the reliance of the working population on social wage rather than their wage earning in the market. This ratio has also been high for Germany (ranging from 52 percent to 64 percent), but not as high as the comparable values for Austria. The comparable ratio for the United Kingdom has been between 40 percent and 49 percent, a significant figure, but much lower than the same ratio for Austria and Germany.

In the entire period, the fluctuations of the net social wage ratio have not been that large. Even during the recession of early 1990s, the net social wage stayed at 6 percent of GDP from 1991 to 1994, increasing to 8 percent in 1995. While social wage was increasing at a modest rate from 1991 to 1994, with a relatively sharp increase in 1995, net social wage ratio remained stable, since the ratio of labor taxes to GDP was also increasing at a smooth rate. This trend was consistent with the trend of unemployment rate that remained stable at 5 percent.

Figure 4. Social Wage & Net Social Wage as a % Labor Income
Austria

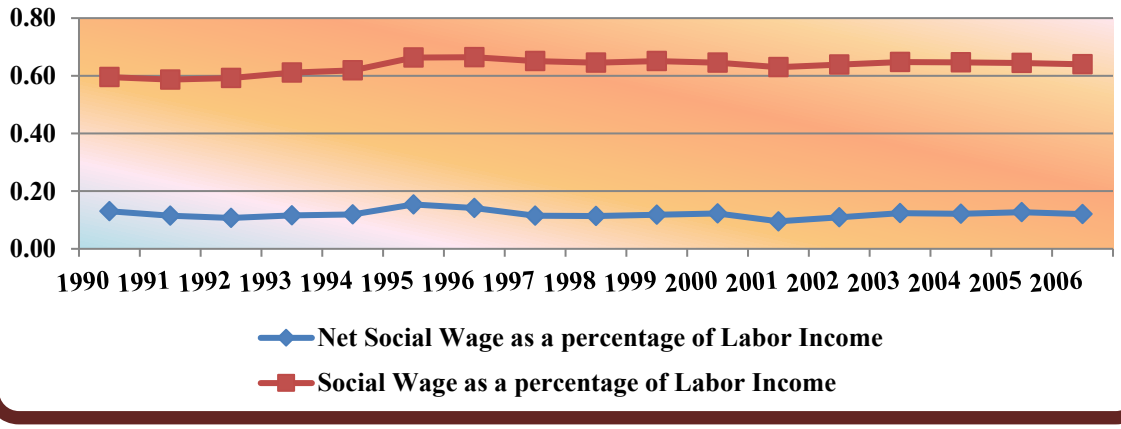


Figure 5. Net Social Wage as a percentage of GDP
Austria

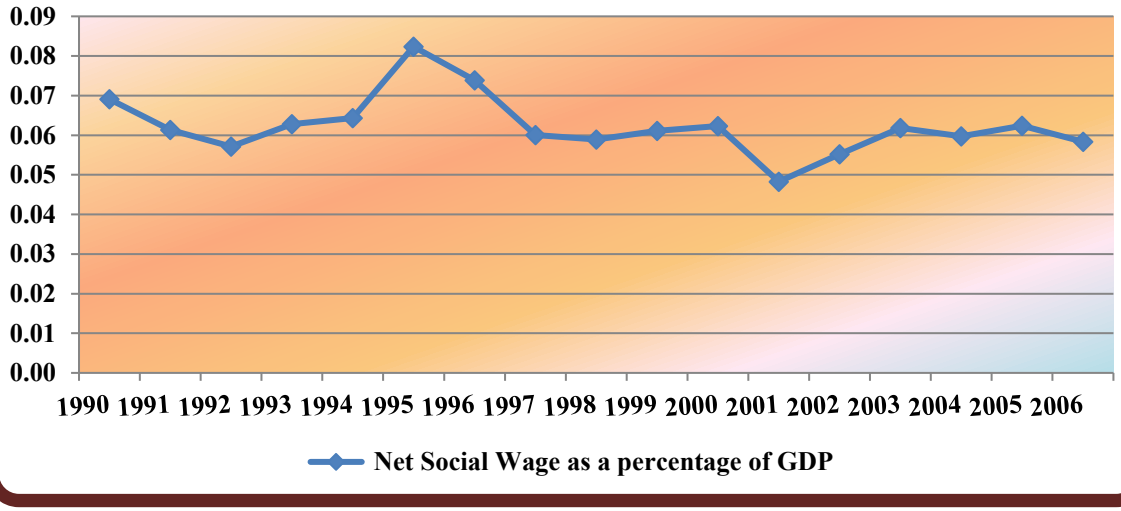


Figure 6. Net Social Wage & Budget Deficit
Austria

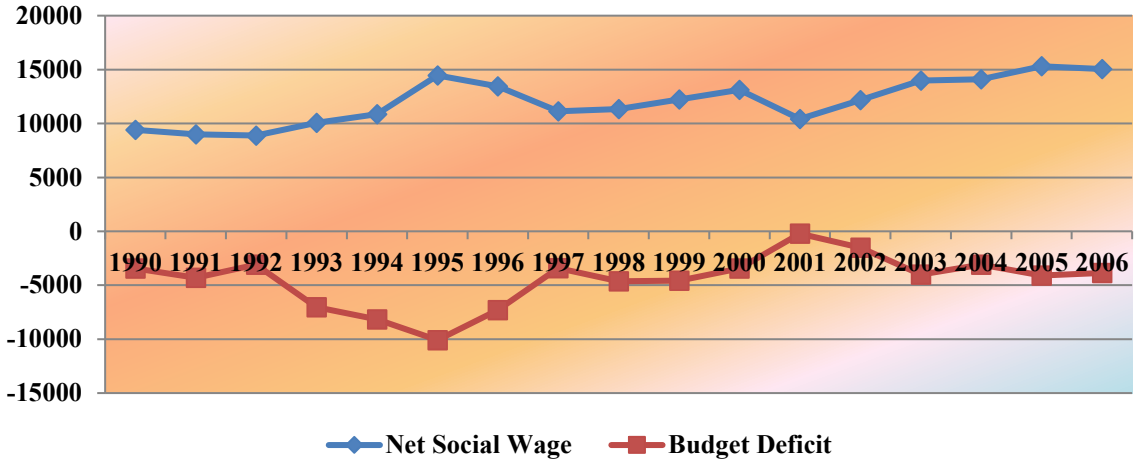
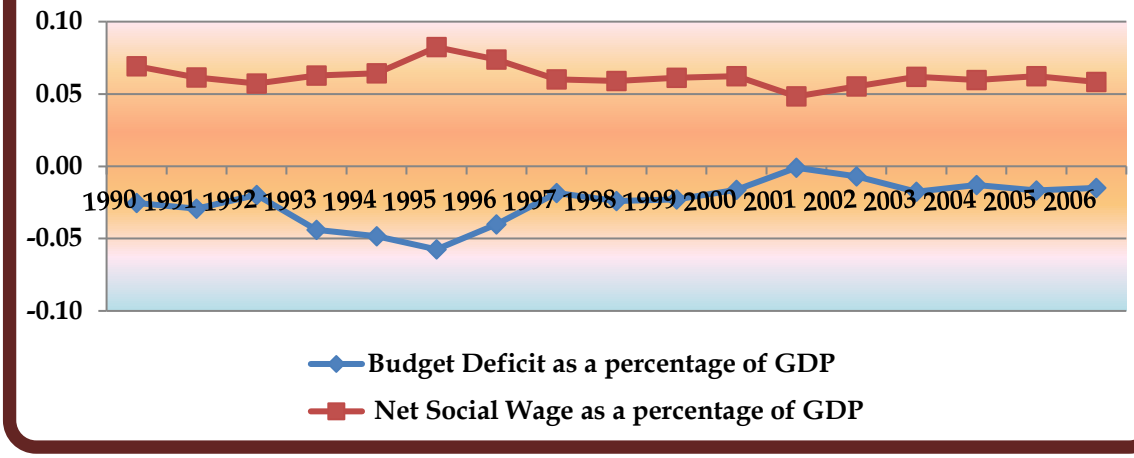
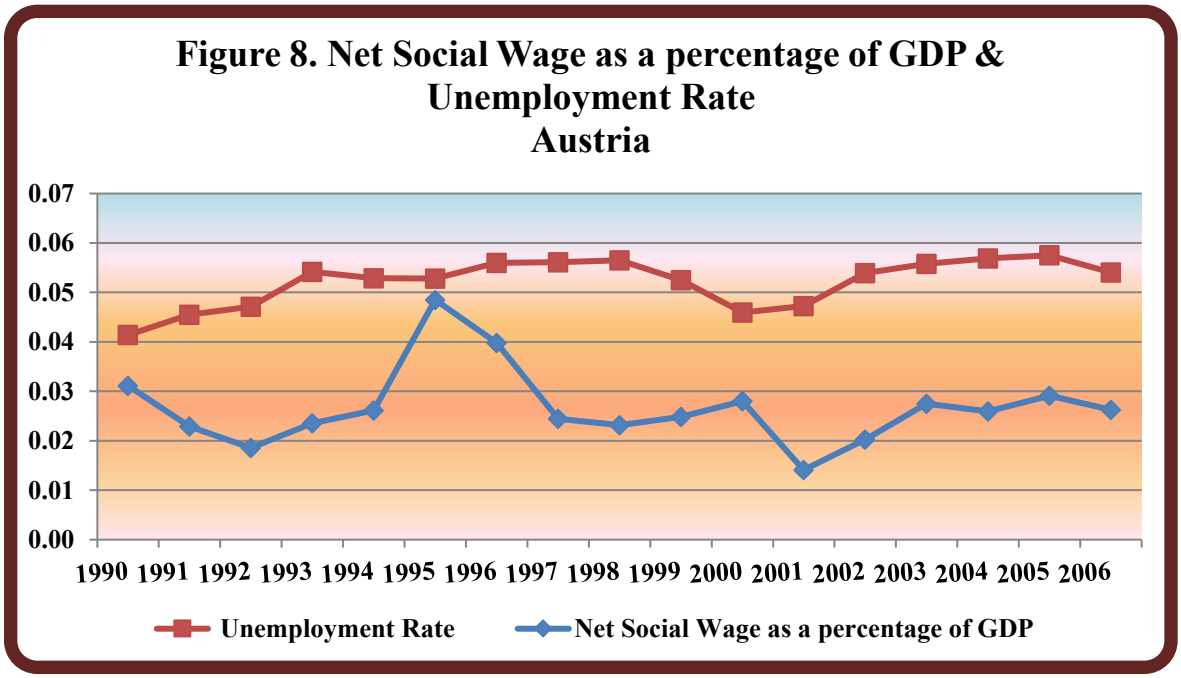


Figure 7. Net Social Wage & Budget Deficit as a % of GDP
Austria





The net social wage declined to 7 percent of GDP in 1996 and stayed at 6 percent in all subsequent years except for one year, 2001, during which it declined to 5 percent. Once again, this trend is consistent with trend of unemployment rate, which stayed at 5 percent in all subsequent years except for 1996 and 1997 during which it increased to 6 percent. Let us add that the trend of net social wage estimated with the assumption of an incidence for consumption taxes would lead to a similar conclusion in terms of close association between net social wage ratio variation and unemployment rate trend. (See Figures 8 & 10)

There is also a close association between the trend of net social wage as the percentage of GDP and the ups and downs of the share of budget deficit in GDP. This ratio steadily increased from 1992 to 1995. The budget deficit was 2 percent of GDP and increased to 6 percent in 1995 and returned to 2 percent in 1997. Budget deficit remained mostly at about 2 percent of GDP except for 3 years in which it decreased to 1 percent and one year, 2001, in which it was reduce to 0.0 percent. This is well within the range set by the European Union.

Austrian public debt has fluctuated between 59 percent and 68 percent of GDP in the last 10 years. In the more recent year (2010), her public debt was $67 billion or 61 percent of her GDP. (Austria Public Debt 2010) Under the EU's Stability and Growth Pact, euro-zone members are bound to maintain public deficits below 3.0 percent of GDP and public debt at less than 60 percent of GDP. They are also expected to work towards balanced budgets and even surpluses in times of economic growth. The debt to GDP ratio stayed within the 65 to 70% range right up to the global financial crisis of 2008. That event caused the Austrian national debt to rise quickly for two years. Under post-crisis conditions, this range has been higher at between 80 and 85% up to 2016. This ratio has, however, declined to 73.8% in 2018 (see tradingeconomics.com/austria/government-debt-to-gdp)

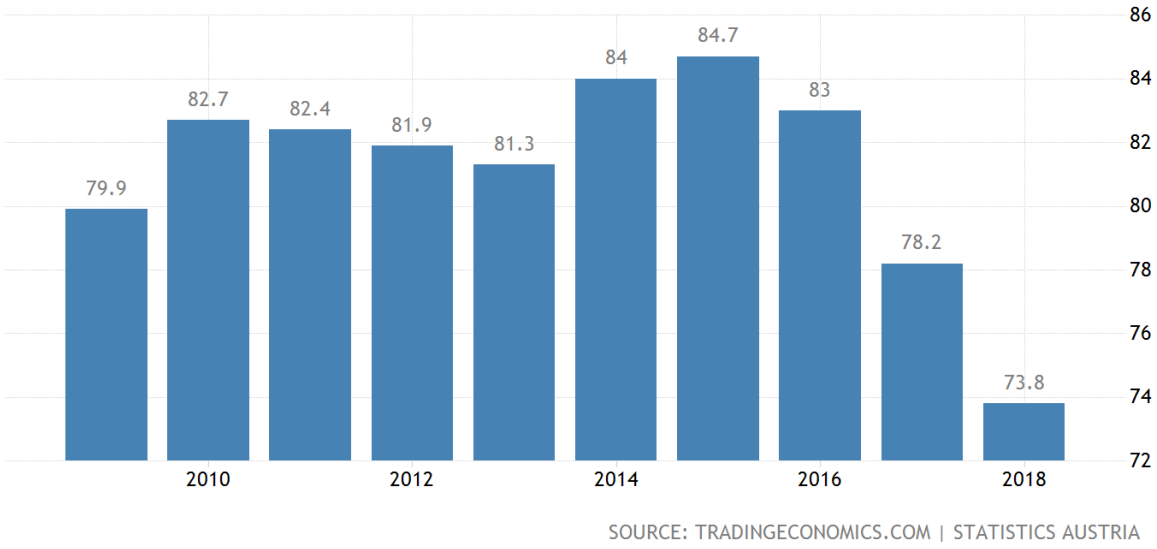
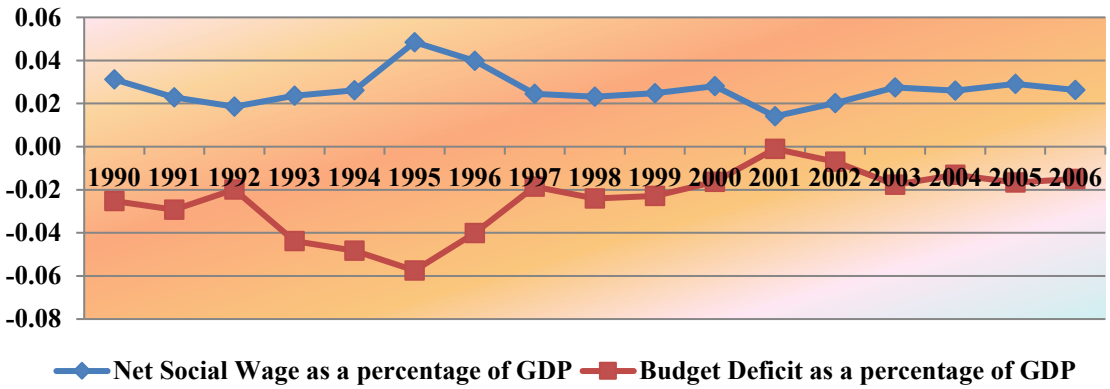


Figure 9. Net Social Wage & Budget Deficit as a % of GDP
Austria (Counting Cons. Taxes)



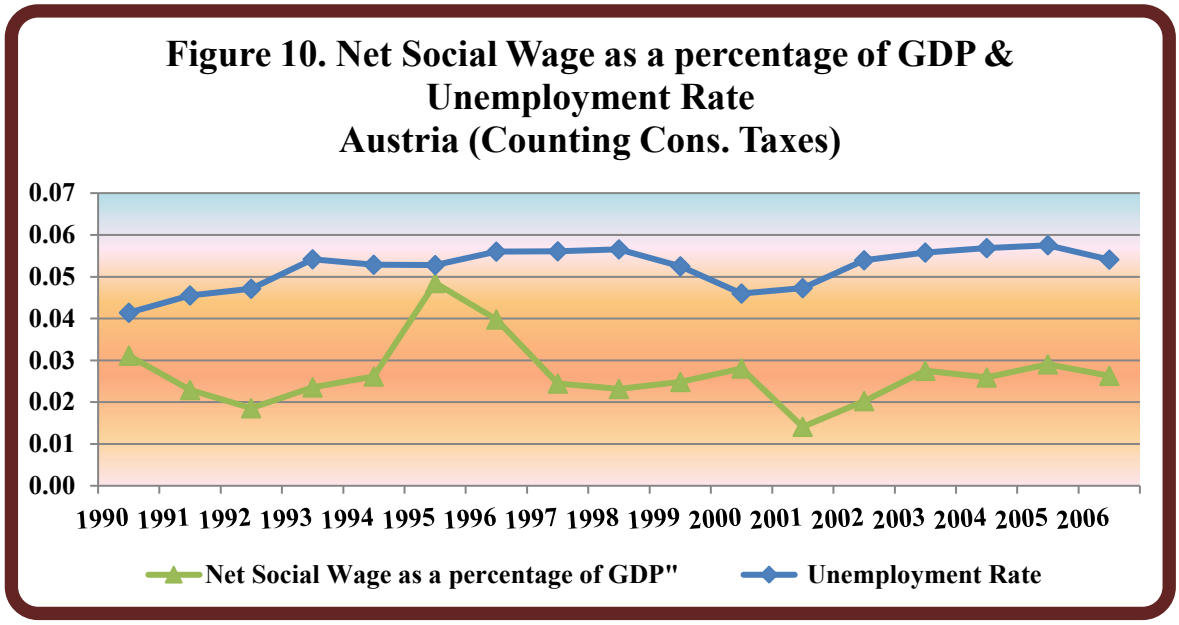


Figure 9 displays the association between the net social wage ratio and budget deficit and Figure 10 between net social wage ratio and unemployment rate. These two figures are based on the second assumption of production tax incidence. Figures 9 and 10 confirm our earlier discussion based on Figures 7 and 8 assuming no production tax incidence for the working population.

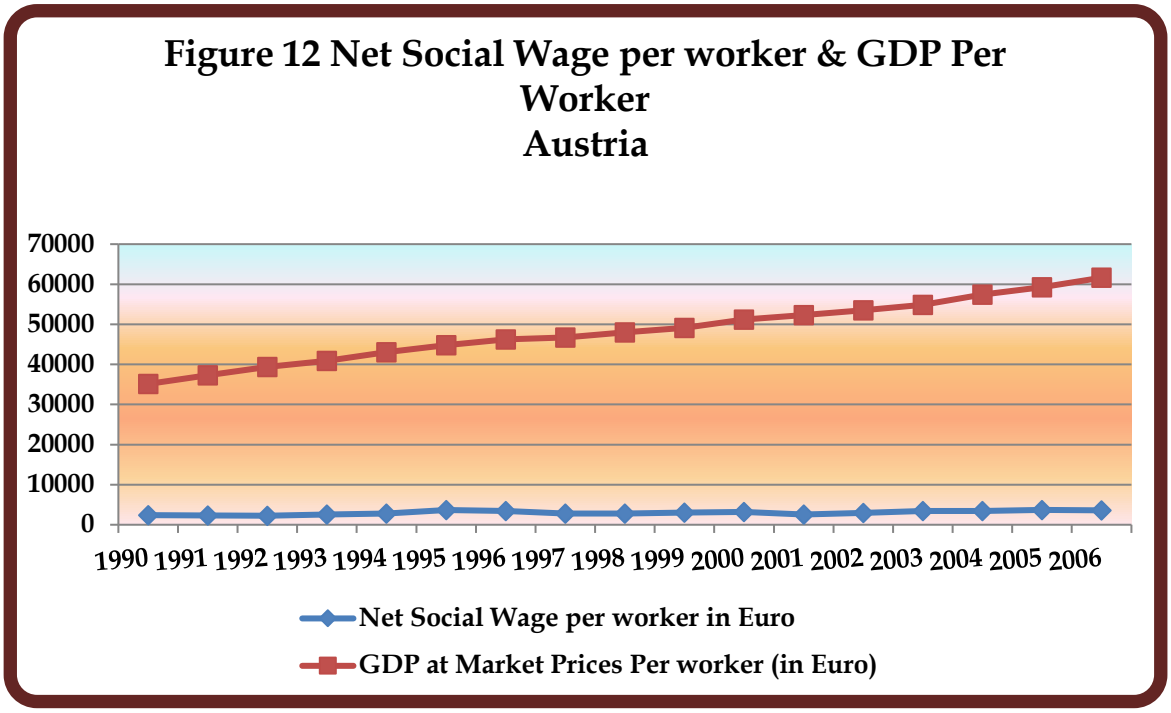


Figure 12 shows that while GDP per worker has been increasing at a reasonable rate, the net social wage per worker has remained rather stable. Thus the growth of the net social wage has remained well within the productive capacity of the Austrian economy and has not been a drag on economic growth.

In comparative analysis, the recent development of the European welfare state has been characterized as a set-back compared to the preceding decades, described as the end of 'the golden age of the European welfare state'[2] and the emergence of a 'neo-conservative turning-point'.[3] Jessop explains this pattern as the outcome of the economic crisis, starting from the 1970's and the loss of social consensus on the 'Fordist' growth model, which had supposedly described the earlier decades after the Second World War. In his view, the recent decades can be characterized as the 'erosion of the nation state' and the gradual displacement of the 'Keynesian welfare state' by a new model that he identifies as the 'Schumpeterian workfare regime'. (see Talos and Fink 2005: P131)

On the other hand, the evidence shows that retrenchment policies have not strongly undermined the provision of social welfare programs in Austria and other continental welfare states. The results of our study confirm that neither the conservative challenges and nor the forces of globalization have succeeded to dismantle the Austrian welfare states. We should, however, indicate that social spending as a share of GDP has stagnated or has been growing at a slower rate than the earlier decades. "Ever since the postwar economic boom ended in the early 1970s, however, social programs have faced mounting political challenges. Questions of expansion have long since given way to an acknowledgment of the limits to welfare state growth and the prospect for extended austerity." (Pierson 1996) In reality, the politics of social policy retrenchment has not posed a major challenge to the existing welfare state programs. "International comparative research still underlines the substantial stability of the welfare state, and that earlier growth has given way to stagnation of a relatively high level of social security." (Talos and Fink 2005: P132)

The other question is to what extent, the current and future development of the Austrian welfare state depends on the European trends of social policy. The European political system, which many scholars expected to be an incipient form of European national state, is now, yet, struggling to move beyond the postwar national state. Since European national state lacks its own well-established institutional heritage of a national state character, the European political system also tends to draw on real national states to acquire its legitimacy. Whether it can break out of such paradoxes by developing a new European 'social contract' remains to be seen.

* Anwar Shaikh's comments and contribution has been indispensable for this and other studies by the current authors.

References:

Austria.Org 2019. "The Welfare State," https://www.austria.org/the-welfare-state

Austria Public Debt 2010. http://www.indexmundi.com/austria/public_debt.html

CIA. 2010. "The World Factbook," https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html; and also http://www.theodora.com/wfbcurrent/france/france_economy.html

---------- "The World Factbook," https://www.cia.gov/library/publications/the-world factbook/geos/nl.html

Dewan, Sabina and Michael Ettlinger. 2009. "Comparing Public Spending and Priorities Across OECD Countries," Center for American Progress, October. http://www.boell.org/downloads/Dewan__Eiingler_Comparing_Public_Spending.pdf

Economy Watch. 2010. "Austria Economic Structure," http://www.economywatch.com/world_economy/austria/structure-of-economy.html

Encyclopedia of the Nations 2010

Eurostat. 2008. "National Accounts," http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/main_tables

IMF EconStats. 2010. "Global Economic Data," http://www.econstats.com/weo/CUSA.htm

IMF EconStats. 2010. "Global Economic Data," http://www.econstats.com/weo/CUSA.htm

International Monetary Fund. Retrieved 22 April 2009

International Monetary Fund. 2018. https://en.wikipedia.org/wiki/International_Monetary_Fund

Jandl, Michael and Albert Kraler. 2003. "Austria: A Country of Immigration?" http://www.migrationinformation.org/Feature/display.cfm?ID=105

OECD 2015. "General government spending," https://data.oecd.org/gga/general-government-spending.htm

OECD Factbook 2010. "Economic, Environmental and Social Statistics" - ISBN 92-64-08356-1

OECD. 2010. "OECD General Government Expenditures (% of GDP) 2007," http://micpohling.wordpress.com/2008/07/03/oecd-general-government-expenditure-of-gdp-2007/

--------- (2008a). National Accounts of OECD Countries Volume I, Main Aggregates, Source

--------- (2008b). National Accounts of OECD Countries, Volume IV, General Government Accounts, Source OECD.

--------. 2010. "Economic Outlook No. 87 Annex Tables," Economic Department.

--------. 2008. *Growing Unequal? Income Distribution and Poverty in OECD Countries,*http://www.contorno.org.mx/pdfs_reporte/diciembre08/growing_unequal_ocde.pdf

OECD Factbook 2010: Economic, Environmental and Social Statistics - ISBN 92-64-08356-1

OECD Stat. Extracts. 2010. http://stats.oecd.org/Index.aspx?QueryId=11112&QueryType=View

OECD Tax Database. 2010. "Tax revenue statistics, ' Table O.1, http://www.oecd.org/document/60/0,3343,en_2649_34533_1942460_1_1_1_1,00.html#trs

OECD 2007 National Accounts

OECD (2011): Divided We Stand: Why Inequality keeps Rising, http://www.oecd-ilibrary.org/socialissues migration-health/the-causes-of-growinginequalities-in-oecd-countries_9789264119536-en, accessed 24.08.2014. --------- (2008a). National Accounts of OECD Countries Volume I, Main Aggregates, Source OECD. --------- (2008b). National Accounts of OECD Countries, Volume IV, General Government Accounts, Source OECD. --------- (2008c): Growing Unequal? Income Distribution and Poverty in OECD Countries, http://www.oecdilibrary.org/social-issues-migrationhealth/growing-unequal_9789264044197-en, accessed 24.08.2014.

Pearson, Paul 1996 The New Politics of the Welfare State, *World Politics* 48.2 (1996) 143-179

Pontusson, Jonas 2005 *Inequality and Prosperity: Social Europe vs. Liberal America*, Ithaca, N. Y: Cornell University Press.

Statista. 2019. https://www.statista.com/statistics/375659/austria-gdp-distribution-across-economic-sectors/

Talos, Emmerich and Marcel Fink. 2005. The Welfare State in Austria, https://link.springer.com/chapter/10.1057/9780230554917_9

Trading Economics. 2010. http://www.tradingeconomics.com/Economics/Inflation-CPI.aspx?symbol=ITL

http://www.tradingeconomics.com/Economics/Inflation-CPI.aspx?Symbol=SEK

Trading Economics. 2018. https://tradingeconomics.com/austria/government-debt-to-gdp

World Bank.2018. International Comparison Program database, https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD

World Bank. 2010. "Gross Domestic Production," http://siteresources.worldbank.org/DATASTATISTICS/Resources/GDP.pdf

Assessing the Financial Feasibility of Slope Protection Through the use of Geocell With Recomposed of Infertile

Dário Etsuro Haji Júnior
dariohaji@hotmail.com
Centro Universitário FAMETRO - Brasil

Estephison Montagnini e Silva
estephison@hotmail.com
Centro Universitário FAMETRO - Brasil

Igor Bezerra de Lima
igorblima@hotmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmailcom
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Camily Murrieta Vasconcelos Oliveira Bezerra
camilymv@hotmail.com
Universidade Nilton Lins - Brasil

Abstract

Soils that have small load capacity need to have their mechanical characteristics improved in order to portray parameters that provide safety to the desired works. The geocells were developed to obtain a cellular confinement system used for reinforcement, protection and coating of slopes, similar to a beehive, which can be filled with soil, granular materials or concrete. However, the present work presents economic viability methods between the projected concrete and the geotextile. With the methodology, it was considered that the alternative use of geocell promoted savings of 35% compared to the projected concrete. The results indicated by tables that compose the projected concrete coatings and geocells were made available by the executing company. Finally, the method was applied to the soil-cement satisfactorily serving the execution, mechanical and economic aspects.

Keywords: Geocells; Slope revestment; Economic viability;

1. Introduction

The mobilities and different aspects of synthetic products succeed in stimulating the application in the great

varieties of Geotechnical Engineering, assuming various roles related from mechanical characteristics such as protection, reinforcement, confinement and erosion control, hydraulic domains that stand out: drainage, soil filtration and waterproofing. It is also noted that geosynthetics present the obligation of separation avoiding the mixing of materials.

However, the handling of materials in engineering works currently obeys some type of design criterion, the particularization is made according to the assignment requested through the conditions established by the work, the basic properties are divided into: physical, mechanical and hydraulic, known geosynthetic attributions as "materials of the future".

In sloping landfill works, the insertion of a landfill geosynthetic component provides a global division between stresses and alterations, enabling the patronage of solutions that demonstrate great difficulty and with low compacted landfill volume.

The article reports events of a work by which synthetic materials were used to explain geotechnical problems, carried out to restore a slope after its rupture. The work is inherent, convenient due to the application of various geosynthetics to an event. Restoration of the slope on the lateral surface of a landfill was carried out with a retaining wall, enveloped soil, geotextile blanket, plus compacted soil-cement to promote greater strength, improving soil mechanical performance designed to meet the primary requirement imposed by the landlord. of the work: restoration of the slope.

2. Literature Revision

In this real chapter will be foundations that refer to the addition of the study on the use of geocell occupied with concrete to harden the soil for the recomposition of the slope, with the foundation of authors who have handled or have been handling theories in order to improve the development of the project. In this theoretical foundation, the following arguments interpreted the origin of soils, tropical soils, slope, geosynthetics, geocells and projected concrete.

2.1 Soil Emergency

Soil mixtures formed by inorganic materials and organic decomposed part waste, for humans, the formation of soil there is one of the most respectable weathering products. Soils are the result of a composition between freely moving particles in intermediate spaces usually filled with water and air [1]. The founder further ensures that such behavior requires the particles that made it up as well as the chemical formation of its original rock.

According to [2], soil is considered a natural material consisting of mineral and / or organic compounds distributed in layers of varying thickness, differing from its original material by morphological, physical, chemical, mineralogical and biological genres.

[3] assure that the soil in its origin until evolution has ancestry, mainly of the weathering (rainwater and temperature), of the components that cause it of the animal and vegetal organisms that help changing the physical and chemical characteristics of the relief.

According to the author [1], debris soils are qualified by their heterogeneity, evidenced by the mother rock, resorting to their complex characterization starting from laboratory tests, an occasion in which specimens

delineated from the same origin may follow different properties.

Whereas transported soils can vary greatly in structure and are more inconsolate than residual soils, and according to [4] claim to depend on different transport agents such as waterways (river and alluvium), gravitational force established with the action of the waters (runoff and talus), the force of the tides (marine sediments) and the action of the wind (wind soils).

2.2 Tropical Soils

They occur in locations that point to tropical and humid climate genres. Tropical soils are generally situated between the imaginary lines that cut horizontally from the northern hemisphere and the southern hemisphere, their properties may vary due to the geological or pedological process characteristic of humid tropical regions [5].

The behavior of tropical soils may reveal distinct reactions in relation to the hydraulic and mechanical behavior conducive to the laterization or latolization process where cations are leached, due to the large residual concentration of iron and aluminum oxide.

According to [5], lateritic conduit soils conceive in the superficial stratum of drained areas, defined by the color in which the red and yellow hues prevail. Its density can range from 2 to 10 meters.

A soil that depicts lateritic performance acquires, when condensed under ideal conditions, increased base capacity and low loss of capacity when immersed in water [6].

2.3 Taludes

According to [7], explains that the consolidation of the slope with the method applied on a slope of land, modified or natural, with the intention of improving its strength aspects, in the event of a possible weakness in the slope, necessary measures to be taken stabilization avoiding a tragic episode.

Slopes are understood as surfaces that cut off a solid earth, rock or both. According [8], they can be natural, cases of the slopes or slope, or synthetic, as the slopes of cuts and embankments. Figure 1 shows the terminology commonly adopted.

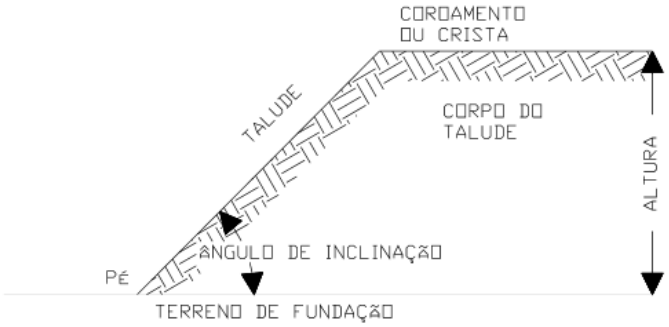


Figure 1 - Terminology usually adopted.
Source: CAPUTO (1988).

The natural slope presents an intensity in its inclination angle from a certain origin of exposed soil notorious to the time. According to [9], in soils composed of individually detached particles in the dry (non-cohesive) state, this angle practically coincides with the internal friction angle, and in cohesive soils (clays), which

are quite impermeable, theoretically equals 90º.

[10] report that the vegetation layer is capable of producing favorable or unfavorable results in slope stability, for example: the presence of the canopy reduces the volume of water reaching the slope surface, the tree stems generate a preferential path. water flow, the root system can act as reinforcement and / or preferential infiltration path, the vegetation cover increases the weight on the slope.

[8] mentions that generally causes of slipping are the increase in weight of the slope (including the applied loads) and the decrease in shear strength of the material where the former is classified as external and the latter as internal.

The table pictured below in Table 1 consists of numerous problems associated with artificial and natural slopes. The many forms of its occurrence are pointed out and the essential causes influence the emergence of this problem.

Theoretically, a slope is subjected to three types of eminent forces: weight strength of its constituent materials, force due to water drainage and force due to shear strength. These three forces must be in equilibrium, as the first two add up and drive the ground mass down the slope, and the third tends to curb this movement [12].

Table 1 - Types of problems related to the slopes, forms of their occurrence and the main causes responsible for the occurrence.

TYPES OF PROBLEMS	OCCURRENCE	MAIN CAUSES
EROSION	• On slopes and embankment (In solution and differential); • Longitudinal along the platform; • Located and associated with drainage works (ravines and gullies); • Internal in landfill (piping)	• Drainage deficiency; • Surface protection deficiency; • Surface water concentration and / or groundwater interception; • Deficiency or lack of internal drainage
SURFACE DEGREGATION	• Surface stacking on cutting slope; • Superficial; • Deep; • Various shapes and dimensions;	• Drying or wetting of material; • Presence of expansive mineral clay or material deconditioning; • Steep slope of slope • Energy Relief; • Soil and rock discontinuity
CUTTING SLIP	• Superficial on natural cuts or slopes; • Deep cuts; • Shapes of varying dimensions; • Large and generalized talus body movement; • Reaching the Landfill Edge; • Reaching the landfill body	• Soil saturation; • Evolution by erosion • Talus body cut; • Drain change; • Inadequate edge compaction
LANDFILL	• Hit the landfill body;	• Foundation deficiency; • Drainage deficiency; • Surface protection deficiency; • Poor material quality; • Inadequate compression; • Slope slope.
REACH ON LANDFILL	• Vertical platform deformation.	• Foundation deficiency; • Drainage deficiency; • Manhole length; • Inadequate compression
BLOCK FALL	• • Usually in free fall	• Action of water and roots on rock mass discontinuity.
BLOCK BEARING	• Rolling block movement on natural cuts or slopes	• Erosion of the base.

Source: [11].

However, there is a technical standard that determines the conditions required for the study and mastery of the stability of slopes and consecutive slopes of cuts and embankments performed on slopes. It is [13], which also encompasses the conditions for studies, design, execution, control and observation of stabilization works.

2.4 Origin of Geosynthetics

According to [14], geosynthetics appear in the history of construction with the first attempts to reinforce soils used to stabilize marshy soils with tree trunks and small shrubs. These applications date from 3,000

BC and have advanced with the emergence of road stabilization by mixing soil or paving with stone blocks. The first citation of the use of fabric in construction was the reinforcement of road pavements in the United States in the year 1926. However, geosynthetics only began to be used systematically name of the twentieth century, after the emergence of synthetic polymers in the 1940s.

[15] reports that the evolution of soil reinforcement led to the beginning of geosynthetic production in the 1950s, due to the emergence of synthetic polymers in the previous decade. Geosynthetics therefore came to be employed due to the conversion of the textile industry in the Netherlands in the 1960s. But it was in the 1970s that geosynthetics established themselves as a building material with the emergence of needled nonwoven geotextiles.

According to [14], the motives that led to the great and rapid advance of geosynthetics were: manufactured for controlled environments; can be put in quickly and effectively, can dodge the use of raw materials (possibility of using recycled materials), circumvent the use of structures with difficult dimensions, their use is more economical than using more traditional solutions, make possible construction on soils that would not normally be considered adequate are introduced at competitive prices.

According to [16] geosynthetics are already being widely applied in various construction works. Its main reasons for its large-scale use over time include its technical advantages (speed and simplicity of application, wide range of products for various purposes), economic (low cost) and environmental (low environmental impact). Thus geosynthetics have become a great alternative to traditional building materials.

[15] reports that the evolution of the geosynthetic industry in recent years has led to an increase in supply and investment in various types of materials such as geotextiles (woven, nonwoven and knitted), geogrids, georedes, geomembranes, geocomposites and geocells. , among others. As a result, geosynthetic functions have expanded, such as drainage, filtration, protection, reinforcement, separation, surface erosion control and fluid barrier.

2.5 Geosynthetic Classification

According to [17], there were approximately five to six types of geosynthetics in 1970, however at the moment there are over 600 distinct geosynthetic products marketed worldwide. Recently, geosynthetics are most frequently acted on reinforced massifs are woven and nonwoven geotextiles, geotiras, geogrids, and tough geocomposites [18].

[19] describes the classification and certainty of the main types of geosynthetics detected in the market, among them are:

a. Geogrids - Flat open mesh composed of tensile-resistant elements joined together.

b. Geotextile - permeable, textile and flat material produced by synthetic or natural polymer. May be divided into fabric, non-woven, or knitted.

c. Geocell - Three-dimensional hexagonal-shaped polymeric structure composed of connected geosynthetic strips.

d. Geomembrane - also known as geosynthetic barrier (GBR), is used to prevent or limit fluid percolation as it has low permeability. It can be polymeric, clayey, bituminous or composite..

e. Georedes - parallel elements superimposed and interconnected with similar elements in several angles.

f. Geotubes - smooth or corrugated, rigid or flexible, perforated or grooved pipe used as conductive and

draining element. Also known as geosynthetic drain pipe.

g. Geomanta - permeable, three-dimensional structure composed of interconnected elements. Also known as geofiber.

h. Geocomposite - formed by overlapping materials where at least one of them is geosynthetic.

2.6 Geosynthetic Employment Employment

For each and every geotechnical work that points out problems of rupture by soil shear, there is a need for the benefits of geosynthetics as reinforcement elements [20]. Works that lack containment structures, floor reinforcement works and staked embankments on soft soils are typical cases that require the use of geosynthetics conducive to their high strength [20]. [21] summarize the different functions that each of the major geosynthetics can perform in engineering as shown in Table 2.

Table 2 - Functions of geosynthetics employed in engineering.

Geosynthetic	Separation	Protection	Filtration	Drainage	Erosion	Reinforcement	Waterproofing
Geotextile	X	X	X	X	X	X	X
Geogrid	X	-	-	-	-	X	-
Geomembran	X	-	-	-	-	-	X
Geode	-	X	-	X	-	-	-
Clay Geocomposit	-	-	-	-	-	-	X
Geocell	-	X	-	-	X	X	-
Geotube	-	-	-	X	-	-	-
Geofiber	-	-	-	-	-	X	-

Source: [21].

The guidelines for geosynthetics used in performance-compliant works must be adhered to, suppliers deliver products to the specifications of the designers, and builders purchase products that meet these requirements, and designers specify both geosynthetics quantitatively and qualitatively. with the technical standards [21].

2.7 Geocell

In the late 1970s and early 1980s, geocells were created to support military vehicles on weak subgrade terrain [22].

The disclosed material has been prepared with the main desire to add low-resistance soil carrying capacity [23]. For [14], the geocell has as its operating source the resistance created by the lateral confinement of a load and the friction of the cell walls with the filler material, making shear breakage and lateral movement of the materials impossible.

Geocells can be produced “on site”, with the advantage of being able to dimension the desired height and length [24]. The global charge transmission system in the geocell as shown in Figure 2 works by combining cell wall resistance, passive filler resistance in adjacent cells and the frictional interaction between the filler soil and the cell walls.

Figure 2: Geocell composition: (a) High density polyethylene; (b) Polypropylene.
Source: [25].

In the manufacture of geocells there is a standardization between cell width (l) and height (h). The heights often encountered are 50, 75, 100, 150 and 200 mm. In general, when expanded, they have plates with an area of around 2.60 x 3.00 m for the minimum size and 2.60 x 6.00 m for the largest [26].

When adopting a filler material for geocells, one tends to take into account the hydraulic, environmental conditions of the supporting ground beyond the site and purpose of the work. In case of steep slopes it is feasible to fill the geocells with soil, vegetation, concrete or mortar, while for soft slopes it is possible to use sand as filler material [27].

For ENGEPOL, geocell filler materials are divided into:

- Granular material: Provides increased erosion resistance by preventing migration of downstream particles by the action of gravity and water flow. It is characterized by being flexible and durable..
- Plant material: Reinforces the soil through rooting, contributing to increased natural resistance to erosion as well as directing water flow over vegetation and reducing moisture loss..
- Concrete: As a flexible lining, the geocell provides controlled concrete cracking and piping control as cells follow the movement of the supporting soil to conform to it. Concrete filling for steep slopes and channel lining is recommended [27].

The knowledge of the geosynthetic relationship with the soil is deeply valuable, a circumstance in which the mechanical characteristics of a reinforced soil reflected the action of the mechanisms of coexistence of the constituent materials, distributing the tensions inside the set.

Increased resistance in the geocell benefits three distinct mechanisms; the confinement effect, the slab effect and the membrane effect. They are generated by the same loads applied to the ground. Although each mechanism can be verified in its own way, they are interrelated and act jointly, improving soil carrying capacity [23].

The confinement effect performs the function in two ways as shown in Figure 3, the first function is by expanding the resistance and minimizing the deformability of the geocell filler material, which is earned by the cellular mold of the geocells, in which the confining stresses in its filler material increases, leading to a compression of this material into the cells, compacting them, resulting in better strength conditions.

The second is through dissipation of the applied charges, where the induction of horizontal tensions from within the cells is distributed and shared between adjacent cells by mobilizing the passive resistance of the confined material [28]. The benefit of the confinement effect is that its process does not differ in the ground

displacements of the foundation, but in the congruent in the transmission of forces to the filler, and between it and the cell walls, as well as the strength and stiffness of the geocell. and your seams [28].

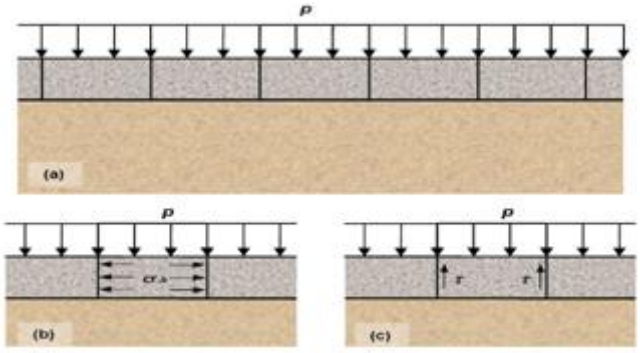


Figure 3 - Illustrative scheme of the confinement effect: (a) application of loading, (b) induction of horizontal stresses within the cell; (c) mobilization of shear stresses at the interface between the filler material and the cell wall.
Source: [23].

3. Materials and Methods

3.1 Study site

The study was developed at Av. Constelação, Aleixo neighborhood, next to the Amazon Network group as shown in figure 4, the main objective was to evaluate the financial viability of steep slope protection by using the geocell with recomposition of infertile material.

Figure 4 - Aerial view with the location of the work under study
Source: [31].

3.2 Materials Used

From the outset when the research study compares the financial feasibility analysis for slope surface protection between projected concrete and geocell reinforcement, it needed to determine the type of materials it integrated into its fill.

3.2.1 Geocells

Geocells, as they refer to manufactured geosynthetics, have a huge range of variations in their own material, such as: geometric (cell width and height) and composition material. StrataWeb geocells were used, whose material is made of high-density polyethylene (HDPE), model SW712 7.5 cm high. The properties of geocells are shown in figure 5.

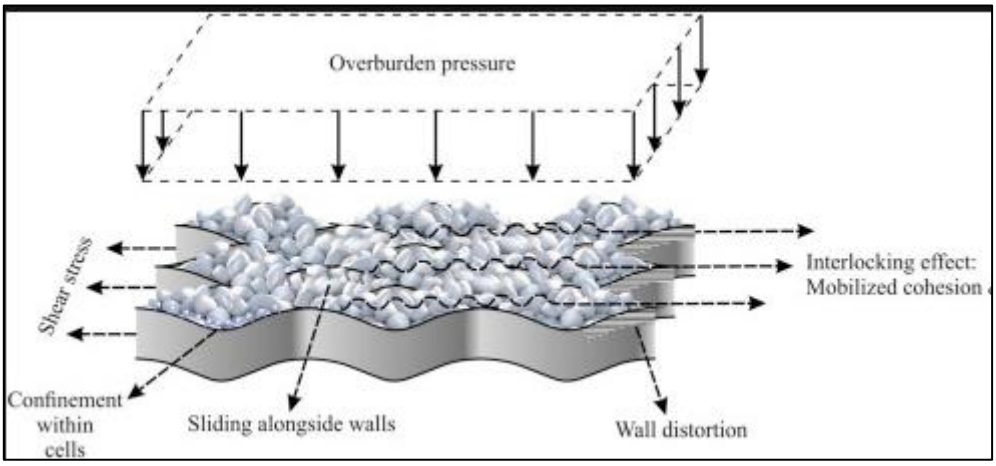


Figure 5 - Geocell technical properties
Fonte: Adapted from [29].

3.2.2 Cement

The executing company has chosen to use MIZU's Portland CP IV 32 RS cement due to its characteristics such as: higher final strength, quick grip, sulfate attack resistance (RS), low hydration heat and operational structure safety and efficiency handling and use, providing functional advantages of the product.

3.2.3 Clay

The clay being a natural material, fine grained, earthy texture with particles of fibrous or lamellar form, due to the clay-minerals, the clays in the water company grow a series of peculiarities such as: resistance, wet mechanical plasticity, shrinkage. drying, compacting and viscosity of aqueous suspensions that explain its wide range of technological applications.
Most of the clay adopted showed no trace of vegetation, an orange hue, as shown in Figure 6.

Figure 6 - Bucket discharging clay.
Source: Author.

3.2.4 Woven geotextile

The geotextile blanket known as bidim has become a useful material for construction, very conducive to its ability to accommodate various environments and the performance of various functions, such as the material is basically made of high quality fibers of polyester or polypropylene, Simple to handle and apply the geotextile blanket is ideal for works of various sizes, so the executing company chose the blanket as shown in figure 7.

Figure 7 - Woven Geotextile Blanket
Source: [30].

3.3 Solution Method.

3.3.1 Slope Rebuild.

For the reconstruction of the slope, all the soil was removed with the heterogeneous vegetal layer keeping at an oblique angle with the help of a backhoe, enabling the most favorable place to start the journey in the reconstruction of the slope as shown in the figure. 8th.

Figure 8 - (a) Moment before part of the slope falls; (b) view from another angle of the slope.
Source: Author.

The soil reconstitution process needed to carry out structural reinforcements such as excavated piles with a diameter of 30cm, where at the top a depth of 8 meters and at the bottom 4 meters were used Ø16mm gauge CA-50 steel and a retaining wall meters high with structural blocks to prevent infiltration-related disasters a horizontal drainage system with Ø75mm PVC pipe was made in the containment.

The problem with soil arises during its replacement, so it was carried out in 2 stages. In the first stage, the clay had a simple process, where every 60cm of clay placed at the site of the removed soil was compaction by means of a manual equipment and then covered by a geotextile blanket, a process that repeated until reaching height of the retaining wall. In the second stage, because the slope is very oblique, a soil-cement technique was used. After carrying out several test sequences with different soil types, they agree that increasing the cement content results in increased compressive strength and, consequently, durability regardless of the desolation.

Soil-cement are some of the low cost alternative materials, acquired by melting soil, cement and some water, in appropriate measures as shown in figure 9. In the creation of material, this mixture resembles a damp "crumbly" and , after compaction and cure, it hardens and over time gains consistency, the figure shows the elaboration of the cement soil.

Figure 9 - Soil-cement process; (a) Four 42.5kg bags of Portland CPII cement and approximately 4.2m³ of clay were used; (b) Mixing process between materials.
Source: Author.

Due to anthropogenic changes, associated with climatic conditions and an inspection with the area decisions for the control of water flow and flow with intuitive taming of the waters on the slopes, a 40cm half-cane channel drainage system was constructed between the retaining wall and the slope, a masonry retarding box was assigned before the public drainage system with the help of Ø150mm PVC material pipes.

The Geotextile mat, having ideal filtration properties and lower cost geomembrane protection with longer life in the impermeability system, determined that it would be applied to the soil-cement after compaction fixed with small clamps.

The geocells were installed on the geotextile blanket so that it covered the entire slope to the channel, to immobilize the geocells, initially established the area and soon after the four edges were fixed by staples or stems in the ground as shown in the figure. 10. In the process of filling the geocells with machined concrete of 20 Mpa obtained as a help a pump carriage and some collaborators who handled the hose and others performed the finishing on the surface.

Figure 10 - (a) application of geotextile over the slope after compaction; (b) fixation of geocells and then application of machined concrete.

Source: Author.

4. Results and Discussions

Prior to the implementation of the slope protection, the site management together with the company coordination performed a cost study comparing the systems suggested by the project author.

The processes compared were the use of machined concrete fill geocells and dry-cast concrete where all costs for such executions were included, values such as equipment leases, supplies of necessary materials as well as additional services after completion of the step such as fine cleaning and paint recovery as shown in table 3.

Table 3 - Composition for projected concrete coating

Item	Input	Und	Qnt.	Value Unit. (R$)	Value Total (R$)
01	TELCON CA-60 SCREEN FRAME Q-138	m²	446,4	13,81	6.164,78
02	DESIGNED CONCRETE 20MPa E = 5cm	m³	22,32	450,74	10.060,52

03	(MATERIAL + EQUIPMENT)	m²	446,4	60,00	26.784,00
04	CONCRETE DESIGNED - LABOR (LAUNCH)	VB	1	3.500,00	3.500,00
05	EQUIPMENT MOBILIZATION AND DEMOBILIZATION	m²	135	16,00	2.160,00
06	ACRYLIC PAINTING - NEAR BUILDINGS	m²	195	8,20	1.599,00
				Value TOTAL (R$)	**50.268,30**

Source: Executing Company (2019).

Due to the geometry and characteristics of the slope, the practical regulations on admission of the geocells and the low cost as shown in table 4 have been replaced by filter-capable fabric geocells.

Table 4 - Composition for geocell coating.

Item	Input	Und	Qnt.	Value Unit. (R$)	Value Total (R$)
01	GEOCELL	m²	446,4	19,15	8.548,56
02	GEOTEXTILE BLANKET	m²	892,8	4,50	4.017,60
03	STEEL WIRE 10mm - CLAMPS	Kg	185,1	6,13	1.134,66
04	MACHINED CONCRETE 20MPa - SUPPLY	m³	31,25	385,00	12.031,25
05	MACHINED CONCRETE 20MPa - LAUNCH	m³	31,25	160,01	5.000,31
06	GEOCLEULA MOUNTING AND FIXING AND GEOTEXTILE MAT	m²	446,4	4,80	2.142,72
				VALUE TOTAL (R$)	**32.875,11**

Source: Executing Company (2019).

From the quantitative material surveys it is possible to determine the total cost for each type of coating as shown in table 5.

Table 5 - Comparison between slope coating systems.

Item	SYSTEM	VALUE TOTAL (R$)	VALUE UNIT. (R$)	DIFFERENCES BETWEEN SYSTEMS	
				VALOR	PORCENTAGEM
01	DESIGNED CONCRETE COATING	50.268,30	112,61	**R$ 38,96**	**34,60%**
02	GEOCELL CLEANING WITH CONCRETE PREVENTION	32.875,11	73,65		

Source: Author (2019).

Through the results, it was possible to compare economically the solution presented and conclude that the techniques would meet the slope conditions and also economic, increasing the profit margin of the contractor. Geocell-coated slope protection solution becomes more viable than projected concrete coating.

6. Final Considerations

In this paper a technical and cost analysis of the geocell use for slope protection was conceived. Choosing a mechanical protection process should involve all studied and efficient solutions, budget checking varies considerably, resulting in a weighted topic when it comes to solution preference.

One of the objectives to be highlighted is that the costs raised refer to one square meter of the slope. Thus, the cost divergences between the solutions tend to be numerous, when enlarged by the proportion of a given work. However, financial feasibility studies are key and reputable in order to extend parameters when choosing the most appropriate circumstances.

7. REFERÊNCIAS

[1] PINTO, Carlos de Souza. Curso Básico de Mecânica dos Solos. 3 ed. São Paulo: Oficina de Textos, 2006.

[2] BIRKELAND, PETER W. Pedology, Weathering and Geomorphological Research. Nova Iorque: Oxford University Press, 1974. 300 p.

[3] SALOMÃO, Fernando Ximenes de Tavares; ANTUNES, Franklin dos Santos. Solos em Pedologia. In: OLIVEIRA, Antônio Manuel dos Santos; BRITO, Sérgio Nertan Alves (Org.). Geologia de Engenharia. São Paulo: ABGE, 1998. p 87-99.

[4] PASTORE, Eraldo Luporini; FONTES, Rita Moura. Caracterização e Classificação de Solos. In: OLIVEIRA, Antônio Manuel dos Santos; BRITO, Sérgio Nertan Alves (Org.). Geologia de Engenharia. São Paulo: ABGE, 1998. p 197-210.

[5] NOGAMI, J. S.; VILLIBOR, D. F. (1994). Identificação expedita dos grupos da classificação MCT para solos tropicais. Anais do X Congresso Brasileiro de Mecânica dos Solos e Engenharia de Fundações. Foz do Iguaçu – PR. V.4, pp.1293-1300.

[6] BERLUCCI, L. B. (1995). Considerações sobre o dimensionamento de pavimentos utilizando solos lateríticos para rodovia de baixo volume de tráfego. Tese de doutorado. Departamento de Engenharia de Transporte da Escola Politécnica da USP. São Paulo – SP 237p.

[7] ABGE, Associação Brasileira de Geologia de Engenharia. Geologia de engenharia. São Paulo: Editores Antonio Manoel dos Santos Oliveira, Sérgio Nertan Alves Brito, 1998.

[8] CAPUTO, Homero Pinto. Mecânica dos solos e suas aplicações. Fundamentos. 6º edição, Rio de Janeiro: Livros Técnicos e Científicos. Volume 1, 1988.

[9] CARDOSO, F. F. Sistemas de Contenção. Escola Politécnica da Universidade de São Paulo. São Paulo, 2002.

[10] GERSCOVICH, D. M. S. Apostila Estabilidade de Taludes. Faculdade de Engenharia/UERJ. Departamento de Estruturas e Fundações. Rio de Janeiro, 2009.

[11] MARANGON, Márcio. Notas de aula: Tópicos em Geotecnia e Obras de terra. UFJF, 2006. Disponível em: http://www.ufjf.br/nugeo/files/2009/11/togot_Unid03-GeoContencoes-Parte01-2006-2.pdf >. Acesso em: 12/09/2019.

[12] FIORI, Alberto Pio, CARMIGNANI, Luigi. Fundamentos de mecânica dos solos e das rochas: aplicação na estabilidade dos taludes. Curitiba: Editora da UFPR, 2001.

[13] ASSOCIAÇÃO BRASILEIRA DE NORTMAS TÉCNICAS - NBR 11682 Estabilidade de Taludes – Terminologia. Associação Brasileira de Normas Técnicas. Manaus (2009).
[14] KOERNER, R. M. (1994). Designing with Geosynthetics, Englewood Cliff, New Jersey, Prentice Hall, 3rd Ed. 761p.
[15] VIOLANTE, F. M. T. Caracterização da danificação mecânica de geossintéticos. 2016. Dissertação (Mestrado em Engenharia Civil) – Faculdade de Engenharia Universidade do Porto, Portugal.
[16] CARNEIRO, José Ricardo da Cunha et al. Durabilidade de materiais geossintéticos em estruturas de carácter ambiental: a importância da incorporação de aditivos químicos, 2009.
[17] HOLTZ, Robert D. Geosynthetics for soil reinforcement. In: 9th Spencer J. Buchanan Lecture. Texas A&M University, 2009
[18] VERTEMATTI, J. C. Manual Brasileiro de Geossintéticos. 2ª ed. Curitiba: Bulcher, 2015. 576 p.
[19] ASSOCIAÇÃO BRASILEIRA DE NORTMAS TÉCNICAS – ABNT NBR ISO 10318 Geossintéticos Parte 1: Termos e definições – Associação Brasileira de Normas Técnicas. Manaus (2015).
[20] MACCAFERRI. Manual Técnico: Critérios gerais para projeto, especificação e aplicação de geossintéticos. São Paulo, Brasil. 2008.
[21] VILAR, Orencio Monje. Geossintéticos em aplicações ambientais. Teoria e Prática na Engenharia Civil, n. 4, p. 69-85, 2004.
[22] ZORNBERG, J. G.; CHRISTOPHER, B.R. Geosynthetics. In: DELLEUR, Jacques W. (Org.). The Handbook of Groundwater Engineering. 2 ed. Florida: CRC Press, 2007. 1267 p.
[23] AVESANI Neto, J. O. (2008). Caracterização do Comportamento Geotécnico do EPS através de Ensaios Mecânicos e Hidráulicos. Dissertação de Mestrado – Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, 227 p.
[24] BARUFFI, Aline. Comportamento mecânico de geocélulas preenchidas com resíduos de pedras preciosas. 2017. 95 f. Dissertação (mestrado em Engenharia Civil). – Programa de Pós-Graduação em Engenharia Civil e Ambiental, Universidade de Passo Fundo, Passo Fundo, 2017.
[25] KOMETA. Manufacturer and Supplier Geocell for Erosion Protection. (2001). Disponível em: <http://www.kometa.by/Geogrid.htm>. Acesso em: Setembro, 2019.
[26] OBER. Catálogo Fortcell Geocélula, 2019. Disponível em: http://www.obergeo.com.br/catalogo/catalogo-FORTCELL.pdf. Acesso em: Setembro, 2019
[27] ENGEPOL. Produtos: Geomembrana Lisa PEAD. Disponível em: <https://docplayer.com.br/2716963-Manual-de-geossinteticos-grupo-nortene.html>.Acesso em: Novembro, 2019.
[28] MANDAL, J. N.; GUPTA, P. Stability of geocell-reinforced soil. Construction and Building Materials. V. 8, n. 1, p. 55-62, 1994.
[29] MEHRJARDI, Gholamhosein Tavakoli; MOTARJEMI, Fariba. Interfacial properties of geocell-reinforced granular soils. Geotextiles and Geomembranes, v. 46, n. 4, p. 384-395, 2018..
[30] TDM Brasil. Produtos, Mantas para controle de erosão, Geomantas. Disponível em: < http://www.tdmbrasil.com.br/products-mantas-geomanta.php>. Acesso em: Setembro, 2019.
[31] Google maps https://www.google.com.br/maps

Urban Mobility in Brazil: A Comparative Between Manaus and Sao Paulo

Leonardo Mota Feitosa
l_m_feitosa@hotmail.com
Centro Universitário FAMETRO - Brasil

Ricardo Brito da Fonseca
ricardof.eng@outlook.com
Centro Universitário FAMETRO - Brasil

Igor Bezerra de Lima
igorblima@hotmail.com
Departamento de Engenharia do Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar (Corresponding author)
david002870@hotmailcom
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Camily Murrieta Vasconcelos Oliveira Bezerra
camilymv@hotmail.com
Universidade Nilton Lins - Brasil

Abstract

Urban mobility is one of the main topics when it comes to urban planning, in Brazil, it is one of the most troubling subjects since the country had a demographic boom in the 60s and 70s leading to unplanned cities that were not capable of properly preparing for its population increase. In order to evaluate what Brazil's cities are lacking, Manaus and São Paulo were compared to leading cities in urban mobility like Hong Kong and Prague reviewing the main indicators which leads to those cities being ranked higher than Brazilian cities. Being the cycle lanes one of the biggest disparities between cities like Prague and Manaus, the urban mobility plans of the Brazilian cities were evaluated to present their guidelines and their plans to unite with the global trend in urban mobility.

Keywords: Urban Mobility; Cycle lane; Public Transport;

1. Introduction

With the growth of the population and cities, there is an increasing need for modes of transport that can serve this population, ensuring that they can go to their places of work, leisure and study. Thus making sure that the economy flows together with activities performed by the population throughout the city. Attributing improvements to the urban mobility system is a constant need as the demand for the service is of interest

to the cities and countries in which it operates.

If urban mobility is not effective in a given city, then there will be a reduction in its productivity and economy indexes, since urban mobility consists of the displacement of people, that is, the labor required for the continuous execution of economic activities.

In Brazil, mobility is a delicate topic as many cities grew in a disorderly pace due to historical events that occurred mainly in the 60s and 70s, causing a rural exodus that caused problematic experiences in the present day of Brazilian cities.

This paper aims to make a comparison between the Brazilian capitals of Manaus and Sao Paulo with global cities which are references in this theme in order to identify the factors that determine their quality of urban mobility and what their cities can learn from each other. Also making a comparison between the urban mobility plans of both Brazilian cities seeking to identify the priorities set by each city in order to improve the mobility present in these large cities.

2. Theoretical Foundation

According to Gomilde and Galindo (2013) [1] urban mobility is understood as the possibilities of displacement of people and loads in cities, either through collective or individual modes, not necessarily motorized. Gomilde and Galindo (2013) [1] also affirm that urban mobility should be considered sustainable when it is capable of enabling people universal access to the city and all the opportunities offered by it in order to contribute to socioeconomic progress without destroying the environment and using road infrastructure rationally.

This being the basis for the formulation of the project that became the National Urban Mobility Policy Guidelines Law (Law No. 12587/2012) [2], this law recognizes and divides urban modes of transport into motorized and non-motorized, classifying them by object, service characteristic and nature.

2.1 Global Overview

In order to observe the global panorama of urban mobility, we used the ranking of "sustainable city mobility index" by Arcadis (2017) [3], it is possible to visualize the global panorama of urban mobility more precisely, as it is invalid to make a direct comparison between global cities, as each city grows and adopts different methods to deal with its geographical, historical and cultural consequences.

According to the information provided on the company's website, Arcadis is a global engineering and management consulting company based in the Netherlands. Through its collected data, it discloses its ranking consisting of the 100 best cities evaluated according to the chosen criteria, These criteria include traffic fatalities, bus and subway stops per square kilometer, annual passenger traffic, the economic viability of public transport modes, city congestion time and many other indicators out of a total of 23.

According to the data presented in the survey, it is possible to observe the European predominance in the ranking since it has cities that occupy 7 of the top 10 positions, according to Arcadis (2017) [3] this European leadership is due to the fluid integration between cities. present in territories of the European Union.

First place, however, was awarded to the city of Hong Kong which together with the cities of Seoul and

Singapore awarded Asia with 3 positions in the top 10 of the ranking. Hong Kong City, despite being one of the most densely populated cities in the world, can meet its limited space challenges through its subway system that carries approximately 12 million passengers daily.

According to LSE (2015) [4] in its publication "Towards New Urban Mobility" European cities like London and Berlin have public transport investment guidelines as well as technology companies that are specializing in electric cars and transportation applications. , the LSE considers these factors as indicators that make these cities ahead of many others when it comes to identifying new transport methods and how to use them to serve the entire population more and more effectively.

Berlin as well as others have in their guidelines a high priority for investments in cycling infrastructure, where according to data collected by the LSE (2015) [4], the number of cyclists has been growing since 1970 with a big boom between 2004. and 2012 where there was a 40% increase in the total number of cyclists in the German capital.

When we bring the ranking observations to the Brazilian situation we find only two cities in the top 100 of the Arcadis ranking (2017) [3], being São Paulo and Rio De Janeiro in 47th and 63rd respectively, unfortunately the city of Manaus did not reach any of ranking positions.

The index developed by Arcadis makes São Paulo the main financial center of Brazil and although it is of economic importance the city still faces the challenges that are common to cities that developed without proper planning causing a social segregation that pushes those with lower purchasing power to the suburbs, but still depending on them as labor force forcing them to move large miles to the place of service. According to Arcadis (2017) [3] over 80% of citizens who own a car would be willing to leave them in the garage if a better public transport option were offered.

2.2 Manaus and São Paulo

Observing the current situation in a national panorama, it is possible to verify that urban mobility is one of the elements present in urban planning that most finds problems in Brazil due to the strong rural exodus that occurred in the 70's and 80's causing an urban expansion to the city. which a large part of the cities were unprepared giving rise to problems in the demand for urban services and the ability of cities to supply them.

According to EMBRAPA (2017) [5] the areas that are considered urban in Brazil represent 0.63% of the national territory and concentrate 160 million inhabitants, this value being equivalent to 84.3% of the entire Brazilian population, ie , more than half of the Brazilian population lives in an area that does not even occupy 1% of the Brazilian territory.

Establishing the fact that more than 80% of the Brazilian population is in urban areas, it is necessary to adapt and evolve the transport models in order to guarantee the constitutional right of the citizen to come and go.

The city of Manaus, object of our study had 1,802,014 inhabitants and a demographic density of 158.06 inhabitants per square kilometer (inhab / km²) according to data from the 2010 IBGE census [6]. The IBGE estimate [6] for Manaus in 2019 is of a population of 2,182,763 inhabitants and a demographic density of 191.45 inhabitants per square kilometer. This value can be considered small when comparing the city of Manaus the city of São Paulo which obtained the value of 7,387.69 (inhab./km²) in the last census

conducted by IBGE [7] in 2010 and in its estimate has approximately 8 thousand inhabitants per square kilometer in 2019. It is possible to observe a large discrepancy of almost 7800 inhabitants per square kilometer when comparing the city of Manaus to São Paulo.

Looking at the past of the cities present in the study, it is possible to verify that, like most Brazilian cities, they grew in a disorderly way, thus negatively impacting their planning capacities.

According to Nogueira, Sanson and Pessoa (2007) [8], in the case of Manaus the city had its explosion in the 70s of the twentieth century with the establishment of the Manaus free zone and at the end of the same decade there was a large expansion directed to the North. and East, an expansion carried out through regular and irregular occupations, which caused a growth that was disproportionate to what urban infrastructure would be able to absorb.

In the case of the city of São Paulo, according to data available on the City Hall portal [9], the demographic explosion occurred mainly in the years when the 1st and 2nd World Wars occurred, which were periods that favored the local production of consumer goods.

According to a survey conducted by the National Confederation of Municipalities (CNM) [10] in 2018, the city of Manaus has the fifteenth largest car fleet in Brazil with 363,000 units and the eighth largest motorcycle fleet with 184,000 units. The city also has the sixth largest bus fleet totaling 7699 units.

In comparison, the city of São Paulo occupies the first place in all the categories mentioned, having more than 5 million cars, 10 times higher when compared to Manaus. São Paulo is the only city in Brazil according to data provided by CNM [10] that has 7 digits in its number of bikes, this value being exactly 1,097,476 bikes, to overcome this value would need to join the other 4 cities that follow just below São Paulo in the survey so that if it were possible to reach a larger number than the SP fleet.

Based on the data collected by the CNM [10], it is possible to observe that the population of São Paulo has a large focus on individual motorized transport modes, be they cars or motorcycles. This mode of transport becomes unfeasible as the city grows as infrastructure is unable to accommodate such a high value of vehicles.

In a study conducted by the company Urban Systems for the Connected Smart Cities ranking [11], the city of Manaus was out of the 50 best cities in 2017 and São Paulo ranked first when analyzing urban mobility, in the 2018 survey. Manaus ranked 20th in the ranking and São Paulo maintained its first place.

According to the publication on the connected smart cities ranking (2018) [11] the criteria used to rank cities in the ranking include the proportion of buses per car, the average age of the vehicle fleet, buses per inhabitant, cycle paths and other modes of transport. public transportation, among others. These criteria are met by the capital city of São Paulo, which has the integration of different types of transport, with the largest availability of mass transit modes, with almost 100 km of subway lines and almost 300 km of rail lines. above that the city still offers over 400 km of cycle paths and has the largest offer of shared ride companies consisting of Uber, 99Pop and Cabify applications.

The city still has three urban bus terminals that connect the city with other Brazilian states, the city still benefits from the proximity and ease of access to the international airports of Guarulhos and Viracopos.

2.2.1 National Urban Mobility Policy

On January 3, 2012, Federal Law No. 12,587 [2] which established the National Urban Mobility Policy,

similar to the master plan, was enacted. Federal law established that all municipalities above 20,000 inhabitants must draw up a mobility plan. The plans were prepared and effective from the beginning of 2015, so both cities of Manaus and São Paulo fit the criteria of the urban mobility plan.

As described in the Manaus Urban Mobility Plan (2015) [12] the guidelines governing its focus include the requalification of urban public transport, the implementation of the cycling system in Manaus, expansion and reconfiguration of the road network, among other guidelines. Observing the plan for the city of São Paulo [13], it has guidelines such as priority for public transportation, qualification of the public transport system and priority for pedestrians and active modes.

Based on the data arranged in both planes, the concern to prioritize urban public transport is noteworthy as it is more efficient in transporting the population when compared to individual modes. According to Folha de São Paulo (2016) [14], which performed a simulation on Pacaembu Avenue, took into account the average of the city of São Paulo, where a passenger car carries around 1.2 passengers per trip. 48 people, although a regular bus has a much larger capacity.

After the simulation the data obtained confirm the need for investment in a more efficient and viable public transport for the population, since for the transport of these 48 people only one bus would be enough and it occupied 50 square meters (m²), 48 bicycles occupied 92 square meters (m²) and 40 cars obeying the average of 1.2 passengers per trip occupied 840 square meters (m²). According to the Manaus Urban Mobility Plan (2015), 3.7 million trips are made daily in Manaus, 39.5% of which are made by public transport.

3.0 Methodology

To make the observation and comparison between the cities of Manaus and São Paulo, the objectives of this study as to the effectiveness of their urban mobility was used as a base bibliographic research, in national and international publications that serve as a reference for the evaluation of cities your urban mobility.

In order to observe the global panorama and identify the items that benefit the best cities in the urban mobility field, the Sustainable Cities Mobility Index 2017 [3] was published as the main source of research. the data for the 10 best cities in the urban mobility category, which uses the factors that make them the reference cities in comparison to the cities studied in order to understand the indicators that distance them, since only one of the cities studied Arcadis Rankings.

In order to observe the national panorama of Brazil where the cities are the object of the study, the publication Connected Smart Cities 2018 [11] by Urban Systems was used, paying attention exclusively to the item of mobility and observing the evaluation indicators to identify the main differences between the study cities. Thus, for the population and demographic density framework of Manaus and São Paulo, the data provided by the IGBE on its official website was verified, using the 2010 census data and the estimates of subsequent years.

In order to identify the priorities of both cities in relation to current mobility issues, we observed the urban mobility plans available on the websites of the municipalities of both cities [12] [13]. Through the mobility plans it is possible to obtain data related to the amount of daily trips made in the study cities, the future

projections for these cities and their priorities. Through these data tables and tables will be prepared to see which city is best aligned with your mobility plan and which city has the best alignment to the global landscape in future scenarios.

To obtain the values related to the vehicle fleets of the study cities, we used the technical studies provided by the National Confederation of Municipalities [10], thus obtaining the size of the municipal fleets of both cities and the relationship between the states, data These are used to compose the panorama of the current situation through graphs, identifying the collective and individual transport fleets. In order to obtain comparison parameters, the cities of Hong Kong, Singapore and Prague were used together to provide a perspective of the scenario of the cities under study regarding their private vehicle fleet and indicators. obtained from official documents of the Ministries of Transport of their respective countries.

4. Results and Discussions

From the results obtained it is evident the predominance of public transport as a priority in the global scenario, where cities are reducing the use of private cars targeting cities like Hong Kong and Singapore where the ratio cars per person is significantly lower when compared to the city. Manaus and São Paulo as can be seen in table 1.

Table 1 - Inhabitants / Car Relationship (2017)

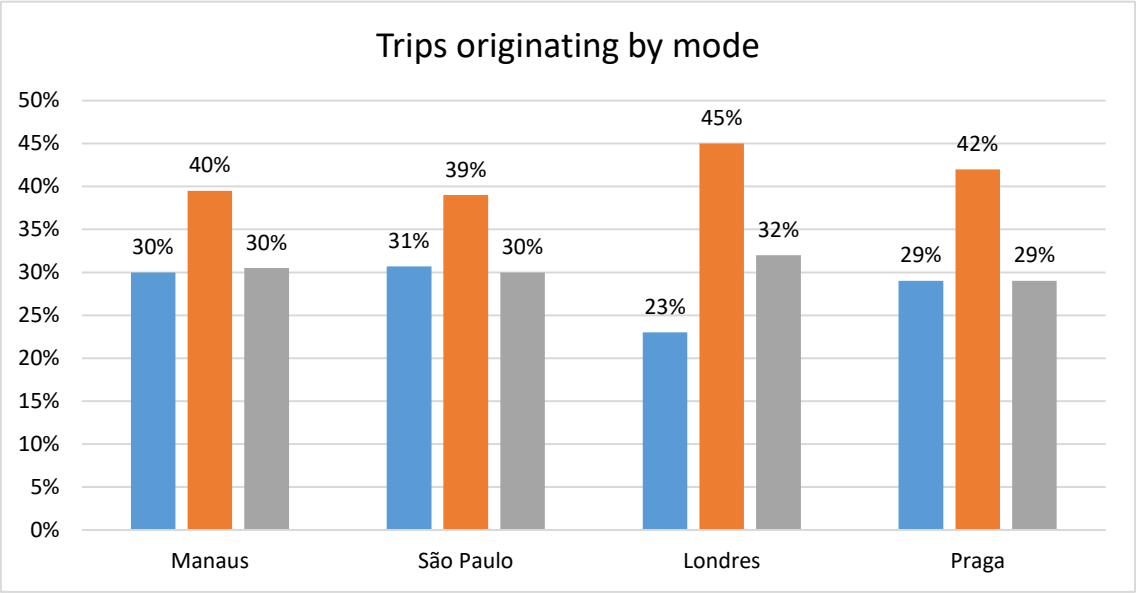
City	Population	Private cars	Inhabitants / Car Ratio
Manaus	2.130.264	358.429	5,94
São Paulo	12.106.920	5.582.546	2,17
Hong Kong	7.413.100	600.443	12,34
Singapura	5.612.300	502.187	11,17

Source: Author (2019)

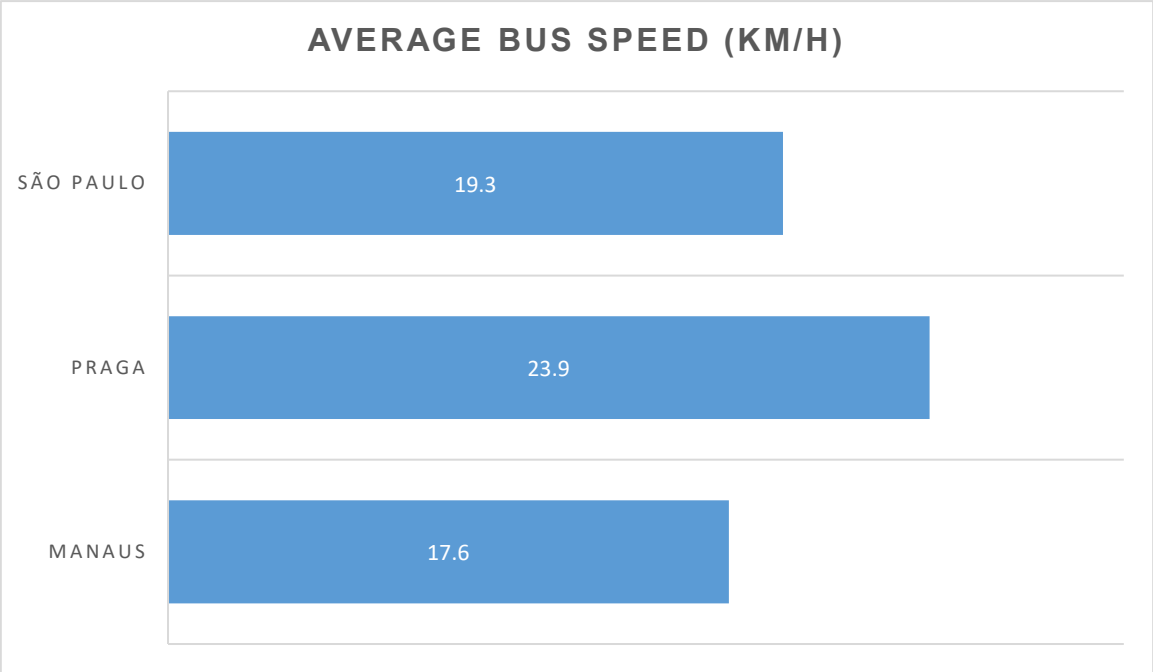
However, it is possible to observe that the city of Manaus is still far from the Brazilian average of 1 car for every 3.89 inhabitants, an indicator that makes the city of Manaus reach higher positions in the ranking of Connected Smart Cities, the city of São Paulo, however, surpasses the Brazilian average despite efforts to reduce the.

Graph 1 [12] [13] [17] [18] shows that Brazilian cities have a large share of the use of the collective transport mode, similar to the major reference cities in Europe, however, through graph 2 [12] [13] [17] it is noticeable that despite the use of modal it is not efficient as its speed when observing the average speed of the buses that make up the collective fleets of these cities.

This fact weighs on the congestion indicators evaluated in the Arcadis ranking, since the reduction in bus modal speed is mainly due to congestion in cities. Although the city of Prague has a smaller urban area and a population 3 times larger than the city of Manaus, the average bus speed in Prague is almost 6.5 km / h higher than in Manaus, which is one of the objectives of the Manaus Urban Mobility which consists in improving the modal bus system and its fluidity in traffic.



Graphic 1 - Trips by mode (2015)
Fonte: Author (2019)



Graphic 2 – Average Bus Modal Speed (2015)
Source: Author (2019)

Being the share of trips made through the collective mode and the average speed very important indicators for the Arcadis ranking that ranks the city of Prague as the fifth best in the world in terms of mobility and São Paulo as the forty-seventh and Manaus out of the top 100. Although it is necessary to check two other indicators that account for most of the score, they are the fatal traffic accidents and the size of the cycling infrastructure that can be observed respectively in tables 3 [12] [13] [17] and 4 [17] [19].

Table 3 - Fatal Accident Ratio / 100 thousand habitants (2017)

City	Population	Fatal Accidents
Manaus	2.130.264	224
São Paulo	12.106.920	762
Praga	7.413.100	17

Source: Author (2019)

Table 4 - Cycling Infrastructure (2017)

City	Cycle Mesh (km)	Cycle Mesh / Total Mesh Ratio%
Manaus	37,4	0,46
São Paulo	498,4	2,93
Praga	477	12

Source: Author (2019)

It is observed that the city of Manaus has a very small bike mesh size when compared to the cities of Sao Paulo and Prague, where the city of Sao Paulo despite having a larger bicycle network than the city of Prague, the ratio when measured with The city's total network eventually declines to just 2.93% while the city of Prague has a cycling network that accounts for 12% of its total network, making it one of the city's priorities to opt for this environmentally friendly method of transport. environment and city decongestion. However, the São Paulo cycle network is a reference in Brazil and is one of the main points of the city in the indicators evaluated by Connected Smart Cities, where this same indicator is responsible for making the city of Manaus not reach higher positions.

5. Final considerations

The study was designed to present the points in which urban mobility reference cities stand out in comparison to the Brazilian cities of Manaus and São Paulo, highlighting the indicators in which both cities can evolve to become international references and improve the quality of life of its inhabitants.

Through the theoretical framework it was possible to understand the main points used in international and national ranking that classify cities and thus compare their strengths and weaknesses, thus obtaining a small overview of the points to improve.

Besides the possibility of study regarding the urban mobility plans of the capitals Manaus and São Paulo verifying thus the guidelines adopted by the municipalities in their projects and how they try to adhere to the global pattern present in the cities references of the urban mobility theme.

6. References

[1] GALINDO, E.; GOMIDE, A. A mobilidade urbana: uma agenda inconclusa ou o retorno daquilo que não foi. Revista Estudos Avançados, v.27, n.79, p.27-39, 2013.

[2] Brasil. Lei n. 12.587, de 3 de janeiro de 2012. Institui as diretrizes da Política Nacional de Mobilidade

Urbana e dá outras providências. Diário Oficial da União. 3 jan 2012

[3] Sustainable Cities Mobility Index. ARCADIS, 2017. Disponível em: < https://www.arcadis.com/en/global/our-perspectives/sustainable-cities-mobility-index-2017/>. Acesso em: 28/agosto/2019.

[4] Towards New Urban Mobility: The Case of London and Berlin. LSE, 2015. Disponível em: <http://eprints.lse.ac.uk/68875/1/london_berlin.pdf>. Acesso em: 5/setembro/2019.

[5] EMPRAPA [homepage na internet]. Mais de 80% da população brasileira habita 0,63% do território nacional [acesso em 28 ago 2019]. Disponível em: <https://www.embrapa.br>.

[6] INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Censo demográfico: dados distritais. Manaus: IBGE, 2019. v.1.

[7] INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Censo demográfico: dados distritais. São Paulo: IBGE, 2019. v.1.

[8] NOGUEIRA, Ana; SANSON, Fábio; PESSOA, Karen. A expansão urbana e demográfica da cidade de Manaus e seus impactos ambientais. In: SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO, 13. 2007, Florianópolis. Anais... Florianópolis: INPE, 2007. p. 5427-5434.

[9] Histórico Demográfico de São Paulo, Prefeitura de São Paulo. Disponível em: <http://smul.prefeitura.sp.gov.br/historico_demografico/introducao.php>. Acesso em: 28/agosto/2019.

[10] A frota de veículos nos Municípios em 2018, CNM. Disponível em: <https://www.cnm.org.br/cms/biblioteca/Evolucao_automoveis%20nos%20Munici%cc%81pios%20de%202018_06_27.pdf>. Acesso em: 28/agosto/2019.

[11] Resultados do ranking CSC 2017 e 2018, CSC. Disponível em: <https://www.connectedsmartcities.com.br/resultados-do-ranking-connected-smart-cities/>. Acesso em: 5/setembro/2019.

[12] Plano de mobilidade urbana de Manaus 2015, Prefeitura de Manaus. Disponível em: <http://www2.manaus.am.gov.br/docs/portal/secretarias/smtu/PlanMobManaus.pdf>. Acesso em: 6/setembro/2019.

[13] Plano de mobilidade urbana de São Paulo 2015, Prefeitura de São Paulo. Disponível em: https://www.prefeitura.sp.gov.br/cidade/secretarias/upload/chamadas/planmobsp_v072__1455546429.pdf >. Acesso em: 6/setembro/2019.

[14] Folha de São Paulo [homepage na internet]. Experiência em São Paulo mostra que carros usam 17 vezes mais espaço para levar mesmo número de gente que um ônibus [acesso em 5 set 2019]. Disponível em: <https://www.arte.folha.uol.com.br>.

[15] Registration and Licensing of Vehicles by Class of Vehicles, Transport Department of Hong Kong. Disponível em: <https://www.td.gov.hk/filemanager/en/content_4883/table41a.pdf>. Acesso em: 6/setembro/2019.

[16] Annual Vehicle Statistics, Land Transport of Singapore. Disponível em: <https://www.lta.gov.sg/content/dam/ltaweb/corp/PublicationsResearch/files/FactsandFigures/MVP01-1_MVP_by_type.pdf>. Acesso em: 6/setembro/2019.

[17] Prague Transportation Yearbook 2017, TSK. Disponível em: <http://www.tsk-praha.cz/static/udi-rocenka-2017-en.pdf>. Acesso em: 6/setembro/2019.

[18] Travel in London report 11, Transport for London. Disponível em: <http://content.tfl.gov.uk/travel-in-london-report-11.pdf>. Acesso em: 6/setembro/2019.
[19] REIS, Thiago; VELASCO, Clara. Em 3 anos, malha cicloviária mais que dobra de tamanho nas capitais do país. Disponível em: <https://g1.globo.com/economia/noticia/em-3-anos-malha-cicloviaria-mais-que-dobra-de-tamanho-nas-capitais-do-pais.ghtml>. Acesso em: 6/setembro/2019.
[20] INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Frota de veículos: dados distritais. Manaus: IBGE, 2017. v.1.
[21] INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. Frota de veículos: dados distritais. São Paulo: IBGE, 2017. v.1.

Anticorruption Education Insertion in Islamic Religious Learning In The *Umar Mas'ud* Kindergarten of Bawean Island Indonesia

Suyadi, Dwi Hastuti, Sumaryati
Universitas Ahmad Dahlan
Indonesia

Abstract

The problem raised in this study is the emergence of new phenomena about corruption cases that ensnared Islamic religious leaders in Indonesia. These cases happened because so far Islamic education in Indonesia did not or had not taught anti-corruption. As a result, Indonesia in 2019 was ranked the fourth most corrupt country in the world. Corruption eradication effort cannot be done by law enforcement alone, but prevention efforts in a structured and systematic way must be carried out, and one of them is through early education or early childhood education. Therefore, the purpose of this study is to find an anti-corruption education model in Islamic religious learning in early childhood education. This research is a qualitative type of phenomenological research. The setting of this study is the Umar Mas'ud Kindergarten located in Sangkapura district of Bawean Island Indonesia. Data collection techniques are done by interview, observation and documentation. Interviews were conducted with 23 kindergarten teachers. Observations were done in anti-corruption classes developed for the Umar Mas'ud Kindergarten in Bawean Island. Data analysis was performed following a descriptive-analytic and interactivity model. The results showed that the anti-corruption education model in Islamic religious learning for Umar Mas'ud Kindergarten is the insertion of an honesty centre in one of the centres, namely Macro-Micro and Honesty centre

Keywords: Insertion, anti-corruption education, Islamic education, kindergarten, *Bawean* Island

1. Introduction

Research on anti-corruption education in Islamic education learning departs from the results of Mahmood and Tian's research which found that the most corrupt state is not a secular state (separating religion and state), but an Islamic state, namely Iraq (Mahmood & Tian, 2018). This finding was reinforced by the results of the Gullap survey cited by ACCH entitled "devout worship but a lot of corruption." Even the Corruption Eradication Commission survey showed that the Ministry of Religion was the most corrupt ministry among 22 other ministries with a score of 5.73 (scale 10). In fact, the ministry of religion is a ministry that regulates the morals of the Indonesian people. Therefore, anti-corruption education in Islamic education learning becomes an urgent need in Islamic countries, especially Indonesia.

Indonesia in 2019 is still ranked fourth as the most corrupt country in the world with an index of integrity perspective of 38 from 100 scales (Fabricius, 2017). In fact, Indonesia is a country with Muslim majority population. In the teachings of Islam, corruption is a grave sin or great shirk. However, so far Islamic

education in Indonesia has not taught anti-corruption education. Islamic education in Indonesia only teaches character or noble character in general, especially honesty, but does not teach widespread anti-corruption, especially *ghulul* and *riswah* or bribery and extortion (Anwar, 2006).

Eradicating corruption through law enforcement expressively although it is important to do is not enough. In fact, the death penalty for corruptors is considered to be less effective because China which applies the punishment to this day still has corruption cases (Gong, Wang, & Ren, 2015). Therefore, structured and systemic efforts are needed in order to prevent corruption. The effort is through education from an early age, namely the insertion of anti-corruption education in Islamic learning at all levels of education. The importance of early insertion of anti-corruption education refers to the total moral quality theory in *pesantren* (Baharun, 2017). In general, the theory set the children's class which replicates the board members' session: if the children's class is full of corrupt behaviours such as cheating, talking dirty, full of violations, then later when the child becomes public official they will commit corruption.

The insertion of anti-corruption education in Indonesia has begun to be widely applied, especially at the secondary school level through the insertion of the learning of *Pancasila* and Civic Education (PPKn). However, the insertion of anti-corruption education into learning has so far been understood as corruption in the field of education in general. As a result, schools that teach anti-corruption education are suspected of corrupt school. Anti-corruption education is still understood to be limited to violating the law, such as misuse of School Operational Assistance funds, illegal collection, bribery of positions and so on. In fact, corrupt behaviour does not only occur at the level of public office, but permeates students' behaviour even in the context of learning (Puhan, Malla, & Behera, 2014), such as cheating, scamming and so on. Therefore, anti-corruption education must be widely understood, not only the legal perspective but also other perspectives, especially education.

Aisyiyah Bustanul Athfal kindergarten in *Bawean* Island is the only early childhood education institution which inserts anticorruption education into Islamic education teaching for the first time in Indonesia. Therefore, the insertion is interesting to study because it will be an important reference for other early childhood education institutions in Indonesia, especially in terms of active and massive participation in preventing corruption in a structured and systematic manner.

2. Theoretical framework

This research uses the theory of anti-corruption education (Sumaryati, Suyadi & Hastuti, 2019) in Islamic education as initiated by Suyadi (Suyadi, 2018b), forms of corruption as proposed by the Corruption Eradication Commission (KPK, 2006), and corruptive behaviour in the learning of early childhood as stated by Suyadi, Sumaryati and Hastuti (Suyadi, Sumaryati, Hastuti, 2019).

2.1 Islamic Education in Kindergarten

The terms of Islamic education and Islamic religious education are still often exchanged. In terminology, "Islamic Education" (without the word Religion), is actually the same as "Islamic Religious Education" because Islam is the name of religion. But etymologically, both have different meanings; The interpretation defines "Islamic education" (without religion) as a system, namely an Islamic education system, so that

other related components (theory, curriculum, methods, evaluations, etc.) are composed of the Qur'an and Hadith while at the same time differentiating it from the system education in general or other "non-Islamic" education. Whereas the term Islamic Religious Education, besides being standardized as the name of subjects in schools, is also more meaningful as the name of learning activities (Huda & Kartanegara, 2015). Thus, the system is "Islamic Education", but the name of the learning activity is Islamic Religious Education. Islamic religious learning in this study is closer to learning activities or Islamic Religious Education, especially at the level of early childhood.

Furthermore, the Indonesian Government Regulation Number 55 of 2007 Concerning Religious Education and Religious Education Article 3 states that each education unit at all levels, levels and types of education is required to organize religious education, including Islamic religious education at the level of kindergarten or early age. Islamic Religious Education in kindergarten or early childhood education is organized in an integrated thematic manner according to the 2013 Early Childhood Education curriculum (Salim, 2014). Another alternative, Islamic education at the Kindergarten level follows the rules of the Directorate General of Early Childhood Education in Indonesia, namely Early Childhood Education based on Isam Religion Education (Dirjen, 2015).

Islamic education in kindergarten referred to in this study is Islamic religious education in the sense of Islamic religious learning activities in early childhood, especially those who are generally aged 4-6 years. In Umar Mas'ud Bawean Kindergarten, Islamic religious education learning activities are carried out at centres of Faith and piety (*Imtaq*). This centre is equal or commensurate with Islamic Religious Education Subjects in schools. Thus, the insertion of anti-corruption education in Islamic religious learning in kindergarten is the insertion of anti-corruption education in the centre itself.

2.2 Anti-Corruption Education in Islam

The word "corruption" comes from the Latin "corruptio" or "corruptus". (Andrea, 1951: 172) Furthermore, it is said that "corruptio" comes from the word "corrumpere", an older Latin (Omokeji, at all, 2014). From the Latin term, then known the terms "corruption, corrupt" (English), "corruption" (French) and "corruptie / korruptie" (Poerwadarminta, 1976: 83). The meaning of the word corruption is literally rottenness, badness, depravity, dishonesty, bribed, immoral, and deviation from holiness. The term corruption that has been accepted in the Indonesian vocabulary, is "crime, rottenness, bribes, immorality, depravity and dishonesty". In terms of terms, corruption can be understood as bad deeds such as embezzlement, accepting bribes, and so on.

In Malaysia, there are anti-corruption regulations where we can find the word "*resuah*". It is derived from the Arabic "*risywah*", in which according to the general Arabic-Indonesian dictionary it has the same meaning as corruption (Hamzah, 2002: 45). Risywah (bribery) terminologically means a gift given by someone to a judge or another to win his case in an unjustified manner or to obtain a position (al-Misbah al-Munir-al Fayumi, al-Muhalla-Ibnu Hazm). All scholars agreed to forbid *risywah* related to the termination of the law, even this act included as a major sin. As has been hinted by some Nash Qur'aniyah and Sunnah Nabawiyah which among others state: "They are people who like to hear lies, eat a lot of what is unclean" (QS Al Maidah 42). Imam al-Hasan and Said bin Jubair interpreted *'akkaaluna lissuhti'* with risywah. So risywah (bribe) is identical to eating something that are forbidden by Allah SWT.

In Islam, the concept of corruption can be found in despicable acts such as lying, slander, denial, unsafe and so forth. Islam clearly forbids, even condemns acts of corruption, as in Surat Al-Anfal verse 27 which states that " O you who have believed, do not betray Allah and the Messenger or betray your trusts while you know [the consequence]."(Surah Al-Anfal: 27). Likewise it is mentioned in Surah Al-Baqarah verse 188 which states that " And do not consume one another's wealth unjustly or send it [in bribery] to the rulers in order that [they might aid] you [to] consume a portion of the wealth of the people in sin, while you know [it is unlawful]."(Surah Al-Baqarah: 88).

In addition, in the hadith, the Messenger of Allah, Muhammad Saw also stated that "Whoever we employ in a position, then we give a salary, even taking more than that, means fraud." (Narrated by Abu Daud). In another hadith, it is stated, "Allah SWT curses people who bribe, take bribes, and who become intermediaries." (Ahmad Ahmad HR). Thus, Islam strongly prohibits acts of corruption because these actions are despicable and can be detrimental to others even the nation and state.

2.3 Kinds of Corruption

According to the legal perspective, the definition of corruption has clearly been explained in Law No. 31 of 1999 jo. UU no. 20 of 2001 a number of 13 articles. Based on these articles, corruption is formulated into 30 (thirty) forms or types of criminal acts of corruption (KPK, 2006: 19-21). These articles describe in detail the actions that could be imposed with imprisonment for corruption. The thirty forms/types of corruption can be grouped into 7 (seven) forms, as follows:

Tabel 1. Kinds of Corruption

No	Type	Corruption Act
1	Loss of State Money	Unlawfully carrying out acts of enriching oneself or another person or corporation; With the aim of benefiting oneself or another person or corporation, abusing its authority, opportunities and facilities
2	Bribery	Giving or promising something to a civil servant or state administrator with the intention of doing something or not doing something in his position; give a gift or promise; receive gifts or promises; accept gifts or promises that are reasonably expected to be given because of the power or authority related to his position, give or promise something to a judge with a view to influencing the case's decision; giving or promising something to an advocate to attend a court session with a view to influencing the advice or opinion to be given, in connection with the case; Judges who receive gifts or promises, even though it is known or reasonably suspected that the gift or promise is given to influence the court's decision.
3	Employee Theft	Public servants or people other than public servants who are assigned to carry out a public office continuously or temporarily, intentionally embezzle money or; counterfeit; damaging securities, deeds, lists used to convince or prove in front of officials that they cannot be used; let others eliminate, destroy, or make goods that are not used because of his position, or the money/securities are taken or embezzled by others or help in carrying out the act.

4	Extortion	Public servants or state administrators with the intention of benefiting themselves or others against the law, or by abusing their power compel someone to give something, pay, or receive payment in pieces or to do something for themselves; asking for or accepting work or delivering goods, as if it were a debt to him, even though it was known that this was not a debt; requesting or receiving or deducting payments to other public servants or state administrators or to the public treasury, as if the public servants or other state administrators or the public treasury have debts to them, even though it is known that it is not a debt.
5	Cheating	Contractor, builder who at the time of building the building, or seller of building materials who at the time of delivering the building material, commits fraudulent actions that can endanger the security of people or goods, or the safety of the state in a state of war; deliberately allowing fraudulent conduct; Everybody who when delivering goods needed by the TNI or the National Police of the Republic of Indonesia commits cheating; cheating intentionally exposes fraudulent acts which can endanger the safety of the state in a state of war.
6	Conflict of Interest in Procurement	Civil servants or state administrators either directly or indirectly deliberately participate in the chartering, procurement or affidavit which, when committed, is wholly or partly assigned to administer or supervise it.
7	Gratuity	Any gratuity to a civil servant or organizer is considered a bribe if it relates to his position and is contrary to his duties.

Further, the seven forms of corruption above will be elaborated in an educational perspective in the form of "corrupt behaviour", so that corruption is not only done by Civil Servants who are against the law, but corruption also allows students who are against rules or regulations in every learning. For example, the corruption that is detrimental to state finances can be translated into corrupt behaviours of students, such as cheating, truant and other forms of violations of the discipline so that it harms school finances. Likewise, other forms of corruption will be explained in the corruptive behaviour of students in learning.

2.4 Values in Anti-corruption Education

The anti-corruption education values that are reffered to in the theoretical framework in this study are the anti-corruption education values formulated by the Corruption Eradication Commission (Puspita, 2011: 75-80). There 9 of the 18 values taken for this study. Those characters areshown in bold 3 below:

Tabel 2. Nilai-nilai anti korupsi

No	Anti-corruption values	Description
1	Honest	No lying, righteous heart, and no cheating.
2	Caring	Heed, pay attention
3	Independent	The process of maturing oneself by not relying on others to do their duties and responsibilities.
4	Discipline	Obedience to the rules, norms, law consistently and continuously.
5	Responsible	circumstances obliged to bear everything (if anything happens may be prosecuted,

		blamed and sued).
6	Hard-working	Perseverance, endurance, clear goals, work power, stance, self-control, courage, determination, energy, strength, manhood and unyieldingness.
7	Modest	According to ability, according to need, do not like to show off wealth, and so forth.
8	Brave	Dare to say and defend the truth, dare to admit mistakes, dare to be responsible, and so forth.
9	Just	Equal, impartial, balanced, proportional.

Sembilan nilai anti korupsi tersebut di atas akan diintegrasikan ke dalam tema-tema pembelajaran dan semua mata pelajaran di setiap jenjang pendidikan dasar dan menengah melalui pendekatan tematik integratif dan atau interdisipliner. Hasil integrasi atau pemaduan inilah yang nantinya akan membentuk model pendidikan tersendiri, yakni model pendidikan anti korupsi.

2.5 Corrupt behaviour in early childhood Islamic Education

The nine anti-corruption values mentioned above will be integrated into learning themes and all subjects at every level of primary and secondary education through an integrative and or interdisciplinary thematic approach. The results of this integration will later form a separate educational model, namely the anti-corruption education model.

In the context of Islamic religious learning, the most visible corrupt behaviour is leaving the obligation to worship, pray, for example. My corrupt behaviour in religion or worship can still be elaborated in more detail by looking at the violations committed by children when worshipping. Just, for example, ablution by using excessive water, ignoring the terms and conditions of prayer, reading improper prayers and so forth. If the corrupt behaviour in worship is allowed to develop, then the child will become a corruptor. The argument is that if God's command to worship alone is dared to be violated, then the commands of humans, such as law and other order will be easily violated as well. Therefore, observance of worship according to the age of the child becomes the most fundamental moral foundation in the development of anti-corruption attitudes in children.

In the context of thematic learning, children's corruptive behaviour can be seen in detail when children carry out thematic learning activities, for example, the theme of my need with halal food sub-theme. When a child is hungry, then the child takes in excess food and cannot finish the excessive food, then the act includes corrupt behaviour. The behaviour of taking large amounts of food but not eating it is another form of greed. Therefore, if the behaviour is allowed, then later when they grow up they will become a greedy and corrupt child. Thus, corrupt behaviour is all forms of actions that are carried out intentionally and planned, both alone and with others that conflict with religious norms, community rules, and school rules.

3. Methodology

This research is a descriptive qualitative research type of phenomenological model of Cresswell (Creswell, 2010). The phenomenological quality approach was chosen because it wanted to describe a new phenomenon in the field of Islamic education that emerged on one of the outer islands in Indonesia, namely

Bawean. The setting of this research is the Umar Mas'ud Kindergarten in Sangkapura Bawean Island, Indonesia, the first kindergarten in Indonesia that carries out the insertion of anti-corruption education in early childhood learning. The subjects of this study were 23 Umar Mas'ud Kindergarten teachers with informant demographics as shown in table 3.

Table 3. Informant Demographics

Demography	**Total**	**Percentage**
Gender		
Male	3	1,31 %
Female	20	8,69%
Age (year)		
20-30	6	26,08 %
31-40	13	56,53 %
41-50	4	17,39 %
51-60	0	0 %
Education Attained		
SMU	1	4,34 %
S1	22	95,66 %
S2	0	
Teaching Experience (year)		
0-10	13	56,53 %
11-20	8	34,77 %
21-30	2	8, 70 %
> 30	0	0 %

Table 3 above draws its own attention because more than 90% of Umar Mas'ud kindergarten teachers as well as other early childhood education teachers are women (Suyadi, 2018a). This raises the potential of students to be more feminine than masculine (Silva & Avila, 2018). Data collection techniques are done by interview, observation and documentation. Observations were made from February to mid-September 2019. The objects observed were anti-corruption learning patterns by teachers to 45 students of Umar Mas'ud Kindergarten. Interviews were conducted with 23 informants. Documentation is carried out on anti-corruption learning activities. The data analysis technique was carried out following Creswell's model; data display, reduction, and interpretation. All data are displayed to see the phenomenon of anti-corruption education as a whole. Data reduction is carried out to determine valid and reliable data with anti-corruption education. The interpretation is done to interpret in-depth meaning about anti-corruption learning behind the data and facts that appear.

4. Result and Discussion

Based on observations throughout February to September 2019, Umar Mas'uad Kindergarten, Sangkapura Subdistrict, Bawean Island, Indonesia conducted an anti-corruption education insertion in Islamic religious

learning activities through three steps, namely developing a sticking of honesty centres in one of the existing centres, namely Micro-macro centres. Second, do the exercises or practices of the sunnah of the two *rak'ahs* and eat together according to their proportions. Figure 1a-e shows some anti-corruption learning activities at the Macro & Micro and Honesty Centers.

Figure 1a-e shows the dynamics of anti-corruption learning activities that are explicitly inserted in the Macro-Micro and Honesty Centers. As far as researchers have observed, there are no educational institutions at all levels of education in Indonesia that explicitly form honesty centres with a variety of anti-corruption learning activities. Generally, the insertion of anti-corruption education is carried out implicitly in certain learning activities, not explicitly by making centres of honesty as practised by the Umar Mas'ud kindergarten in District of Sangkapura, Bawean Island. A full description of the three forms of anti-corruption education insertion in Islamic religious learning in Umar Mas'ud Kindergarten, Sangkapura District, Bawean Island can be seen as follows.

Figure 1. Anti-corruption learning activities at the Macro & Micro Center and the Honesty Center. Figure 1a is the front view of the Macro & Micro and honesty center classrooms. Figure 1b is an Islamic religious learning activity in 2 raka'at prayers, Figure 1c is an activity to eat together and share food supplies brought by each child. Figure 1d is the interior design of Micro-Macro and Honesty Center, and Figure 1e is a form of writing to friends who are having difficulties. The visual design of honesty centers that are religiously patterned like the place of Imam Majid is an integration of Islamic art, science and religion itself (Suyadi, 2018c) that can stimulate children to learn more spiritually. This honesty center can also be of added value because other kindergartens do not yet have it, so it can be a promotional medium that attracts children's learning interests as is the case in Kenya (Mwangi & Makuna, 2019).

4. 1 Honesty Centre

The honesty centre is basically an anti-corruption centre. However, kindergarten does not use the term "anti-corruption center" because in the perception of the Bawean island community the word has a negative

connotation as in other corruption cases. Therefore, the Kindergarten Umar Mas'ud chose a term that has a positive connotation, namely by taking one of the core values of anti-corruption education, which is honesty. On this basis, the term "honesty centre" was formed. In this case, KK, one of the teachers said:

> "In our perception, the term anti-corruption or the like is closer to a negative connotation, because the information we receive from electronic media and other social media, the term corruption is a term of crime. We want to teach the value of honesty as a form of anti-corruption behaviour so that the term we use is the centre of honesty, not the centre of anti-corruption."

Kk's statement supported by the other teachers contradicts Xiao's research findings on the Shanghai Chinese people's perception of anti-corruption, that the Shanghai people are looking forward to the results of every anti-corruption movement (Li, Gong, & Xiao, 2016). Although China is not the cleanest country in the world of corruption, the index of perception of corruption in China is far better than Indonesia. This is why Chinese people's perceptions of Indonesia are very different and even contradictory to corruption. It is because the perception index of corruption in Indonesia is still very low. This analysis is strengthened by the research of Paul and Kristoufek who make a cluster of perceptions of corruption in a country. Indonesia occupies cluster 3a of 4 clusters created (Paulus & Kristoufek, 2015).

Thus, the challenges of developing anti-corruption education in Indonesia are far more severe than the insertion of anti-corruption education in other countries. However, the Umar Mas'ud kindergarten is brave and capable of innovating, creating and breaking new ground, namely the insertion of anti-corruption education into the Macro-Micro centre. The explicit anti-corruption education insertion at Umar Mas'ud Kindergarten can be equated with the development of anti-corruption courses in high schools (Indawati, 2015).

Furthermore, the honesty centre is affixed (inserted) to one of the centres in the Umar Mas'ud Kindergarten, the Micro and Macro centres as shown in Figure 1a. Thus, the honesty centre is not a separate centre which is separated from one centre with another but instead relies on one of the existing centres, namely Macro-Micro and Honesty. Why is it not inserted into the Imtaq centre as mentioned in theories of early childhood learning? Because Umar Mas'ud Kindergarten Bawean Island adheres to the theory of integration, i.e. imtaq integrated into all centres (Suriansyah, 2018). In the 2013 curriculum for early childhood education in Indonesia, it also recommends thematic learning, so that all fields of learning should be integrated into themes arranged according to needs (Wahyuningsih & Haryani, 2015).

4. 2 The Practice of Dhuha Prayer

The practice of the Duha Sunnah Prayer is a routine activity that is held every morning at 09.00 WIB in the Umar Mas'ud kindergarten. In the teachings of Islam, actually, the duha prayer is the sunnah (better done), not mandatory (it doesn't have to be done). The right time to do the Duha Sunnah Prayer is since the sun rises, but before the midday prayer arrives, which is 12.00 WIB. However, because the children before the prayer must arrive home (noon at 12.00 WIB), then the learning of the prayer performed is the *duha* prayer. But for the whole day schooler, the Duha and Duhur prayer activities are an important agenda in developing the Islamic character of students (Madjid, 2018).

The practice of *duha* prayer is based on the importance of building the religious character of students (Mahfud at all, 2019), which in Islam the character can be developed with the custom of the *duha* sunnah

prayer (Setyaningrum, 2017). In this case KK said:

> "As an Islamic-based school, we always invite children to get used to the Duha Sunnah Prayer every morning at 09.00 WIB. This activity aims to build the Islamic character of children so that they become *solih* and *solihah* (good person), intelligent and moral. In the beginning, most children were difficult to be conditioned, but after a few days, they began to get used to it, except for a few children who were difficult to pray in an orderly manner. "

It is not uncommon, that new habituation requires more conditioning, including the early days of habituation as stated by the KK above. But when the refraction has been repeated over and over within a certain period of time, one month, for example, there are still children who are not disciplined to practice the practice of the Duha Prayer, then the child can be said to have potentially corrupt behaviour. These children need special treatment so that their corruptive behaviour can be prevented and minimized early on.

Nevertheless, it needs to be emphasized that the customization of the Duha Sunnah Prayer program scheduled by the school is relevant to research in the field of Islamic education in early childhood which makes duha prayer one of the rituals for the development of Islamic character. (Hidayat, 2017). In Islamic teachings the fundamental rituals of prayer, including duha prayer is a ritual for spiritual practice (Mazaya & Ainissyifa, 2018).

4.3 Eating Together

Theoretically, actually eating together is a routine activity to improve the nutritional quality of children's breakfast (Harahap at all, 2019). On the other hand, Zarotis research states that this kind of activity can be a strategy to reduce the risk of obesity in early childhood (Zarotis, 2018). Therefore, the activity of eating together is only supplementary, not a staple food. For example, the Kindergarten always provides morning snacks with high-quality nutrition, so that the nutritional needs of the child are met. However, often the snacks provided are cakes rich of carbohydrate that actually make children easily full and sleepy.

In the perspective of anti-corruption education, a student can be called having corruptive behaviour if he takes snacks beyond his rights (Suyadi, 2018b). In reality, it turns out the students in the Umar Mas'ud often take snacks more than specified. However, the teachers allow their corruptive behaviour because the snack is openly presented and each child is free to take it. The teachers argued there are some who eat a lot and taking one snack maybe not enough for them.

In addition to additional snacks every morning, *Umar Mas'ud* also organizes joint dining activities. The food menu that children eat is not entirely from the institution, but rather the food supplies brought by the children themselves from home. The institution only provides additional nutrition twice a week. When the children eat together, the teacher accompanies and guides the children to share a small portion of the supplies brought to their friends. Thus, there was an exchange of some of the food supplies carried by the children there.

Referring to the theory of corrupt behaviour, especially greed, the child can be said to have corrupt behaviour if he is not willing to share his food provisions, but he accepts if given some of the food provisions from his friends. Corrupt behavior in eating together with children often asks for and even seizes

even a small amount of food brought by their friend (Suyadi, 2018b). In fact, he knew that the food he brought was enough that it would not even run out if added to the food from his friend. Such corruptive behaviour in Islam is called 'all' or greed.

How is the condition of eating with children in Umar Mas'ud kindergarten, does anyone have corrupt attitudes and behaviour? in this case, xxx one of the Kindergarten Teachers Umar Mas'ud said:

> "Children are orderly eating together, sharing with each other. In fact, they always spend their lunches, because it has been predicted by their parents in accordance with their respective eating positions. Even so, there have also been cases where children did not finish their food because they were full. "

The interview data with the Teacher above is reinforced by the documentation in Figure 1c which depicts the clean plates or bowls of children's meals. This shows that the habit of eating together by sharing provisions with one another has developed anti-corruption values, such as modesty and caring (Suyadi, 2018). Thus, the activity of eating together by sharing can be a medium to minimize and even eliminate the seeds of corrupt behaviour, especially greed.

The incidence of children who do not finish the food because they are full can be caused by many things, one of which is decreased appetite or even being unwell (sick). However, in the perspective of anti-corruption education, this can be categorized as "rationalization", ie justification for mistakes (KPK, 2006). That is, because they feel full and then feel entitled not to spend food. As a result, food is wasted. Therefore, anti-corruption education requires that if food is not on the plate or the bowl is not used up, it should be reduced to be distributed to colleagues, so that he only eats as much as he can eat.

5. Conclusion

Based on the research problem, the theoretical framework used and the methodology applied in this study, it can be concluded that the anti-corruption education model in the Umar Mas'ud kindergarten in Sangkapura Subdistrict, Bawean Island, Indonesia is by inserting an honesty centre into the Macro-Micro centre. An honesty centre is another term for an anti-corruption centre that is intended to create a more positive perception of school residents about efforts to prevent corruption in a structured and systematic way through early education. The ability to accommodate school community perceptions of changing the term from "anti-corruption centre" to honesty is an indigenous skill based on local wisdom of Umar Mas'ud kindergarten stakeholders. The exchange of honesty centres into the Macro-Miro centre explicitly can be equated with the development of anti-corruption education courses in the curriculum which has so far only been carried out at the level of high education. This insertion has even more significant impact than the insertion of anti-corruption education done implicitly in certain subjects such as the integration of anti-corruption education into Pancasila and citizenship education which so far has mostly been done by universities.

6. Acknowledgement

The research team would like to thank the Ministry of Research, Technology and Higher Education of the Republic of Indonesia and Universitas Ahmad Dahlan Yogyakarta for the funding provided to complete this research properly.

7. References

Madjid, A. (2018). Full Day School Policy For Children's Character Development: Lessons From Indonesian Islamic Education. *The Online Journal of New Horizons in Education*, *8*(3), 51–60.

Andrea, F. (1951). *Rechtsgeleerd Handwoordenboek, Kamus Hukum, terjemahan*. Bandung: Bina Cipta.

Anwar, S. (2006). *Fikih Anti Korupsi Perspektif Ulama Muhammadiyah*. Jakarta: Majelis Tarjih dan Tajdid Pimpinan Pusat Muhammadiyah.

Baharun, H. (2017). Total Moral Quality: A New Approach For Character Education In Pesantren. *Ulumuna: Journal of Islamic Studies Published by State Islamic Institute Mataram*, *21*(1), 57–80.

Creswell, J. (2010). *Educational Research: Planing, Conducting, and Evaluating Qualitative and Quantitative*. London: Pearson Edcation Inc.

Dirjen PAUD. (2015). *PAUD Berbasis Pendidikan Agama Islam*. Jakarta: Kemendikbud.

Fabricius, A. H. (2017). The lure of internationalization : paradoxical discourses of transnational student mobility , linguistic diversity, 577–595. https://doi.org/10.1007/s10734-015-9978-3

Ganiyu, R. Omokeji, R., Bamidele, Taiwo, F. O. (2014). Socio-Political And Economic Impacts Of Corruption In Nigeria. *International Journal for Innovation Education and Research*, *2*(1), 35–42. Retrieved from www.ijier.net

Gong, T., Wang, S., & Ren, J. (2015). Corruption in the Eye of the Beholder: Survey Evidence from Mainland China and Hong Kong. *International Public Management Journal*, *18*(3), 458–482. https://doi.org/10.1080/10967494.2015.1057629

Hamzah, A. (2002). *Pemberantasan Korupsi Ditinjau Dari Hukum Pidana*. Jakarta: Penerbit Pusat Hukum Pidana Universitas Trisakti.

Harahap, H., Widodo, Y., Khouw, I., Deurenberg, P., & Consultant, N. (2019). Quantity And Quality Of Breakfast Of Children Aged 2.0 To 12.9 Years In Indonesia. *GIZI INDONESIA: Journal of The Indonesian Nutrition Association*, *42*(1), 31–42.

Hidayat, M. A. (2017). Ibadat, The Body And Identity: Islamic Rituals And The Construction Of Muslim Identity. *The Journal of Society & Media*, *1*(2), 1–17.

Indawati, N. (2015). The Development of Anti-Corruption Education Course for Primary School Teacher Education Students. *Journal of Education and Practice*, *6*(35), 48–54.

KPK. (2006). *Memahami Untuk Membasmi*. Jakarta: KPK.

Li, H., Gong, T., & Xiao, H. (2016). The Perception of Anti-corruption Efficacy in China: An Empirical Analysis. *Social Indicators Research*, *125*(3), 885–903. https://doi.org/10.1007/s11205-015-0859-z

Mahfud, C., Prasetyawati, N., & Agustin, D. S. Y. (2019). The Urgency of Civic Education and Religious Character Education for Early Childhood in Indonesia. *Elementary*, *5*(1), 97–106.

Mahmood, M. A., Yizhuang, T., K. A. A. (2018). How Corruption Affects Economic Growth : Perception of Religious Powers for Anti- corruption in Iraq How Corruption Affects Economic Growth : Perception of Religious Powers for Anti-corruption in Iraq (pp. 1465–1474). Singapore: Springer International Publishing AG. https://doi.org/10.1007/978-3-319-59280-0

Mazaya, M. S., & Ainissyifa, H. (2018). Character Education Through the Obligation to Wear Santri' s Dress. In *International Conference on Islamic Education (ICIE 2018)* (Vol. 261, pp. 309–311).

Atlantis Press: Advances in Social Science, Education and Humanities Research.

Miftachul, H. M. K. (2015). Aim Formulation of Education: An Analysis of the Book Ta'lim al Muta' Allim. *International Journal of Humanities and Social Science*, *5*(2), 143–149.

Paulus, M., & Kristoufek, L. (2015). Worldwide Clustering of The Corruption Perception. *Q-Fin.EC*, *26*(Januari), 1–16.

Poerwadarminta. (1976). *Kamus Hukum Bahasa Indonesia*. Jakarta: Balai Pustaka.

Puhan, R. R., Malla, L., & Behera, S. K. (2014). Current Ethical Issues in Teacher Education: A Critical Analysis on Pre-Service and In-Service Emerging Teachers. *American Journal of Educational Research*, *2*(12), 1–7. https://doi.org/10.12691/education-2-12A-1

Puspita, R. O. B. dan N. T. (2011). Nilai dan Prinsip Anti Korupsi. In *Pendidikan Anti Krupsi Untuk Perguruan Tinggi* (pp. 75–80). Jakarta: Kementerian Pendidikan dan Kebudayaan RI Direktorat Jenderal Pendidikan Tinggi.

Salim, A. (2014). Pendekatan Saintifik dalam Pembelajaran Pendidikan Agama Islam (PAI) di Madrasah. *Cindekia*, *12*(1), 33–48.

Setyaningrum, E. A. (2017). The Implementation of the Characters Education to the Early Childhood Based on Akidah (4-6 Years Old) in TK Khalifah 29 Surakarta. *Early Childhood Education Papers (Belia)*, *6*(2), 137–142.

Sri Wahyuningsih, E. H. (2015). The Implementation Kurikulum 2013 in Early Childhood Education: Early Findings. *Indonesian Journal of Early Childhood Education Studies*, *4*(2), 81–85. https://doi.org/10.15294/ijeces.v4i2.9460

Sumaryati, Suyadi, Hastuti, D. (2019). *Pendidikan Antikorupsi di Keluarga, Sekolah dan Masyarakat*. Yogyakarta: UAD Press.

Suriansyah, A. (2018). The Integration Of Sentra-Based Learning And Involvement Of Family Program At Early Childhood In Developing Character Building (Multi Case At Paud Mawaddah And Paud Alam Berbasis Karakter Sayang Ibu Banjarmasin, Indonesia). *European Journal of Education Studies*, *5*(7), 49–63. https://doi.org/10.5281/zenodo.1494207

Suyadi, Sumaryati, Hastuti, D. (2019). *Inovasi Pendidikan Anak Usia Dini: PAUD Tahfidzulqur'an, PAUD Antikorupsi, PAUD Ramah Otak Berbasis Neurosains, PAUD Siaga Bencana, dan PAUD Adiwiyata*. Yogyakarta: UAD Press.

Suyadi. (2018). Diferensiasi Otak Laki-laki dan Perempuan Guru Taman Kanak-kanak Aisyiyah Nyai Ahmad Dahlan Yogyakarta: Studi Pendidikan Islam Anak Usia Dini Perspektif Gender dan Neurosains. *Sawwa: Jurnal Studi Gender*, *13*(2), 179–202.

Suyadi. (2018). Integration of Anti-Corruption Education (PAK) In Islamic Religious Education (PAI) With Neuroscience Approach (Multi-Case Study in Brain Friendly PAUD: I Sleman Kindergarten Yogyakarta). *Inferensi, Jurnal Penelitian Sosial Keagamaan*, *12*(2), 307–330.

Suyadi. (2018). The Synergy Of Arts, Neuroscience, And Islam In Early Chilhood Learning In Yogyakarta. *Tarbiya: Journal of Education in Muslim Society*, *5*(1), 30–42.

Zarotis, G. F. (2018). Significance , causes and effects of obesity in childhood and adolescence. *International Journal For*, *6*(11), 136–150.

Institutional Assessment Plans and Rubrics for Establishing Graduate Engineering Programs: A Practical Example

Hisham A. Maddah (Corresponding author)
King Abdulaziz University,
Rabigh, 25732, Saudi Arabia.
hmaddah@kau.edu.sa

Abstract

Institutional assessment plans are designed to provide a better education experience through investigating activities, abilities, and other indicators to check student's success and methods validity. However, effective cultural characteristics require good engagement and open communication. Here, we show a practical example of the application of the various assessment techniques to improve the student's performance and establish new graduate engineering programs in higher institutions. Rubrics must be designed to assess faculty members in the university as well as the program curriculum. Faculty should be qualified for teaching graduate-level with decent technical skills for curriculum development to initiate intended graduate programs. Gathering information about each rubric criterion from the university should be considered via evaluating campus culture, faculty attitudes, funding, and technology infrastructure. These criteria must be assessed from either the university websites, assessment reports, or long-term assessment goals as a guideline. Using the provided 'VALUE Institute Template' would greatly help in refining the assessment; critical thinking ability prepares undergraduate students for graduate studies. The proposed assessment plan will cover the following domains: diversity, course satisfaction, admission and advising, academic writing/support, curriculum change, and knowledge availability to understand the students' motivation towards learning. Moreover, effective teaching, good delivery, syllabus formatting, and classroom interactions are all some of the general aspects that can be evaluated. Data collection can be done through distributed questionnaires and/or face-to-face interviews where program directors shall take the lead in this initiative. Implementing the outcomes assessment in the institution will help in improving the student's performance and keep the educational programs up to date. The opportunity of having an MS program in the engineering department (to be implemented in the future) would not be possible without maintaining the continuous evaluation and analysis of the assessment tools for the university to become a world-class university.

Keywords: Institutional assessment; evaluation; higher education; student performance; graduate program

1. Introduction

The culture of assessment can be defined as the understood concepts and methods of assessments widely known by the faculty and staff with shared beliefs to have continuous improvement. The culture of assessment and campus culture can impact on the student's performance and/or the overall assessment process. In universities, there should be open communication and faculty involvement in the improvement process by making everyone feel that they have ownership of the adopted experimentation and assessment methods to have successful inclusion of all the different parties [1]. Evaluations are meant to help the student to provide a better education experience. Diversity role should be also included where special groups of students must raise diversity awareness within the campus. Faculty and students must be involved in workshops and training courses to promote inclusion and acceptance of any culture-based assessment tools (Figure 1) [2]. Activities, abilities, and other indicators should be investigated to check their impact on the success of the students and check the validity of the assessment tools. Effective cultural characteristics regarding the assessment in the institution involve good engagement and open communication between faculty, administration, and students. For example, in the medical school at King Abdulaziz University (KAU), twenty-four faculty and 142 students from the 4th and 5th clinical years participated voluntarily to overcome possible cultural challenges the may hinder the evaluation process through focus group discussions (FGD) and questionnaires. The culture of assessment has been developed

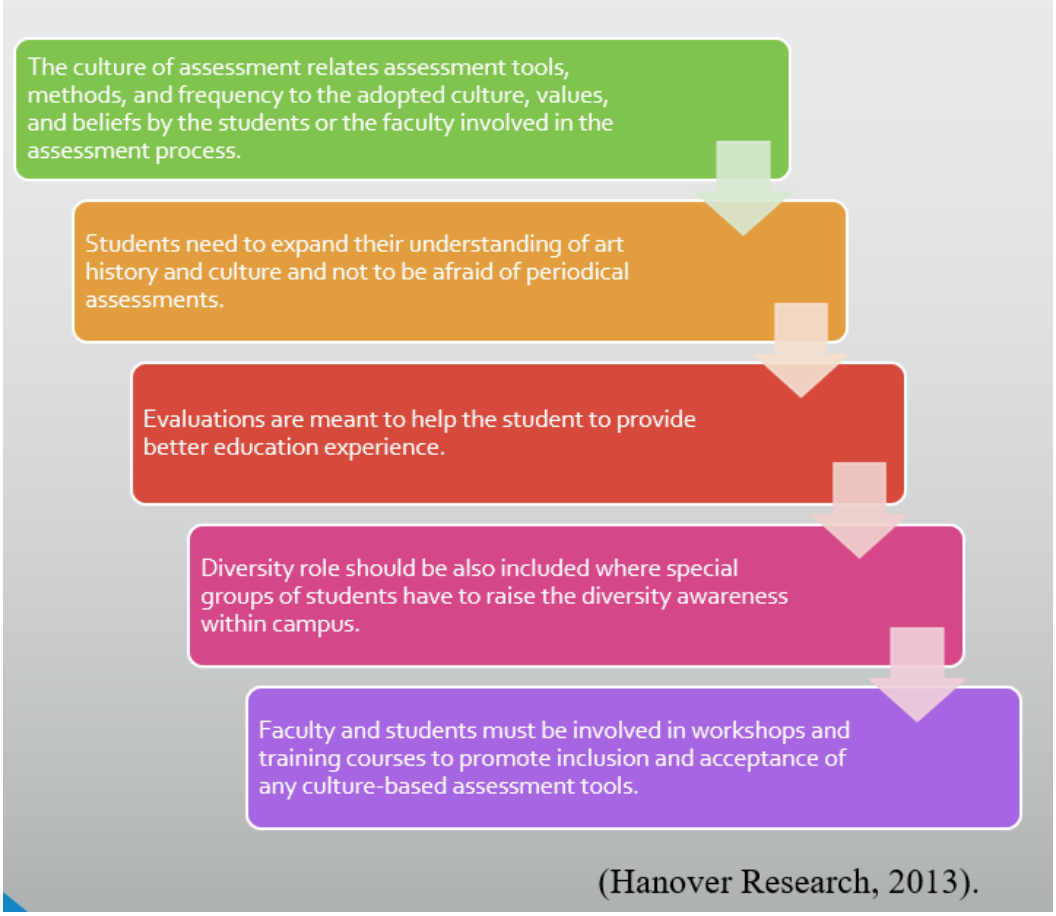


Figure 1. Development of Adopted Methods for Culture of Assessment.

by having open communication between faculty and students; hence, giving the chance to understand the students' needs, culture differences, and apply the appropriate assessment methods. The other cultural characteristic regarding assessment that might have been ineffective includes the need to understand that students may experience mental anxiety from unbalancing study load and training due to the gap between learning theories and assessment practices. This may be perceived from the false perception that 'learning is teacher-centered' according to the past learning and assessment experiences. Thus, the ineffective cultural characteristic may be regarded as wrong perceptions about learning and how assessment should take place [3]. Possible plans should take into consideration that learning must be student-centered for a better culture of assessment in the institution and at the classroom levels. Students need to expand their horizon and their understanding of knowledge and culture and not to be afraid of periodical assessments since evaluations are meant to help the student to provide a better education experience. Here, we show a practical example of the application of the various assessment techniques to improve the student's performance and establish new graduate engineering programs in KAU-Rabigh.

2. Mission and Vision Statements

The mission and vision statements considered for the institutional assessment in KAU are as the following: **Mission:** Improve students' disciple-specific knowledge, skills and learning abilities, and other problem-solving and commination skills as well as the faculty staff capabilities and program curriculum *via* utilization of various assessment rubrics and tools to evaluate the progress towards establishing graduate programs and/or the possibility of having an MS program in the engineering department. **Vision:** The university administrators should seek their faculty progress in teaching, knowledge delivery, and development to become more knowledgeable about the current situation of the faculty (and curriculum) and whether it is possible to initiate the MS program or not; by doing so, having faculty with acquired skills and qualified for curriculum development and teaching graduate-level courses must be the adopted vision for initiating such graduate programs and becoming a world-class university with clear educational-oriented goals and better students learning opportunities.

3. Culture of Assessment Plan Outline

Gathering information about each rubric criterion from the university will be considered as the following: (1) campus assessment culture from looking at the university annual assessment reports, checking the diversity, and identifying the shared values and beliefs; (2) faculty attitude towards assessment from understanding faculty/student interactions and possible engagement and open communications reported in the report; (3) administrator attitude towards assessment from the leadership approach; (4) perceived value of assessment from interviewing students, faculty, and understanding their thoughts about the assessment process; (5) respect towards assessment as a method of improving teaching and learning from relating how respectful are the students as mentioned in the reports and how cooperative are they with the faculty to implement the assessment plan; (6) time commitments to assessment from checking on the given timeline for the assessment process and whether the plan is carried annually or semi-annually with a quality time; (7) staffing for assessment from checking on the hidden values of the hired staff and how they are treated

by university leaders; (8) funding for assessment from contacting the university student affairs centers and checking for possible grants and funds devoted for the assessment process; (9) infrastructure (technology) for assessment from identifying the assessment tools and technological equipment utilized to effectively improve assessment; as shown in Table 1.

Table 1. Common Criteria of Assessment Culture Rubric Utilized in Information Gathering.

Criteria	Likert Scale			
1. campus culture,	1 Attitudes, beliefs, and knowledge are not shared.	2 Slightly common knowledge.	3 Students feel to be involved.	4 Greatly enhanced diversity and shared knowledge.
2. faculty attitude,	1 Negative attitudes towards students.	2 Few engagements with leaders.	3 Better interactions and open commination.	4 Open communication/good engagement with the students and leaders.
3. administrator attitude,	1 Unapproachable.	2 Top-down leadership	3 Feeling the importance of faculty.	4 Giving the complete chance for everyone to talk freely!
4. perceived value of assessment,	1 Students feel overwhelmed.	2 Faculty explain the reasons.	3 Administrators/ faculty give awareness.	4 Everyone becomes very engaged in the assessing process.
5. respect towards assessment as a method of improving teaching and learning,	1 Less respected assessment shows careless management.	2 Unrelated improvement might be confusing.	3 Faculty becomes responsible for teaching.	4 Complete understating of testing and improvement.
6. time commitments to assessment,	1 Very poor results.	2 Better analysis.	3 Improved quality of testing.	4 Students will have a developed education from the better analysis.
7. staffing for assessment,	1 Non meet personnel needs.	2 Become part of the staff.	3 Leaders have crew for tests.	4 Students evaluated progressively.

8. funding for assessment, and	1 Unproductive analysis from short funding.	2 Faculty becomes motivated.	3 Enhanced assessments from funding.	4 Excess funding ensures workability of assessment tools.
9. infrastructure (technology) for assessment, etc.	1 Quite bad evaluations from poor time quality.	2 Leaders will think about technology.	3 Faculty/leaders become more excited.	4 Students will be tested in short times with quick analysis.

Each of the nine items discussed will be evaluated according to the gathered information to support our assessment plan rubric. Thus, each of these criteria will be assessed from either the school websites, assessment reports, or long-term assessment goals as a guideline for us to relate our findings to previous analysis. FGD and other qualitative data gathered from engaging faculty with students will be considered. Also, other quantitative data that were gathered for the assessment based on the analysis of distributed questionnaires from previous studies will be another way to compare our data with. Previously made surveys and/or performed interviews will be taken into account for data gathering and comparison purposes. Some university people (administrators and faculty) might be contacted to gather data about the student's performance, campus diversity, shared values, faculty interactions, and other areas which will help us to answer some of the selected questions that would lead into filling up the rubric with the best outcomes for better assessment plan. Each of the criteria will be measured according to the collected data, available reports, and possible findings related to that point; then reported in the rubric accordingly from less important (1) to a highly recommended criterion (4).

4. Student Assessment Tools

It is critical to include different aspects of the assessment plan of the institution from the following: assessment of faculty delivery and knowledge; assessment of students' performance and understanding; and assessment of current engineering programs and the possibility to extend our plans to include MS degree in engineering. Application of "The American Association of College and University (AAC&U)" rubrics by university leaders using the provided 'VALUE Institute Template' would greatly help in refining the assessment process. The rubrics should be designed to assess the critical thinking value for undergraduate students in higher education institutions to make them prepared for such possible graduate studies [4]. Diversity plays a key role in determining the students' education and that less diverse classrooms and/or campus will hinder our goals to deliver good education quality to our students (Mohamad Karkouti, 2016). Also, curriculum change and reform will be the second priority that will be assessed periodically to allow our leaders to investigate the importance of the taught subjects, materials, and their relation to the possibility to extend our plans and establish graduate engineering programs [6]. The third priority will be knowledge availability and easy accessibility of information. Students should be able to find any required information and/or new findings for their intended study using the internet [7].

The need for such effective rubrics to evaluate the student's abilities and motivate them to explore possible issues and problems exist on-campus is very critical. Students in the institution (KAU-Rabigh) are usually good communicators and volunteers and open for discussions with faculty and administrators to improve the overall assessment tools in the institution. However, there are still many aspects need to be addressed like critical thinking and abilities to identify current problems for the present students and the incoming ones. The suggested rubric can be helpful for the faculty members to be applied in classrooms where undergraduate students take part in exploring issues regarding assessment and culture of assessment. Critical thinking would allow students to increase their awareness and be able to explain the found issues for further analysis. Instructors can also use the rubric to check for the credibility of the sources of the data which would identify the student position as well. Different students' perspectives have to be evaluated seriously to reach fruitful outcomes reflecting the students' needs to fulfill them by the administrators. Our students need to become good critical thinkers besides their acquired good communication skills to have a complete understating of what can be changed for a better culture of assessment. According to Grant et al. [8], critical thinking capabilities must stand as the top goal of undergraduate education where the assessment of students' skills should involve evaluation of their evolving critical thinking abilities. A sample of 176 students has been previously examined for the change in their critical thinking skills at the University of Colorado Boulder (UCB) or Colorado College (CC) employing a Critical-thinking Assessment Test (CAT). CAT instrument is an effective tool for assessing the critical thinking skills of the students across higher education institutions [8]. It is feasible to apply CAT for the incoming students in classes to emphasize the impact of learning on critical thinking or student engagement and communication.

5. Performance Outcomes

The assessment plan will cover the following domains: diversity, course satisfaction, admission and advising, academic writing/support, curriculum change, knowledge availability, and other major/program-related assessment to understand the students' motivation rrrrrrrs learning and give them directions and guidelines from proper and regular assessments (using the provided 'VALUE Institute Template') [4].

1) **Excellent Diversity:** Diversity plays a key role in determining the student's education where less diverse classrooms and/or campus will hinder our goals to deliver good education quality to our students (Mohamad Karkouti, 2016). The assessment of the diversity component in the university should allow faculty and university leaders to investigate the missing parts required for enhanced diversity. Diversity can be on campus or also can be related to diversity in curricula. The university should seek instructional diversity as well as cultural diversity as explained before by Bohmer [9]. Cultural diversity will make the students feel safe to share their ideas and feel more involved in the campus activities while instructional diversity goals include satisfying all class groups and ensure the proper participation from students without the fear to say different and/or uncommon ideas related to the course work.
2) **Improved Course Satisfaction:** Course satisfaction should also be investigated by both faculty and university leaders to check for the student's suggestions and create a continuous development in the taught courses' materials.

3) **Smooth Admission and Advising:** Admission and advising will be the other focus in the rubric and assessment plan adopted by the university. The admission office should implement advising sessions to the prospective students and there should be a 24/7 website or email communication for any inquiries or questions regarding the admission process.
4) **Enhanced Critical Thinking:** Critical thinking should be also investigated to allow students to increase their awareness and be able to explain the found issues for further analysis. Instructors can also use the rubric to check for the credibility of the sources of the data which would identify the student current progress as well. Our students need to become good critical thinkers besides their acquired good communication skills to have a complete understating of what can be changed for a better culture of assessment.
5) **Improved Academic Writing and Support:** According to Grant et al. [8], academic writing and support for the students should be evaluated by the university leaders from contacting faculty members and understand the current situation and progress in the students' performance. Faculty staff must keep an eye on the writings of their students and see how scientifically their students can write to have proper guidelines, workshops, or advice given to them to improve their writing skills.
6) **Initiated Curriculum Change:** Curriculum change and reform will be assessed periodically to allow our leaders to investigate the importance of the taught subjects, materials, and their relation to the possibility to extend our plans and establish graduate engineering programs [6].
7) **Increased Knowledge Availability:** Knowledge availability and easy accessibility of information will be taken seriously since students should be able to find any required information [7].

Implementing the outcomes assessment in the institution will help in improving the student's performance and keep the educational programs up to date. KAU (Rabigh Branch) should create a clear plan and rubrics for assessing students in various domains related to their education and the mission/vision of the university. In a higher education institution, students who create good relations with others are turned out to be more successful in life as well as in their education journey [10]. The assessment of the diversity component in the university should allow faculty and university leaders to investigate the missing parts required for enhanced diversity. The plan and rubrics will contain several planned activities and gatherings to bring students together along with the faculty and administration staff for better communication and a developed understanding of the possible diversity issues that exist on campus. Diversity and other studied domains will be evaluated and assessed for both the students and faculty from a scale of (0) to (5) where 0 refers the minimum and 5 refers to the maximum scores representing how strong is the student/faculty attitude oriented towards diversity. The other assessment domain (course satisfaction) should also be investigated by both faculty and university leaders to check for the student's suggestions and create a continuous development in the taught courses' materials. Moreover, admission and advising will be the other focus in the rubric and assessment plan adopted by the university. Lastly, academic writing and support for the students should be evaluated by the university leaders from contacting faculty members and understand the current situation and progress in the students' performance.

6. Instructor and Program Evaluation Process

Assessment tools and practices can be utilized and planned carefully in the university to have successful engineering programs. The development of an assessment plan requires understanding the university requirements and guidelines as well as the student needs and instructors' abilities to have successfully implemented programs and assessment tools that would satisfy everyone. At KAU, we plan to open a new engineering program (MS in Chemical Engineering), using the studied rubrics and available assessment tools, it would be very useful for the university to evaluate the progress towards this program and the possibility of having an MS program in the department (to be implemented successfully in the future).

Goals and Objectives: Assessment rubrics must be designed to assess faculty members in the university as well as the program curriculum to fit international education standards and the student needs. The overall goal of the plan is to evaluate the current professors' abilities and skills to teach graduate-course levels in the suggested MS program in chemical engineering. Professor evaluation is very important for improving the students learning where the university administrators must monitor their faculty progress in teaching, knowledge delivery, and development. Then, the university would become more knowledgeable about the current situation of the faculty (and curriculum) and whether it is possible to initiate the MS program or not.

Assessment Plan for the Engineering Program: The designed assessment plan should be aligned with the program goals and the whole university mission. The selections of rubrics criteria and the scoring guidelines are both very critical stages to improve the selected rubrics scores quality. The objective of the university should involve providing different assessment rubrics for the department and with different criteria that will take care of the needs of that department and what the faculty must acquire to be qualified and successful educators. The department may have a different vision, but would finally align its vision with the whole university scope. Teaching skills and curriculum development for graduate-level courses should be evaluated from different aspects. Other important criteria considered in the assessment include faculty interactions, syllabus and curriculum formatting, and knowledge delivery; (Table 2).

Assessment Methods: Effective teaching, good delivery, syllabus formatting, and classroom interactions are all some of the general aspects that can be involved in the assessment rubrics for any department. Gathered feedback from either students or faculty can be used to identify the specific criteria for the suggested program where those criteria will be also considered in the evaluation process to enhance the results. The 'Face to Face Evaluation Rubric' can be utilized to check for the presentation quality as it covers different criteria including faculty knowledge of the subject, his communication skills to deliver the materials information, method of presentation and motivation for teaching, evidence of preparation, and professional conduct [11]. All of these would help in convincing the management to establish the MS program once they realize the existence of the desired qualifications in the department faculty. Any faculty should have the bare minimum of knowledge (or degree) that show eligibility of the faculty member to teach such a course [12]. The face-to-face rubric will help a lot in seeing the communication skills of the faculty and how class interactions are carried out to deliver the course information in a graduate-level. On the other hand, the 'Online Faculty Teaching Evaluation' is more related to the faculty professional etiquette and interactions with students but not teaching [13]. The faculty can be evaluated online by the students to

check for his behavior towards students for the whole semester. A respectful manner is a must and every faculty member is expected to be treating his students in a good manner while respecting their ideas and providing clear guidelines and expectations for the student learning [14]. This is important to sustain good relationships between advisors and their students to have successful graduate programs from good mentoring. Grading and faculty availability for discussion with students about the given feedback is also another key criterion to be considered.

Data Collection: Data collection may be done through interviews and most likely via questionnaire surveys distributed to students to check for the faculty performance, curriculum, and other suggested ideas about opening the new MS program. Collected data should be shared with the Deans so that they have a chance to go back and look at the history of the university employees to take the correct actions aligned with both student's success as well as the university mission/vision (this will help a lot in deciding about initiating the graduate-level program). Again, the date can be collected from attending in class or through online surveys distributed for students; assessment should be performed electronically by the management only in professional meetings at the end of the semesters (twice a year). Collected data must be considered to reconsider hired faculty and whether they can be replaced and/or given certain workshop courses and training before trying to initiate the MS program to be successfully established. The whole rubric will be very useful for the success of the students *via* improving the teaching and communication of faculty; hence, allowing the university to decide about the MS program after deep analysis of collected information.

Table 2. Evaluation Rubric for Faculty Abilities and Motivation.

Evaluation Rubric for Establishing New MS Engineering Program: Criteria	Does Not Meet Expectations (Unacceptable) 0 point	Below Expectations (Poor/needs improvement) 1 point	Meets Expectations (Satisfactory) 2 points	Exceeds Expectations (Good) 3 points	Greatly Exceeds Expectations (Exceptional) 4 points
Evaluator: (Administrators or Student)	Faculty Abilities/Skills and Professional Interactions				
Current professors' abilities and skills to teach graduate-course levels in the suggested MS program in chemical engineering.					
Knowledge delivery and development for noticeable progress in the field.					
Teaching skills and curriculum development for graduate-level courses.					
Syllabus and curriculum formatting, to be aligned with the program goals and the whole university mission.					

Classroom interactions, communication skills with students, and knowledge delivery according to the asked questions for extra explanations.					
Evaluator: (Administrators)	Faculty Abilities/Skills to Conduct Research and Teach				
Motivation for teaching students.					
Evidence of preparation and grasp of knowledge.					
Professional conduct, and ability to do research.					
Teaching methods and its alignment with the university mission and MS program.					
Relationships between advisors and their students to have successful graduate programs from good mentoring.					

Recommendations for the Change: Program directors should take the lead in this initiative where the rubrics and finalized assessment tools and methods (as discussed earlier) should be approved before giving the directions to evaluators to check on the progress of the faculty members and suggested graduate courses/syllabi. University management can also give feedback to the department in every single semester based on the students' comments and the received evaluation reports for better performance from faculty and overall improved education quality. Also, both students and administrators can be involved in the online rubric where the management can check for collaboration and adherence of faculty to course policies and the plan of initiating new programs. A semi-annual assessment would be better and more accurate than annual evaluations. Classroom evaluation is the most important measure besides the behavior and interaction measures which would show how instructors are professional in both knowledge and communication skills; giving us the full opportunity to establish the new MS program in the department with successful outcomes.

7. Implementation and Evaluation Plans

The assessment rubric should contain distributed survey questions at the end of the semester to be filled by every student. The survey should indicate questions related to the course development and student satisfaction with the course content or instructional delivery. Faculty members should collect students' answers by the end of the semester to develop the course materials and improve the satisfaction of the coming students. On the other hand, the first-year experience of the students should be another domain of interest in the assessment rubric. The plan must contain how freshmen students dealt with possible

challenges in the university from monthly interviews with the new/incoming students. Data collection can be carried out by either student affairs individuals or even by the faculty members who are teaching those students. Regular interviews (of about 10 min each) will give the opportunities for the educators to convey the students' message to the faculty members or even to the students of the consequent years. Assessment of the students' behavior and understanding their needs from the beginning will help the university to understand the current and possible struggles that might face freshmen students due to their transition from high schools to universities.

The admission office should implement advising sessions to the prospective students and there should be a 24/7 website or email communication for any inquiries or questions regarding the admission process. Those questions can be used by educators to address common problems to be added in the assessment plan to enhance the education quality. Advising must be also taken seriously where the plan should contain sections about how an advisor would take care of his students. Proper guidelines will include that advisors have to devote weekly times to their students to discuss their progress and report any education-related problems. One-on-one interviews and survey questions will be the methods to collect the data in the advisement session [8][8][8][10]. The academic support will be also considered to ensure the completeness of the assessment rubric where most of the development is devoted to the students for better learning experiences. All the mentioned guidelines, instructions, assessment domains, and data collection methods should comply with the university mission/vision as an attempt to satisfy national or regional accreditation standards and become a world-class university!

8. Data Presentation

It would be very useful for the university to evaluate the progress towards initiating the graduate program and the possibility of having an MS program in the engineering department (to be implemented successfully in the future). Assessment rubrics must be designed to assess faculty members in the university as well as the program curriculum to fit international education requirements and the student needs. The overall goal of the plan is to evaluate the current professors' abilities and skills to teach graduate-course levels in the suggested MS program in chemical engineering. Professor evaluation is very important for improving the students learning where the university administrators must monitor their faculty progress in teaching, knowledge delivery, and development. Faculty must acquire proper interpersonal/teaching skills to be successful professors, and able to collect data for evaluation and future analysis. Presenting the data to the management is also critical to reach proper solutions and take forward actions in the improvement process. Evaluations will be done during the semester with annual and semi-annual reports to show the results. The method of data collections will be done from distributed survey questions, face-to-face interviews and/or FGD for the analysis of:

(1) Teaching skills and curriculum development for graduate-level courses.

(2) Faculty interactions, syllabus and curriculum formatting, and knowledge delivery.

(3) Student satisfaction, performance, academic skills, and knowledge availability.

Data will be analyzed in group meetings with brainstorming sessions devoted to providing proper actions towards the change. Teaching skills and curriculum development for graduate-level courses should be

evaluated from different aspects. Other important criteria considered in the assessment include faculty interactions. The 'Face to Face Evaluation Rubric' can be also utilized to check for the presentation quality as it covers different criteria including faculty knowledge of the subject, his communication skills to deliver the materials information, method of presentation and motivation for teaching, evidence of preparation, and professional conduct. Any faculty should have the bare minimum of knowledge (or degree) that show eligibility of the faculty to teach such a course with its formatted syllabus and curriculum and/or knowledge delivery methods.

Faculty evaluation in classrooms is the most important measure besides the behavior and interaction measures (Table 3 for results as an example) which would show how instructors are professional in both knowledge and communication skills; giving us the full opportunity to establish the new MS program in our department with successful outcomes.

Table 3. Example of the Evaluation Rubric for Faculty Abilities and Motivation (Results).

Evaluation Rubric for Establishing New MS Engineering Program: Criteria	Does Not Meet Expectations (Unacceptable) 0 point	Below Expectations (Poor/needs improvement) 1 point	Meets Expectations (Satisfactory) 2 points	Exceeds Expectations (Good) 3 points	Greatly Exceeds Expectations (Exceptional) 4 points
Evaluator: (Administrators or Student)	Faculty Abilities/Skills and Professional Interactions				
Current professors' abilities and skills to teach graduate-course levels in the suggested MS program in chemical engineering.		#			
Knowledge delivery and development for noticeable progress in the field.					#
Teaching skills and curriculum development for graduate-level courses.				#	
Syllabus and curriculum formatting, to be aligned with the program goals and the whole university mission.					#
Classroom interactions, communication skills with students, and knowledge delivery according to the asked questions for extra explanations.	#				
Evaluator: (Administrators)	Faculty Abilities/Skills to Conduct Research and Teach				
Motivation for teaching students.				#	
Evidence of preparation and grasp of knowledge.					#
Professional conduct, and ability to do research.				#	
Teaching methods and its alignment with the university mission and MS program.				#	
Relationships between advisors and their students to have successful graduate programs from good mentoring.		#			

9. Maintenance

The assessment plan will be maintained with continuous evaluation and analysis of the collected data. The below areas should be investigated periodically to see the quality of the proposed assessment plan in improving the student/faculty skills:

- Changes in the communication skills, and delivery methods of the faculty members.

- Course delivery and in-class activities for enhanced communication and interactions. For example, in-class group assignments would greatly help in understanding the course materials and pave the way for initiating the MS programs.
- Student/advisor relationship for improved communication qualities. For example, undergraduate students should be encouraged to build-up professional relations with their senior-project advisor for the possibility to continue in the MS program once it is approved.

Assessment tools must be aligned with the university mission/vision and must be as effective as possible following the standards and principles of good assessment practices for students learning (e.g. understating of learning, providing explicit goals, involving the community, and promoting the change) [15].

Assessments methods such FGD will be used to collectively gather qualitative data from engaging faculty with students. Moreover, an implemented 'Face to Face Evaluation Rubric' can be utilized to check for the presentation quality [11]. Any faculty should have the bare minimum of knowledge (or degree) that show eligibility of the faculty to teach such a course [12]. On the other hand, another rubric on 'Online Faculty Teaching Evaluation' will be used to check for the faculty professional etiquette and interactions with students but not teaching [13]. The faculty can be evaluated online by his students to check for his behavior towards students for the whole semester [14]. Collected data must be considered in rehiring faculty where the whole rubric will be very useful for the success going side-by-side with the university mission/vision to establish the intended graduate programs [15].

10.Reflection

Assessing the different suggested domains will certainly allow university leaders to understand the current students/faculty skills and their progress towards the possibility of initiating new graduate-level courses and/or programs. The assessment plans with the inclusion of the three different assessed domains as diversity; curriculum reform and change; knowledge availability and easy accessibility would make it much easier for our educational leaders to decide on the current progress achieved and what else is remaining to reach the university goals and open the intended graduate programs. Moreover, these areas are important because curriculum development and diversity or inclusion of students will improve the education quality and ensure the students are getting the up-to-date knowledge from different perspectives or viewpoints according to the present cultures in the university. Students should become more familiar and engaged in the class discussions; while faculty members will be also motivated to provide the latest available knowledge in the field. Graduate programs can be initiated after careful evaluation and consideration of the current curriculum and after ensuring that the current knowledge and/or articles [online] are easy to be accessed and available for all the university students; which would ensure the success of the prospective graduate students.

The suggested methods and rubrics can be helpful for the faculty members to be applied in classrooms where undergraduate students take part in exploring issues regarding assessment and culture of assessment. Critical thinking would allow students to increase their awareness and be able to explain the found issues for further analysis. According to Grant et al. [8], critical thinking capabilities must stand as the top goal of undergraduate education where the assessment of students' skills should involve evaluation of their

evolving critical thinking abilities. Directions must be provided to evaluators to check on the progress of the faculty members and suggested graduate courses/syllabi. The semi-annual assessment would be better and more accurate than the annual evaluations to establish the new MS program in our department.

11.Conclusions

We have discussed higher education assessment plans and evaluation methods meant to provide the student with better education experience. Activities, abilities, and other student indicators should be investigated to check their impact on the students' success as well as the validity of the assessment tools. Effective cultural characteristics involve good engagement and open communication. We show a practical example of the application of the various assessment techniques to establish new graduate engineering programs. Having faculty with acquired skills and qualified for curriculum development and graduate-level teaching is critical and must be the adopted vision for initiating graduate programs. The rubrics should be designed to assess the critical thinking value for undergraduate students to make them prepared for such possible graduate studies. Also, rubrics should be capable of assessing faculty members in the university as well as the program curriculum to fit international education standards. Program directors should take the lead in this initiative by implementing the outcomes assessment in the institution for the possibility of having an MS program in the engineering department (to be implemented successfully in the future). The overall assessment process would greatly help the institution in becoming a world-class university with clear educational-oriented goals and better students' learning opportunities.

12.Acknowledgement

The author would like to thank Dr. M. Meadows (from Tiffin University) for her invaluable feedback and discussions which greatly polished the research assessment plan.

13.References

[1] M. R. Lane, P. L. Lane, J. Rich, and B. Wheeling, "Improving assessment: Creating a culture of assessment with a change management approach," *J. Case Stud. Accredit. Assess.*, 2014.

[2] Hanover Research, "Best and Innovative Practices in Higher Education Assessment," 2013. [Online]. Available: https://marlenharrison.files.wordpress.com/2016/08/best-and-innovative-practices-in-higher-education-assessment-4.pdf.

[3] R. Al-Wassia, O. Hamed, H. Al-Wassia, R. Alafari, and R. Jamjoom, "Cultural challenges to implementation of formative assessment in Saudi Arabia: An exploratory study," *Med. Teach.*, 2015.

[4] The American Association of College and University (AAC&U), "Critical Thinking VALUE Rubric," 2019. [Online]. Available: https://www.aacu.org/value/rubrics/critical-thinking.

[5] I. Hohamad Karkouti, "Professional Leadership Practices and Diversity Issues in the U.S. Higher Education System: A Research Synthesis.," *Education*, vol. 136, no. 4, pp. 405–412, 2016.

[6] Texas Education Agency, "Curriculum Standards and Student Support Division: Texas Essential Knowledge and Skills," 2019. [Online]. Available: https://tea.texas.gov/curriculum/teks/.

[7] J. S. Martin and R. Marion, "Higher education leadership roles in knowledge processing," *Learn. Organ.*, 2005.

[8] M. Grant and M. Smith, "Quantifying Assessment Of Undergraduate Critical Thinking," *J. Coll. Teach. Learn.*, 2018.

[9] S. Bohmer, "Using Assessment to Guide and Revitalize Diversity Instruction," *Divers. Democr.*, vol. 12, no. 1, 2009.

[10] C. McCauley and B. Mawr, "Diversity Workshops on Campus: A Survey of Current Practice at U.S. Colleges and Universities," *Coll. Stud. J.*, 2000.

[11] "Face to Face Evaluation Rubric: EDU 590." [Online]. Available: https://online.tiffin.edu/pluginfile.php/2195042/mod_folder/content/0/Rubrics/Online Rubric for Instructor Evaluation.xlsx?forcedownload=1.

[12] AACSB, "Criteria Examples Eligibility Application for Business Accreditation," 2018. [Online]. Available: https://www.aacsb.edu/-/media/aacsb/docs/accreditation/business/eligibility/business-eligibility-criteria-examples.ashx?la=en&hash=74E6E4EF1CDC5FC86E92A9D5332DA638FB882BF4.

[13] "Online Faculty Teaching Evaluation Rubric: EDU 590." [Online]. Available: https://online.tiffin.edu/pluginfile.php/2195042/mod_folder/content/0/Rubrics/Online Rubric for Instructor Evaluation.xlsx?forcedownload=1.

[14] T. Lickona, *Educating for character: How our schools can teach respect and responsibility.* Bantam, 2009.

[15] T. Hutchings, P., Ewell, P., & Banta, "AAHE principles of good practice: Aging nicely," *Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment*, 2012. [Online]. Available: https://sites.evergreen.edu/tlni2016/wp-content/uploads/sites/166/2016/07/AAHE-Principles-of-Good-Practice.pdf.

Categorizing Recycling Cooperatives as a Form of Social Innovation and Social Development

Marcelo Okano, Graziela Bizin Panza, Marcelo Eloy Fernandes

Abstract

The process of social innovation produces the effect of reconstructing social relations systems, as well as the structure of rules and resources that reproduce such systems. The objective of this research is to verify how recycling cooperatives are adapting to social innovation and social business model. The multiple case study was chosen as research strategy, the approach will be qualitative and will be exploratory and descriptive. The epistemological positioning is positivist and the interview was the main source of data collection. Although social innovation is recent, recycling cooperatives have demonstrated that they have all of their characteristics and also make it clear that they are going through a transition from a business model of a bona fide organization to a competitive company with the characteristics of a social.

Keywords: Recycling cooperative; social innovation; social business; business model.

1. Introduction

Companies are changing their form of organization and administration, some as a result of the new business models that are appearing, others due to the evolution of technologies and business networks and more recent because of the new values that customers are accepting as social, sustainable, and economic.

These processes are revolutionizing social relations, as well as the structure of rules and resources that reproduce such systems, characterizing itself as social innovation.

Among these transformations we can mention social businesses that are oriented to solve social, economic and environmental problems that have been plaguing humankind for a long time, such as lack of housing, diseases, hunger and pollution [1] and income is reverted to the company itself.

The solid waste generated after the consumption of goods and services by the population in general is one of the most serious problems for the local public power, who have to dispose properly and represent a huge waste of natural resources. According to De Jesus and Barbieri [2], the recovery of this waste in the forms of energy reuse, recycling and revaluation increases the useful life of landfills and reduces the cost of collecting household waste. At the same time, it contributes to increase the sustainability of the Planet by reducing the need for extracting natural resources to meet the needs of production of goods and services demanded by society.

Recycling cooperatives are examples of these organizations that are transforming or adapting themselves to this new scenario, being a mixed of NGOs and company with social and lucrative ends, fight in the market to be able to survive the several difficulties.

The objective of this research is to verify how the recycling cooperatives are adapting to social innovation and the social business model.

2. Theoretical framework

In this chapter we will cover the main subjects for the theoretical framework of this research work.

2.1. Social Innovation

Social innovations constitute a component of social change not limited to the action of governments, through the creation of products, services and models, aiming at reaching social needs [3], see Figure 1.

Innovation	+	Social Aspects	=	Social Innovation
Introduction of novelty or improvement in the productive or social environment that results in new products, processes or services. Novelty, performance improvement, magnitude, implementation		Social needs or problems Social value Balance between creation and capture of public value		

Figure 1 - Social Innovation [3]

The process of social innovation produces the effect of reconstructing social relations systems, as well as the structure of rules and resources that reproduce such systems. Therefore, according to the author, it is only about social innovation "when changes alter processes and social relations, changing pre-existing power structures" [4].

Already Cloutier [5] considers social innovation as a new response, defined in action and with lasting effect, to a social situation considered unsatisfactory, which seeks the well-being of individuals and/or communities.

For Bignetti [6], it is the result of knowledge applied to social needs through the participation and cooperation of all stakeholders, creating new and lasting solutions for social groups, communities or society in general.

For Castor et al. [7] include "search, discovery, experimentation, development, imitation, and adoption of" alternative social arrangements "to produce something. And it defines alternative social arrangements as other forms of organization of the collective effort of production, differing from traditional forms of production. Therefore, forms other than those usually adopted by strictly economic, constitution-oriented firms focus on profit and competitiveness. It aims to create innovative projects for economic and social purposes.

Murray et al. [8] define as new ideas (products, services and models) that simultaneously satisfy social needs and create new social relations or collaborations. In other words, they are innovations that, at the same time, are good for society and increase the capacity of society to act.

Ten recent social innovations according to Phills et al. [9]:

1. Charter Schools: publicly funded primary or secondary schools that operate free of some of the regulations that normally apply to public schools. Administrators, teachers and parents thus have the opportunity to develop innovative teaching methods.

2. Community-Centered Planning: A process that draws on the knowledge and resources of local residents to help create solutions tailored to local needs. Allowing people to create and implement their own plans for the community helps lead to sustainable development.

3. Emissions Trading: A pollution control program that uses economic incentives to reduce emissions. A limit is set for the total quantity of a given pollutant that can be emitted, and the pollutant emissions are issued to all participating companies. Those with higher emissions can buy credits from companies that have reduced their emissions. Over time, the limit is reduced.

4. Fair Trade: an organized movement that establishes high commercial standards for coffee, chocolate, sugar and other products. By certifying traders who pay producers a living wage and meet other social and environmental standards, the fair-trade movement improves farmers' lives and promotes environmental sustainability.

5. Habitat Conservation Plans: an agreement that creates economic incentives for wildlife conservation, allowing habitat development of an endangered species if the owner protects endangered species elsewhere. The plans are managed by the US Fish and Wildlife Service and the Environmental Protection Agency.

6. Individual Development Accounts: Equivalent savings accounts that poor workers use to save for a college education, to buy a home, to set up a business, and other productive activities. For every dollar a person saves, philanthropic, government, or corporate sponsors donate an average of $ 2 for the account.

7. International Labor Standards: legally binding norms that protect the rights of workers to freedom, equity, security and human dignity. The standards have been developed by the International Labor Organization, governments, officials and workers and are implemented by member countries.

8. Microfinance: financial institutions that provide services such as banking services, loans and insurance to the poor and disadvantaged who do not have access to these services. By saving money, getting loans and having insurance, the poor can improve their lives and even get out of poverty.

9. Socially Responsible Investment: an investment strategy that attempts to maximize financial and social returns. Investors often favor companies and other organizations whose practices support environmental sustainability, human rights, and consumer protection.

10. Supported employment: programs that help disabled or otherwise disadvantaged workers find and retain good job opportunities.

2.2. Social Business

Social affairs are oriented to solve social, economic and environmental problems that have been plaguing humankind for a long time, such as lack of housing, diseases, hunger and pollution [1]. For social businesses, clients are poor people [10], which differs from social enterprises, which do not necessarily have the poor as clients.

The investor has no capital gain per se, only the return, seeks to help other people without making a profit until the business is self-sustaining, which means generating enough revenue to cover their own costs. Profits are reinvested in the company itself. Consequently, social business should be described as a lossless and dividend-free enterprise, completely dedicated to the social objective [11].

According to Hoque [12] the characteristics of a social business are:

• it is not primarily a charitable organization, but a competitive enterprise;

• needs to recover total costs to achieve high sustainability;

• the owner never receives profits / dividends; however, he has the right to recover his invested amount only;

• Profit can be reinvested to expand the business and

• seeks to maximize social benefits rather than profit. He tries to achieve social goals rather than personal gain.

For Yunus and Weber [11] to establish and manage a social business enterprise, it is necessary to meet certain standards and norms that will guide it in its journey to achieve the desired social objectives:

• The commercial objective is to overcome poverty, or one or more problems that threaten people and society - not to maximize profit;

• The company will achieve financial and economic sustainability;

• Investors receive only the value of the investment. No dividend is given beyond the return on the original investment;

• When there is a return on investment, profit remains with the company for expansion and improvement;

• The company will be environmentally conscious;

• The labor force obtains market wages with better than standard working conditions.

There are three fundamental perspectives on social business. The North American, the European and the perspective of the developing countries [13]:

a) North American perspective

The American perspective defines social enterprises mainly as private organizations that apply the logic of the market for the resolution of social problems and includes any entrepreneurial action of market that has social impact with its commercial action, being able to assume diverse legal forms, like limited companies, organizations without for-profit, corporations, and corporations [13].

According to Comini et al. [13], since the seminal article by Prahalad and Hart [14] on the relevance of the Base of the Pyramid (BoP), much has been written on the subject, which indicates that a market still little explored are the "billion aspirants to poor accessing the market. " The central idea of this approach is to develop products and services accessible to this public, without, however, departing from the generation of profit and the consequent distribution of dividends to shareholders. The discussion, which began on the potential of this market [14][15], has evolved to incorporate ways of developing business models that can provide access to products and services for BOP, while also helping to reduce the high deficit world.

Authors such as Prahalad and Hart [14] pioneered the important role that multinationals should play in mitigating socio-environmental problems. The authors pointed out that corporate social responsibility actions would be limited, and in some cases ineffective, to contribute to improving the living conditions of marginalized people. The main contribution of multinational corporations would be to offer innovative

products and services that would meet a demand quite different from that traditionally large corporations had focused on.

Buchko [16] considers that the American approach is divided into two schools: the first is called "social innovation" and is related to the concept of the "Ashoka" organization, the second is labeled "earned income" and refers to business activities in support of its objectives.

b) European perspective

The European perspective, born of the tradition of social economy (associations and cooperatives), emphasizes the role of civil society organizations with public functions [13]. According to the European concept, the pioneering model of social enterprise is "social cooperative" that appeared in Italy, and then spread to other European countries. Subsequently, the other legal forms of social enterprises were legislated in Europe [17].

The prevailing academic approach in Europe emphasizes the importance of beneficiary participation in decision making as well as the reinvestment of profit in the organization itself to enhance growth and social impact. This view is premised on the existence of a tension between obtaining financial and social results. Thus, the distribution of profit would have as a driver the search for the maximization of financial return to the shareholders / investors, which would be conflicting with the search for the maximization of social impact [13].

c) Developing country perspective

Unlike Europe, where the term social business prevails, and the US, where the term "social business" is generally applied to strategies connected to BOP, in emerging countries the term including business appears more strongly. It emphasizes market initiatives aimed at reducing poverty and transforming social conditions for marginalized or excluded individuals [13].

From the perspective of developing countries, for Comini et al. [13], the usual term is inclusive business. It considers that the Latin American vision like the Asian vision of Yunus [1] has common elements and analyzes them together. They affirm that both views point out that social or inclusive businesses are strongly concerned about poverty reduction and initiatives of this type should have a positive, effective, and above all long-term social impact.

The main reference for understanding the vision of social affairs in Latin America is the texts of researchers from the SEKN (Social Enterprise Knowledge Network) network. Formed in 2001 by leading business schools in Latin America, SEKN seeks to advance the frontiers of knowledge and the practice of social entrepreneurship through collaborative research, shared learning and case-study [13].

In this case, according to Comini et al. [13], the social benefit stems from the fact that the dividends and financial growth produced will benefit the poor and reduce their poverty.

2.3. Business Model

a) Conventional business model

Yunus et al. [18] suggest that a business model has three components, as shown in Figure 2:

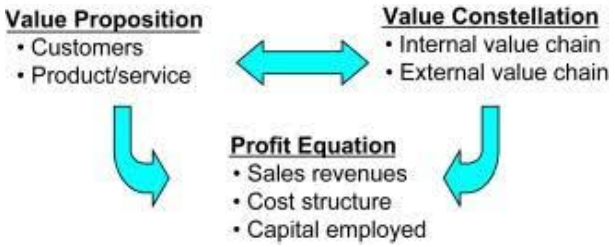


Figure 2. The three components of a conventional business model [18].

A value proposition is the answer to the question, "Who are our customers and what do we offer them that they value?". A constellation of value is the answer to the question, "How do we offer this offer to our customers?" This involves not only the company's value chain but also its value network with its suppliers and partners. These two components need to fit together as pieces of a puzzle to generate a positive profit equation, which is the financial translation of the other two, and includes how the value is captured from the proceeds generated by the value proposition and how the costs are structured, and the capital employed in the value constellation.

b) Social Business Model

To adapt the model to the social business, Yunus et al. [18] propose the following changes:

The first change is the specification of stakeholders and the provision that the value proposition and constellation are not customer-only but are expanded to encompass all stakeholders. The second is the definition of desired social benefits through a comprehensive ecosystem view, resulting in a social profit equation. The third is that the equation of economic profit aims only at the full recovery of cost and capital, not the maximization of financial profit. These changes are illustrated in Figure 3.

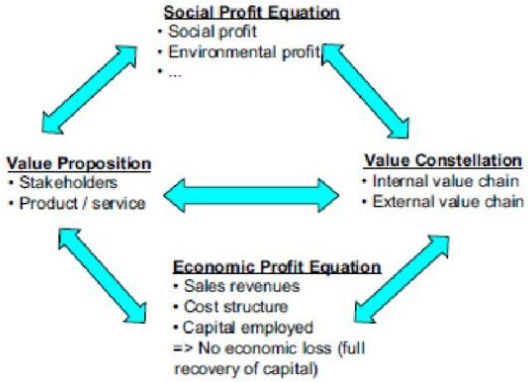


Figure 3. The four components of a social business model [18].

2.4. Cooperatives of Recyclable Materials

In both large and small cities, the process of collecting recyclable material is characterized by the formation of collectors' cooperatives, in which the workers act in a cooperative way with an employment relationship with the cooperatives; there is also the presence of the independent (autonomous) collectors who collect recyclable material on their own, reselling it to the recycling companies, and these collectors do not have any link with any type of institution, and their performance, in most cases, happens under

precarious working conditions, individually, in an autonomous and dispersed manner on the streets and in dumps [19].

The social meaning attributed, historically to garbage, as something to be kept apart, hampers a cultural change that involves the population in a joint action that reverts to the current discard logic [20].

It is in this scenario that the collectors appear as social actors, since, given their exclusion conditions, they accept the contact with the trash as a way of survival and, later, other actors are inserted in this scenario when they envision in the activity a source of complementary income [20].

The figures of recyclable waste pickers are workers who are unemployed, or who, for lack of better work options, often work full-time from childhood with their families, or there are still those who intercalate with other works, eventually as a form of income supplementation [21].

For the poorest populations, selective collection represents an important source of income, contributing significantly to the livelihoods of the families.

In Brazil, the first associations and cooperatives of garbage collectors appeared in the 1990s, in parallel with the emergence of the National Movement of Collectors of Recyclable Materials (MNCR) in 1999. Then, in 2000, the occupation was identified by the Brazilian Classification of Occupation (CBO) due to the demonstrations and struggles of the collectors, and to the national mobilization for better living and working conditions [22]. It is observed that the number of collectors of recyclable materials is constantly increasing, year after year. It is estimated that in Brazil there were more than 380 thousand waste pickers in 2010, which had average pay above the minimum wage [23].

The ownership of the cooperative belongs to its members, and is managed by its owners, and the profit generated for them, with the objective of economically empowering the poor, encouraging self-sufficiency, and promoting economic development [1].

The cooperative paradigm, in contrast to the competitive paradigm, emphasizes the collaboration that allows small entrepreneurs to access new resources that they could not develop or buy on their own, the main advantage of collaborative agreements being the grouping of leveraged resources by the partners that leads to the development of a broader and networked portfolio [18].

However, for Yunus and Weber [11] it is possible that a cooperative becomes a social enterprise, as long as the owners of the cooperative are low-income people, because in that case whatever profit generated by the cooperative would go to the poor and help them out of poverty, thus becoming a socially beneficial economic activity.

3. Materials and Methods

With the objective of discovering how recycling cooperatives are becoming social businesses, a multiple case study was chosen as research strategy, the approach was qualitative and exploratory and descriptive. The epistemological positioning is positivist [24] and the interview will be the main source of data collection.

For Yin [25], a case study is "an empirical investigation that investigates a contemporary phenomenon within its real-life context, and when the boundaries between phenomenon and context are not clearly defined." And with respect to the question of research, the case study seeks to answer "how"

and "why" a phenomenon happens; does not require control over behavioral events; and still has a focus on contemporary events [25].

On the other hand, according to Eisenhardt [26] case studies can be used to provide a description, test a theory or generate a new theory and is especially appropriate in new areas of topics as social enterprises because the developed theory is emerging in the sense of that it is situated and developed by recognizing patterns of relationships within and through case studies [26][27].

Field research, in the form of multiple case studies, will be used because it creates a more robust theory because the propositions are more deeply rooted in varied empirical evidence; the constructs and relationships are more precisely delineated because it is easier to determine precise definitions and appropriate levels of construction abstraction of multiple cases; and allows the researcher to determine whether an emergent discovery is idiosyncratic to a single case or, more broadly replicated in several cases [27].

The qualitative approach emphasizes the perspective of the individual being studied, so that it is possible to obtain information from these perspectives, to interpret the environment in which the problem is or the research environment. Also, in relation to the qualitative approach, it is possible to affirm that [28]: "the subjective reality of the individuals involved in the research is considered relevant and contributes to the development of the research. And this subjective reality can interfere, in the development of research, in the construction of an objective reality. "

For Marshall and Rossman [29], the character of the research will be exploratory and descriptive when investigating phenomena poorly understood; identify or discover important variables; or generate hypotheses for future research; and concomitantly with the descriptive purpose of documenting the phenomenon of interest.

3.1. Selection of cases

The cases will be selected respecting the assumptions raised in the conceptual framework:

Replication - Replicate previous cases or extend emerging theory, or they can be chosen to fill theoretical categories and provide examples [26].

Theoretical Sampling - Since the objective of the research is to develop the theory, not to test, and so the theoretical sampling (not random or stratified) is appropriate. Theoretical sampling simply means that cases are selected because they are particularly suited to illuminate and broaden the relationships and logic between constructs [26][27].

Intensity sampling - defined as "information-rich cases that manifest the phenomenon of interest intensely (but not extremely)" [30].

Number of cases - Although there is no "ideal number" for the cases, from four to ten cases it is suggested to work well, stopping when the theoretical saturation has been reached, that is, the point where each additional case adds an incremental learning minimal [26].

We selected three recycling cooperatives located in the cities of São Paulo, Barueri and Cotia, in the state of São Paulo. These will be called alpha, beta and gamma, whose characteristics are described in Table 01.

Table 1. Characteristics of cooperatives

Interview	Interviewee	Gender	Position / Function	County	No. Workers	Beginning of Activities	Initiative
Cooperative Gamma	E1-1	Female	Founder and responsible for the electronics sector	Cotia	45	2000	Association of Neighborhood Residents
	E1-2	Female	Founding President				
	E1-3	Male	Treasurer				
Cooperative Beta	E2-1	Male	President Founder	Barueri	53	2002	Association of Waste Pickers
	E2-2	Female	Treasurer Founder				
	E2-3	Female	Secretary				
Cooperative Alfa	E3-1	Male	Founding President	Sao Paulo	35	2005	Catholic church
	E3-2	Female	Founding Treasurer				

3.2. Data collection

The data collection through interviews is of significant importance at the moment of information gathering, making it possible for the researcher to understand how individuals interpret their expectations [31]. The interview allows the researcher both to ask key respondents about the facts in a way and to ask their opinion on specific events [25].

The interview was the main source of data collection and were conducted in 2018. The protocols were composed of a series of open and semi-structured questions to guide the general discussions. The interviews were previously scheduled so that they could happen in an appropriate place, thus avoiding the intervention of other people from their daily living or activities.

In addition to the interviews, for triangulation, we used methodological procedures: direct observation, direct observation during the field visit and documentation, documentary information relevant to all the topics of the case study [25].

3.3. Analysis of the data

The interviews were recorded and transcribed. Each set of interviews and materials were then synthesized according to the common categories of the interview protocol and developed as a detailed case study for each organization, following a common format, systematically exploring the same facets of each social enterprise in turn.

This strategy within the case helped to synthesize large volumes of data in each case and allowed researchers to become intimately acquainted with each case as an independent entity, and to allow the unique patterns of each case to emerge before looking for generalizable patterns through cases [26].

Once the interviews were transcribed, a content analysis was done. According to Bardin (1977), content analysis is a technique for analyzing communications, analyzing what was said in the interviews or observed by the researcher, and when analyzing the material, classifications were made on topics or categories that help in understanding what is for behind the speeches.

Content analysis involved the coding process of domains and categories, taxonomic and componential analysis.

According to Spradley [32], a taxonomy differs from a domain in only one respect: it shows the relations between all popular terms in a domain. A taxonomy reveals subsets of popular terms and how these subsets are related to the domain as a whole.

For Spradley [32], a compositional analysis includes the entire process of searching for contrasts, sorting them out, grouping some as dimensions of contrast, and then inserting that information into a paradigm. It also includes verifying this information with informants and filling in any lack of information.

Throughout the data analysis process, the information collected was worked out in order to be comprehensible, so that the preparation of different analyzes was carried out in a consistent manner, as well as the representation of such data. There is also the pretense of reducing the distance between theory and data, between context and action, seeking the understanding of phenomena by their description and interpretation.

4. Results and Analysis

After a review of the literature, which served as a theoretical basis for the development of the research instrument, we selected the main characteristics to prove how recycling cooperatives are becoming social business.

4.1. Characteristics of Innovation and Social Business

The Theoretical Framework presented the characteristics of innovation and social business, which were questioned and observed in the cooperatives, according to Table 02.

Table 2. Characteristics of innovation and social business

Characteristic	Innovation or Business	Cooperative Beta	Cooperative Gamma	Cooperative alfa
Do changes change social processes and relationships by changing pre-existing power structures? [4]	Innovation	Yes	Yes	Yes
Is it a new response to a social situation considered unsatisfactory? [5]	Innovation	Yes	Yes	Yes
Is it the result of knowledge applied to social needs through the participation and cooperation of all stakeholders? [6]	Innovation	Yes	Yes	Yes
Is it intended to create innovative projects for economic and social purposes? [7]	Innovation	Yes	Yes	Yes
Are new ideas (products, services and models) simultaneously satisfying social needs and creating new social relationships or collaborations? [8]	Innovation	Yes	Yes	Yes
Is it a competitive company? [12]	Business	Yes	Yes	Yes
Is profit reinvested to expand the business? Hole (2014)	Business	Yes	Yes	Yes
Are the goals social? Hole (2014)	Business	Yes	Yes	Yes
Has the company achieved financial and economic sustainability? [11]	Business	Yes	Yes	Yes
Is the commercial goal to overcome poverty, or one or more problems that threaten people and society - not to maximize profit? [11]	Business	Yes	Yes	Yes
Is the company environmentally aware? [11]	Business	Yes	Yes	Yes
Does the labor force get market wages? [11]	Business	Yes	Yes	Yes
Are the owners of the cooperative the cooperatives themselves? [11]	Business	Yes	Yes	Yes

The managers' responses revealed that cooperatives have all the characteristics of an innovation and social business, emphasizing that Cooperatives are competitive companies, all profits obtained are reinvested in the cooperative itself, the objectives are social or overcome poverty, the owners are the cooperative, the salaries paid are consistent with the market, are environmentally conscious and have achieved financial and economic sustainability.

4.2. Business Models

We use the conventional and social business models of Yunus et al. [18] to analyze the scenes before and after the formation of the producers' association, Table 3.

Table 3. Conventional and social business models applied to the recycling cooperative

		Cooperative Beta	Cooperative Gama	Cooperative Alfa
VALUE OFFER	Economic value	Crossers and industries: material in quantity; Large generators: correct disposal;	Crossers and industries: material in quantity; Large generators: correct disposal;	Crossers and industries: material in quantity; Large generators: correct disposal;
	Social value	social inclusion; generation of work and income.	social inclusion; has a stated mission; generation of work and income.	social inclusion; generation of work and income.
	Functional Value	recyclable material in quantity; provision of cleaning service; disposal.	recyclable material in quantity; provision of collection and cleaning services; proper disposal;	recyclable material in quantity; provision of collection and cleaning services; proper disposal;
	External customer segment	Buyers: brokers and industries;	Buyers: brokers and industries; large universities, malls, supermarkets, bars and pharmacies;	Buyers: brokers and industries;
	Internal customer segment	cooperated;	cooperated;	cooperated;
VALUE CONSTELLATION	Internal value chain	redemption of citizenship; reintegration into the labor market;	redemption of citizenship; reintegration into the labor market; education; self-esteem and joy;	redemption of citizenship; reintegration into the labor market;

	External value chain	garbage screening in Barueri; press; weighing; sale of recyclables	waste sorting; press; weighing; sale of recyclables; advertising via social media (Facebook, Channel on YouTube and Instagram);	screening; press; weighing; sale of recyclables;
EQUATION OF SOCIAL PROFIT	Social profit	social inclusion generation of work and income; cleaning of the municipality proper disposal of recyclable materials; participation in sustainability events;	social inclusion generation of work and income; cleaning of the municipality appropriate disposal of recyclable materials; participation in events; professional training program;	social inclusion generation of work and income; cleaning of the municipality appropriate disposal of recyclable materials; professional training program;
	Environmental Profit	Creation of value beyond financial value; Ecological value through environmental impact reduction; Ecological value positive regenerative.	Creation of value beyond financial value; Ecological value through environmental impact reduction; Ecological value positive regenerative.	Creation of value beyond financial value; Ecological value through environmental impact reduction; Ecological value positive regenerative.
		Cooperative Beta	Cooperative Gamma	Cooperative Alfa

EQUATION OF ECONOMIC PROFIT	Key Activities	garbage screening in Barueri; press; weighing; sale of recyclables	garbage collection in São Paulo; waste sorting; press; weighing; sale of recyclables; advertising via social media (Facebook, Channel on YouTube and Instagram);	collect the garbage in Cotia; screening; press; weighing; sale of recyclables; initial environmental education in condominiums and
	Key resources	cooperated; trucks; balance; running machine; presses; bags;	cooperated; trucks; balance; running machine; presses; bags;	cooperated; trucks; balance; sorting table; presses; bags; crane;
	Partners	ABIHPEC; Town hall; Fatec Barueri; Leroy Merlin; Drager ;	Rotary; São Judas University; Uninove ; FGV; USP; Movement in Defense of the Favelados (MDF); European Union; Tetra Pak; Coke; Town hall; Paulista Network;	ABIHPEC; Town hall; Tetra-Pak; Pro- Lab; Poly-USP; Condos; schools and supermarkets;

Based on the social business model of Yunus et al. [18], we analyze the results obtained.

1. Value Proposition:

The cooperatives present three types of values that in the sum we can emphasize:

• Economic value - The main raw material is recycled garbage, the cooperatives receive from the municipal garbage collection such as the cases of the Alfa, Beta and Gamma cooperatives and the so-called

large generators that are condominiums, industries, shopping centers, etc. The sale of this separate and sorted garbage to industries or brokers (firms that buy scrap and resell to industries) revert to the main source of revenue for cooperatives.

• Social value - Cooperatives offer their members social inclusion, generation of work and income. This allows the cooperative to work in the cooperative itself and will have an income and meals.

• Functional Value - The greatest contribution of recycling is the reuse of the material, thus avoiding to produce new products and saving resources to produce as well.

We find two types of cooperative clients:

• External customers - Buy recycled materials from cooperatives such as industries and middlemen.

• Internal Clients - Clients themselves are the internal customers.

2. Constellation of Value:

• External value chain - Transformation of waste into recyclable material

• Internal value chain - Rescue of the human dignity

3. Equity of social profit

The cooperatives presented two forms of profits in the social area:

• Social profit - It is the social inclusion of the individual (cooperative) after a negative event such as being in jail, involvement with drugs, etc.

• Environmental Profit - Creation of value beyond the financial value as the ecological value through environmental impact reductions.

4. Economic profit equation

The cooperatives presented that the economic profit is obtained through Key Activities, Key Resources and Partners.

• Key activities - Bring financial resources through the sale of recycled material

• Key resources - Produce material for sale

• Partners - Help in the absence of a resource.

5. Conclusions

Although social innovation is recent, the recycling cooperatives have demonstrated that they have all of their characteristics and also make it clear that they are going through a transition from a charitable organization business model to a competitive company with the characteristics of a social business.

It can be said that cooperatives are competitive enterprises, all profits obtained are reinvested in the cooperative itself, the objectives are social or overcome poverty, the owners are the cooperative, the salaries paid are market-friendly, are environmentally conscious and have achieved financial and economic sustainability.

The social business model of recycling cooperatives presented two proposals of value beyond economic, social and functional; two types of clients, the external who buys the recycled material and the

internal, the cooperative itself that receives for the work and two types of profits, the social and the economic.

As a future work, a study is suggested in cooperatives as social enterprises and also with a larger number of cooperatives.

References

[1] YUNUS, M. (2007) Creating a World Without Poverty: social business and the future of capitalism. New York: Public Affairs.

[2] De JESUS, Fernanda Santos Mota; BARBIERI, José Carlos. (2013) atuação de cooperativas de catadores de materiais recicláveis na logística reversa empresarial por meio de comercialização direta/acting of scavengers cooperatives in reverse logistics business programs through direct commercialization. Revista de gestão Social e Ambiental, v. 7, n. 3, p. 20.

[3] QUIRINO, Bruno Silva et al. (2015) Análise do programa habitacional Minha Casa, Minha Vida nas perspectivas da inovação social e a evolução das políticas públicas. Revista de Gestão Social e Ambiental-RGSA, São Paulo, v. 9, n. 3, p. 97-117.

[4] FLEURY, S. (2001) 'Observatory on social innovation', Anais do Congresso Internacional Del Clad Sobre La Reforma Del Estado Y De La Administración Pública, Buenos Aires, Vol. 9, November

[5] Cloutier, J. (2003). Qu'est-ce que l'innovation sociale? (pp. 1-46). Montréal: Crises.

[6] BIGNETTI, L.P. (2011) 'Social innovations: a raid by ideas, trends and research focus', Ciências Sociais Unisinos, Vol. 47, No. 1, pp.3–14.

[7] CASTOR, B.V.J. (2007) Social Innovation and Development, FIEP–Federação das Indústrias do Estado do Paraná.

[8] MURRAY, R., Caulier-Grice, J. and Mulgan, G. (2010) The Open Book of Social Innovation, National Endowment for Science, Technology and the Art, London.

[9] PHILLS, J.A., Deiglmeier, K. and Miller, D.T. (2008) 'Rediscovering social innovation', Stanford Social Innovation Review, Vol. 6, No. 4, pp.34–43.

[10] MAIR, J.; MARTÍ, I.; VENTRESCA, M.J. (2012) Building inlusive markets in rural Bangladesh: how intermediaries work institutional voids. Academy of Management Journal, Vol. 55, No. 4, 819–850.

[11] YUNUS, M.; WEBER, K. (2010) Building Social Business: the new kind of capitalism that serves humanity's most pressing needs. New York: PublicAffairs.

[12] HOQUE, Sayema. (2014) Social Business: A Revolutionary Idea in the Field of Poverty Alleviation. IIUC Studies, v. 8, p. 81-94.

[13] COMINI, G.; ROSOLEN, T.; TISCOSKI, G.P. (2013) Empreendedorismo Social e Negócios Sociais: Um Estudo Bibliométrico da Produção Nacional e Internacional. Rio de Janeiro: ANPAD.

[14] PRAHALAD, Coimbatore Krishnarao; HART, Stuart L. (2002) O pote de ouro na base da pirâmide. HSM Management, v. 32, p. 14-27.

[15] PRAHALAD, C. K. (2005) A Riqueza na Base da Pirâmide: Como Erradicar a Pobreza com o Lucro. Porto Alegre: Bookman.

[16] BUCHKO, Tetiana. (2018) Social Entrepreneurship and Its Implications for Hungary. Periodica Polytechnica. Social and Management Sciences, v. 26, n. 1, p. 38.

[17] DEFOURNY, J.; NYSSENS, M.; (2010) Conceptions of Social Enterprise and Social Entrepreneurship in Europe and the United States: Convergences and Divergences. Journal of Social Entrepreneurship.

[18] YUNUS, M.; MOINGEON, B; ORTEGA, L.; (2010) Building Social Business Models: lessons from the Grameen Experience. Long Range Planning, Vol. 43, 308-325.Author 1, A.B.; Author 2, C.D. Title of the article. Abbreviated Journal Name Year, Volume, page range.

[19] MMA. Catadores de Materiais Recicláveis. Available in : < http://www.mma.gov.br/cidades-sustentaveis/residuos-solidos/catadores-de-materiais-reciclaveis > Access in: 04 de nov 2017

[20] FILARDI, Fernando; SIQUEIRA, Elisabete Stradiotto; BINOTTO, Erlaine. (2011) Os catadores de resíduos e a responsabilidade socioambiental: a percepção sobre seu lugar social. Revista de Gestão Social e Ambiental-RGSA, São Paulo, v. 5, n. 3, p. 17-35.

[21] IPEA. Situação Social das Catadoras e dos Catadores de Material Reciclável e Reutilizável, IPEA, Brasília 2013.

[22] BORTOLI, M. A. (2009) Catadores de materiais recicláveis: a construção de novos sujeitos políticos. Revista Katálysis, Florianópolis: Edufsc, v. 12, n.1, p. 105-114, jan. /jun. 2009. Disponível em: <http://www.scielo.br/pdf/rk/v12n1/13.pdf>. Acesso em: 25 mai. 2017.

[23] IPEA. Catadores de Materiais Recicláveis: Um encontro nacional. IPEA, Brasília 2016. Disponível em:<http://www.ipea.gov.br/agencia/images/stories/PDFs/livros/livros/160331_livro_catadores.pdf> Acesso em: 05 de nov. 2017.

[24] GREGOR, Shirley. (2006) The nature of theory in information systems. MIS quarterly, p. 611-642.

[25] YIN, R.K. (2001) Estudo de caso: planejamento e métodos. Porto Alegre: Bookman.

[26] EISENHARDT, K. M. (1989) Building theories from case study research. Academy of Management Review, 14(4), 532–550.

[27] EISENHARDT, K. M., & GRAEBNER, M. E. (2007) Theory building from cases: Opportunities and challenges. Academy of Management Journal, 50(1), 25–32.

[28] CAUCHICK, P.A.; MARTINS, R.A. (2012) Metodologia de pesquisa para engenharia de produção e gestão de operações. Rio de Janeiro: Elsevier.

[29] MARSHALL, C.; ROSSMAN, G. B. (1995) Designing qualitative research. Sage: Thousand Oaks,.

[30] Patton, M. Q. (2002). Qualitative interviewing. Qualitative research and evaluation methods, 3, 344-347.

[31] BOGDAN, R.; BIKLEN, S. (1994) Investigação Qualitativa em Educação: uma introdução à teoria e aos métodos. Porto: Porto Editora.

[32] SPRADLEY, J.P. (1979) The Ethnographic Interview. New York: Harcourt Brace.

Making Groups Better

Dr. Jim Thomas & Dr. Matthew Lutey
Indiana University Northwest

Abstract

How can we best prepare students for careers in our competitive environment? This paper examines how group work or cooperative learning is beneficial in the learning process. It examines certain areas of learning that lend themselves to cooperative learning. Cooperative learning leads to benefits and potential problems in working with groups. We examine ways to prepare successful groups for a project. The paper suggests ways to monitor group work in the classroom. Finally, it reports on a group work study taking place over many semesters in an introductory accounting class. Results include a very successful semester. While subsequent semesters provided good results, results were mixed. What can we do to enhance our students' success in group work projects? The research points to several problem areas that can be addressed. What factors can we consider to improve our results? The research points to ways to prepare students for group work. This paper adds to the research by exploring ways to make group work more successful.

Key Words: Group work, group work issues, group work preparation.

Introduction

Group Work

Group work or cooperative learning has aroused the imaginations of educators as a panacea to elevate learning and enhance the creation of knowledge. It holds the promise to be the one tactic that helps every student reach the class outcomes and learn to work together. Group work also teaches social skills, which are handy in careers after college. However, research is limited on the conditions where it works and where it is not beneficial. The literature is limited in preparing students for group work.

The basic dilemma with cooperative learning involves two issues. Why does it work sometimes and other times create issues? How can we structure the project so that everyone is involved? We are going to examine group based quantitative classes over semesters. This study found group work advantageous in one semester and with limited success in another semester. This suggests many issues. What does the literature suggest regarding strategy in cooperative learning? How do we prepare students for successful learning in groups? What is a successful group? What do we do with unsuccessful groups?

The literature is abundant on successful group work. Much of the literature deals with precollege students. Most of the studies deal with uncontrolled field situations. Springer (1999) finds that uncontrolled field studies gain ecological validity but loose internal validity. He suggests more laboratory-controlled studies to validate the process. Gaps in the literature converge around preparation of groups, types of outcomes best suited to group work, dealing with hesitant group members, encouraging members to participate and measuring outcomes.

Literature Review

Definition

Group work or cooperative learning has been around for a long time. Cohen (2014) defines group work as students working together in a group small enough that every student can participate on an assigned task. It enables students to achieve intellectual and social learning goals. The work consists of talking, listening, asking, reasoning and reaching consensus. Students become the authority and create knowledge based on cooperation. Peters (1998) defines collaborative learning as people laboring together to construct knowledge.

Smith (1996) describes what group work is not. Group work and cooperation is not having students sit side-by-side at the same table to talk with one another as they do their assignments. Cooperation is not assigning a report to a group of students, on which one student does all the work and the others list their names. Cooperation is not having students do a task individually and then having the ones who finish first help the slower students. Cooperation is much more than being physically near other students, discussing material with other students, helping other students, or sharing material among students, although each of these is important in cooperative learning.

Instead, Smith (1996) implies that to be cooperative a group must have clear, positive interdependence. Members must promote each other's learning and success face-to-face. Students should hold each other personally and individually accountable to do a fair share of the work. They should appropriately use the interpersonal and small-group skills needed for cooperative efforts to be successful. Students should approach the project as a group and effectively work together. These five essential components must be present for small group learning to be truly cooperative. They are positive interdependence, face-to-face interaction, individual accountability, teamwork skills and group processing.

Benefits

There are many reported advantages for group work or cooperative learning. Neville (2018) mentions shared ideas, students working closely together, developing skills, cultivating strengths, dealing with challenges, finding new perspectives, making friends, developing communication skills and active learning skills. Springer (1999) lists the advantages as effective academic achievement, favorable attitudes, persistence, active learning and collaboration.

Researchers seem to flock to group work. There is a substantial body of research supporting group work. Links between cooperative learning theory, research and practice are "one of the greatest success stories in the history of education" (Slavin, 1996). Some meta-analyses support this interest. A meta-analysis of twenty years of students in science classes showed significant gains in classes using group work (Springer, 1999). Another meta-analysis of 390 science studies found significant gains in classes using group work (Shroeder, 2007).

Research shows that collaborative learning can enable students to engage in activities that are valuable for learning (Sweller, 1988). Collaborative learning models show us that certain types of learning happen interactively rather than through a one-way transmission process (Johnson, James, Lye, & McDonald, 2000). Kuh (2008) includes group learning as one of the ten high impact practices necessary for student

learning. Pedagogical research on collaborative learning techniques in education is abundant (Delucchi, 2007; Drouin, 2010; Gorvine & Smith, 2015; Koçak, 2008; Schroeder et al., 2007; Tsay & Brady, 2010; Woodzicka et al., 2015).

Group work and cooperative learning feature the development of soft skills. Because soft skills are critical for productive performance in today's workplace, current and future business leaders are emphasizing the development of soft skills through group learning (Nealy, 2005). Research reports the importance of soft skills in the workplace (Klaus, 2010; Mitchell et al., 2010; Nealy, 2005; Smith, 2007; Weldy, & Icenogel, 1997). One study found that 75% of long-term job success depends on people skills, which group work enhances while only 25% is dependent on technical knowledge (Klaus, 2010).

Some studies list additional gains using group work. Using groups, both cognitive and social adjustment gains can happen (Bruffee, 1978). Triesman (1992) reported significant learning gains from having minority students work together in calculus classes. The shared learning allows students to engage in discussion, take responsibility for their learning, and thus become critical thinkers (Totten, Sills, Digby, & Russ, 1991). Dewey's (1943) experiential philosophy suggested that group work in a nonthreatening environment leads to learning naturally (Springer, 1999). Cognitive theorists (Piaget, 1926; Vygotsky, 1978) suggest that interactions among students increase achievement and facilitate cognitive growth as students learn from each other (Springer, 1999). Terenzini (2001) in a study of engineering students found that group work achieved significant and substantially greater learning.

Group work can address different outcomes. Learning outcomes for collaborative studies fall into three groups. Some outcomes seek analytical processes (Gokhale, 1995; Lazonder, 2005; Woodzicka et al., 2015). Some outcomes reflect attitudes (Drouin, 2010; Koçak, 2008; Stein et al., 1994; Terenzini, 2001; Tsay & Brady, 2010). Some outcomes concern course material retention (Delucchi, 2007; Drouin, 2010; Gorvine & Smith, 2015; Perkins & Saris, 2001; Schroeder et al., 2007; Shibley & Zimmaro, 2002; Smith et al., 1991; Tsay & Brady, 2012). Group work lends itself better to analytical processes and ethical issues than memorization.

Issues

Research on its effects have been promising, but the results are not always positive (Kester & Paas, 2005). Placing learners in groups and assigning tasks does not guarantee they will work together, engage in effective collaborative learning processes, and show positive learning outcomes (Soller, 2001). Springer (1999) points out the classic argument of competition versus cooperation. If our classmate succeeds, he will lesson my grade. Cohen (2014) adds simply that some groups work, some do not work. We live in a social context, experiencing and recalling the milestones and the minutiae of our lives with friends, family, co-workers, and even strangers (Congleton, 2011). Group work highlights this context.Notable gaps in the research base question whether short term uncontrolled experiments should affect practice (Springer, 1999). Motivational theories emphasize the importance of individual responsibility (Springer, 1999). Small groups are not a panacea. Although group work has the potential for supporting learning, talking and working together with peers is the source of a whole series of problems (Cohen, 2014).

Problems can arise in many areas. Neville (2018) states that problems can come from the process or the people. Process problems include lack of ground rules, agenda, roles, leaders, meetings or records. People

problems include members that just do not get along, lack of communication, someone dominating, some people don't speak, people don't listen, people ignoring others, quarreling and angry remarks. Stains (2018) suggests monitoring group size, positive interdependence, criteria of referenced grading, monitoring, time and structure.

Cohen (2014) states that groups activate the status issue where slow or minority students reflect a low status and can be ignored. Students come to class with preconceived notions about each other. Smart students have higher status. Slower students have lower status. Minority students have lower status. Foreign students may have lower status. Status may influence a student participating or speaking. Class games may limit status issues (Cohen, 2014).

Types of Outcomes

Not all learning is the same. Rutherford (2018) mentions multiple studies that point to the advantages of group work in course material retention. However, the outcomes may determine the best use of cooperative learning (Cohen, 2014). Certain outcomes such as memorization may not fit with group work (Cohen, 2014). Some problems require students to recognize a problem and apply a rule. The benefits of group work are more applicable to conceptual problems such as solving a challenging math problem or resolving an ethical dilemma. Group work seems especially useful in areas such as math (Cossey, 1997), science (Bianchini, 1997), and conceptual areas (Durling, 1976). Cohen (2014) suggests matching the pattern of working together with the learning outcomes.

Preparation

There are many ways to prepare students for group work. Peters (1998) suggests that we get students involved early in the semester, point out how group work is similar to student's experience, show everyone respect, display trust in students, help students form relationships within their groups and give everyone in the group equal status. Cohen (2014) has suggestions to limit free riders. Make sure everyone has an individual assignment. Group goals contain individual assignments. Assign routine, well-defined tasks. Monitor performance throughout the semester. Conceptual learning requires the necessary resources, appropriate cognitive and linguistics skills, relevant information, and proper instructions (Cohen, 2014).

Neville (2018) states that successful groups go through a learning sequence displaying acceptance, communication, decisions, productivity and control. He mentions the six hat concept where successful groups display information, intuition, optimism, creativeness and big picture thinking. Smith (1996) finds instructors need to specify the outcomes, make instructional decisions, explain the task, expect positive interdependence, monitor learning, intervene when needed, evaluate learning and help students process.

Several preparatory games help to introduce group work. Games will help to improve communication, define group member roles, encourage ideas and establish trust. Games encourage talking, listening, asking, reasoning and reaching consensus (Cohen, 2014). Shipwreck is such a game. Imagine that your group is on a cruise ship near an island. Your ship is sinking. You can take one item to the island. From a list of eight items, which one should your group take? Cohen (2014) lists over ten other such warm up games. The purpose of the warm up game is to get students in a group used to sharing thoughts, listening, contributing, treating each other with respect and finally arriving at a conclusion.

In general, group work or cooperative learning has many potential benefits and many potential hazards. While most of the literature concentrates on grade school and high school students, some do represent college students. The following study seeks to bring the issues to light.

Method

Accounting Sample

To improve learning in an introductory accounting class, group work was introduced in a Fall 2017 accounting class. Students created groups of four to five people. Students reported a group name and group members. Students were to communicate and work together on weekly projects, compare answers and respond with the best answer. This class was the experimental group because it used group work. Other accounting classes were the control classes. Control classes did not use group work. All classes used the same book, homework, resources and quizzes.

The financial accounting course has many objectives. Students learn accounting concepts and what accounting does. Students learn the language of accounting and the accounting equation. Students learn about assets, liabilities, equity, revenue and expenses. Students learn to construct financial statements including the balance sheet, the income statement, the statement of retained earnings, and the statement of cash flows. Students learn to balance accounts and bank statements. Students learn to diagram accounts such as inventory. Students learn to calculate amounts such a bond interest. Students learn to make decisions based on financial principles. Students learn to measure financial results using ratios.

The work required was conceptual. Each chapter contained a different concept. Accounting also uses specific wording to describe the concepts. Students need to become familiar with the language. Students were required to learn a concept, become familiar with the wording associated with the concept, learn the format of the response and answer questions, create diagrams or solve problems using the concept. For example, students considered the accounting equation, assets equal liabilities plus owners' equity. Students were required to read the concept in the book and follow the examples there. For example, what is the effect on the accounting equation when the business earns revenue? Does the business assets, liabilities or equity increase, decrease or have no change?

Student also had weekly homework and quizzes from the text. Group assignments were required weekly. Several tests were concentrating on application of the concepts. An online project was required. Classes demonstrated the concept, solved problems using the concept, recorded transactions, created schedules and answered questions regarding the concept. Class time was devoted to groups working together on the weekly group assignments.

Accounting classes can be difficult. Accounting is one of the one hundred lowest graded classes. There is a two-course sequence in this topic. The drop, fail, withdraw rate (DFW) at a major Midwest university is over 60% for accounting classes. Accounting classes tend to require a lot of work and a step up in difficulty over freshmen classes. The concepts are difficult to some students. Some students in the class were retaking the class. The instructor explained and demonstrated concepts and procedures in class. Homework, reading materials, videos, Learn Smart publishers video and interactive publisher' slides were available or assigned as well. Tutors were available some of the time. The instructor had daily office hours. The use of group

assignments was to be an aid for students in completing the course. Every chapter has a video, which explained the concept and solved a problem.

The use of groups also gave students another resource to help them learn the material. Students formed their groups. Students picked a leader, a secretary and a name for their group. They were encouraged to share contact information and choose a means to communicate.

The instructions were for each student in the group to submit a solution to the weekly problems to the other members of the group. The groups would choose the best answer and submit it to the instructor. The instructor graded the problem and assigned a grade for the group. Problems were due on Fridays. Group work accounted for 10% of the grade.

Group members also graded each member of the group. In the better groups, this worked well. Students gave realistic grades to each other. In the weaker groups, students tended to assign all the group members high grades whether they deserved them or not.

Our goals were to help an individual students learn the material, alleviate student fears, help students overcome difficulties, encourage attendance, encourage communication, fight discouragement, teach students to work in teams and help students to socialize. To measure the goals, we tracked class quiz scores and DFW (Grades of D, failing grades, and drops) rates. We also surveyed students. All of the accounting sections submitted quiz scores. Some classes used group work, some did not. All of the classes used the same books, ancillary materials, and quiz banks. Instructors used different tests. Instructors usually assigned homework and quizzes from the same materials.

The DFW rates are significant for several reasons. Our campus compares our results to a national average of colleges that admit 75% to 90% of student applicants. Our grade average is 2.43. Our DFW rate is 28%. Our freshman retention rate is 68%. Our eight-year campus graduation rate is 31%. All of these are below the national average for similar schools. National figures suggest that a 1% decrease in our DFW rate will increase our grade point average by 4%, increase our retention rate by 1% and increase our graduation rate by almost 1%. These are significant goals for our students.

Finance Sample

Another professor used small groups in Finance. He divided the class into smaller sections if the sections were too large. The professor assigned students randomly to groups. Projects were assigned to each group. The first group completed the project and explained the result to the other groups. Groups were limited to three students. Groups were assigned at the beginning of the semester. Groups learned together. This keeps them accountable. Individual projects would not have worked as well.

The instructor used this technique in an introduction to finance class (Principles of Financial Management) at a different university in 2017. The process was successful. Students seemed to enjoy getting into their groups. This would typically last for the better part of a 50-minute class period.

During the following fall and spring, group work continued in an introduction to Macroeconomics course and an introduction to Microeconomics course. Both groups of students enjoyed group work. Students requesting more group work in the courses.

In the following semester, the instructor introduced a new method by putting students into small groups and having each group work on a problem set which was due at a later date for homework. The groups

would then take turns explaining one of the problems from the assignment to the rest of the class. This helped keep them accountable and we were able to go around the room and see who was working on the assignment and who needed help. Our feedback suggested the students enjoyed this.

Results

The results were encouraging in the Accounting samples. We examined DFW rates. The DFW rate in the group work class was 20%. The DFW rate in three other classes 37%, 22%, and 28%. The other classes averaged 29%. This was consistent with our hopes. We examined quiz grades. The group work class averaged 74% on their quizzes. The average quiz score in control group classes was 56%. Bases on ANOVA analysis the results were significant ($F(157)= 8.76$, $p<.01$).

Since this class is considered difficult, we surveyed students to see what they did if they could not solve the problems. We asked their first and second sources of help. The top answer was the text (first place 57%, second place 31%). The second answer was peers or their group (first answer 21%, second place 13%). Some students used Google to solve the problem (first place 18%, second place 25%). Other students used the videos (first place 3%, second place 31%).

Subsequent classes reported DFW rates of 27%, 21%, and 25%. The Fall classes had lower DFW rates. The Spring classes had higher DFW rates. We do not have comparative quiz results from other classes after the Fall of 2017.

The Finance sample did not track DFW rates, quiz or test averages. The main metric used was student satisfaction with the process. Students in this sample enjoyed the group work and asked for more group assignments. Students successfully learned the materials.

Discussion

Reasonable Results

The results suggest that the Fall group work accounting class was successful. Subsequent accounting classes had good results but not as good as the initial course. Students who took the course in the Fall session had better results than students who took the course in the Spring. We looked at the literature to improve our results. These are our recommendations.

First, we need to make sure that we are giving clear directions and demonstrating the concepts in class. Instructors need to be honest and open to student issues. All of the weekly materials including the book the assigned materials, available materials, videos, and notes address the concept and procedures the student needs. The instructor demonstrated the concepts and application and gave students a chance to work together. This was the first collaborative class for many students.

It is important to be familiar with the research on group work and collaborative learning. The research points to ideal group size, group dynamics, and preparation.

Next, we need to look at matching the concepts and application to corresponding problems for the group. The tests cover concepts and applications. We choose problems that covered concepts and applications. The group work needs to lead to the outcomes.

Class games proved to be a good preparation for group work. Performing a class game encouraged class participation and group communication. The results must include responses and agreement from each group member. This encourages everyone to participate. This also encourages groups to come to reach a consensus. Class games helped limit status issues.

Certain students had issues accessing online materials because of internet issues or just lack of experience with cloud-based assignments. Those students needed extra help with tutors or visits to the instructor's office. Other students seemed to have trouble taking notes. We started posting notes along with the videos.

I had used little preparation in class to get students ready for group work. While groups were encouraged to meet, set up a means of communication and discuss the procedures; there was little work preparation. In the future, groups will perform an in-class prep game to encourage participation and communication. Shipwreck seems appropriate for college students.

Some of the students in certain classes did not do any work and relied on other group members to solve problems for them. Each group member can be given a specific assignment and problems can be split up between the members of the group. Each member can be given a particular part of the problem. Members who slack off are noticed.

Another way to address this issue is to start with a problem that requires the group to answer individually and hand in each student's responses. Students should vote for the best answer if there are differences. This will alleviate the issue of group members covering for each other when they graded each other.

Having students grade each of their members did not always work. The better groups graded their students fairly. The weaker groups did not grade each other as well.

To encourage group members to participate, group assignments start slowly. The first assignment will be an individual assignment turned in by the group. Subsequent assignments are divided by group members. Students who don't answer will receive no credit.

Accounting is a difficult subject. Some students have a difficult time learning the concepts and applying them to solve problems or create schedules. Some students do not have the time to complete the assignments and fall behind. Some students take the time to do the required work but fail to use ancillary materials to help them understand the concepts. Other students just drop out. The purpose of the group work is to give better students a chance to have a deeper understanding of the materials and encourage their study of accounting. The purpose of the group work for average students is to help them to have a better understanding of accounting, get a good grade and understand accounting principles in their careers. The purpose of group work for weaker students is to give them access to another avenue to learn the materials. Hopefully, marginal students will benefit from group work and improve their understanding of the learning objectives.

There are several limiting factors for this study. This study takes place at a high percentage of acceptance, commuter university. Results at other universities and with other demographics of students may vary. We assumed all of the accounting professors are the same. Professors vary. The final grades contained tests. All of the professors used different tests. Some professors used multiple-choice tests, some used application problem tests, and some tests may have been more difficult than other tests. The assumption is that all test was equally difficult. While all of the accounting professors used the same quiz

bank from the same book, not all may have used the same questions or the same degree of difficulty in the questions chosen. Some test applications, some professors use test multiple-choice tests.

Because classes are different, some groups are not as successful as other groups. With better preparation, instructors should achieve better results and consistency. The way we lead students into group work could help us achieve better results.

In general, the use of group work or cooperative learning in this study was beneficial. The DFW rate dropped increasing grades, retention and graduation rates. The quiz scores increased showing better understanding and demonstration of the concepts and problems. Students have another learning resource to help them increase their understanding of the learning objectives. Students learned social skills to help them in their careers. The study also pointed to the literature to improve group work in the future.

Ten Steps to Better Group Outcomes:

1. Check yourself first, are you open, accessible and familiar with the research.
2. The concept can be difficult, make sure the task is simple and well defined.
3. Prepare students with group work in class.
4. Demonstrate the concepts and application in class.
5. Make sure students understand the procedure and have all of the necessary resources.
6. Encourage students to utilize the resources.
7. Watch for status issues in groups.
8. Start out requiring individual responses and group agreement.
9. Provide resources addressing multiple learning styles.
10. Monitor groups and encourage them.

References

Bianchini, J. (1997). Where knowledge construction, equality, and context intersect: Student learning of science in small groups. Journal of Research in Science Teaching, 34, 1039-1065.

Bruffee, K. A. (1978). The Brooklyn Plan: Attaining Intellectual Growth through Peer-Group Tutoring. Liberal Education, 64(4), 447-68.

Cohen, E. (2014). Designing Groupwork: Strategies for the heterogeneous classroom. (3rd ed.). New York, N.Y.: Teachers College Columbia Un.

Congleton, A. R., & Rajaram, S. (2011). The influence of learning methods on collaboration: Prior repeated retrieval enhances retrieval organization, abolishes collaborative inhibition, and promotes post-collaborative memory. Journal of Experimental Psychology: General, 140(4), 535.

Cossey, R. (1997). Mathematical computation: Issues of access and equality. Unpublished dissertation, Stanford University, Stanford, CA.

Delucchi, M. (2007). Assessing the impact of group projects on examination performance in social statistics. Teaching in Higher Education, 12, 447-460.

Dewey, J. (1943). The school and society (Rev. ed.). Chicago: University of Chicago Press.

Drouin, M. A. (2010). The group-based formative summative assessment relates to improved student performance and satisfaction. Teaching of Psychology, 37, 114-118.
Durling, R. & Shick, C. (1976). Conceptual attainment by pairs and individuals as a function of vocalization. Journal of Educational Psychology, 68, 83-91.
Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. Journal of Technology Education, Vol. 7 (No. 1), 22-30.
Gorvine, B. J., & Smith, H. D. (2015). Predicting student success in a psychological statistics course emphasizing collaborative learning. Teaching of Psychology, 42, 56-59.
Johnston, C. G., James, R. H., Lye, J. N., & McDonald, I. M. (2000). An evaluation of collaborative problem solving for learning economics. The Journal of Economic Education, 31(1), 13-29.
Kester, L., & Paas, F. (2005). Instructional interventions to enhance collaboration in powerful learning environments. Computers in Human Behavior, 21(4), 689-696.
Klaus, P. 2010. "Communication Breakdown." California Job
Journal 28:1-9.
Koçak, R. (2008). The effects of cooperative learning on psychological and social traits among undergraduate students. Social Behavior and Personality: an International Journal, 36, 771-782.
Kuh, G. D. (2008). Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. Association of American Colleges and Universities, 19-34.
Lazonder, A. W. (2005). Do two heads search better than one? Effects of student collaboration on web search behavior and search outcomes. British Journal of Educational Technology, 36, 465-475.
Mitchell, G. W., L. B. Skinner, and B. J. White. 2010. "Essential Soft Skills for Success in the Twenty-First Century Workforce as Perceived by Business Educators." The Delta Pi Epsilon Journal 52(1):43-53.
Nealy, C. (2005). Integrating soft skills through active learning in the management classroom. Journal of College Teaching & Learning (TLC), 2(4).
Neville, C. (2018). Making Groupwork Work. http://creativecommons.org/licenses/by-nc-sa/2.0/uk/.
Perkins, D. V., & Saris, R. N. (2001). A "jigsaw classroom" technique for undergraduate statistics courses. Teaching of Psychology, 28, 111-113.
Peters, J. M. & Armstrong, J. L. (1998). Collaborative learning: People laboring together to construct knowledge. New directions for adult and continuing education, No. 78, Fall 1998, 75-85.
Piaget, J. (1926). The language and thought of the child. New York: Harcourt Brace.
Rutherford, M. L. & Daniel, F (2018). Collaborative quizzes: Impact on student performance and attendance. Unpublished paper.
Schroeder, C. M., Scott, T. P., Tolson, H., Huang, T., & Lee, Y. (2007). A Meta-Analysis of National Research: Effects of Teaching Strategies on Student Achievement in Science in the United States. Journal on the Research of Science Teaching, VOL. 44,(No. 10), 1436–1460.
Shibley Jr, I. A., & Zimmaro, D. M. (2002). The influence of collaborative learning on student attitudes and performance in an introductory chemistry laboratory. Journal of Chemical Education, 79, 745-748.
Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. Contemporary educational psychology, 21(1), 43-69.

Smith, K. A. (1996). Cooperative Learning: Making groupwork work. New Directions for Teaching and Learning, (No, 67), Fall 1996, 71-82.

Smith, M. E., Hinckley, C. C., & Volk, G. L. (1991). Cooperative learning in the undergraduate laboratory. Journal of Chemical Education, 68, 413-415.

Soller, A. L. (2001). Supporting social interaction in an intelligent collaborative learning system. International Journal of Artificial Intelligence in Education, 12, 40–62.

Springer, L., Stanne, M. E., & Donovan, S. S. (1999). Effects of Small-Group Learning on Undergraduates in Science, Mathematics, Engineering,and Technology: A Meta-Analysis. Review of Educational Research, Vol. 69, No. 1 (Spring, 1999), pp. 21-51.

Stein, C. H., Cislo, D. A., & Ward, M. (1994). Collaboration in the college classroom: Evaluation of a social network and social skills program for undergraduates and people with serious mental illness. Psychosocial Rehabilitation Journal, 18, 13-33.

Stains, M., Harshman, J., Barker, M. K., Chasteen, S. V., Cole, R., DeChenne-Peters, S. E., ... & Levis-Fitzgerald, M. (2018). Anatomy of STEM teaching in North American universities. Science, 359(6383), 1468-1470.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive science, 12(2), 257-285.

Terenzini, P. T., Cabrera, A. F., Colbeck, C. L., Parente, J. M., & Bjorklund, S. A. (2001). Collaborative learning vs. lecture/discussion: Students' reported learning gains. Journal of Engineering Education, 90, 123-130.

Totten, S., Sills, T., Digby, A., & Russ, P. (1991). Collaborative learning: A guide to research. Scandinavian Journal of Educational Research, 33(4), 231-243.

Treisman, U. (1992). Studying students studying calculus: A look at the lives of minority mathematics students in college. The College Mathematics Journal, 23(5), 362-372.

Tsay, M., & Brady, M. (2012). A case study of cooperative learning and communication pedagogy: Does working in teams make a difference? Journal of the Scholarship of Teaching and Learning, 10, 78-89.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychologi-cal processes. (M. Cole et al., Eds.). Cambridge: Harvard University Press.

Weldy, T. G., & Icenogle, M. L. (1997). A Managerial Perspective: Oral Communi cation Competency Is Most Important for Business Students in the Workplace Jeanne D. Maes. The Journal of Business Communication (1973), 34(1), 67-80.

Woodzicka, J. A., Ford, T. E., Caudill, A., & Ohanmamooreni, A. (2015). A successful model of collaborative undergraduate research: A multi-faculty, multi-project, multi-institution team approach. Teaching of Psychology, 42, 60-63.

Application of Games as Learning Tools in the Preservation of Streams in Amazonas

Felipe de Oliveira Pantoja
felipepantoja.fp7@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Julyson Batista Nogueira
julyson100@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Bruno Pereira Gonçalves
golcalves.bruno@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

David Barbosa de Alencar (Corresponding author)
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Paulo Oliveira Siqueira Júnior
paulojunior051996@gmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Abstract

This paper presents the use of games as a strategy for teaching the principles of environmental education, focusing on preserving the rivers and streams of Manaus, polluted daily. The research is qualitative, using indirect documentation for data collection, based on articles and websites that address the subject. After the survey were listed the main points about environmental education, water pollution and how to use digital games for environmental awareness. The concepts were applied in the construction of a game prototype that warns about the importance of river preservation and how to avoid pollution. The aim is to achieve this through the simple and dynamic language that games can offer, while at the same time alerting about this environmental cause, focusing on children from six to ten years old, because they have more interaction with the games and are in their age of critical opinion formation. Research has found that water is an important resource, but it is still not preserved as it should. Nevertheless, the combination of gaming entertainment with environmental awareness concepts has proved to be a good alternative to combat the problem.

Keywords: *Defense in River; Water Pollution; Preservation; Environmental Education.*

1. Introduction

The growth of cities occurs increasingly rapidly in the contemporary world, which implies a significant expansion of the urban environment over the natural environment. And with so many people and population increase, the greater the number of waste produced. According to data from manaus Prefecture of July 2019, cleaning actions in manaus streams remove 887 tons of garbage per month from streams, including packaging, plastic bottles, bags, organic remains, among others.

Despite all existing ways to prevent these debris from harming the environment, the human being performs dumping mostly directly into the soil, atmosphere and rivers.

Because of this, working on environmental awareness is necessary, which is done through Environmental Education, whether in schools (formal education) and in other sectors of society (informal teaching). Environmental education aims to lead to engagement regarding the principles of sustainability through processes through which the individual and the collectivity develop values so that there is the preservation of the environment. For this, everyone needs to be aware of their role in ensuring sustainable growth.

Despite the importance of environmental education, both in formal and informal education there are obstacles that basically consist of teaching methods that do not efficiently affect the individual, especially younger age groups. In view of this, it is proposed the use of digital games to increase the methodologies applied in the classroom. With the technological advancement and dissemination of games among children's audiences, it is possible to use these forms of entertainment as drivers of teaching in environmental education and a means of disseminating in the individual in critical thinking training the notions about preservation of natural resources.

Environmental pollution covers various ecosystems. In this work, the focus is on contamination of rivers, and so it is necessary to highlight this particular theme. Without water there is no life and without it many of the daily human activities can not happen. From bathing to food production, water is present. And the water used in all these processes is precisely the fresh water, found for example in rivers, lakes and glaciers. Fresh water is the most used, but the one that is in the smallest amount of the total volume on planet Earth, which is composed of 97.4% of water resources and of this number, only 2.6% is freshwater.

For this pollution framework to be reversed, a global engagement is needed and for this, every contribution corroborates the preservation of rivers, which every day lose liters of drinking water. One way is the use of games in environmental education. Through a direct language, simple and with entertainment from the universe of games this can be a tool of awareness, especially of children, between six and ten years of age.

2. Development

2.1 Environmental Education

According to the National Curriculum Parameters, environmental education can be understood as "the processes through which the individual and the collective build social values, knowledge, skills, attitudes and competencies aimed at the conservation of the environment, as well as common use of the people, essential to sound quality of life and their sustainability" [BRASIL, 1997].

It is observed that the application of any proposal to solve environmental problems needs to start in each individual and be part of general thinking. This is reinforced by Santos et al [p.29, 2013], when he states

that "solutions to environmental problems will only be possible if there is involvement and participation of the whole society along with the support of consistent public policies".

This connection between all these sectors is related to another characteristic of environmental education, it must be interdisciplinary. The environment concerns education, politics, economics, family, culture, among others. According to Medina and Santos [1999] apud Santos et al [p.31, 2013], "EA is not only highlighting the environmental issues that are already in the contents of various disciplines, or adding environmental components to the materials, giving priority to natural sciences, is in the it is to build an environmental knowledge that if all disciplines, through a social process of knowledge production.

In EA it also takes innovation to engage people, uniting to traditional forms of teaching other strategies that can draw society's attention to the subject. In this sense, it is necessary to present environmental education in two means: in formal and informal.

Formal education is one that occurs in the school field. According to Reis et al [p. 51, 2012], "environmental education in school education is understood to be developed within the curricula of public and private educational institutions, encompassing: I - basic education; II - higher education; III – special education; IV - vocational education; V - education of young people and adults".

The application of environmental education within formal education has its relevance Despite this, it faces some mishaps, which according to Reis et al [p. 54, 2012], consist: in the search for methodological alternatives that converge the disciplinary approach to the indisciplinary; in the barrier of the curricular structure in terms of content workload, evaluation, among others; and in raising teachers' awareness, in the face of new challenges and reformulations that require work and creativity.

Environmental education enters the informal environment. According to Reis et al [p. 51, 2012], it comprises educational actions and practices aimed at raising awareness of the collective on environmental issues and their organization and participation in the defense of the quality of the environment, which can be done through the means of communication, school, universities, NGOs, ecotourism, among others [REIS et al, p. 51, 2012].

However, awareness in the various social segments also encounters barriers. According to Reis et al [p. 57, 2012] in Brazil there are not many investments for the implementation of work in environmental education in non-formal education.

In federal conservation units (parks and reserves) there are few educational programs, since most of the few resources are used in the supervision and not in the education of the population. This is mainly due to the lack of documentation of well-developed projects, and that demonstrate the effectiveness of these work when compared to their costs [REIS et al, p.57, 2012].

Despite these obstacles, today the tools are many. With this, technological advances stand out. With the technology increasingly present in society, especially among children, it is understood that uniting an environmental cause to the technological universe of games is an effective and efficient way to generate awareness. Because while searching for fun the player dynamically and simply absorbs learnings to preserve natural resources.

In this work, the problem discussed is the pollution of rivers. The choice is due to the need to discuss the theme that affects the largest watershed in the world, highlighted by the Amazon River, which among several locations passes through Manaus, where the environment of the game that will be presented at work

takes place. Before entering the application of games in the educational area, it is necessary to explain the subject of water pollution that among environmental problems contains in itself a number of issues that deserve own attention.

2.2 Importância da Água e Poluição

Approximately 71% of the Earth's surface and 75% of the human body is water. The use of this resource is also wide, whether for cleaning, food preparation, drug manufacturing, among other options, water is present. And for all these applications one specifically employs fresh water.

Freshwater comprises rivers, lakes and dams, infiltrated into the spaces of the soil and rocks, clouds, living beings and glaciers, where they are concentrated in greater quantity. Of the total water that makes up planet Earth, approximately 97.4% is salty and is in the oceans. Only 2.6% is sweet, and only 1% is usable, since the rest is in solid state and is not accessible.

These numbers and the relevance that fresh water plays in the maintenance of life and daily activities attest to the need to preserve the water resources of lakes and rivers. However, human society moves in the opposite direction as it dumps every variety of pollutants into waterways, reducing the amount of drinking water on the planet.

According to Barbioti and Campos [s.d., p. 1], "water pollution is the introduction of chemical, physical and biological materials that spoil water quality, and affects the body of living beings. This process ranges from simple paper bags to the most dangerous toxic pollutants, such as pesticides, heavy metals (mercury, chromium, lead) and detergents."

According to Oliveira and Molica [2017, p. 12], all natural ecosystems have an ability to decompose to a certain limit the organic matter generated by human activities, but when the entry of effluents is greater than this limit pollution begins to transform that environment. "Surface waters are largely polluted because of untreated sewers and garbage that are thrown every day into their beds, leaving water in some cases so contaminated that it is neither used nor to be treated again" [OLIVEIRA E MOLICA, 2017, p. 12].

According to the authors, Brazil holds in its reserves 12% of all water in the world, and the Amazon holds 80% of all water in the country. In this scenario, the Northern region, which holds more than 50% of the water throughout the country plays a significant role in water preservation, especially if it is considered that in the region passes the largest river in volume and extension in the world, the Amazon River. However, according to the figures presented by Oliveira and Molica [2017, p. 13], the region needs more enforcement measures to further avoid river and affluent pollution.

According to the Ibge National Basic Sanitation Survey (2008), only 55% of Brazilian municipalities have a sewage collection system, with the largest number of municipalities located in the Southeast region (95%) and the smallest in the North region (13%). In relation to the treatment of domestic sewage, the situation is even worse: only 27% of Brazilian municipalities treat their sewage, most of these municipalities are located in the Southeast region of the country (47%) and the smallest in the North region (8%) [OLIVEIRA E MOLICA, 2017, p.13].

In a booklet of the National Water Agency, the federal agency presents recommendations that can help combat pollution of rivers and other sources of water and avoid waste, such as the reformulation of products

to produce less pollution; reduction of the use of toxic materials for pest control; modification of equipment or technologies to generate less waste; implementation of improvements in the areas of training, maintenance and home management to reduce leaks. [National Water Agency, 2013, p. 51]

The above initiatives can be quite effective for preserving rivers, however, if there is no awareness of the population and companies so that they apply this knowledge in daily life there is no way to make significant changes.

If the issue of the importance of water resources is understood and the need to encourage environmental awareness in society is understood, it is necessary to go to actions.

Following the thought of innovation as an important point to disseminate environmental causes presents here the video games or games. It is believed that they can be of great value for awareness and dissemination of ideals of preservation in society as a whole, in this case, more specifically in the environmental education of children within the school environment, which are the target audience of the game created.

2.3 Jogos Eletrônicos na Educação Ambiental

Previously, the need for innovation in environmental education was highlighted in order to create engagement with environmental issues in the individual. The alternative presented this is the union between technology and knowledge. With this hook, it gives a highlight to children, who handled the technology offered in a natural way, whether through smartphones, tablets, computers, smartTVs, video games, among others.

The proximity to these equipment for a long time was and is still seen as something harmful. But the mere fact that they represent entertainment does not mean uselessness. This is discussed by Nogueira and Galdino, which justifies the use of games in education by attracting students to participate in the construction of their knowledge, in addition to modernizing learning.

It is possible through video games to motivate and increase the productivity of students, in addition to bringing them closer to teachers. "Today's young man grew up playing video games and games are part of his reality. It is sought, then, to present the games as an exit to minimize the distance between the student, the teacher and the school" [NOGUEIRA And GALDINO, p. 2, s.d.].

Based on this, the game DEFESA IN RIO was created, set in the city of Manaus and aims to make the player help in cleaning the polluted streams in the city. In the match, the player will be alerted to the importance of preserving rivers and the role he plays in this process.

It is believed in good receptivity with DEFENSE IN RIO since, because it is a game is seen as a form of entertainment. The style employed in the game is cross-platform and so can be used in the classroom in a playful way, since access to smartphones is wide. Therefore, uniting technology with environmental causes proves to apply in the teaching of the preservation of rivers, which can be followed by several other projects outside this subject.

The Rio Defense app prototype is a game created in the tower defense style, i.e. the player must prevent enemies from traveling the map, using means of defense such as traps or obstacles to delate/destroy them. The game takes place in a forest where a river crosses it. The tower defense style has been applied so that the river is the place to be protected, garbage and waste are enemies, and characters as agents of cleaning filters. These are the means of defense to protect the river.

Figure 1. Game home screen

The game starts when the player presses the "play" button.

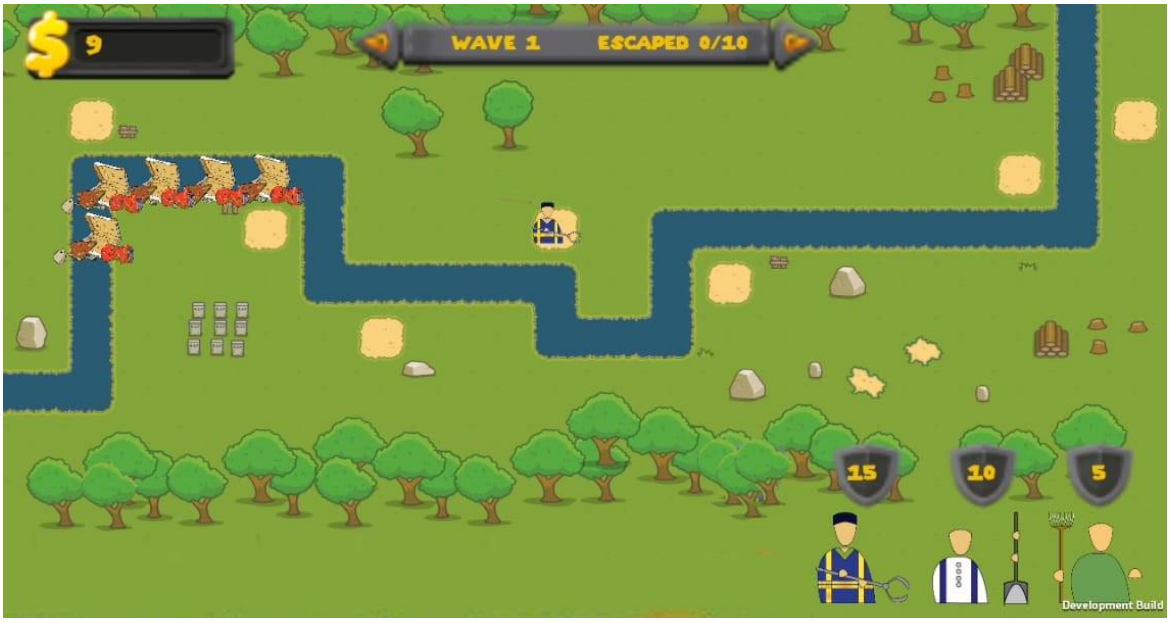


Figure 2. When the player starts the game, the trash begins to travel through the river from left to right

After the garbage begins to travel through the river, the player needs to position his defense characters in strategic points, to prevent the garbage from reaching the end.

Figure 3. Increased player score

It is noted that with each garbage collected the player receives a score (game money). With this, he can acquire different types of characters.

Figure 4. Stage 5 of the game with a larger number of garbage

With the course of the stages (waves) of the game, the amount of garbage increases, making the match more difficult.

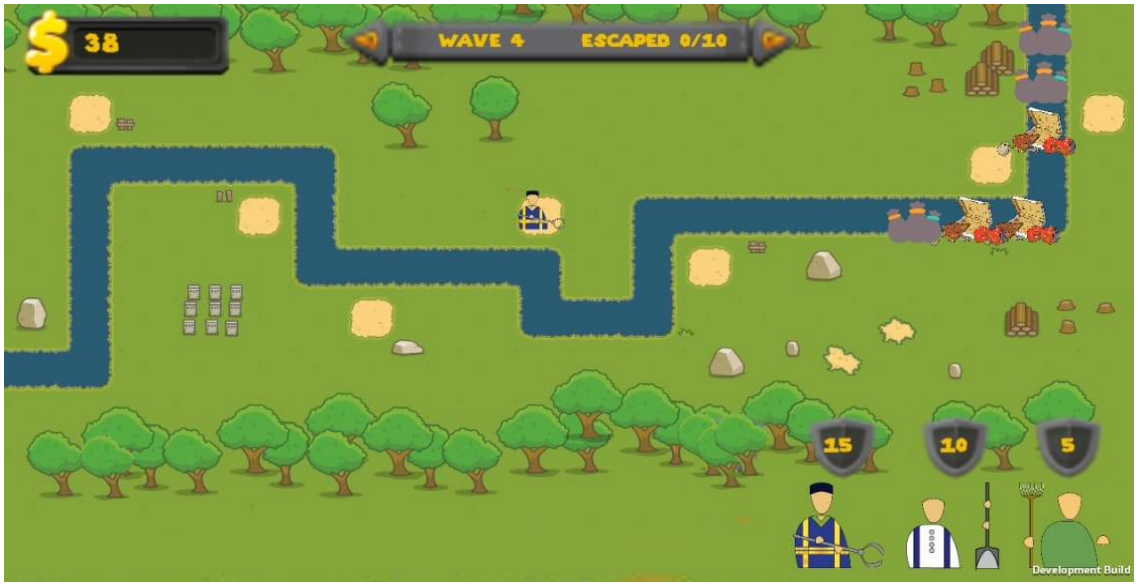


Figure 5. Leaking waste

The game counts the waste that was not collected, in a total of a maximum of ten.

3. Methodological Procedures

The methodological procedure adopted in this work began with research on websites and articles that deal with pollution, environmental education and the use of digital games as environmental awareness tools. Data collection was done through indirect documentation, using sources that discuss materials from other references on this subject. The research is qualitative and is based on the interpretation of bibliographic content for the application of the concepts learned in the development of the game and debate on the importance of preserving the environment.

The choice of the public of six to ten years occurred because there is a connection of this group with digital games and to disseminate in the individual while the importance of environmental preservation is still new. For this reason a prototype of gambling was created, in a beta way, which aims to guide the public to combat pollution in rivers and thus contribute to environmental education.

4. Final Considerations

Based on the theoretical survey of this work, it is observed that although fresh water is the one that exists in the smallest amount on the planet and is one of the most important for the maintenance of life, society constantly contaminates rivers and lakes in actions of complete neglect to the environment. It was found in the data presented that the preservation of the fauna and flora of the Amazon region is threatened, with the decrease in the amount of drinking water and destruction of ecosystems with pollutants of all kinds. Even with this scenario, society mostly insists on environmental losses without worrying about the replenishment of the natural resources exploited.

To combat this situation, it was found that it takes a commitment from society as a whole. It is known that the Northern region is one of the largest freshwater holders in the country, but also one of the most polluting.

In this sense, joining the other actions that exist for the preservation of rivers, the present work built a game, so that it acts within the aspect of awareness, which was aligned with the environmental problems exposed and relevant to the environmental awareness, important but poorly valued today.

DEFENSE IN RIO used this series of aspects raised during the research and in a simple and direct way introduced to the children's public this cause. Combining entertainment and environmental causes proved to be efficient, as the strategy of reaching out to the public proves accessible and completely applicable. In addition, it is observed that this means of awareness can be used in games with other topics that also want to contribute to reflection and actions for other causes. This contribution to combating river pollution and other projects for purposes similar to this may arise is therefore left.

5. References

(2008), “A Água no Planeta”. [GS Search];

Agência Nacional de Águas, ANA. (2013). Cuidando das Águas: Soluções Para Melhorar a Qualidade dos Recursos Hídricos. Programa das Nações Unidas para o Meio Ambiente. 2. ed. Brasília. http://arquivos.ana.gov.br/institucional/sge/CEDOC/Catalogo/2013/CuidandoDasAguas-Solucao2aEd.pdf;

Amazonas Atual. (2019) . “Limpeza em Igarapés de Manaus Retira 887 Toneladas de Lixo por Mês Diz Semulsp”. [GS Search];

Barbioti, E. M.; De Campos, R. B. (2011). Poluição dos Rios. Faculdade de Ciências Sociais e Agrárias de Itapeva. http://fait.revista.inf.br/imagens_arquivos/arquivos_destaque/QLF007aFh29pSRz_2014-4-16-17-35-57.pdf;

De Miranda, E. E. (2004). “A água no corpo humano”. [GS Search];

De Oliveira, E. J. A; Molica, R. J. R. (2017). A poluição das águas e as cianobactérias. Instituto Federal de Pernambuco, IFPE, Recife. https://capacitacao.ead.unesp.br/dspace/bitstream/ana/195/1/Cartilha%20a%20Polui%C3%A7%C3%A3o%20das%20%C3%81guas%20IFPE.pdf;

Dos Reis, L. C. L et al. (2012). Conscientização Ambiental: da Educação Formal a Não Formal. Universidade Serverino Sombra. http://editora.universidadedevassouras.edu.br/index.php/RFEU/article/view/442;

Dos Santos, R. M. de Sousa et al. (2013). A necessidade de uma nova conscientização ambiental: A educação ambiental como prática. Universidade Federal de Campina Grande, UFCG, Mestrado em Sistemas Agroindustrais. https://www.gvaa.com.br/revista/index.php/REBES/article/view/2132/2846;

Nogueira, A. S.; Galdino, A. L. (2011). Games como agentes motivadores na educação. Fundação Educacional Unificada Campograndense, Coordenação dos cursos de Licenciatura em Computação e Sistemas de Informação, Brasil. www.comunidadesvirtuais.pro.br/seminario-jogos/files/mod_seminary_submission/trabalho_12/trabalho.pdf.

Air Conditioner Production Failure Analysis Techniques

Fernanda Yakushijin Gomes dos Santos
fernanda.yakushijin@outlook.com
Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Marden Eufrasio dos Santos
nedram.santos@gmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Abstract

This paper aims to apply the use of quality tools for fault analysis techniques and internal circuit board defect reduction in an air conditioner company. We currently have millions of air conditioners installed and produced annually on all continents and consecutively there is increasing consumer complaints that internal circuit boards are one of the most critical components of an appliance and it is it that controls its functions as a for example: receive the temperature signal chosen on the remote control so that it works to increase or decrease the temperature as per customer requirement. According to vendor defect, data our top one defects are related to evaporator EEPROM non-write defect circuit board problems and with that 3.12% defect work, we achieved a 0% reduction of defects after Work completed with 2 weeks of follow-up.

Keywords: Indoor unit; Outdoor unit; EEPROM;

1. INTRODUCTION

The present work was conducted in an air conditioner industry where failure analysis techniques were applied, being a company of Japanese origin, which uses the "QC STORY" methodology which is also used by other multinationals around the world. like Toyota in its TPS which is the Toyota production system, Nissan, Honda and QC STORY is best known to us Brazilians for problem solving method with its acronym MASP in which it aims to produce an improved product or service. cheap, easier to maintain, safer with faster delivery and the following tools have been used and still second [1] is crucial for the control to be

exercised. The problem analyzed is based on internal and external facts and data and is justified by increasing climate change and consecutively higher sales demand. The objective of this work is to apply the failure techniques meeting the expectations of customers to buy products with required quality, also enabling greater competitiveness in the market with high quality and value added products, better quality indices, lower costs with poor quality, better organizational knowledge of the teams involved in continuous improvement using the "QC STORY" quality tools.

2 THEORETICAL FOUNDATION

2.1 PCDA

According to [2], the first activities developed with the PDCA cycle methodology took place in the 1920s by [3] and according to the book Quality Management of [4] says that the concept of the cycle consists in establishing improvements to the standards set in the organization. , which serve as a reference for its management. Thus it was used so that all work had a direction in the following aspects of the tool in which P is (Plan) which is the planning of the work in which the methods and goals are defined, the (Do) where it should be performed, educate and train, the (Check) where we should verify the results and the (A) action action where we should act correctly.

2.2 Pareto Chart

[5] points out that the Pareto chart helps determine priorities in an order of solving each problem. [6] cites 5 steps for a pareto analysis, 1) problem identification, 2) problem stratification, 3) maximum related data collection, 4) through the prioritization chart, and 5 assigning responsibility for solving the problems. problems. And according to [7] his concept is that 80% of problems originate from only 20% of causes.

2.3 Cause and Effect Diagram

Cause-and-Effect Diagram [4] is one of the 7 original quality tools proposed by Japanese professor Kaoru Ishikawa in 1968, she clearly investigates the relationship between the causes and effect of the problem, in which each effect has various causes and if uses the 6M's, such components are: 1) labor, 2) method, 3) materials, 4) measurements and 6) environment (business or environment).

2.4 Flowchart

[9] points out that the flowchart is an excellent tool for analyzing the process and is used to map the steps of each activity. Processes through a series of sequential activities that should be taken into consideration in problem analysis, making it clear which process sequences the product or part is produced best visualize who is responsible and what types of processes are involved.

2.5 Check Sheet

Compliance check sheet [10] is a means of facilitating, standardizing and organizing the collection of records and data for later compilation and analysis to be optimized. To check a given situation or sample quantity or defect in an inspection amount over a period of time to quantify process testing, process change,

process deviation or even validation of a change to collect data for analyzes used the check sheet.

2.6 5W2H

As [10] mentions that 5W2H is a tool that assists in planning the proposed actions that will be developed, this tool is made up of a spreadsheet by columns and each of the letters means: Why, What, Who, When, Where, How, How Much. It is used to secure and also inform a set of action plans, diagnosing problems by planning their respective actions. In the spreadsheet or table used in this tool it is possible to visualize the appropriate solution of a problem, with possibilities of monitoring the execution of an action. Seeking to facilitate understanding through the definition of deadlines, responsibilities and methods, resources and also the objectives. For [10], the technique used is equivalent to describing the problem, defining how it affects the process analyzed, the people and circumstances arising from these situations and can be monitored the details of who should do what, when will do how.

3 Methodology

A case study was done in an air conditioner company to reduce internal circuit board failure where it was done according to the following steps as shown in Figure 1. Steps are: 1) Process Overview, 2) Choice of Theme 3) Current problem situation, 4) Goal definition, 5) Factor factorial analysis, 6) Countermeasures application, 7) Results and effects assessment, 8) Defined non-recurrence methods and 9) Choice of next theme challenge.

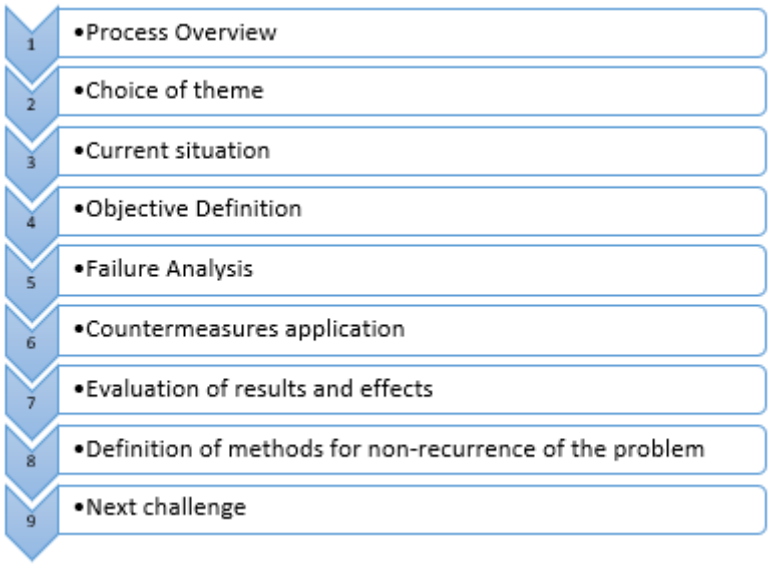


Figure 1 (Failure Analysis Flow)

4 Study Application

4.1 Process Overview

The internal problem-solving analysis method proved to be very effective compared to previous work because it is a standardized and guided defect resolution methodology based on data and facts in a logical sequence. In the process vision step, it was necessary to make 3 layouts because we had the internal factory

process and we also had 2 plate assembly processes in our supplier which resulted in the layout we call factory layout (figure 2) which is the process of AC factory, SMD layout (figure 3) automatic plate processing and DIP layout which is the manual and plate testing process (figure 4).

The layout factory process flow (figure 2) has the following process the product as soon as it leaves the supplier comes to the factory and is entered in the inbound inspection sector that checks some quality items according to the technical, dimensional and visual specification of the parts. and soon after they are released for storage and when requested by the productive sector that works as demand are delivered to the production where the electrical assembly is assembled passes the microprocessor functional test and is then assembled the other components of the conditioner together with the assembly. electric air conditioner and undergoes functional testing where the entire product is thoroughly tested to certify its operation.

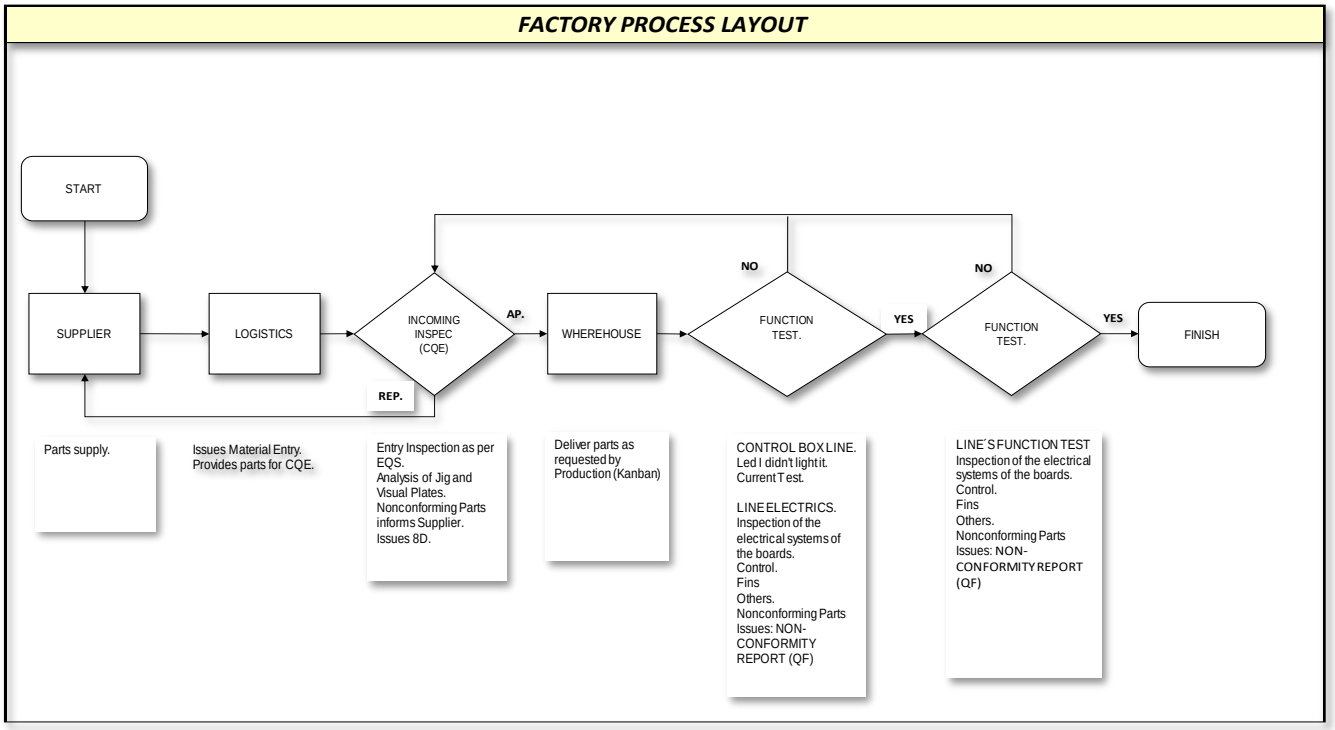


Figure 2 (FACTORY LAYOUT)

The flow of SMD processes (figure 3) goes through the stock with controlled humidity and temperature, goes through the printer a machine where the components are automatically placed in the unmounted pcb, when the components are inserted it must be added with a glue so that If the board on which we call the printer is stuck after this process the board goes through a machine called SPI that checks the volume of the glue and then the assembly of the chip then goes through the 1st inspection, the oven, the inspection 2 ° AOI a camera that checks the position of the components, if approved position will go through the visual inspection finalizing the process the top side of the board we call TOP, the bottom side process or bottom side some components that cannot be inserted by the top side are made to insertion by the machine called axial and radial passed by visual inspection so that it can go to the next process step (DIP).

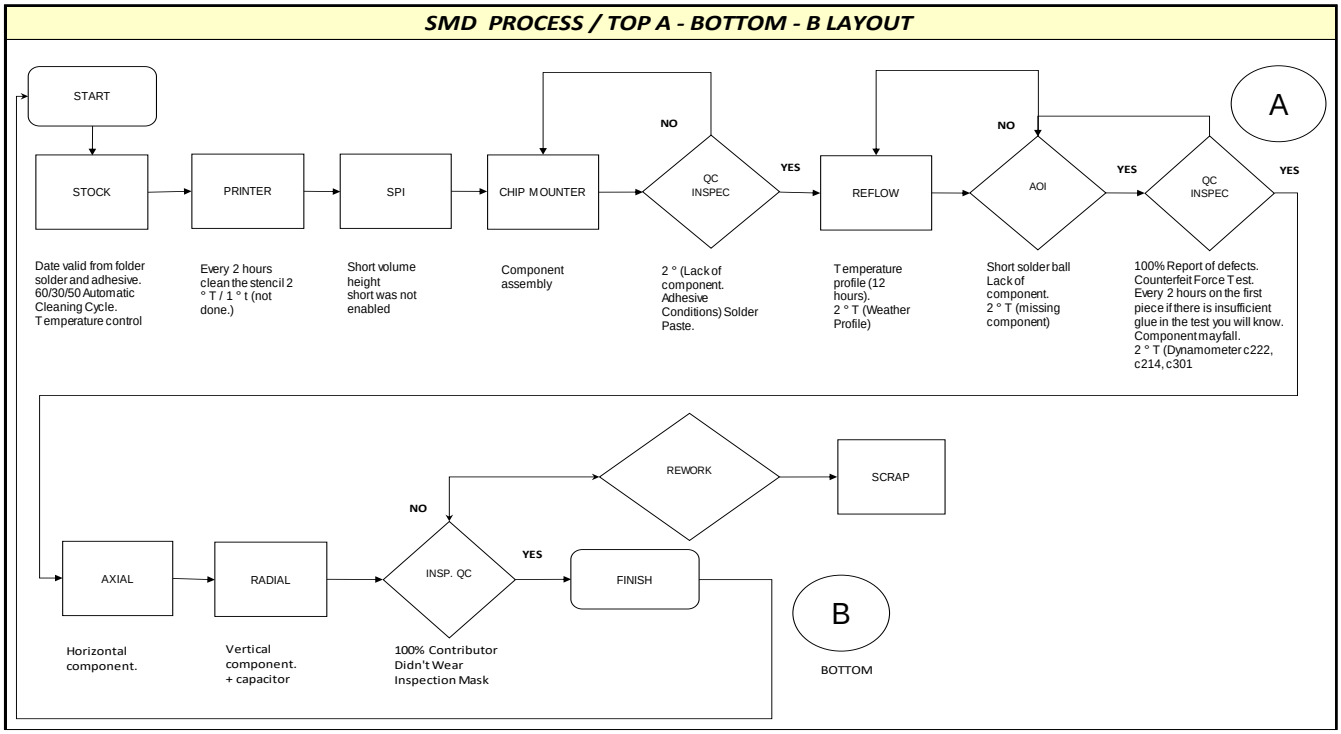


Figure 3 (SMD LAYOUT)

The DIP line flow process (Figure 4) is where the plate components that have been assembled on the SMD, axial and radial machines are finished, in this process step parts that cannot be inserted by machines are made manually by passing then by an oven that has melted solder paste welding the components, that glue that is passed on the printer serves to prevent the components from falling into the wave, the rectifier bridges are also soldered manually, presence testing of the components is done and then ICT The FCT undergoes functionality testing and its last step is that of protective coalting which is handmade with a brush so that components and parts that cannot be sealed are protected using JIG for such activity.

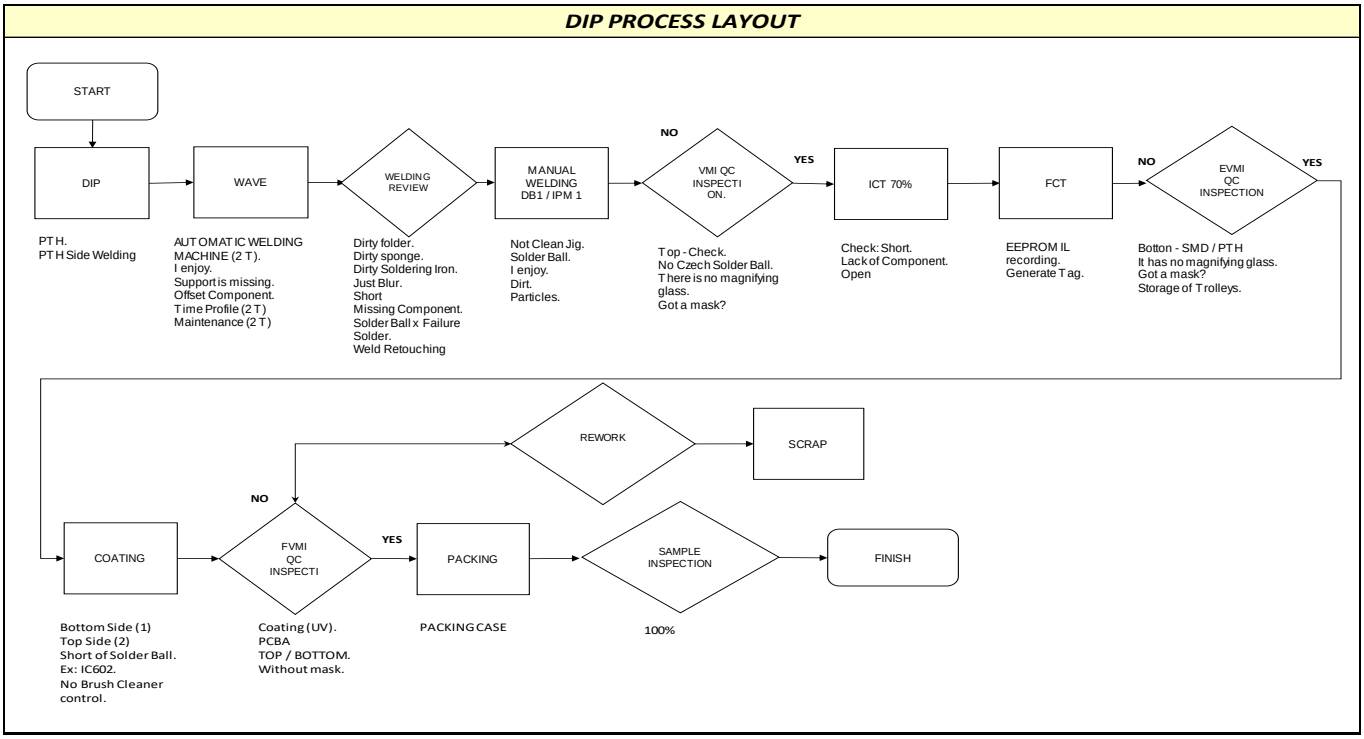


Figure 4 (DIP LAYOUT)

4.2 Choice of theme

As shown in figure 5 (Choice of theme) we can see were raised index data from suppliers A, B, C, D, E, F and G and from 2017 and 2018 and we can see that supplier A in 2017 represented 3 , 1% of the defects in Pareto chart already in 2018 he had a very high nonconformity high going to 63% with 839 defect units and supplier B had zero defects in 2017 and 267 defects in 2018, in this first analysis we can see that supplier "A" had the highest defect rate in% and per unit of defects in 2018, so supplier A with the most nonconformities was the supplier chosen for problem analysis.

As we know that supplier "A" was the lowest performing and highest number of non-conforming suppliers in 2018 with 839 defects representing 64% of the chart, among these 839 defects there were 4 types of products that we will call Plate A with 679 nonconforming items representing 96.9% on the chart, Plate B with 65 defect items representing 99.9% on the Pareto chart, Propeller A with 95 defect items representing 99.7% of defects and Propeller B representing 100% of the chart.

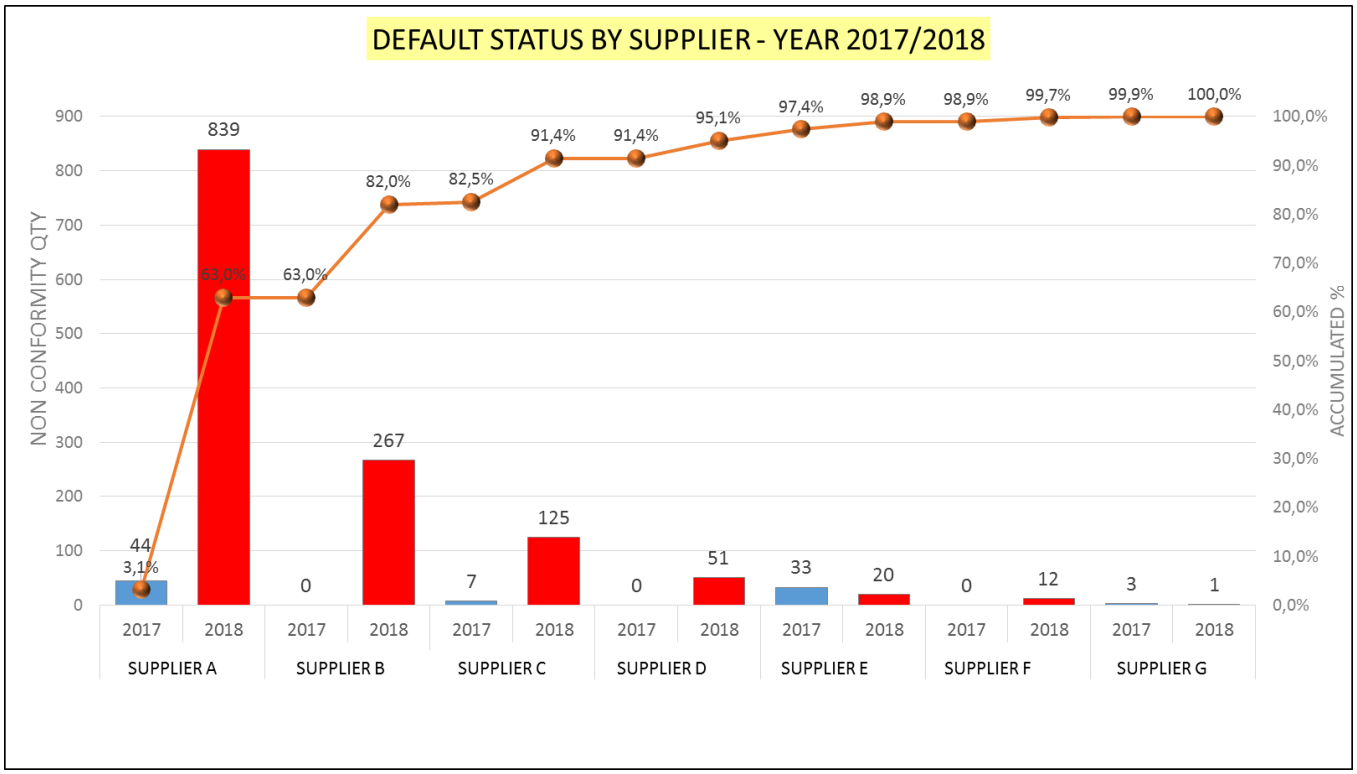
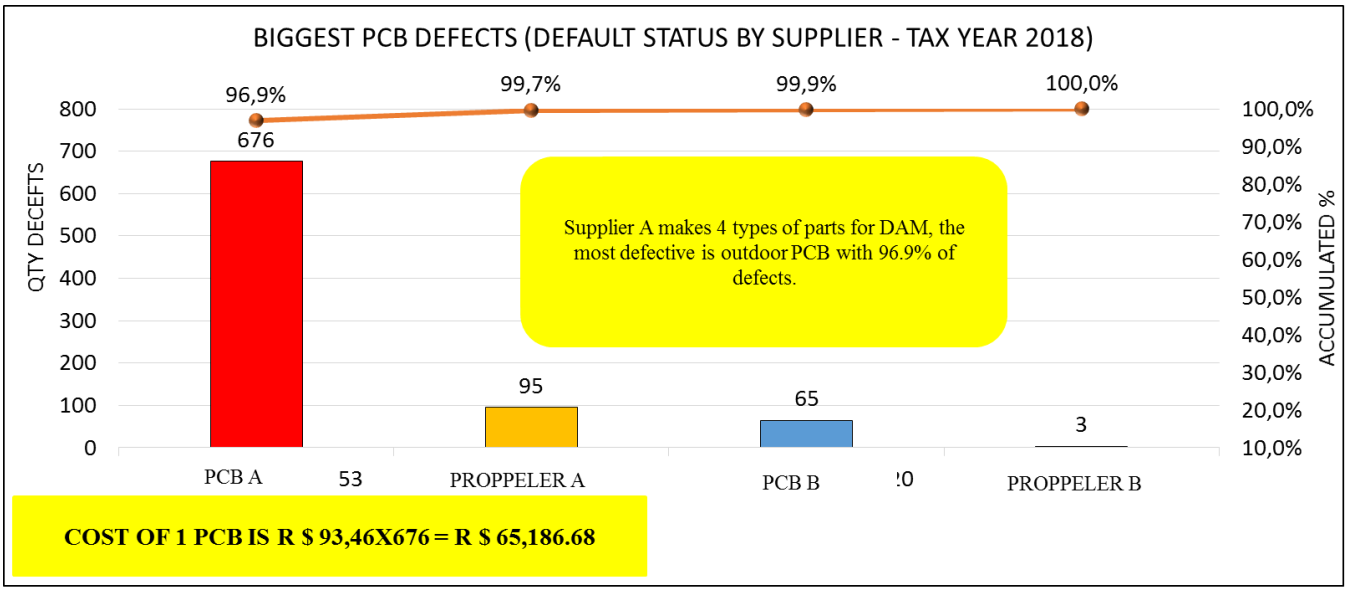


Figure 5 (Choice of theme)

4.3 Current Situation

As in the current situation stage we must use graphs so that we can illustrate the scenario of the problem, was made the survey of defects by suppliers from 2017,2018 and 2019 until the month of February, so that we could know which was the supplier. underperforming, after knowing which supplier (A) had the worst result with 63% of supplier defects. We did a survey to see how many items he provided and we identified that were 4 items as (Figure 6) (Biggest PCB defects) May, of these 4 items we found that the PCB of the air conditioner outdoor unit had a higher rate than 96, 9% and after that we made a survey and made a Pareto chart to know what types of defects existed and further deepening the data identified that the defect that had the highest index was the non-compliance of the LED board did not light in the test. micon ID recording which had a higher Pareto chart index with 30.4% with 156 defect units following the IC out of specified with 55.6 %% with 129 defect units and 62.2% exposed copper and 65 units of nonconformities, the analysis and application of the defect analysis tools will be used on the largest defect Led Does not light.



ITEM	SUPPLIER A			
	PCB A	PROPELLER A	PCB B	PROPELLER B
QUANTITY PRODUCED	21658	29061	44850	22089
AMOUNT OF DEFECTS	676	95	65	3
PERCENT	3,12%	0,33%	0,14%	0,01%
ACUM %	96,9%	99,7%	99,9%	100,0%

Figure 6 (Biggest PCB defects)

4.4 Definition objectives

The objective of the analysis of the data collected and defined by the quality team was that of the three largest defects would be reduced to zero defect thus leaving 156 LED defects does not light to zero defect as shown in figure 7 below.

DEFECT TYPE	Defects QTY	GOAL
LED does not light	156	ZERO DEFECT

Figure 7 (Goal Setting)

In the factor analysis of the problem proposed for improvement was the part that we use the most problem analysis tools, in this step we use the brainstorm to raise all possible causes and effects after that we use the cause and effect diagram allocating all possible causes in its “M”, after drawing up the cause-and-effect diagram that was worked out together with the kaizen team of the quality industry factory with a group of 3 people from the supplier where we had quality, process and process engineering people, was Also defined in meeting which responsibilities of each member and dates for checking each cause raised during the survey we noticed that some problems were detected such as the lack of grounding in the functional testing equipment of the components of the board called FCT, was also evidenced. that in the factory process there was an ungrounded screwdriver, the red items While in the cause and effect diagram according to Figure 8, items with non-standard deviation, non-specific or undetermined, items in blue and green are items that conform with no anomaly found.

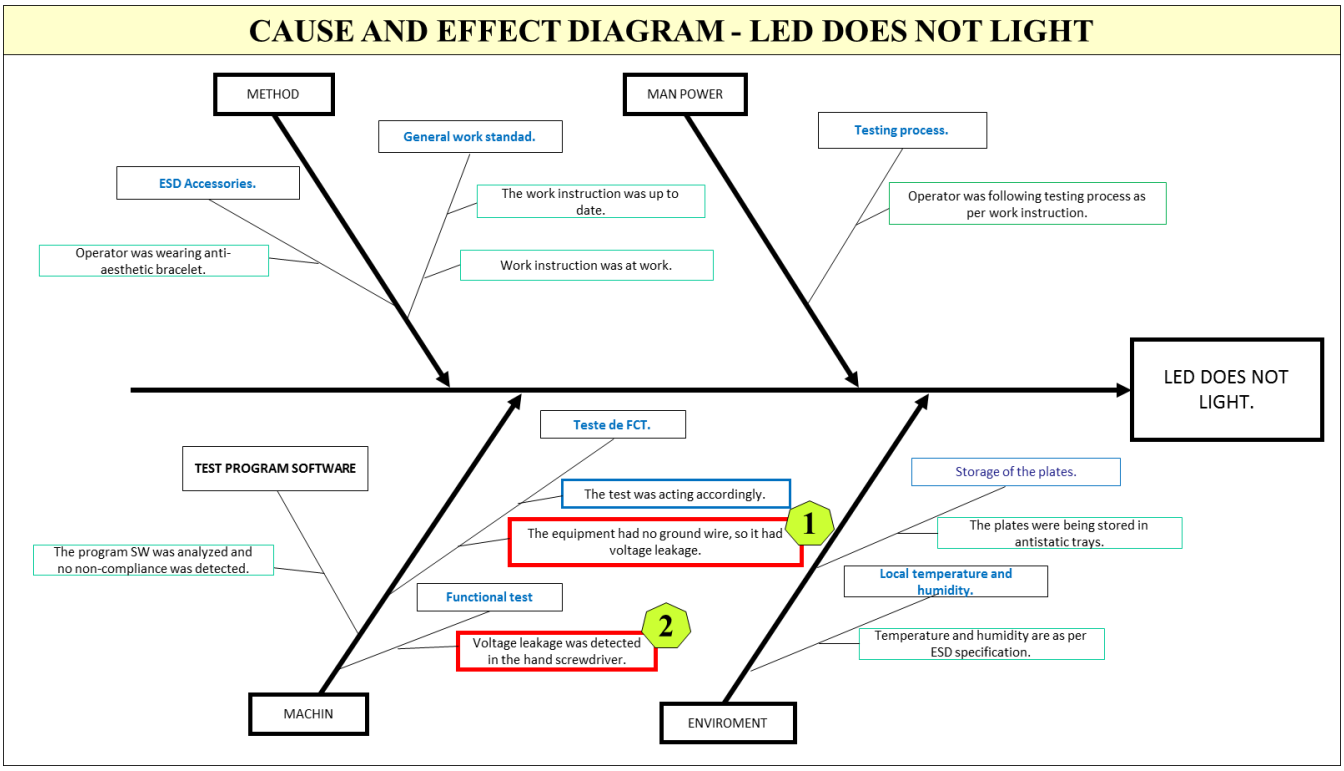


Figure 8 (Cause and Effect Diagram, Author: Fernanda Yakushijin)

The nonconformities found were analyzed and dealt with as shown in Figure 9 below two nonconforming items and one item verified nonconformity are in the image, the functional test grounding and the ungrounded screwdriver both processes were installed grounding and subsequently met to specification and The recording confirmation of the functional test program was confirmed by daily checklist with quantity produced vs. quantity of recording records checked on the equipment computer if the tested quantities were the same as those recorded on the test computer.

ACTIONS OF NONCONFORMITY ITEMS- LED DOES NOT LIGHT

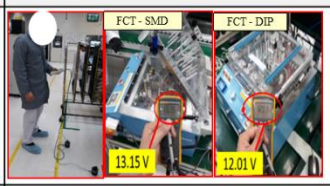
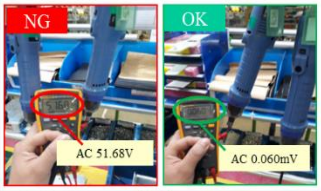
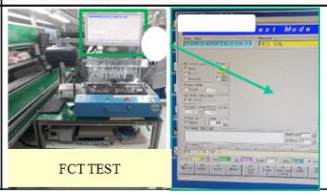
No	4M	WORKSTATION	TYPE OF ACTIVITY	DESCRIPTION	POSITION SPECIFIED	EVIDENCE	STATUS
1	MACHIN	FCT SMD/DIP	FUNCTION TEST	EQUIPMENT NEEDS GROUNDING TO AVOID CURRENT LEAKAGE.	FCT MACHIN.		NG ↓ OK
2	MACHIN	FUNCTION TEST	FUNCTION TEST	ELECTRIC SCREW REQUIRES GROUNDING TO AVOID CURRENT LEAKAGE.	FUNCTION TEST.		NG ↓ OK
3	MACHIN	FCT SMD/DIP	SW RECORDING ON FCT TEST.	MAKE SURE RECORD TEST ACCORDS DAY PRODUCTION.	FCT MACHIN.		OK

Figure 9 - Actions of Nonconformity Items-Led does not Light.

5 Results and discussions

Our results obtained as shown in (figure 10) were where we had a reduction of 156 LED defects does not light up to zero defects equivalent to 100% after the improvement, in December we had 92 nonconformities in March nine and the first two weeks of. April after improvement we had zero defects during the post-implementation effectiveness check period.

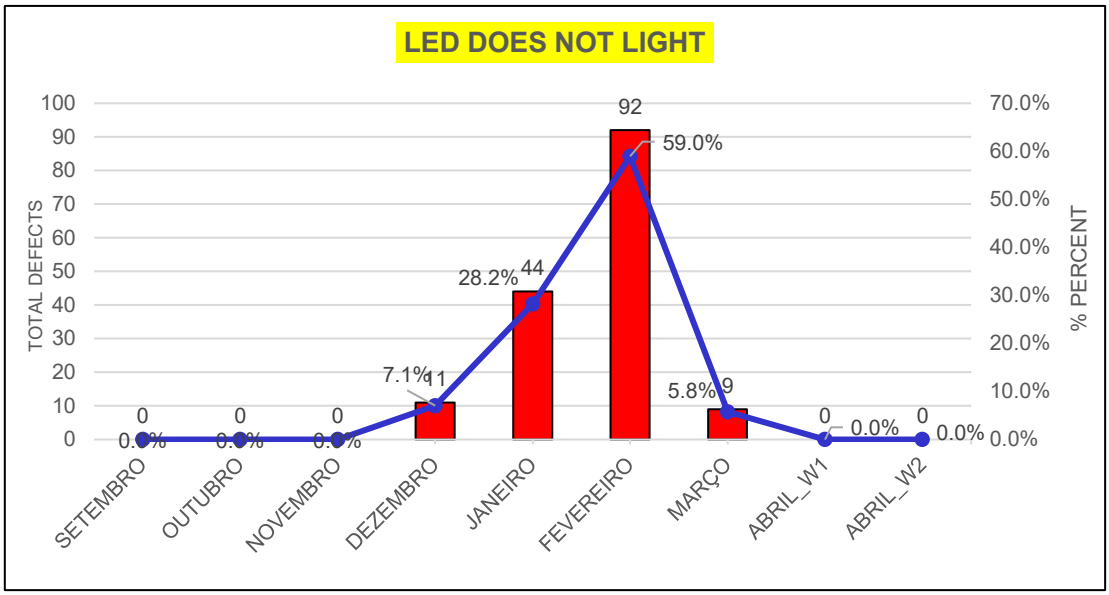


Figure 10 Results Led does not Light

In order to be sure that the problems did not recur, some rules, procedures, standards and specifications were created for everything that was found out of place and also what was pointed out as a cause or potential point avoiding a possible future problem for these definitions. a plan using 5W to define the responsibilities of each item pointed out until status verification.

ACTION PLAN 5W

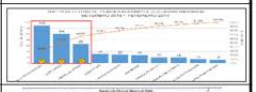
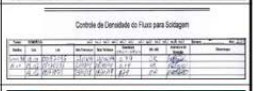
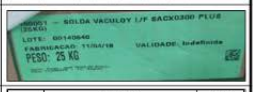
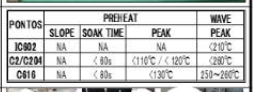
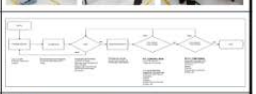
IT.	WHAT?	WHO?	WHEN ?	WHERE ?	HOW ?	STATUS	EVIDENCE
1	STRATEGIC MEETING FOR PLATE DEFECT REDUCTION (BRAINSTORM).	RICARDO	30/01/2019	FORNECEDOR"A"	Assemble defect reduction strategy using quality tools.	CONCLUÍDO	
2	DEFECT INDEX CREATION FOR NON-CONFORMITY CONTROL.	FELICIA	30/01/2019	EMPRESA AC	CHECK STATUS OF DEFECTS DETECTED ON AC.	CONCLUÍDO	
3	PREVENTIVE MAINTENANCE OF WAVE CHAIN, WELDING MACHINE.	RICARDO	05/02/2019	FORNECEDOR"A	MAINTENANCE PLAN.	CONCLUÍDO	
4	WELD DENSITY FLOW.	WANDER	05/02/2019	FORNECEDOR"A	LEAD FREE WELDING DENSITY STATUS.	CONCLUÍDO	
5	WELDING BAR WITH VALIDITY TIME.	ERIKA	05/02/2019	FORNECEDOR"A	ANALYSIS OF PRODUCT EXPIRY DATE WITHIN.	CONCLUÍDO	
6	APPROVAL PROCEDURE (PROFILE).	WANDER	20/02/2019	FORNECEDOR"A	SEND EVIDENCE TO TEAM AC COMPANY - EQUIPMENT SPECIFICATION.	CONCLUÍDO	
7	(ESD) ANALYSIS, GROUNDING.	ERIKA	06/02/2019	FORNECEDOR"A	PROCESS AUDIT (MAKE SURE THE PROCESS IS IN ACCORDANCE WITH ESD / EOS AND GROUNDING SPECIFICATIONS.	CONCLUÍDO	
8	CUSTOMER PROCESS LAYOUT VS SUPPLIER.	ANDREA	08/02/2019	EMPRESA AC	COMPLETED BY SUPPLIER "A" AND AC COMPANY.	CONCLUÍDO	
9	TEMPERATURE MEASUREMENT STATUS AND LOCAL HUMIDITY.	ERIKA	01/02/2019	FORNECEDOR"A	MAKE SURE TEMPERATURE IS ACCORDING TO SPECIFICATION. 18 ~ 28° C; 40 ~ 60%.	CONCLUÍDO	

Figure 11 Action Plan 5W

6 Final Considerations

When the work began it was found that the defects of Led does not light was a defect that could not be identified by visual inspection and its high rate of nonconformity was the main reason for choosing this theme so we use Failure Analysis Techniques In a production line of air conditioners, because of this the general objective of the work was to discover the causes of the problem using the analysis techniques tools and consequently it was demonstrated that with the use of the proposed tools and their logical sequence the The conduction of the work was more agile due to its format that helped in the elaboration of the work without having to return to the previous topic thus reducing the time and better results. The initial goal of zero defects was achieved with the discovery of the source of the problem that was not grounding the machinery causing a current leakage damaging the equipment and after the adjustment of the groundings no more LED defects does not light up and the hypothesis that we did not have an electronic component defect was confirmed after analyzing the proposed problem and discovering the source of the failure. As the work was conducted using analysis tools such as first place verification, current factual situation, defect data by supplier type, defect type, survey of possible probable causes, tests to prove the problem beyond the methods used we noticed a certain It is difficult to find FCT testing content and issues involved with FCT testing, so we needed the help of FCT software engineer from headquarters to help us with questions about the design and operation of this test.

7 References

[1] FALCONI, Vicente. TQC: Controle da Qualidade Total (no estilo Japonês). Rio de Janeiro: Bloch, 1992. 229 p.

[2] AGOSTINETTO, J. S. Sistematização do processo de desenvolvimento de produtos, melhoria contínua e desempenho: o caso de uma empresa de autopeças. Dissertação (Mestrado em Engenharia de Produção) - Escola de Engenharia de São Carlos, Universidade de São Paulo, São Carlos, 2006.

[3] SHEWHART, W. Economic control of quality of manufactured product. New York: D. Van Nostrand Company, 1931. 501 p.

[4] ABRANTES, José. Gestão da Qualidade. 1ª. ed. Rio de Janeiro: Interciência, 2009.

[5] GIOCONDO, Francisco I. César; FRANCISCO, I. Ferramentas Básicas da Qualidade. **Instrumentos para gerenciamento de processo e melhoria contínua. São Paulo: Biblioteca24horas**, 2011.

[6] CHIAVENATO, Idalberto. Administração nos novos tempos. Rio de Janeiro: Ed. **Campos**, 1999.

[7] JURAN, J.M. Planejando para a qualidade. São Paulo: Pioneira, 1990.

[8] LUCINDA, Marco Antônio. Qualidade: Fundamentos e práticas para cursos de graduação. Rio de Janeiro: Brasport, 2010.

[9] LUCINDA, Marco Antônio. Qualidade: Fundamentos e práticas para cursos de graduação. Rio de Janeiro: Brasport, 2010.

[10] WERKEMA, M. C. C. Ferramentas Estatísticas Básicas para o Gerenciamento de Processos. 1. ed. Belo Horizonte: WERKEMA, 2006.

Proposal for Implementation of a Kanban System in the Auxiliary Inventory Sector in an Auto Parts Company

Tamires Lima de Souza
tamiresralic@hotmail.com
Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Mauro Cezar Aparício de Souza
mcas1691@gmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Abstract

The article presents a proposal for the implementation of a kanban system in an auxiliary inventory sector in an auto parts company. The overall objective of the research was to propose a methodology that seeks to efficiently and cost-effectively control inventory for the company in order to avoid wastage of resources and to foster more adequate planning of resource reallocation by avoiding unnecessary inventory spending through of the kanban system. The study methodology was applied based on a bibliographic research and an action research, in which data were collected on site and the results of the research substantiated the proposal of the kanban system in the company's auxiliary stock sector. The results showed that the kanban system will bring an adequate organization of work in order to enable the operation in inventory control, replenishment and calculation of material demand to be performed more effectively, generating greater financial profitability through the company. a leaner inventory management system.

Keywords: Kanban system; Inventory management; Efficiency;

1. Introduction

Currently, market competitiveness has required companies to invest heavily in strategies and actions that optimize their management and, consequently, boost results to ensure greater profitability. Faced with this

scenario, companies are investing in tools that seek to optimize their production x waste ratio, so that the elimination of failures is a crucial factor to ensure a greater return on production effectiveness and, thus, ensuring increased competitiveness. Market

This quest for equilibrium in the production system is critical for lean production, thus avoiding material obsolescence, misuse of resources and unnecessary spending on raw materials. This lean production control system is a philosophy widely practiced by organizations that systematize their production in a logical way, without overloading the stock with excessive demands.

Another crucial aspect of lean inventory control is ensuring a truly productive production chain. There is a difference between an efficient supply chain and an inefficient and costly overproduction chain. It is observed that an efficient production chain refers to a chain that produces cohesively, balancing resources with production demand, without overloading the production system. However, an overproduction chain, if not properly managed, tends to overwhelm the entire production system.

In Brazil, the Just in Time philosophy has been adopted by major automotive manufacturers and also by corporations that have invested in production improvements on the shop floor. This production management system was adopted mainly by the search for efficient inventory management as a differential factor of other competitors. [1] states that investments in lean production systems, still in the mid-80s, began to be adopted as market differentiation strategies.

The research had as object of study the choice of an auto parts company, located in the industrial sector of the city of Manaus-AM, which has a great deficit in the organization and logistic planning of clutch parts control and other types for stock replacement and shipping to sales. The research problem starts from the following analysis: How can a system of improvements in production flow contribute to optimizing the workflow in an inventory sector and generate greater profitability for the company? The proposal presented aims to improve the production flow and contribute to a reduction in idle inventory expenses.

The article is justified in its contribution to the company based on a proposal of improvement of the inventory management and the logistic planning of the company, helping the inventory management in the decision making and promoting a better economic planning of the company, thus avoiding unnecessary expenses with spare parts in stock.

Thus, the study of a proposal for the implementation of the kanban system in a company has as its contribution to offer to the company's managers, as well as to the technical staff responsible for the administration and planning of the resource management, to offer, through a systematic study of the control. stock, an overview of the waste of investment and the calculations of demands needed for work to flow efficiently in the inventory sector.

The overall objective of the research was to propose a methodology that seeks to efficiently and cost-effectively control inventory for the company in order to avoid wastage of resources and to foster more adequate planning of resource reallocation by avoiding unnecessary inventory spending through of the kanban system. The specific objectives of the study were: to propose the improvement in the company's auxiliary inventory sector; ensure cost-effectiveness with the proposal for more efficient inventory management control; and submit a kanban proposal to facilitate the logistics performance of inventory in the company.

2. Theoretical Foundation

2.1. The Toyota Production System

The Toyota Production System has as its central idea the promotion of a harmonic flow of materials between workstations, in order to provide a work philosophy that allows a more efficient communication in a productive environment [1]. This conception of a more objective mode of production and work, with the lowest possible incidence of external actions, brought to the Toyota Production System the name Lean Manufactring, according to the approach of [2].

The entire process of globalization and the need for companies to be aligned with the required competitiveness in the market demands an efficient inventory and production control system. Since the 1970s, with the emergence of the philosophy developed by the Toyota Motors Company, which sought a lean system with the purpose of minimizing costs and prioritizing efficiency, the market has been adopting the quality model in the effectiveness of systems that aim to optimize production.

Just in time, or more popularly known as the kanban system, is one of the most widely used models in production systems that seek efficiency in the management of the production process, so as to focus on the alignment of the operation with a methodology called “system of production”. pull". The philosophy adopted by the Just in Time methodology aims to optimize the production system by adopting a sequential control of the production system [3].

In the period of World War II, in Japan, there was a latent need to resume investment in industrial production in order to rebuild the economy of the country. In this scenario, it is important to know the role of Toyota Motor Company as a company that came up with a work philosophy proposal that aimed to seek a better quality, efficient and in line with market demand [2].

[4] analyzes that the production performed at Toyota was characterized by the production performed by demand method, that is, the production of small volumes of a certain product assembly part, in the same assembly line, based on a demand. specific. This modus operandi impacted the production area at the time, as most companies still operated according to general demand, regardless of efficient inventory control.

In the mid-1950s there was marked competitiveness between Japanese and American industry. The focus of American industry was based on large-scale mass production, such as Ford, which was a major benchmark of American production at the time. However, the Japanese industry, based on a rational process philosophy and focusing on waste elimination, has managed to align manufacturing production with the most cost-effective on the market [4].

With the development of the Toyota Production System, production tools emerged to facilitate operation in this work model. Among them, the main one was Just in Time (JIT), which means a tool with the purpose of producing in a timely manner. The idea of JIT arose to optimize the Toyotist philosophy of ensuring efficient production based on the proposal to eliminate waste [5].

Another tool in the Toyotist philosophy of work, which together with JIT, work as waste reduction and production optimization tools is Jidoka. [4] says that the term Jidoka human touch automation, that is, in Lean philosophy the application of Jidoka aims to provide machine operation with the ability to detect abnormal working conditions.

The JIT method has the function of reducing manufacturing time in order to make inventory control more

efficient, seeking to work only with the necessary material, ie, according to market demand [5]. The JIT methodology with the application of Jidoka allows, in general, to prevent the emergence of defects and process failures to ensure that the company has a better use of its resources.

The concept of pull production is based on the perception of Japanese production to develop its production based on specific demands. This concept is applied in JIT and has as main features: predefined replacement, continuous flow and the talk time method. [1] conceptualizes talk time as the time required for the complete production of a product according to demand, ie, it is a method directly linked to lean production methodology.

In Toyotism, the rationalization of the work process is the main focus on the division of work and the execution of tasks. The leadership aspect and the distribution of tasks are principles of the systematization of the work form, since lean production starts from the distribution of tasks in a coordinated, systemic and synchronous way [2].

[1] discusses that the lean philosophy of the Toyota Production System is JIT's production planning so that the continuous flow of activities is not overloaded by excessive workload. There is then a production control schedule that uses the transmission of information through letters, then called kanban.

2.2. Kanban system

The concept of kanban can be presented as a signaling card that controls production or transport flows in an industrial sector based on visual and informational communication [6]. This concept addresses one of the tools that emerged in the Toyota Production System in the post-World War II period, within the philosophy of lean production control.

[6] says that the kanban system aims to control production rationally and logically by programming the production system through information flows. This conception of the system seeks not to produce beyond what is required (specific demand) based on lean production and waste disposal.

One of the guiding aspects of the kanban system is its mode of production, which is considered a pulled mode of production, ie it only produces it as per the customer's request. [7] state that this type of production is essential for organizations to develop actions aimed at eliminating waste of raw materials and that it is able to speed up the production system based on drastically reduced inventory controls.

The kanban system is developed from the use of cards, which are called kanbans or signaling cards, whose function is to signal during the production process the operating status in the system (current situation) to operate logically [7].

The structures of the kanban card typologies are presented according to [6] for card types I and III; [8] for card type II and IV and [9] type V, VI and VII card.

I. Kanban Production Card

II. Kanban Internal Requisition Card

III. Supplier Kanban Card

IV. Kanban Container: Kanban Square

V. Electronic Panel

SAW. Computerized Kanban

The kanban system has a methodology that values efficiency in stock control and production based on

rationalizing the use of raw materials to avoid waste in stock. [10] presents the kanban system calculation based on: demand forecast determination (N), product processing time (t) and time between processes (tp).

[6] presents the main prerequisites for deploying a kanban system: level production, reduced setup time, machine layout, job standardization, activity improvement, and automation. Production must be in line with the objective of the kanban system, which is to reduce inventories based on minimizing production stock cycles and intermediate stocks.

2.3. Inventory Management

Stocks are, according to [11] piles of raw materials, inputs, components and finished products that are available at points in the logistics channels of a particular company. Therefore, it can be considered that inventories should not only be termed as inputs or materials that are in process, but also the finished product that is on the shelf or in the sales sector.

[11] states that stocks can be presented in two forms: physical or potential. The most common form of inventory in companies is those that are in physical format (physical goods) and that require companies to have a more rational and objective control of these components. Accumulation of inventory can lead to a chain of logistical and administrative barriers and thus need to be managed.

Inventory management is the management process responsible for controlling, managing, rationally storing and supporting decision-making throughout the process of managing inventory flows [12]. The need for inventory management is in line with the importance of developing rational control in a company's logistics system, as controlled inventory ensures a much more efficient process.

Inventory control is one of the most important areas within the structure of a company, as it is responsible for controlling the entry and exit of all material received and supplied by the company for production. Therefore, the concern with resource management is fundamental to ensure that the company has an efficient use of its production stocks.

[12] states that inventory control is critical to efficiently managing inventories in order to allow a balance in consumption and the production system not to be overloaded. This type of management is ideal for having a holistic view of the entire production process, from its inventory phase to raw material supply and auxiliary inventory control. [13] complements the concept of inventory control by addressing that inventory, given its primary purpose in the business (supply of materials) ensures that flexibility in production processes is practiced.

[13] defines that inventory management is an integrated management process, in accordance with company management policies, whose objective is to optimize the inventory chain in production. The idea of inventory management is to develop integrated supply chain control in line with customer demand and to distribute through distribution channels.

[14] says that inventory management arose from the need to address companies' lack of inventory and production chain control. One of the major problems of inventory management in the early twentieth century, for example, was the methodology of controlling its warehouses, as there was no methodology of supply demand in sync with the production process.

[12] say that the integration of inventory management is directly linked with the general administration,

information technology, control and automation sectors and the planning sector. This systematic feature of inventory management allows us to understand that inventory control is global, that is, it is present from the organization of the raw material in the warehouse to the finishing of the finished product and the shipment for sale.

For [15] inventory management is critical for any company that seeks to ensure the best use of its financial resources by avoiding unnecessary spending on inventories and unwanted supplies. Thus, it is understood that managing inventory means ensuring information subsidies for the company's management, as well as for the financial sector, aiming to avoid accumulation in the production process and avoid overloading the production axes.

[16] states that inventory management cannot be developed in isolation; on the contrary, it needs to be integrated and systematized with the entire productive, administrative and financial process of the company. This feature of inventory management demonstrates that it is a management model that directly influences the mode of production and the delivery of the product to the customer.

[17] address the cost of inventory management and classify this process into four types: acquisition cost, storage cost, order cost, and shortage cost. This breakdown is intended to assist in the determination of inventory levels in order to more accurately (but undefined) project inventory expenditures so that there is no problem with storage.

This relation of stock cost with stock levels is pointed out by [18] as a major factor for the financial control of stock and aid in projecting the company's strategic planning. This information assists in making decisions for the acquisition of the most cost-effective raw materials, the best market turnover and the highest return on profitability for the company.

3. Methodology

The research process took place, a priori, by the bibliographic survey of the most recent studies on Quality Management and the application cases of kanban in companies in the logistics sector.

Subsequently, an initial diagnosis stage was carried out at the company to survey the problems and barriers regarding parts organization and distribution of functions in the production process and meeting the demand for the sales sector.

4. Results and Discussions

The proposal was linked in the following actions (Figure 1):

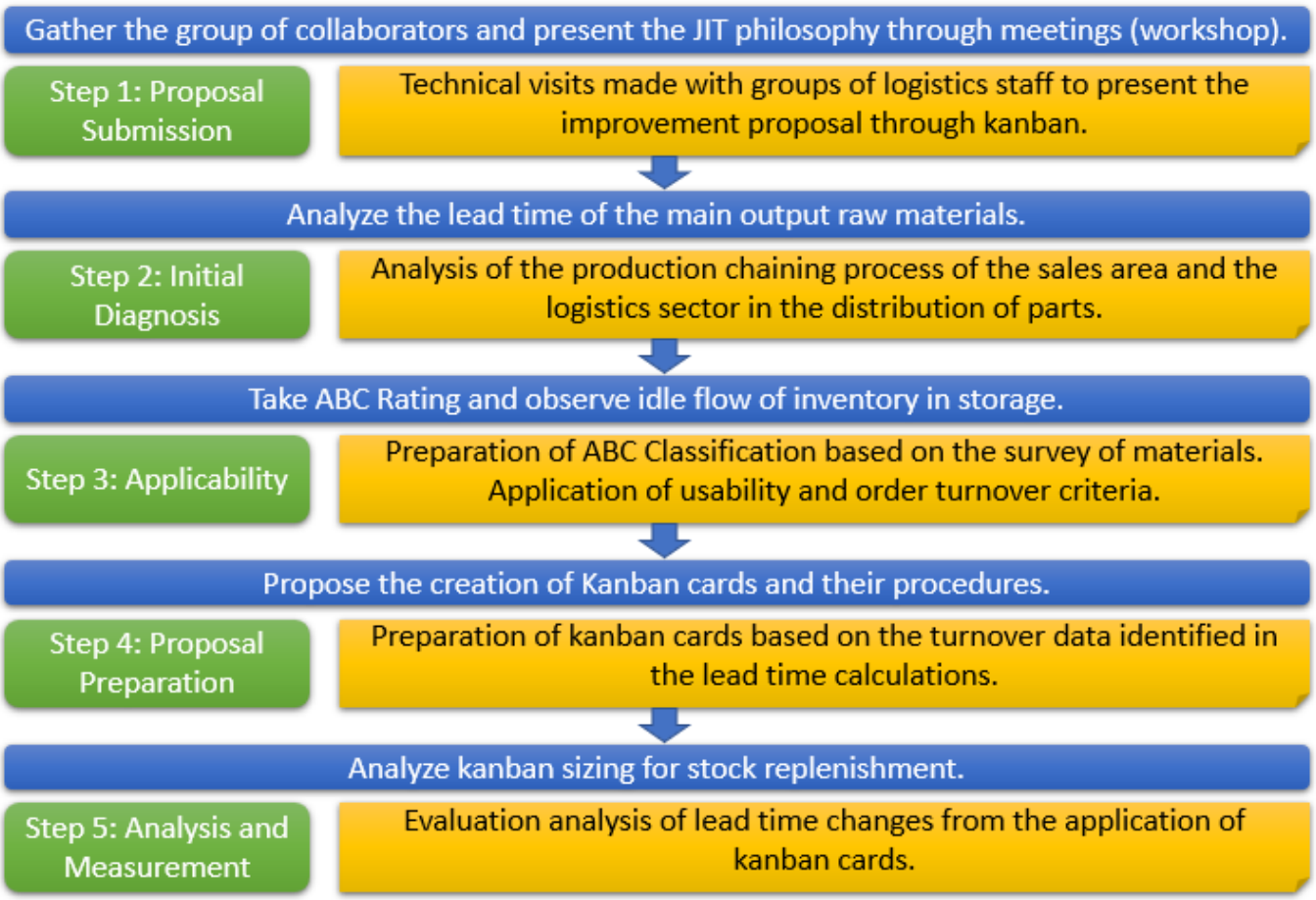


Figure 1 - Flowchart of the study steps
Source: Prepared by the author (2019)

Tucumã Peças, the object of study of this research, is an auto parts company with the main activity the production of motorcycle clutch assembly. It is located in the Industrial District, in the city of Manaus - AM and mainly serves the assembling companies such as Moto Honda da Amazônia and Yamaha Motor Company.

Since 2015 she has entered the 4-wheel business, developing clutches for the Ford company. Its current market segment is considered mixed, because in addition to the manufacture of parts, it also acts in project preparation and technical consulting activities.

The auxiliary stock sector is responsible for storing part of the materials that are required for clutch production. One of the industry's primary functions is to work on the material receipt and storage flow, as well as to make material payments through requisitions through the Production Order (O.P).

Due to the major problem faced by the company when the reallocation of resources for the purchase of materials and the increase of re-supply barriers due to the purchase of materials that are not used and become obsolete in stock, management has been analyzing in its strategic planning. a methodology that makes inventory control effective in the auxiliary inventory sector, given that it is a strategic sector for the flow of production and sales in the enterprise.

Initially, together with the company's employees (auxiliary inventory sector), the managers responsible for logistics and one (01) representative of the company's management, a series of technical meetings

(workshops) were presented for the presentation of JIT's philosophy. and the kanban system proposal.
The workshop was called the company's "I JIT Philosophy Workshop". The schedule was defined in three (03) technical meetings, which were held within the company's internal meeting space. The time set for the meetings was during breaks, in the morning, with the presence of invited collaborators.
The JIT Philosophy was explained and the Kanban system proposal for the employees and management was presented. A preview of the article was presented, as well as other cases implemented in companies that were successful in controlling inventory management and logistics planning.
After the workshop phase, the study surveyed the inventory management process of the company's ancillary inventory sector and analyzed the current process lead time to look at the inventory and logistics management situation (Figure 2). :

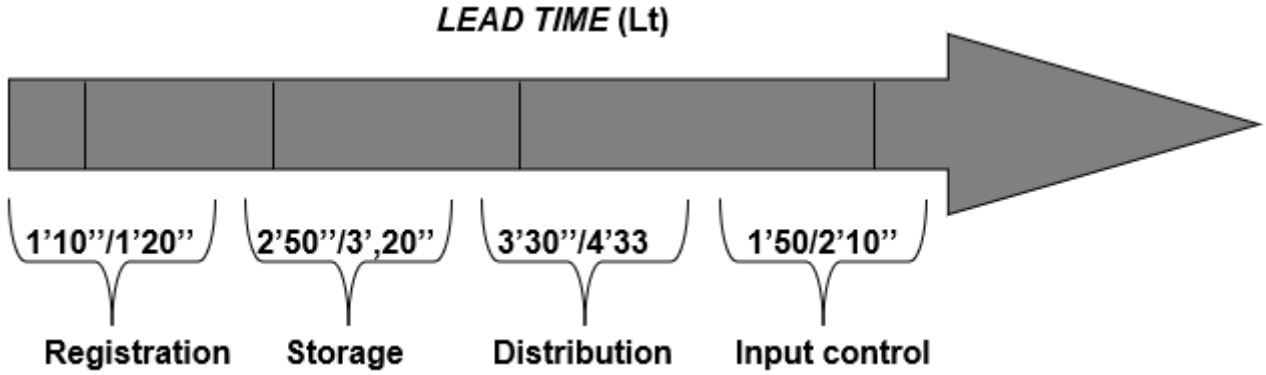


Figure 2 - Auxiliary Inventory Lead Time
Source: Prepared by the author (2019)

After calculating the lead time, the parts with the highest inventory output and those with the least inventory output (idle) were surveyed for the ABC classification. [19] state that this type of method is fundamental for carrying out a stock examination in order to assess the consumption of stock values and thus identify stock items according to their degree of usability (A - most important; B - intermediate and C - less important).
Following is Table 1 with the ABC classification performed in the company's auxiliary inventory sector:

Table 1 - ABC Classification

ITEM DESCRIPTION	CODE	DEMAND 2017	COST	VALUED DEMAND (DV)	%	ABC
STEEL COIL	04G1312C0119AC	253409	0,0693512	R$ 5.213,35	59,69	A
FRICTION DISC	22201MJ80000	87591	0,459311	R4 9,70	13,22	A
FRICTION BOARD	22201MS66201	43983	0,789122	R$ 7,98	9,90	A
CLUTCH SPRING	22401KVSJ010M1	20982	0,509210	R$ 0,90	4,12	A
SCREW	90050KFL8500	19864	0,789911	R$ 0,18	3,00	A
WELDING RETAIL	PR107	19456	0,090912	R$ 27,35	1,12	A
FIXING PLATE	22105KCY9000H1	19340	0,045321	R$ 5,70	0,96	A
CUSHION	11904G7200	17800	0,056123	R$ 2,98	0,94	A

KVS Cushion	22106KRM8400H1	15634	0,067540	R$ 3,12	0,88	A
YOSHIRO OIL	MA17745	12098	0,213849	R$ 5.780,00	0,87	A
STEEL WASHER	17504G4300	10900	0,119408	R$ 0,20	0,81	B
MUCAMBO GLOVE	MA34221	10235	0,459690	R$ 13,70	0,71	B
CIRCLIP	MA63625	10100	0,983890	R$ 0,10	0,69	B
KPS BUSHING	22126KBB9000BR	9988	0,230298	R$ 9,85	0,66	B
PRINTED DISC RING	22203KWSA9010R	9542	0,450989	R$ 17,90	0,55	B
WOOD PALETTE	3020371	9109	0,230494	R$ 70,00	0,47	B
5RM GEAR	11004G1303	872	0,192010	R$ 13,70	0,35	C
KPS Rivet	231151073101R	732	0,103829	R$ 0,20	0,41	C
ANALOG WATCH	MA15331	540	0,129280	R$ 17,00	0,44	C
CNC BREAKER	PR15069	234	0,201932	R$ 27,70	0,21	C
TOTAL	xxxxxxxxxxxxxxxxx	xxxxxxxxxx	xxxxxxxxx	R$ 11.227,31	100%	xxxxxx

Source: Prepared by the author (2019)

After the ABC classification based on stock circulation products was developed, it was defined which type of kanban to use. For the study, it is proposed to use the card, aimed at the circulation of stock based on the stock flow of the sector. For the determination of kanban cards it will be necessary to choose the colors of the cards based on the degree of need for stock replenishment, also called kanban sizing.
Below is in Table 2:

Table 2 - Kanban Sizing

ITEM DESCRIPTION	***DARK BLUE KANBAN***	***KANBAN LIGHT BLUE***	***KANBAN YELLOW GRAY***
STEEL COIL	19000	1000	5000
FRICTION DISC	5500	3000	1500
FRICTION BOARD	5000	2500	1000
CLUTCH SPRING	4500	2000	1000
SCREW	4200	1800	800
WELDING RETAIL	4000	1200	700
FIXING PLATE	3500	1000	600
CUSHION	3200	800	550
KVS Cushion	2500	650	460
YOSHIRO OIL	2200	620	400

Source: Prepared by the author (2019)

The methodology in the JIT calculation process corresponded to cash flow control based on the replacement of products. It has been noted that there is a waste in the procurement industry when

purchasing low-turnover parts, as shown in classification C. Kanban cards will help to reduce inventory through more effective control of procurement and turnover to meet the demand of the sales sector.

5. Final Considerations

The objectives of the study were achieved in the following proportions: Regarding the general objective of the study, the proposal was able to build a methodology to optimize the workflow in inventory control through kanban cards based on the elaboration of the ABC classification and through the identification of idle stocks.

From this identification it was observed that the products at level C are those that have low turnover and do not offer a profitable cost-benefit to the company, and the reallocation of expenses for the acquisition of other products may be suggested. Improved production efficiency was observed through the adoption of a leaner system aimed at reducing process waste.

As for the specific objectives of the study, the kanban methodology will be able to improve the flow of inventory control by targeting cards and reducing idle inventories. This will improve the company's cost-effectiveness in purchasing products that have a higher inventory turnover (A-rated products) and thus reallocate investments from other acquisitions. The proposal of a kanban system will thus facilitate, through inventory control, the logistics performance of the company, since the use of cards should help in the process of inventory flow in the sector.

The contribution of the JIT methodology through the kanban system will bring greater efficiency in inventory control and logistics of the company's auxiliary inventory sector. Implementing this tool will improve workflow, drive greater profitability by reallocating product acquisition costs in idle inventory, and streamline workflow to more effectively serve the company's sales industry.

JIT can be pointed out as a philosophy that stands out for a vision that proposes quality with greater efficiency and the reduction of waste in a production process. As such, companies are seeking to tailor their strategies around a more profitable work philosophy that focuses on increasing productivity without generating idle inventory losses and pent-up demand.

The results showed that the kanban system will bring an adequate organization of work in order to enable the operation in inventory control, replenishment and calculation of material demand to be performed more effectively, generating greater financial profitability through the company. a leaner inventory management system.

It is concluded that companies need to adapt to management models that bring greater efficiency to the production process and bring greater potentiality in logistics management and inventory management. As Liker (2005) points out, it is of paramount importance that a company's production system be sound in its logistics process so that it eliminates downtime and streamlines workflow.

The purpose of this study arose precisely from the need to contribute for Tucumã Peças to optimize its inventory control and, thus, readjust its financial planning for the acquisition and reallocation of products.

6. References

[1] MONDEM, YASUHIRO. Sistema Toyota de Produção: uma abordagem integrada ao Just-in-time. 4. ed. Porto Alegre: Bookman, 2015.
[2] CORRÊA, H. L. Administração de produção e de operações. Manufatura e serviços: uma abordagem estratégica. 1. ed. São Paulo: Atlas, 2012. 446 p.
[3] LIKER, J. K. O modelo Toyota: 14 princípios de gestão do maior fabricante do mundo. Tradução de Lene Belon Ribeiro. Porto Alegre: Bookman, 2005. 316 p.
[4] CARPINETTI, Luiz César Ribeiro. Gestão da qualidade: conceitos e técnicas. 3. ed. São Paulo: Atlas, 2016.
[5] CARVALHO, Marly Monteiro de; PALADINI, Edson Pacheco. Gestão da Qualidade: teoria e casos. 2. ed. rev. ampl. Rio de Janeiro: Elsevier, 2012.
[6] TUBINO, D. F. Manual de planejamento e controle da produção. 2. ed. Atlas, São Paulo, 2000.
[7] VILLAR, A. de M.; SILVA, L. M. F. e; NÓBREGA, M. M. Planejamento, Programação e Controle da Produção. João Pessoa: Universitária da UFPB, 2008.
[8] MOURA, Reinaldo A. A simplicidade do controle de produção: kanban. São Paulo: IMAM, 1994.
[9] BOEG, Jesper. Kanban em 10 passos. São Paulo: InfoQ, 2014.
[10] COLIN, Emerson C. Estudo da implementação do sistema Kanban em uma empresa brasileira de auto-peças: dificuldades e caminhos. In: XVI Encontro Nacional de Engenharia de Produção, Piracicaba: Anais, 1996.
[11] BERTAGLIA, Paulo Roberto. Logística e gerenciamento da cadeia de abastecimento. São Paulo: Saraiva, 2015.
[12] BOWESOX, Donal J. et al. Gestão Logística da Cadeia de Suprimentos. Porto Alegre: Artmed, 2013.
[13] PAOLESCHI, Bruno. Estoques e armazenagem. São Paulo: Érica, 2014.
[14] VIANA, J. J. Administração de materiais: um enfoque pratico. Sao Paulo: Atlas, 2002.
[15] LOPES, R.,A.; LIMA, J., F., G.; Planejamento e Controle da Produção: um estudo de caso no setor de artigos esportivos de uma indústria manufatureira. In: XXVIII Encontro Nacional de Produção (ENEGEP), 2008, Rio de Janeiro.
[16] BETTS, A. et. al. Gerenciamento de Operações e de Processos: Princípios e Práticas de Impacto Estratégico. Porto Alegre: Bookman, 2008, 552 p.
[17] FRANCISCHINI, Paulino Graciano; GURGEL, Floriano do Amaral. Administração de materiais e do patrimônio. São Paulo: Pioneira Thomson, 2002.
[18] NOGUEIRA, A. Logística Empresarial: Uma visão local com pensamento globalizado. 1 ed. São Paulo: Atlas, 2012.
[19] MARTINS, P. G.; CAMPOS, P. R. Administração de materiais e recursos patrimoniais. São Paulo: Saraiva, 2009.

The Use of BSc With the Regulatory Perspective for A Private Higher Education Institution in Brazil

Ana Célia Galdino Leite (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
aanacgl@yahoo.com.br
Phone: +55 69 98140-9954
Address: 6200, Rodrigo Octávio Ave., Manaus – Amazonas
Zip Code: 69080-900

Marcelo Albuquerque de Oliveira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
marcelooliveira@ufam.edu.br
https://orcid.org/0000-0003-2496-646X

Dércio Luiz Reis (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
dercioreis@ufam.edu.br
https://orcid.org/0000-0001-8175-3212

Raimundo Kennedy Vieira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
kennedy71@gmail.com
https://orcid.org/0000-0003-3685-0034

Gabriela de Mattos Veroneze (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
gveroneze@ufam.edu.br
https://orcid.org/0000-0002-1978-9190

Abstract

Higher-Education Institutions need to meet the quality requirements required by the Ministry of Education - MEC, which define the criteria that should be included in the HEI Planning. In this way, using the balanced scorecard - BSC model, using the objectives and goals established in the PDI can help the leaders in the

strategic management of HEI. Given this, the objective established for this work is to propose a BSC model from the perspective of Regulation for a private HEI. The methodology was qualitative, using the bibliographic research procedure and case study of a private IES in Porto Velho - RO. After the literature review, a fifth perspective for the BSC was developed, which was called the Regulatory Perspective, creating a Strategic Management model for the researched institution, thus improving decision-making processes.

Keywords: Strategic Management; Balanced Scorecard; Higher Education Regulations.

1. Introduction

Higher-Education Institutions in Brazil have been facing a very competitive market, and it is necessary that, besides worrying about the quality of education. They also have to worry about acting in the market, because before, these institutions had their business competing only locally, but faced with so many changes that have occurred in this market over the last few years, they have had to adapt and fit into a competitive market.

In addition, this has caused many difficulties for the management of these companies, as the higher-education institutions are extremely complex, and it is necessary to establish strategic planning to survive in the market and at the same time have to comply with the requirements of the Ministry of Education (MEC). According to Ralston *et al.* (2015), strategy is the factor that differentiates a company from its rivals. In contrast, the Higher-Education Legislation in Brazil requires that HEIs have to fulfill several mandatory requirements that often do not fit the creativity of strategic thinking.

The Brazilian Association of Higher-Education Maintainers (ABMES) released the result from a survey where 40% of high-school students intended to enter a college and started working. Of these, 18% consider the financial issue to choose the Faculty, 17% consider academic aspect and quality, and 60% have as a dream a decision factor for choosing the course (ABMES, 2017). For competitiveness in education, it is necessary to think differently about School Management with the construction of strategies and requires a new meaning for competitiveness in education (Maduro *et al.*, 2018; Menezes, 2002). This paper intends to propose a strategic management model for a private educational institution in Brazil, in the Amazon Region.

2. Strategic Management in Higher-Education Institutions

From Mccaffery (2018) perspective, higher-education institutions need to develop appropriate strategies that enable them to address the new and increasingly competitive educational environment.

External pressures consist of scarce resources and a complex and highly competitive environment, with demands for rapid response and new governance and management challenges. Higher-Education Institutions (HEI's) are subject to intensive policies, as they are perceived in a broader socioeconomic context.

Every business is created to achieve goals and strategy is the path they seek to survive. In Pucciarelli (2016) view, education is becoming a global service, an increasingly complex and competitive market. To address these challenges, higher-education institutions need an appropriate strategy. According to Sperling (2017), private higher-education institutions need to be treated as companies, despite the differentiated nature of their products and services, which cannot be evaluated in the short term. The major challenge of private HEI's is their ability to innovate in a competitive market such as education and at the same time bureaucratic with regard to educational legislation.

HEI's seek to improve themselves to offer quality education, with the new educational technologies that are in the market, using new teaching tools, as well as new methodologies that can satisfy the aspirations of new generations of students. The great challenge of HEI's is the speed of information through the Internet and the new technologies that are becoming more accessible to everyone. There needs to be a shift in thinking and acting in education to survive in the education market. From the perspective of Falabela-Cárdenas and García-Treviño (2014), it is evident the close relationship that exists between business schools that have private sector universities.

According to the studies by Menezes (2002), the school could not keep up with the dynamics of a complex and transitory society. The choice of new courses themselves is constantly changing, as there are some professions that are disappearing and others that are emerging, and it is not yet known how to be graduate them. All of this deserves special attention from Managers of Higher-Education Institutions, as they must face a number of challenges to survive in a rapidly evolving world and train professionals to meet the demands of the labor market.

From the perspective of Meyer *et al.* (2012), it is necessary to build a proper management model for private educational institutions, while following the guidelines and priorities established by the plans.

3. Brazilian Higher Education: Policies and Legislation

According to the Federal Constitution, in its articles 205 and 206, educational activity is a public function, but it is not exclusive to the State, requiring the participation of society (ZOCCOLI, 2012). Through the implementation of evaluation policies established by the Ministry of Education, quality indicators have come to be recognized by Brazilian society as a way of assessing the skills and competences of students graduated from HEI's.

In accordance to Drucker (2017), we now have the knowledge society, the information age, the network society, among other expressions, in an attempt to define the transition from an industrial condition to the speed of culture and technological economy. The Ministry of Education has advanced in pursuit of quality education. There are several strategies used by the government to make HEIs fit the indicators. The new models of on-site assessment and also through the National Student Performance Examination (ENADE) have brought society closer to the Higher-Education Institutions, because before it was not chosen a course

by the evaluation that it received from the MEC, but this factor became to be a competitive differential in the market.

In this sense, according to Silva Júnior *et al.* (2014), the regulatory processes to which higher education institutions are submitted evaluate the Institutional Development Planning (PDI) where planning is the act by which the future of the institution is decided and the monitoring of what is under construction.

4. Balanced Scorecard as a Strategic Management Tool

For Kaplan and Norton (1992), the BSC's conception and proposition resulted from the need to modify the performance indicators used by organizations (Figure 1).

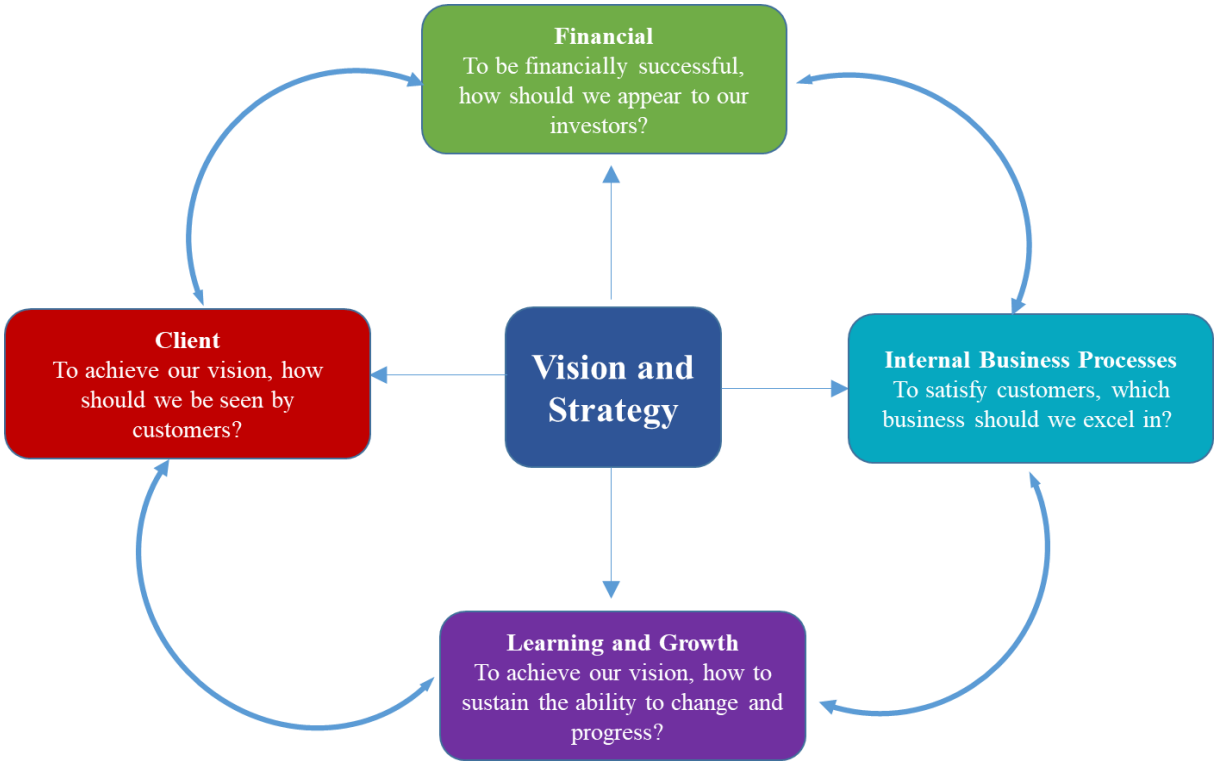


Figure 1. Balanced Scorecard (adapted from Kaplan and Norton (1992).

In the view of Ribeiro (2005) and Fooland *et al.* (2015), BSC is used to realize the strategies, achieve practical results and successful achievements, and translate the strategy into action. They also add that BSC makes the manager focus his attention on a set of fundamental factors for the business. Its purpose is to direct the company's activities according to the organization's vision and strategy, improving internal and external communication aiming at strategic objectives. The BSC uses four central and important strategic development perspectives that should be properly defined and then measured and tracked.

BSC became a performance appraisal system whose purpose was the implementation of strategies. Kaplan and Norton (2004) say that company assets benefit from this ability to learn and grow. The three groups of inducers of learning abilities are human capital, informational capital, and organizational capital. According to Jensen (2017), BSC should be complemented by a corporate vision that unites the organization's

participants in their struggle for mastery of its competitive arena. Regarding the use of BSC as a strategic management model, these authors state that it is an efficient strategy formulation and management tool.

According to Antunes and Mucharreira (2015), the era of knowledge and new technologies requires any organization to anticipate and strategically react to the constant changes that are emerging in the context in which it operates. Intangible assets, and more precisely intellectual capital, prove to be a very effective strategic factor that enables differentiation and the creation of competitive advantage among its competitors. The authors also state that the importance of BSC is undoubtedly acknowledged and gather's consensus regarding its relevance as a strategic management tool.

In the view of Martello *et al.* (2016), BSC measures are tools for leaders to use to establish financial performance measures and complement those measures with factors that drive the cause and effect relationships of measures derived from the organization's strategy.

4.1 Balanced Scorecard Perspectives

For Kaplan and Norton (1997), companies that want to survive and thrive in the information age cannot motivate and measure performance with financial measures alone, and propose the Balanced Scorecard that incorporates a more generic and integrated set of measures linking performance from the financial, customer, internal process and learning and growth perspective.

In Coe and Letza's (2014) view, the balanced scorecard has now become an effective management tool that drives strategy for many organizations globally. Akkermans (2018) states that BSC has become a popular concept for performance measurement. It focuses management attention on just a few performance measures and interconnects different functional areas as it includes non-financial measures.

4.1.1 Financial Perspective

For Kaplan and Norton (1997), typical financial goals have to do with profitability, growth and shareholder value. Many created the financial measures because of their well-documented inadequacies, their focus in the past, and their inability to reflect contemporary value-creating actions. In Costa's (2008) view, measures such as return on investment and economic value added are excellent indicators for this perspective, as an organization's financial objectives represent long-term results. Akkermans (2018) summarizes this perspective on how the company wants to be viewed by its shareholders.

4.1.2 Customer Perspective

Kaplan and Norton (1997) and Silva (2011) state that a company's performance from the perspective of its customers has become a top management priority. The new economy has shown that customer management may have become the most important dimension of many organizations. Managers must translate their overall customer service mission statement into specific measures that reflect what really matters to them.

In Pascoa's view (2013) the perspectives are interconnected, because it is through customers who have the

good financial performance, it is necessary to have confidence that customers are the ones that contribute most to the positive result of the organization. Hladchenko (2015) states that in an educational institution, clients are not only external stakeholders in society and the professional world, but also students who have the demands corresponding to the results of the learning process.

4.1.3 Internal Processes Perspective

For Kaplan and Norton (1997) internal process perspectives must originate in factors that affect cycle time, quality, employee skills and productivity. Companies should also try to identify and measure the company's core competencies. The critical technologies needed to ensure continued market leadership, must decide which processes and competencies to excel, and specify measures for each.

In the perception of Martello et al. (2016), the objective of this perspective is to generate indicators that allow tracking its progress and efficiency, not only in relation to the process itself, but also in relation to the results it causes in the financial and customer perspectives. According to the classic approach, the success of any venture depends on customer satisfaction that is related to the quality of internal processes, motivation and qualification of staff.

4.1.4 Internal Processes Perspective

From the perspective of Kaplan and Norton (1997), a company's ability to innovate, improve and learn is only possible through its ability to launch new products, create more value for customers and continually improve operating efficiencies, and thus increase shareholder value. According to Soares (2013) to promote learning and growth and continuous improvement throughout the organization, the company needs to develop actions to improve long-term processes.

5. BSC Proposal with the Regulatory Perspective

Higher-education institutions seek to establish management systems that can monitor their performance and allow them to adjust to the challenges and requirements of the Ministry of Education. One of the challenges of HEI's is to achieve results in terms of products and services for customers (students) and positive concept regarding MEC regulation. BSC becomes an essential tool for HEI's strategic management.

The researched higher-education institution uses its Institutional Development Plan (PDI) as a strategic framework. To create the BSC, the objectives and targets set in the PDI for the 2017-2021 period were chosen. After the choice of objectives and goals, indicators and initiatives were created for each one, and subsequently grouped according to each BSC perspective.

The main conventional perspectives are financial, customer, internal business process, learning, and growth. The purpose of this paper is that HEI can use a fifth perspective called regulation. This analysis reveals the applicability of BSC in HEI and the perspectives of BSC that are relevant to it (Figure 2).

Higher-education institutions are generally considered nonprofit. Their vision and mission typically focus more on customer (student) satisfaction than profitability concerns. On the other hand, BSC implementation can use existing tools, such as a Strategic Map, to increase clarity. In this way, each one can visualize how their activities contribute to the institutional strategic objectives and the results.

Figure 2. Balanced Scorecard Proposal with the Regulatory Perspective.

The HEI's strategy map surveyed is comprised of five basic components, usually from the bottom up: *Learning and Growth Perspective, Internal Process Perspective, Student Perspective, Financial Perspective and Regulation Perspective*, providing a visual framework that illustrates the standards of cause-and-effect chain, connecting desired outcomes to key factors essential to achieving them (Figure 3). This provides a more practical way to implement the BSC framework for higher education.

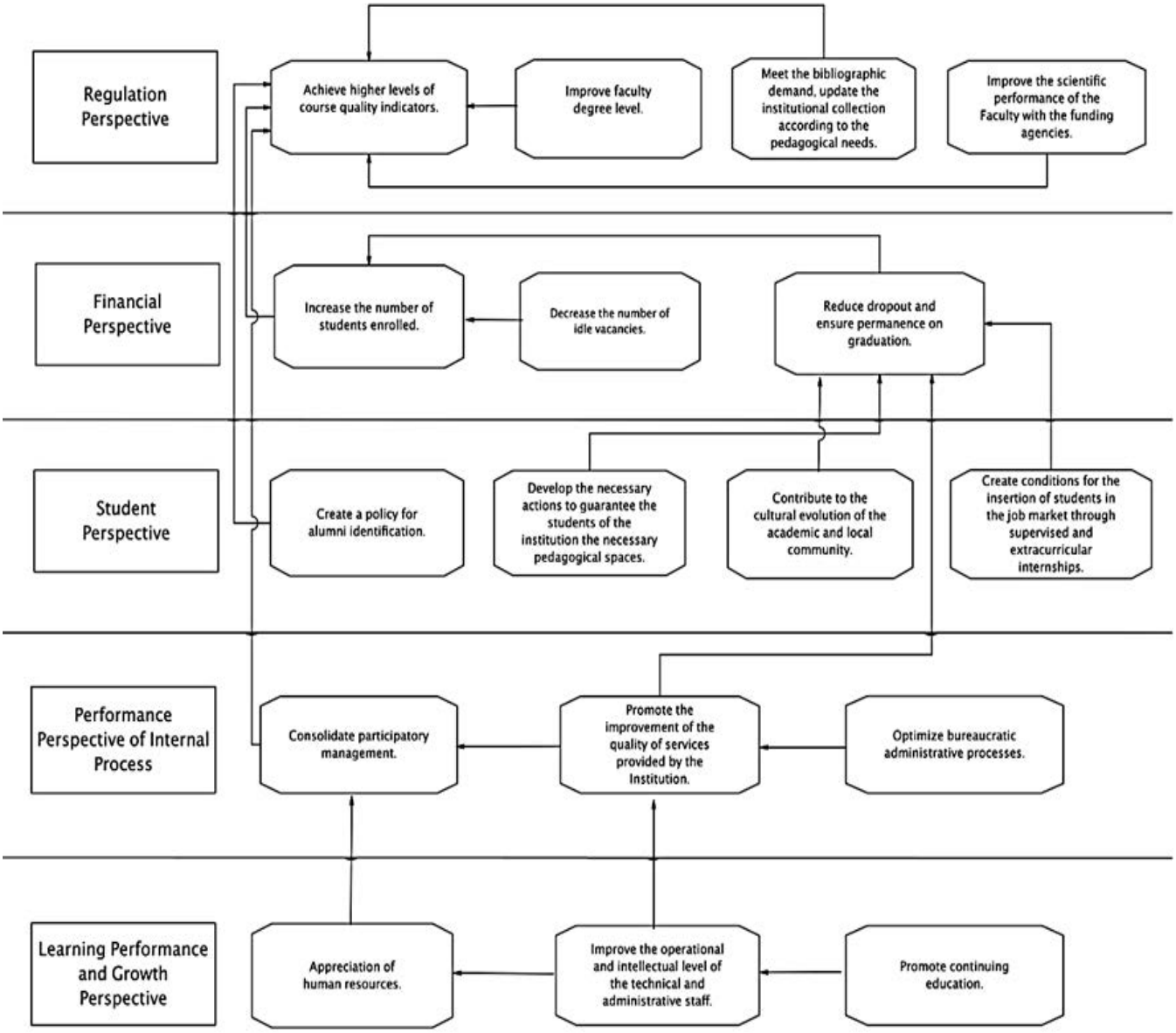


Figure 3. BSC Strategic Map of the Higher Education Institution.

5.1 Higher-Education Institution Financial Perspective

The financial perspective describes how intangible assets will be converted into tangible value. Its goal is to control how a company manages its financial resources and stakeholder involvement in the operation of the company.

In the researched HEI, the following objectives were included: *reduction of idle vacancies, reduction of dropout, guaranteeing student retention and increasing the number of students enrolled*. Table 1 presents the objectives, goals, indicators and initiatives for this perspective.

Table 1 - Financial Performance Perspective: Return on Investment and Economic Value Added; Profitability; Increased revenue mix and Productivity and cost reduction.

OBJECTIVES	GOALS	INDICATORS	INITIATIVE
Decrease the number of idle vacancies.	Decrease by 20% the percentage of current idle vacancies.	Number of vacancies remaining.	Develop marketing and partnership with schools to attract more students who are new.
Reduce dropout and ensure permanence on graduation.	Identify the cause of dropout and create a retention program in 100% of undergraduate courses.	Report of the Faculty system with the amount of dropouts.	Map the causes of student dropout and retention by applying a questionnaire; Improve the communication channel of the educational institution with its academics; Create a permanence management sector.
Increase the number of students enrolled.	Increase by 30% the total amount of students.	Increase in the total number of students enrolled.	Effectively use the existing infrastructure in the institution.

5.2 Higher-Education Institution Customer Performance Perspective

The customer perspective refers to customer relationships and markets, with an emphasis on customer wants and needs. The main measure of a customer's perspective includes stock market share, customer acquisition and customer continuity, customer satisfaction and customer profitability.

According to Ribeiro (2005), the client of a higher education institution are the students, because without them there would be no reason for HEI to exist.

The objectives chosen for this perspective are *to improve the quality of teaching, to guarantee adequate pedagogical spaces, to contribute to the cultural evolution, to promote the insertion of the students in the job market and to create a politics of identification of graduates*. Table 2 presents the objectives, goals, indicators and initiatives for this perspective.

Table 2 - Customer Performance Perspective: Market Share; Customer acquisition; Customer retention; Customer Profitability and Customer Satisfaction.

OBJECTIVES	GOALS	INDICATORS	INITIATIVE
Develop the necessary actions to guarantee to the students of the HEI the adequate pedagogical spaces.	Ensure the necessary spaces for the development of courses and Professional Practice; Take at least one-half-yearly action on entrepreneurship.	Report with practical activities developed; Academics with knowledge and desire to undertake.	Expansion of laboratories for professional practice; Creation of Junior Company of Administration and Accounting Sciences courses; Develop actions for awareness, sensitization and training on entrepreneurship.
Contribute to the cultural evolution of the academic and local community.	Develop cultural and extension programs; Encourage the participation of students and teachers in scientific initiation programs.	Cultural activities and extension courses being developed by all courses; Have students and teachers with projects developed and approved by CNPQ;	Expand the offer of extension, undergraduate and lato sensu specialization courses in the area covered by the Faculty of Rondônia - FARO; Expand Research and Extension; Improve the means of communication for the dissemination of extension actions; Expand cultural actions; Improve the site with updated information; Create an FARO newsletter; Create cultural project on the campus of FARO; Establish partnerships with SESI, SENAI, SENAC in holding events.
Create conditions for students to enter the job market through supervised and extracurricular internships.	Increase the amount of internships offered to academics.	Internship sector report on the number of students with internship relationship with companies and related agencies.	Strengthening of the Legal Practice Center; Accompaniment of the Junior Company of Civil Engineering - ECONCI; Creation of Junior Companies for the Administration and Accounting Sciences courses; Promote partnership with local businesses from various segments.
Create a policy for alumni identification.	Identify the alumni's of the College and	Have alumni students to	Develop a project to accompany alumni's;

	their insertion in the job market.	participate in College activities.	Develop one action a year, aimed at monitoring alumni's.

5.3 Higher-Education Institution Performance Perspective of Internal Process

This perspective is important because the company can analyze its current internal capacity and react according to market needs. In the context of HEI, the objectives of the internal process performance perspective refer to the realization of an effective learning process and excellent curriculum matrix.

The objectives of the internal process performance perspective are *to promote quality improvement, consolidate participatory management and optimize processes*. Table 3 presents the objectives, goals, indicators and initiatives for this perspective.

Table 3 - Performance Perspective of Internal Process: Failure indices; Product or service acceptance rate; Unplanned Downtime and Activity Costs x Competition.

OBJECTIVES	GOALS	INDICATORS	INITIATIVE
Promote the improvement of the quality of services provided by the Institution.	Implement the Institutional Evaluation Project and consolidate the CPA.	Satisfied Customer Index.	Promote the feasibility of the applicability of online assessments for all segments; Training for employees to improve service quality; Develop a service quality improvement project for the support of CPA.
Consolidate participatory management.	Implementation of an effective system for capturing and disseminating information; Implement calendar of periodic meetings of the board with representatives of the organs, at all levels, to monitor the management of the Faculty of Rondônia - FARO; Encourage the revitalization of student, teacher and	Capture system for dissemination of information implemented; Regular meetings with all those involved in college management; Participation of student representatives in periodic meetings of the Academic Board.	Adopt more flexible attitudes regarding the concepts of power and influence, which implies the adoption of strategies compatible with the involvement and engagement of employees, enabling the appreciation of human potential.

	technical-administrative representation bodies.		
Optimize bureaucratic administrative processes.	Rationalize and standardize processes; Implement process quality control.	Standardized and quality control processes.	Creation of a project for process optimization.

5.4 Learning Performance and Growth Perspective

This perspective includes three key evaluation criteria, which include employee satisfaction, employee continuity, and employee productivity. In the context of higher-education institutions, it is necessary to highlight staff motivation, development and curriculum innovation.

The objectives chosen for this perspective were *to improve the operational and intellectual level of the technical and administrative staff, valuing human resources and promoting continuing education*. Table 4 presents the objectives, goals, indicators and initiatives for this perspective.

Table 4 - Learning Performance and Growth Perspective: Employee Satisfaction; Retention of employees; Profitability per employee.

OBJECTIVES	GOALS	INDICATORS	INITIATIVE
Improve the operational and intellectual level of the technical and administrative staff.	Conducting training courses.	Have qualified administrative staff.	Offer short courses for employee training; Encourage employees by offering undergraduate and graduate scholarships.
Valorization of Human Resources;	Achieve 80% employee satisfaction goal.	Employee satisfaction.	Implement an assessment and recognition system.
Promote continuing education.	Promotion of actions to provide continuing education.	Relationship with the number of teachers and administrative technical staff and their qualifications.	Create a training and human resources development program that aims to keep staff in a constant educational process, with the purpose of improving individuals and consequently improving the assistance provided to users.

5.5 Regulation Perspective

The regulatory perspective for higher-education institutions focuses on the Ministry of Education's assessment that it is essential for HEI's to remain in the educational market, as the institution must achieve

grades ranging from 1 to 5, with grades 1 and 2 considered insufficient by the MEC.

For the proposal of the perspective of regulation, the following objectives were chosen: *to reach higher levels of the indicators of the quality of the courses, to improve the faculty degree level, to meet the bibliographic demand, to update the collection according to the pedagogical needs and to improve the performance of the Faculty with the funding agencies*. Table 5 presents the objectives, goals, indicators and initiatives for this perspective.

Table 5 - Regulation Perspective: Meet the requirements of Educational Legislation.

OBJECTIVES	GOALS	INDICATORS	INITIATIVE
Achieve higher levels of course quality indicators.	Achieve concept five (05) in all courses.	ENADE Evaluation and On-site Evaluation.	Create an ENADE evaluation follow-up project for each course; Create a teaching methodology that better qualifies academics; Meet the requirements of the MEC evaluation form for on-site evaluations.
Improve the Faculty titling level.	80% of teachers with a stricto sensu degree.	Stricto sensu qualification of teachers.	Promote partnerships with federal and private institutions for the qualification of teachers; Institutional support for teacher qualification; Authorize the removal of teachers for qualification.
Meet the bibliographic demand; Update the collection according to the pedagogical needs.	Expand the library's collection.	Update of the collection of all courses with works of at least three (03) years of publication.	Virtual Library Subscription; Update of the bibliographic collection; Subscription of journals.
Improve the scientific performance of the Faculty with the funding agencies.	Facilitate the publication of the scientific production of teachers and students; Create follow-up mechanism and systematic support to research groups;	Teachers with at least three (03) publications per annum; Research groups in operation; Scientific events happening systematically	Encourage teachers to publish in qualitative journals by adding to the Teaching Career Plan the promotion of the number of publications; Create research groups in all areas to develop research with the academic community; Create scientific events by publishing research developed by the academic

	Encourage the realization of scientific events; Achieve the Qualis concept in the Faculty's Scientific Journal.	during the school year; Publication of quality articles of scientific relevance in the Faculty Journal.	community; Encourage the publication of articles in the Journal of the Faculty that has scientific relevance.

6. Conclusion

The failures in higher-education organizations are attributed to the lack of strategic planning, but it is observed that higher-education institutions have some difficulty in implementing a management model, as they need to comply to the requirements of the Ministry of Education.

In this work, we used the Balanced Scorecard (BSC) model as a strategic management tool to identify the most appropriate perspectives to consider and to evaluate the performance of the researched higher-education institution. This analysis allowed verifying the applicability of BSC in the researched higher-education institution.

Given the problems of this study, the institution's PDI (Institutional Development Plan) was analyzed, and objectives and goals were found that were transformed into indicators and initiatives. The strategic map used the four perspectives of the Kaplan and Norton model, and the customer perspective was transformed into students. In addition, the perspective of regulation was added, with its objectives and goals, which were also extracted from the institution's PDI.

Therefore, this study meets the proposed general objective of *"proposing a Balanced Scorecard (BSC) model from the perspective of Regulation for a private HEI"*. The limitation of this work is the lack of further study of the new perspective of regulation.

The proposal as a BSC model with the fifth regulatory perspective is a step towards organizational performance measurement systems that match their specific goals and characteristics. One of the advantages over the model is that the system can be adjusted to changes in legislation. As future work, it is recommended to apply the new BSC model in the researched educational institution and evaluate the achievement of the goals for each category.

8. References

[1] AKKERMANS, Henk A.; VAN OORSCHOT, Kim E. Relevance assumed: a case study of balanced scorecard development using system dynamics. In: System Dynamics. Palgrave Macmillan, London, 2018. p. 107-132.

[2] ANTUNES, Marina; Ribeiro Mucharreira, Pedro. Os Intangíveis no Balanced Scorecard: A sua relevância na gestão empresarial e na estratégia do negócio. Portuguese Journal of Finance Management and Accounting, Vol 1, Nº 1, March 2015.

[3] BRASIL. Constituição (1988). Constituição da República Federativa do Brasil. Brasília, DF: Senado

Federal: Centro Gráfico, 1988.

[4] COE, Nicholas; LETZA, Steve. Two decades of the balanced scorecard: A review of developments. The Poznan University of Economics Review, v. 14, n. 1, p. 63, 2014.

[5] COSTA, E. A. DA. Gestão Estratégica: Da Empresa que temos para empresa que queremos. 2ª ed. São Paulo: 2008.

[6] DRUCKER, Peter. The age of discontinuity: Guidelines to our changing society. Routledge, 2017.

[7] FABELA-CÁRDENAS, M. A.; GARCÍA-TREVIÑO, A. H. Gestión de la calidad educativa en educación superior del sector privado. Magis. Revista Internacional de Investigación en Educación, v. 6, n. 13, p. 65–82, 2014.

[8] HLADCHENKO, Myroslava. Balanced Scorecard–a strategic management system of the higher education institution. International Journal of Educational Management, v. 29, n. 2, p. 167-176, 2015.

[9] JENSEN, Michael C. Value maximisation, stakeholder theory and the corporate objective function. In: Unfolding stakeholder thinking. Routledge, 2017. p. 65-84.

[10] KAPLAN, R. S.; NORTON, D. P. How strategy maps frame an organization's objectives. Financial Executive, 2004.

[11] KAPLAN, R. S.; NORTON, D. P. The balanced scorecard - meadures that drive performance. Harvard Business Review, 1992.

[12] KAPLAN, Robert S.; NORTON, David P. A estratégia em ação: balanced scorecard. Gulf Professional Publishing, 1997.

[13] MADURO, Soraia; FERNANDES, Paula O.; ALVES, Albano. Management design as a strategic lever to add value to corporate reputation competitiveness in higher education institutions. Competitiveness Review: An International Business Journal, v. 28, n. 1, p. 75-97, 2018.

[14] MARTELLO, Michael; WATSON, John G.; FISCHER, Michael J. Implementing a balanced scorecard in a not-for-profit organization. Journal of Business & Economics Research (Online), v. 14, n. 3, p. 61, 2016.

[15] MCCAFFERY, Peter. The higher education manager's handbook: effective leadership and management in universities and colleges. Routledge, 2018.

[16] MENEZES, J. M. Administração estratégica como ferramenta de gestão escolar. Dissertação (Mestrado em Engenharia da Produção) - Universidade federal de Santa Catarina, Santa Catarina, 2002.

[17] MEYER JR, V.; PASCUCCI, L.; MANGOLIN, L. Gestão estratégica: um exame de práticas em universidades privadas. Revista de Administração Pública, v. 46, n. 1, p. 49–70, fev. 2012.

[18] PÁSCOA, Dionisio João Manuel. Concepção do Balanced Scorecard na Fisipe S. A. Dissertação (Mestrado em Ciências Empresariais Ramo de Gestão de PME). Instituto Politécnico de Setúbal. Setúbal, 2013.

[19] PUCCIARELLI, Francesca; KAPLAN, Andreas. Competition and strategy in higher education: Managing complexity and uncertainty. Business Horizons, v. 59, n. 3, p. 311-320, 2016.

[20] RALSTON, Peter M. et al. A structure–conduct–performance perspective of how strategic supply chain integration affects firm performance. Journal of Supply Chain Management, v. 51, n. 2, p. 47-64, 2015.

[21] RIBEIRO, Nuno Adriano Baptista. O Balanced Scorecard e a sua aplicação às instituições de ensino superior público. Dissertação (Mestrado em Contabilidade e Auditoria). Universidade do Minho, Braga, 2005.

[22] SILVA Junior, Annor da *et.al.* Políticas públicas para a educação superior: a avaliação, a regulação e a supervisão de IES privadas em debate. Ensaio: Avaliação e Políticas Públicas em Educação, vol. 22, núm. 82, pp. 215-239, enero-marzo, 2014. Red de Revistas Científicas de América Latina, el Caribe, España y Portugal Sistema de Información Científica.

[23] SILVA, Jorge Francisco Vaz da. Aplicação da metodologia Balanced Scorecard numa Escola Básica do ensino Público. Dissertação (Mestrado em Gestão de Sistemas de Informação). Instituto Universitário de Lisboa. Lisboa, 2011.

[24] SOARES, Leonardo Humberto. Gestão de Instituições de Ensino: o ensino superior privado e os novos parâmetros de perenidade. Universitas Gestão e TI, v. 3, n. 2, p. 79-87, jul./dez. 2013

[25] SPERLING, John. For-profit higher education: Developing a world class workforce. Routledge, 2017.

[26] ZOCCOLI, M. M. DE S. Educação Superior Brasileira: Política e Legislação. 1ª ed. Curitiba: Intersaberes, 2012.

Effectiveness of Developed Comic Strips as Instructional Material in Teaching Specific Science Concepts

Pet Francis H. Casumpang[1], Odinah C. Enteria[2]
[1]Adlay National High School; petfranciscasumpang@gmail.com[1]
[2]Surigao del Sur State University-Cantilan Campus; ocuartero@yahoo.com[2]

Abstract

The study assessed the effectiveness of developed comic strips as an instructional material on teaching specific science concepts. The study also determined the perception of the respondents on the use of developed comic strips with regards the enhancement of their science process skills. Moreover, the study provided results on the mean difference between the pre-test and posttest performance of the respondents when aided by developed comic strips. The researchers made used of validated rubrics and survey-questionnaire as the primary tools of the study. The findings showed that the developed comic strip was effective as an instructional material in teaching science concepts, on waste generation and management topics in particular. It was rated acceptable and commendable by the expert-evaluators. There was a significant difference between the pre-test and posttest mean scores of the respondents. The respondents positively perceived that the developed comic strips had enhanced their inferring and communicating science process skills. Hence, the results further motivate the respondents to appreciate waste generation and management and put value on its effect to human and environment. Future utilization of this comic strip as an instructional material in teaching specific science concepts would raise environmental awareness and campaign.

Keywords: Comic Strips; Instructional Materials; Waste Generation and Management; Science Process Skills.

I. INTRODUCTION

Instructor's teaching effectiveness and student's learning are sometimes dependent on the Instructional Materials (IMs) used. Muzumdar (2016) noted that there are numerous researches supporting the contention that IMs affect students' learning. On the other hand, traditional instruction approaches caused negative image in the learning process especially in teaching science subjects and developing the science process skills of the students (Özdemir, 2010). Thus, improving quality teaching is the most significant goal in the education system.

Recently, the Philippine Government has shown serious commitment to Information and Communication Technology (ICT) education, but the Philippines as a developing country still is facing the big challenge in adapting technology (Reodique, 2017). Accordingly, the education department should be

flexible and invent ways how to deliver learning in this fast changing world. Teachers are getting challenged to adapt modernization that the department offered, but not all educators can cope with the challenges, particularly those in far-flung places which have lesser access to electronic sources such ICT and other non-traditional models of teaching. In the area of science, particularly on delivering the concepts of waste generation and management, most teachers in the province are unendingly searching for new instruments to improve learning. In fact, the Division of Surigao del Sur province is highly promoting contextualization and development of local materials to meet this concurrent demand on the absence of ICT and launching more interesting IMs in the rural context, a non-electronic material such as magazines and comic strips.

There are several modern teaching methods used in science teaching and learning process, one of these methods includes the use of non-electronic materials like comic strips. A study conducted by Estacio (2015) states that comic strip as an instructional material has a positive effect on the performance of the students in class where students learn the lesson easily as the picture diagram presented the topic. It also reiterates other findings that cartooning concept can improve the performance of students even in struggling subjects like Physics. Additionally, Toledo, et.al. (2014) gleaned that students' issue resolution skills in environmental education were significantly better upon exposure to media cartoon. The researcher also observed the active participation of the respondents in media cartooning that enable them to make better plans, actions, and solutions to local and global environmental issues.

The theories of Espada (2003), Gary (2012) and Özdemir (2016) stated that comics as an instructional material can facilitate students' learning of overarching concepts, such as cognitive development, motivation, and information processing. Scientifically accurate comic strip is an innovative way to promote higher order thinking skills through presenting scientific knowledge in a popular form that is enjoyed by most students. Comic strips as instructional material in science classes can promote science literacy and increase students' performance in some specific concepts (Tilley, et.al, 2017). However, none of the theories have claimed that comic strips in teaching science could enhance student's science process skills.

With the present situation and existing theories on comic strips as instructional materials, the researchers tried to fill the gaps by promoting another theory on comic strips as a productive tool in improving students' performances in a specific science concept, and how it enhance student's science process skills. The study also provided an evaluation on the effectiveness of the developed comic strips, its effect on the students' pretest and posttest performance and its contribution to the development of student's science process skills.

II. METHODOLOGY

The study made use of "design and development" type of research adopted from the study conducted by Institute of Education Science IES (2013) and Özdemir (2016), aiming to develop an instructional materials based on an existing theory and get feedback from the performance of students in a particular

science concept and the development of their process skills. The study has undergone three phases. Phase 1 on the evaluation of the effectiveness of the developed comic strips by the expert-evaluators from the Department of Education using the validated rubrics. Phase 2 was focused on the determining the respondents' pretest and posttest performance through the aid of developed comic strips. The researchers conducted lessons on the specific science concepts with a lesson plan implemented on the two homogeneous sections from the two selected public high schools in the province. The researcher-made lesson plan was composed of the following parts: a.) objectives b) activity plan c.) materials needed, d.) procedures and e.) assessment (multiple choice). Finally, Phase 3 covered the perceptions of respondents on the use of comic strips as instruction materials in teaching science concepts. The researchers adopted and modified the research instrument from the study of Özdemir (2016). The adopted instrument was categorized into two: Category one on how comic strips help Learning (LEA) and Category two on how comic strips develop students' Science Process Skills (SPS). LEA as category one was into two sub-categories division which measures the retention (RET) and comprehension (COM) skills of the respondents. While the category two researcher self-made questionnaires focus on the development of Science Process Skills (SPS). SPS was composed of competencies which could address the science process skills which include: observing, measuring, inferring, identifying cause and effect, classifying, predicting, experimenting, communicating, predicting, formulating models, analyzing, interpreting, making conclusions, and evaluating. The researcher also added another category which measures the perceptions of the respondents on the use of comic strips to Learning Waste Generation and Management (LWGM). Indicators were rated using the Likert Scale.

III. RESULTS

Table 1. Evaluation Rating of Comic Strips on its Effectiveness as Instructional Material

Area of Assessment	WM	Description
Factor 1: Content	3.87	Very Satisfactory
Factor 2: Format	3.67	Very Satisfactory
Factor 3: Presentation and Organization	3.89	Very Satisfactory
Factor 4: Accuracy and Up-to-datedness of Information	3.67	Very Satisfactory
Overall Mean	3.78	**Very Satisfactory**

Legend: 4.00-3.1- Very Satisfactory (VS), 3.00-2.1- Satisfactory (S), 2.00-1.1- Fair, 1.00-Poor

Table 2. Mean Scores and Standard Deviation Value for the Pretest and Posttest

		Pre-test		Post-Test	
Type of Group	**N**	**Mean**	**SD**	**Mean**	**SD**
Control Group	30	**6.3**	2.47	**9.67**	2.76
Experimental Group(Comics)	30	**8**	1.91	**12.8**	2.55

Table 3. T-test for Equality Means

Academic Performance	df	t-value	p-value	Decision	Conclusion
Control Group Experimental Group	58	4.576	.000	Reject Null Hypothesis	Significant

Table 4. Summary of the Weighted Mean Distribution of the Level of Perceptions of the Respondents on The Use of Developed Comic Strips in Teaching Waste Generation and Management.

Comic Strips Help Learning (LEA)	WM	Description
A. Retention (RET)	3.69	Strongly Agree
B. Comprehension (COM)	3.77	Strongly Agree
C. Science Process Skills (SPS)	3.72	Strongly Agree
D. Waste Generation and Management (WGM)	3.72	Strongly Agree
Overall Mean	3.73	**Strongly Agree**

Legend: 4.00-3.1- Strongly Agree, 3.00-2.1- Agree, 2.00-1.1- Disagree, 1.00-Strongly Disagree

IV. DISCUSSION

The developed comic strip was evaluated by different experts to assess its effectiveness in terms of content, format, presentation and organization, accuracy and up-to-datedness of information using the valuation rating sheet provided by the DepEd-Division of Surigao del Sur. Based on the result of the evaluation (Ref. Table 1), all the items are rated very satisfactory by the experts with an average weighted mean of 3.78. The results imply that the developed comic strips is suitable to the learner's level of development, contributes to achievement of the specific objectives, free from biases and prejudices, enhances the development of creativity and innovation, communication, collaboration, productivity, accountability, leadership and responsibility. The overall evaluation on its effectiveness revealed that the comic strip as a developed instructional material in teaching specific science concepts is highly usable. Expert-evaluators inferred that the comic strips possess a high level of acceptability and efficacy. The experts considered the material as potential instructional materials to enhance learners' performance in a particular concept.

Tables 2 and 3 showed the pretest and posttest mean scores of the respondents. The results conveyed that the group of students aided with the developed comic strips performs better than those in control group. The increase of their mean score is an indication that the students have really understood and perform well all the activities given to them. They showed ultimate interest in the science concept presented. There is an increase of the performance and development of their science process skills particularly on understanding

and appreciating waste generation and management topics. The results are supported with the ideas of Mallia (2007) and Ozdemir (2010) that comics promotes productive classroom engagements and shows a cognitive potentials for students' motivation and retention purposes. It further agrees with different assertions coming from different existing studies of Ritcher (2015), Soluhob (2015) and Affeldt (2018), that comics as a verbal visual element closes students to environmental issues and concerns, increases student's societal knowledge that gives them motivation to support environmental works and sanitation within their locality. The results also indicate that there is a significant difference between the pretest and posttest performance of the respondents in teaching science concept with the use of developed comic strip and from traditional teaching method. The claim is also supported with the study of Arroio (2011) and Weber, et al. (2013) stating that the use of visual and text format presentation gives comic a potential in getting away from traditional mode of delivering classes with the use of traditional textbook materials.

An examination of table 4 results on the summary of the perceptions of the respondents on the use of developed comic strips as an instructional materials presented positive attitude in all indicators. The results revealed that the student respondents generally have favorable attitudes towards comic strips as instructional materials for learning science concepts, science process skills, and waste generation and management. They appeared to have learned better, developed their science process skills and show the visionary trend towards waste generation and management. Most of the students perceived that the developed comic strips is a good provider of information about instant solution on waste management, solve environmental issues and concerns, provide them comprehensive and contextualized situation and plan on how to help the environment. The results agreed with the different assertions coming from different exiting studies that comic as a verbal and visual element closes in the students to environmental issues and concerns (Solohub, 2015), and a material in which situational context supports the environmental works (Affeldt, 2018). It increases students' societal knowledge that gives them motivation in making steps toward sanitation that may create a continuous impact on cleanliness within their locality (Ritcher, 2015).

IV. CONCLUSION

Based on the findings of the study, the researchers concluded that the developed comic strip was effective as instructional materials in teaching specific science concepts. Experts strongly agreed that the instructional material is acceptable and commendable to use in the classroom setting. Students perceived that comic strip helped promotes good comprehension, enhanced the development of their science process skills and raised better awareness on topics about waste generation and management and its effect on human and environment. Moreover, through the developed comic strips, the students were able to appreciate in an interesting ways, the importance of healthy environment, which led them to be supportive of environmental projects and advocacies. The utilization of the developed comic strips served as good tool to raise environmental awareness and campaign not just in young generation but for everyone's concern. Thus, future researches on developing another tool or set of comic strips in various areas of science and across different disciplines of different grade levels is invigorated.

VI. REFERENCES

Affeldt, F., Meinhart, D. & Eilks, I. (2018). The use of comics in experimental instructions in a non-formal chemistry learning context. International Journal of Education in Mathematics, Science and Technology (IJEMST), 6(1), 93-104. DOI:10.18404/ijemst.380620

Arroio, A. (2011).Comics as an Alternative in Natural Science Education: Western Anatolia Journal of Educational Sciences (WAJES).

Espada, W. (2003). Integrating physical science and the graphic arts with scientifically accurate comic strips: rationale, description, and implementation: Revista Electrónica de Enseñanza de las Ciencias, Vol. 2, Nº 1, 58-66 (2003), USA.

Estacio, R. (2015). Development and Validation of a Learning Assessment Tool and Instructional Material in Physics 1 (Mechanics): Eulogio "Amang" Rodriguez Institute of Science and Technology. Philippines.

Gary, C. (2012). Connecting Through Comics: Expanding Opportunities for Teaching and Learning: US-China Education Review B 4 (2012) 389- 395, University of South Carolina, USA.

Institute of Education Sciences (2013) Common Guidelines for Education Research and Development. Retrieved from http://ies.ed.gov/pdf/CommonGuide-lines.pdf.

Mallia, G. (2007). Learning from the Sequence from the Sequence: The Use of Comics in Instruction: Retrieved from http://www.english.ufl.edu/image/ etext/archieves/v33_/mallia/.Florida,USA.

Muzumdar, J. (2016). An Overview of Comic Books as an Educational Tool and Impli- cations for Pharmacy, Innovation in Pharmacy: University of Minnesota Libraries,Vol.7 (4): Article 1.

Özdemir, E. (2010). The Effect of instructional Comics on Sixth Grade Students' Achievement in Heat Transfer: Retrieved from https://www.researchgate. net/publication/319903513, Middle East Technical University, Turkey.

Özdemir, E. (2016). Humor in Elementary Science: Development and Evaluation of Comic Strips about Sound: International Electronic Journal of Elementary Education, June 2017, 9(4), 837-850, Turkey.

Reodique, A. (2017). How Deped is Digitalising Philippines' education sector. Computer World Philippines.

Richter, T., Rendigs, A., Maminirina, CP. (2015). Conservation Messages in Speech Bubbles– Evaluation of an Environmental Education Comic Distributed in Elementary Schools in Madagascar: Sustainability 2015, 7(7), 8880;doi:10.3390/ su7078855.Germany.

Solohub, L. (2015).The Interaction of Visual and Verbal Components in Comics in the English Textbooks on Ecology. "SMART IDEAS – WISE DECISIONS" Ltd., BULGARIA. Ukraine.

Tilley, C. L., & Weiner, R. G. (2017). Teaching and Learning with Comics. In F. Bramlett, R. T. Cook, & A. Meskin (Eds.), The Routledge Companion to Comics (pp. 358-366). New York & London: Routledge.

Toledo, M., Yangco, R., Espinosa, A. (2014) Media Cartoons: Effects on Issue Resolution in Environmen- tal Education: *International Electronic Journal of Environmental Education Vol.4, Issue 1, 2014, 19-51*. Philippines.

Weber, K., Saldanha, T., De Sousa E Silva., Santos, P., Souza, D., Arroio, A. (2013). Introducing Comics as an alternative Scientific Narrative in Chemistry Teaching: Cilt: 04, Sayı: 08, 2013, 1-14 , Turkey.

Cost Management in Educational Services: The Importance of Strategic Cost Control in Educational Institutions

Marcelo Albuquerque de Oliveira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas,Amazonas, Brazil.marcelooliveira@ufam.edu.brhttps://orcid.org/0000-0003-2496-646X

Maria do Socorro dos Santos Montoia Arrais (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas,Amazonas, Brazil.socorromsarrais@gmail.comPhone: +55 69 99233-4669Address: 6200, Rodrigo Octávio Ave., Manaus – Amazonas Zip Code: 69080-900

Dércio Luiz Reis (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
dercioreis@ufam.edu.br
https://orcid.org/0000-0001-8175-3212

Raimundo Kennedy Vieira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas,Amazonas, Brazil.kennedy71@gmail.comhttps://orcid.org/0000-0003-3685-0034

Gabriela de Mattos Veroneze (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas,Amazonas, Brazil.gveroneze@ufam.edu.brhttps://orcid.org/0000-0002-1978-9190

Abstract

The educational market in Brazil has become very competitive and, according to the Higher Education Sense, 88.20% of Higher Education Institutions are private. To make a difference in the market, HEIs must offer quality services. This offer requires a lot of intellectual as well as financial investment. Given this reality, managers need to control their revenues, but especially control their costs, which, for this business, are very high. Managers need to adopt strategic cost management methods so that they can know how their company is facing its own reality, make comparisons with other companies in the same sector, and have sufficient subsidies for decision-making. This article, through a data analysis research, seeks, through an appropriate methodology, to demonstrate the importance of applying appropriate cost management methods in private Higher Education Institutions that offer Lato Sensu Specialization courses.

Keywords: Costs management; Education costs; Financial performance.

1. Introduction

Currently there is a great competition in the Educational Market and according to data from Census INEP 2019 (data 2018), private institutions occupy 88.20% of the total of Higher Education Institutions - HEI registered with the Ministry of Education - MEC. According to a publication in Panorama magazine of Private Higher Education in Brazil (2018), the growing demand for continuing education has fostered a considerable growth in the offer of specialization courses, mainly due to the market demands of qualified professionals. With this scenario, the offer of specialization courses has become attractive and for the higher education institutions that already offer the undergraduate courses, this market share is gaining more and more space. This facility is due to the Ministry of Education legislation because, for registration, few requirements are required. According to Resolution No. 1, of April 6, 2018, of the Ministry of Education - MEC, private HEIs that want to offer Lato Sensu specialization courses only need to be in good standing before this same ministry and do not need recognition and renewal recognition for these courses.

Given this fact, in order to remain in the market, HEIs need to offer excellent services and, as a result, they will have to undertake major investments and, as a result, need to adopt adequate cost controls. In an attempt to remain in the market, it is important for higher education institutions to maintain the improvement and effectiveness of systems that involve people, materials, information, equipment, energy and greater understanding and skills within a management line with the provision of educational services. As a result, they need information to help them manage their costs and make decisions. In this sense, the use of accounting information is of great importance.

In this sense, Souza *et al.* (2003) and Reckziegel *et al.* (2007) understand that in many entities the role of accounting has failed due to the lack of adaptation to the new competitive universe. Kobs (2008) understands that a Higher Education Institution to remain in the market must continuously improve its services and procedures, adapting its organizational structure to reality, especially in a scenario of great competition, making strategic management an essential tool for survival.

It is important to highlight those factors such as corporate failure can be avoided with the help of management accounting, especially with regard to cost management, as understood by Gonçalves and Leal (2015). In addition, Junior and Lopes (2015) highlight the lack of ready-made models and administrative theories that meet the specificities of these educational organizations, making them vulnerable.

Given the above statements, this article is justified by raising the following question: *What is the importance of adopting adequate costing methods for Higher Education Institutions within the scope of offering Lato Sensu Specialization courses*? This approach aims to seek answers to the problems currently faced by institutions, pointing out possible ways forward.

2. Theoretical Referential

Nowadays, with globalization and the high demands in the labor market, there has been a great increase in the demand for professional development and qualification. With this, there was an accelerated growth of institutions, mostly private, that offered postgraduate courses in the Lato Sensu modality. For a period, it was a highly lucrative branch of activity. However, in recent years, the scenario has changed and in order for the Institutions to remain in the market, it was necessary to know the business deeply and learns how to manage resources and their costs in a property way. The following is the theoretical basis for this study, regarding the understanding of services, costs and cost management.

2.1 Service Understanding

Kotler (1998) defines service as any act or performance that one party may offer to the other that is essentially intangible and does not result in ownership of anything, and its production may or may not be linked to a physical product. Corroborating with him, Lovelock and Wright (2005) add that services are cost-effective activities that create value and deliver benefits to customers at specific times and places because of making a desired change to the recipient of the service. Correia and Gianesi (2019) add that technological evolution has made possible the emergence of new services and, therefore, companies had to adapt to new models to stay in the market.

Junior et al. (2008) state that educational institutions have different characteristics. One of these is the large volume of labor, are the teachers, for the most part, which strengthens the inequality in their cost structure relative to industries. Another factor pointed out by Junior and Lopes (2014) is that the administrators of higher education institutions are unaware or unimportant of their particularities, thus contributing to the lack of control in cost management. Tauil and Mainardes (2013) understand that the expansion of services provided by private institutions favored greater access to undergraduate courses, creating a scenario where certification was not enough to establish professional qualification, creating a growing demand for specialization courses.

According to Ribeiro (2011), cost is the expense with goods and services employed or spent in the manufacture of other goods or services. This understanding is the basic concept for starting a management process within Cost Accounting. Data provided by SEBRAE (2019) shows that currently. The service sector is the fastest-growing in the market. Martins (2015) noted that cost information was of great relevance to public or private institutions. However, it is in the third sector that there is a large increase in this practice. It also states that cost accounting is becoming stronger and gaining more space.

Cost accounting enables data measurement, generating information such as profitability, breakeven point, cost reduction, performance evaluation, among others, through techniques that inform management of the result of the sale of products or the rendering of services, analyzing the fulfillment of the goals foreseen in the budget planning (Viceconti and Neves, 2013; Crepaldi and Crepaldi, 2018). Gonçalves and Leal (2015) already visualized that the cost management in the entities offers subsidies to the decision-making, guiding the best way to face the challenges and reinforce that the accounting information is of great relevance in the management processes. Kaplan and Norton (1997) state that through controls, it is possible to know the

real state of an organization. To calculate costs, there are costing methods, which are a way to calculate the costs of products or services in institutions, according to Castro and Santos (2012).

2.2 Importance in Cost Management in Educational Services

It is understood that in order for information on HEI results to be transformed into concrete data where senior management can make assertive decisions, it is necessary to focus on strategic cost management. Maintaining these institutions in a highly competitive market requires them to adopt the practice of using management methods in order to measure their results. For educational institutions, as well as for other segments, cost control and its correct classification and application requires a certain degree of knowledge on the subject, because in practice it is much more complex than what is seen in the literature. The correct application of cost controls should be done in such a way as to help management make the most efficient decision-making possible.

Several authors understand that cost management, in addition to being strategic for organizations, shows that market knowledge, prices, customers and suppliers, business-related legislation directly or indirectly influence the management and preparation of strategic and tactical planning organization, and are fundamental to the institutions' survival (Cintra et al., 2019; Coelho and Callado, 2019; Bruni and Famá, 2012; Carastan, 1999).

In addition, Fonseca and Fonseca (2016) emphasize the importance of combining the academic side with the managerial control of its resources and costs, and adapting to the new management scenario of HEIs evolves the ideological, administrative and financial aspects. Because it is a differentiated feature in relation to cost management, in the case of educational institutions, planning for cost control can result in savings, but their measurement is not easy. Green (2207) argues that managers, academic and administrative personnel must be prepared for controls to work. On the other hand, Santos *et al.* (2016) identified the low rate of institutions using some appropriate costing system.

3. Materials and Methods

This paper deals with a case study conducted in a private higher education institution, which is located in Porto Velho-RO, in order to evaluate the cost management processes most appropriate to the different activities of the organization. The main objective of this article was to make a case study on the Cost Management methods currently used in the market and to observe which are the most suitable for companies providing services in the field of higher education in the Specialization courses in Lato Sensu modality.

The approach was quantitative, due to the exploration of the data through the balance sheets of previous exercises, course budget spreadsheets and the first results analysis practiced by the institution, with the objective of reviewing what happened in the past. The qualitative approach is related to data analysis, taking into consideration the entity's particularities to respond to the problem in question and applying the most

appropriate model as identified during the present study.

4. Case Study

The Institution studied has been in the market for over 20 years, and for much of that period has achieved significant revenue that slackly covers all its costs and still has reserves. With the crisis that has hit Brazil since 2016, coupled with the high unemployment rate, the reduction in the number of students enrolled in the Institutions, among other factors, IES had to change the way it managed its costs and resources. With regard to the offer of Lato Sensu Graduate courses, the situation has worsened, as there are a large number of institutions working with the same follow-up, both in person and in Distance Education.

In addition to the commercial strategy, such as the recruitment of new students and the location of the center's facilities, the studied HEI had to reevaluate all management processes, based on the data collected, the situation was evaluated, and initial measures were taken for effective control of costs. At first, all the control resources that the institution maintained through the educational and administrative system used were raised, and it was found that it treated each course by cost center. With this finding, there were some adjustments to the structure already implemented.

This structure facilitated the process of implementing improvements, so the next step was to evaluate how cost and expense allocations were handled. Many inconsistencies in postings were raised by reviewing the balance sheets for the years already ended, where costs and expenses were not allocated correctly in their respective cost centers, thus distorting information.

The next step was to map the process of generating, releasing and posting costs and expenses, in order to identify possible bottlenecks. The process has been redesigned and bottlenecks have been fixed. From this point on, employees were trained. Information such as the concepts of Costs, Expenses and Management, as well as why working with cost centers and what may or may not be allocated to each other, were also covered. Following this system evaluation work, mapping and improving the processes and providing training to the involved teams, the institution tried to study how to evaluate the results.

4.1 Results and Discussion

After evaluating the processes involving the provision of services related to the Postgraduate courses, some of the ABC costing, Full Absorption and Variable Costing methods were studied, in order to identify which one was the most appropriate for the organization and even the ones your internal processes.

As a premise that served as the basis for the evaluation of the methods, the Institution intends to know the total profitability of each course, taking into consideration its direct and indirect costs, as well as the fixed costs that are apportioned according to the course load of each course in the periods when the modules are taught.

Then each method was evaluated and compared with the needs of the institution and what fit most was applied to a certain period and some courses for analysis. Table 1 shows the results associated with each costing methodology adopted by the educational institution.

Table 1 - Cost Methodology Evaluation.

Cost Methodology	Results
Activity-Based Costing (ABC method)	The Activity Based Costing (ABC) does not fit the objectives of the studied institution because it is a method that evaluates each process that involves the course offer; The reason for the non-compliance is that the course offer requires few processes that would justify the result analysis with this methodology.
Variable Costing	Variable Costing also does not meet the objectives of the Institution studied by treating only variable costs, not considering fixed costs; Thus, the analysis does not include all the costs and expenses that the course consumes from the resources that are spent for its operation; The justification for not using such a model is that the higher volume of costs, in the case of this HEI object of this study, is precisely the fixed costs; However, the evaluation of this methodology will be used for comparative analysis.
Full Absorption Costing	This costing method has as its concept the kind of costing that attributes all production costs; This means that all costs and expenses associated with the courses offered and the allocation through fixed cost apportionment proportionally portrays how much each one spends within his or her capacity; Thus, it is possible to obtain the opportunity cost of resource use.

4.2 Quantitative Analysis of Costing Methodologies

According to the controls raised, it is clear that the Institution maintains the course budget spreadsheets individually, which allowed for more detailed information search. The variable and direct costs are the costs of paying teachers, materials used, tickets and lodging of teachers from outside the city of Porto Velho, which are directly linked to the courses.

Fixed costs, which are concentrated in a particular center costs, were prorated according to the total hours the course stays in the facilities during the period it is offered. A second objective of this form of apportionment is strategic, that is, it is also to know the number of idle hours, which is the object of future

studies. The dynamics of this apportionment are shown in Table 2 and occur as follows:

- Column 1: List of courses, which in this table are only covering 4 courses, but the institution in this period offered on average 7 courses, some with more than 3 classes;
- Line 1-Column 5: Total hours that the facilities are in operation, regardless of having a course;
- Line 2-Columns 8 and 9: In this example only 2 months were shown, but includes all months of the studied periods. Each month will be pro-rated with the amount each course consumes from the Facility's fixed expenses. The purpose of this way of apportioning costs was due to knowing the monthly amount of costs consumed per course during the different accounting years.
- Line 3-Column 2: Total academic workload of courses.
- Line 3-Columns 6 and 7 - These are the amounts of the fixed expenses for 2017 and 2018 that will be prorated, such expenses are concentrated in a single cost center;
- Line 4-Columns 6 and 7: Amounts prorated according to the fixed expenses of each exercise according to the workload in which the courses are being taught.

Table 2 - Rate of Costs and Fixed Expenses.

Cost Center	Monthly Workload: Course			280	2017	2018	may/17	apr/17	may/18	nov/18	dec/18	TOTAL
	Hourly Value per Month						R$ 142,29	R$ 112,50	141,38	196,55	197,08	
	Worload	Start	End	Hourly Worload per Month	453.990,88	618.555,96	39.840,30	31.500,78	39.587,55	55.034,42	55.182,48	
Course 1	360	jul/17	out/18	22	19.683,71	39.940,93						59.624,64
Course 2	360	may/17	ago/18	22	25.379,92	31.350,47			3.110,45			56.730,38
Course 3	360	nov/17	nov/18	22	7.416,61	44.265,06				4.324,13		51.681,67
Course 4	360	dec/17	dez/18	22	4.308,17	48.600,83				4.324,13	4.335,77	52.909,00

Table 3 lists some courses, which took place from 2017 to 2018, and are exemplified as a way to demonstrate the application of this method.

Table 3 - Application of the Full Absorption Costing Method.

Course	Period	Number of Students	Variable Costs	Fixed Costs (RATE)	Total Costs	Unit Cost per Student	Cost Representation per student in relation to total costs
Course 1	07/2017 a 10/2018	25	12.962,08	59.624,64	72.586,72	2.903,47	4,00%
Course 2	05/2017 a 08/2018	23	12.900,00	56.730,38	69.630,38	3.027,41	4,35%
Course 3	11/2017 a 11/2018	18	12.035,26	51.681,67	63.716,93	3.539,83	5,56%
Course 4	12/2017 a 12/2018	28	16.319,32	52.909,00	69.228,32	2.472,44	3,57%
TOTAL			**54.216,66**	**220.945,68**			

According to the application of this method, it was possible to know the unit cost per student of each course. In this study, each student represents between 4% and 6% of the total costs. With this knowledge, management will be able to make decisions based on their total cost, including all costs and expenses, being able to know their gross margin. A comparative study between the Variable Costing and Full Absorption Costing Methods was performed. For a better understanding, a comparative application of the methods was elaborated as shown in Figure 1.

Figure 1 - Comparison of Full Absorption Costing and Variable Costing.

Sales				
Product	Quantity of Students	Sale price		**Revenues**
Course 1	25	R$	5.250	R$ 131.250
Course 2	23	R$	6.000	R$ 138.000
Course 3	18	R$	4.875	R$ 87.750
Course 4	28	R$	4.200	R$ 117.600
Total	**94**			**R$ 474.600**

Variable Cost					
Product	Quantity	Cost per Sudent	Unit Variable Cost	Variable Cost	**Total Variable Cost**
Course 1	1	R$ 518,48	R$ 518,48	R$ 2.330,811	R$ 58.270,28
Course 2	1	R$ 560,87	R$ 560,87	R$ 1.812,328	R$ 41.683,54
Course 3	1	R$ 668,63	R$ 668,63	R$ 1.251,458	R$ 22.526,25
Course 4	1	R$ 582,83	R$ 582,83	R$ 582,833	R$ 16.319,32
Total		**R$ 2.330,81**			**R$ 58.270,28**

Fixed Costs (Prorated Expenses)	
Cursos	**Valor**
Course 1	R$ 59.624,64
Course 2	R$ 56.730,38
Course 3	R$ 51.681,67
Course 4	R$ 52.909,00
Total	**R$ 220.945,68**

Absorption Cost					
Product	Classes by course	Modules	Unit Value per Student	**Total Absorbed Value**	Percentage
Course 1	1	15	R$ 2.454,95	R$ 61.373,80	27,8%
Course 2	1	15	R$ 2.668,43	R$ 61.373,80	
Course 3	1	12	R$ 2.727,72	R$ 49.099,04	
Course 4	1	12	R$ 1.753,54	R$ 49.099,04	
Total		**54**		**R$ 220.945,68**	

Contribution Margin		
(+) Revenues	R$	474.600,00
(-)Variable costs	R$	58.270,28
Profit Margin - Gross Contribution	**R$**	**416.329,72**
(-) Absorption Cost	R$	220.945,68
Profit Margin - Net Contribution	**R$**	**195.384,04**

According to the data, the profit margin of each method offers very different values. Working with the Full Absorption Costing you can have the worst possible cost view, thus demonstrating the real margin in the offering of courses. Using the variable costing method, management may run the risk of understanding that an unreal gain is occurring and making decisions that may affect the financial health of the educational institution.

5. Conclusion

The analysis of the costing models allowed us to identify which method is the most appropriate to meet the Institution's needs, making it possible to know which type of cost deserves more focus. As in the market, there are several methods that must be evaluated individually, the application and analysis in a deeper study, considering the particularities of the sector, the reality of your region and the Institution provides an understanding of which cost model is the most appropriate for the institution's cost management.

Faced with the phenomenon of expansion in the number of higher-education institutions, and due to the current crisis, the economic crisis and the decline in enrollment, thus reducing the demand, most of the institutions went into crisis. Given this scenario, the institutions that make use of the available methods, knowing and controlling their costs and resources and, with that being able to make the best decisions given the result shown, will be more likely to remain in the market. Cost management gives you a thorough

understanding of the real situation of your company.

The involvement of all sectors of the institution in this process is of relevant importance, because unlike what reality in Higher-Education Institutions shows, they must work in a structured way, where all sectors, from Educational to Administrative, participate demanding information that will generate data that will serve as a basis for applying the most appropriate costing methods.

Thus, the Institutions, knowing their reality, will be able to make relevant and lean investments, obtaining in return the training of more qualified professionals who will act in the various market segments, being important for the institution itself as for society in general as highly skilled professionals will return to the market.

The correct classification of costs, the form of apportionment and the choice of the most appropriate method, will allow the educational institution to know its indicators, make market comparisons, control its actions, as well as improve the performance of managers, by knowing the reality of supply of the services it manages. When a company applies cost management methods appropriately, they have the opportunity to foresee possible bottlenecks, as well as project their growth or retraction according to market movement. Based on the information obtained from properly classified reports, HEIs can make investments and improve service to both external and internal customers.

8. References

[1] ALMEIDA, MELINA ANDREA FERNANDES LEAL DE; PACHECO, DIEGO AUGUSTO DE JESUS. Gestão Estratégica De Serviços Em uma Microempresa Prestadora De Serviços - Latin American Journal of Business Management - Recebimento: 3/12/2014 - Aceite: 7/12/2014. Acessado em:11/05/2019.
BRASIL. Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep). Censo da Educação Superior 2018: notas estatísticas. Brasília, 2019.
[2] BRESSAN, VERÔNICA PALUDO; BASSO, KENNY; BECKER, LARISSA CARINE BRAZ. Avaliação Da Qualidade Percebida Em Serviços Educacionais: Proposta De Uma Escala - Revista GUAL, Florianópolis, v. 8, n. 2, p. 216-236, maio 2015 www.gual.ufsc.br. Acessado em: 11/05/2019

[3] BRUNI, ADRIANO LEAL; FAMÁ, RUBENS. Gestão de custos e formação de preços: com aplicações na calculadora HP 12C e Excel, 6ª. ed. - São Paulo: Atlas, 2012.

[4] CASTRO, LUIZ RICARDO AGUENA JACINTHO GIL DE; SANTOS, FERNANDO DE ALMEIDA. Implantação do Custeio Abc em uma Empresa do Ramo de Prestação de Serviços. Revista Científica Hermes [en linea] 2012, 7 (Julio-Diciembre) Disponível em: http://www.redalyc.org/articulo.oa?id=477647818007. Acessado em: 05/05/2019.

[5] CARASTAN, JACIRA TUDORA. Custo Meta e Custo Padrão como Instrumentos do Planejamento

Empresarial para obter Vantagem Competitiva - VI Congresso Brasileiro de Custos – São Paulo, SP, Brasil, 29 de junho a 2 de julho de 1999. Acessado em: 11/05/2019

[6] CINTRA, LEANDRO PINHEIRO; VIDIGAL, PEDRO GUATIMOSIM; BRAGA, RENATO DA COSTA. Método De Apuração De Custos: Estudo De Caso Em Uma Fundação De Apoio De Minas Gerais1 - Revista Eletrôn ica Gestão & Sociedade v.13, n.34, p. 2736-2765 | Janeiro/Abril – 2019 - ISSN 1980-5756 DOI: 10.21171/ges.v13i34.2555. Acessado em: 11/05/2019

[7] COELHO, DANILO JOSÉ CAMPOS, CALLADO, ANTÔNIO ANDRÉ CUNHA. Evidências de Isomorfismo na Gestão de Custos de Entidades sem Fins Lucrativos do Brasil - Artigo publicado nos anais do Congresso de Ciências Contábeis e Atuariais da UFPB. Evento realizado em João Pessoa - PB, nos dias 30 e 31 de agosto, e 01 de setembro de 2018. Submissão em 11/09/2018. Revisão em 22/10/2018. Aceito em 10/12/2018. Publicado em 25/01/2019. Acessado em:11/05/2019

[8] CORREIA, HENRIQUE LUIZ; GIANESI, IRINEU GUSTAVO NOGUEIRA. Administração Estratégica de Serviços: Operações para satisfação do Cliente – São Paulo: Atlas, 2019.

[9] CREPALDI, SILVIO APARECIDO; CREPALDI, GUILHERME SIMÕES. - Contabilidade de Custos – 6. ed. – São Paulo: Atlas, 2018. 383p.

[10] FONSECA, MARILIA, FONSECA DIRCE MENDES DA. A Gestão Acadêmica Da Pós-Graduação Lato-Sensu: O Papel Do Coordenador Para A Qualidade Dos Cursos - Educ. Pesqui., São Paulo, v. 42, n. 1, p. 151-164, jan./mar. 2016. Disponível em http://dx.doi.org/10.1590/S1517-9702201603136263.

[11] GONÇALVES, ANA FLÁVIA FARIAS; LEAL, EDVALDA ARAÚJO. Utilização da Gestão de Custos em Micro e Pequenas Empresas: um estudo com empresas do Programa Empreender. I Congresso UFFO de Contabilidade. Uberlândia-MF. 2015. < http:/ /www.cont.facic.ufu.br/sites/cont.facic.ufu.br/files/2-2903-2904_utilizacao_da_gestao_de_ custos.pdf>. Acessado em:23/02/2019.

[12] JÚNIOR, LUIZ CARLOS LEMOS; ESPEJO, MÁRCIA MARIA DOS SANTOS BORTOLOCCI; VOESE. SIMONE BERNARDES; LOURENÇO, ROSNERY LOUREIRO. Gestão de Custos nas Instituições Privadas de Ensino: Um estudo Empírico dos Mpétodos de custeio. XV Congresso Brasileiro de Custos – 12 a14 de Novembro/2008.https://anaiscbc emnuvens.com.br/anais. /article/view/1407. 2008. Acessado em 14/05/2019.

[13] JÚNIOR, VICTOR MEYER, LOPES, MARIA CECILIA BARBOSA. Administrando o imensurável: uma crítica às organizações acadêmicas, Cad.EBAPE.BR, v. 13, nº 1, artigo 3, Rio de Janeiro, Jan./Mar.

[14] KAPLAN, ROBERT S; NORTON, DAVID P. A estratégia em Ação: Balanced Scorecard. Trad. Luiz

Euclydes T. Frazão Filho. Rio de Janeiro: Campus, 1997. 344p. Tradução de The Balanced Scorecard.

[15] KOTLER, P. Administração de marketing: análise, planejamento, implementação e controle. São Paulo: Atlas. 1998.

[16] LOVELOCK, C.; WRIGHT, L. Serviços: Marketing e Gestão. São Paulo: Saraiva. 2005. 416p.

[17] MARTINS, ELISEU. Contabilidade de Custos - 11. ed. - São Paulo: Atlas. 2018. 380p.

[18] Pesquisa SEMESP 2018 - https://www.semesp.org.br/imprensa/crise-de-nivel-superior – Acesso em:14/05/2018.

[19] Quero Educação – Panorama do Ensino Superior Privado no Brasil 2018 - 2019

[20] RESOLUÇÃO N° 1, DE 8 DE ABRIL DE 2018. Disponível em: http://www.in.gov.br/ma teria/-/ asset_publisher/Kujrw0TZC2Mb/content/id/9579890/do1-2018-04-09-resolucao-n-1-de-6-de-abril-de-2018-9579886

[21] SEBRAE - http://www.sebrae.com.br/sites/PortalSebrae/artigos/o-melhor-negocio-para-montar-em-2019-e-no-setor-servicos,8ce685e533629610VgnVCM1000004c00210aRCRD. Acesso em:14/05/2019.

[22] TAUIL, AMIRE, MAINARDES, EMERSON W. Fatores determinantes na escolha de cursos de pós-graduação lato sensu. Buenos Aires, XIII Colóquio Internacional sobre Gestão Universitária nas Américas - Revista GUAL, Florianópolis, v. 10, n. 4, p. 227-251, Edição Especial 2017 www.gual.ufsc.br. Acessado em 14/05/2019.

[23] VICECONTI, PAULO; SILVÉRIO DAS NEVES. Contabilidade de Custos. 11. ed., rev. e atual. – São Paulo: Saraiva. 2013.

Forecasting incidence of tuberculosis cases in Brazil based on various univariate time-series models

Rhuan Carlos Martins Ribeiro [a], Thaynara Araújo Quadros [b], John Jairo Saldarriaga Ausique [b], Otavio Andre Chase [a], Pedro Silvestre da Silva Campos [a], Paulo Cerqueira dos Santos Júnior [a], José Felipe de Almeida [a], Glauber Tadaiesky Marques [a]

[a] Federal Rural University of Amazonia (UFRA), Cyberspatial Institute (ICIBE), Brazil
[b] Federal University of Pará (UFPA), Science and Technology Park of Guamá (PCT-Guamá), Center for the Valuation of Bioactive Compounds in the Amazonia (CVCBA), Brazil

Abstract

Tuberculosis (TB) remains the world's deadliest infectious disease and is a serious public health problem. Control for this disease still presents several difficulties, requiring strategies for the execution of immediate combat and intervention actions. Given that changes through the decision-making process are guided by current information and future prognoses, it is critical that a country's public health managers rely on accurate predictions that can detect the evolving incidence phenomena. of TB. Thus, this study aims to analyze the accuracy of predictions of three univariate models based on time series of diagnosed TB cases in Brazil, from January 2001 to June 2018, in order to establish which model presents better performance. For the second half of 2018. From this, data were collected from the Department of Informatics of the Unified Health System (DATASUS), which were submitted to the methods of Simple Exponential Smoothing (SES), Holt-Winters Exponential Smoothing (HWES) and the Integrated Autoregressive Moving Average (ARIMA) model. In the performance analysis and model selection, six criteria based on precision errors were established: Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percent Error (MAPE) and Theil's U statistic (U1 and U2). According to the results obtained, the HWES (0.2, 0.1, 0.1) presented a high performance in relation to the error metrics, consisting of the best model compared to the other two methodologies compared here.

Keywords: Forecasting, Holt-Winters, Tuberculosis, Time Series, Univariate Models.

1. Introduction

Tuberculosis (TB) is a contagious, often fatal infectious disease caused by the Mycobacterium tuberculosis bacillus, which targets the lungs (pulmonary TB) and can sporadically settle in other organs (extrapulmonary TB). It is transmitted through air contaminated with the antigen and easily contracted by inhalation. According to Drain, et al., 2018, the limited understanding of the clinical and pathogenic spectrum of M. tuberculosis infection is one of the factors that make TB the leading cause of infectious agent mortality globally. In this sense, the World Health Organization's Global Tuberculosis Report (WHO, 2018) presented data for the year 2017, approximately 10 million people developed the disease and 1.3

million died.

Recent research indicates that about 23% of the world's population are at risk of acquiring the infection in its latent form and developing the disease over a lifetime. However, the progress of research for the control of M. tuberculosis is still low in most cases, because the bacillus is multidrug resistant (MDR-TB) or extensively resistant (XDR-TB) to the drugs used (BORISOV, et al., 2017). A study by Stein et al. (2018) show that Human Immunodeficiency Virus (HIV) infection and low body mass index contribute to a faster evolution of TB. Similarly, the overall treatment effectiveness rate for MDR-TB is <55% (FALZON, et al., 2017) and for XDR-TB, the mortality rate is up to 80% because it is resistant, at least four of first and second-line drugs (PIETERSEN, et al., 2014). Alternatively, Merker et al. (2015) consider that the cause of this resistance may be related to inadequate treatment of the disease, resulting as an evolutionary pressure to the etiological agent.

In 2017, the first global meeting at the end of TB was held, with the aim of devising combat strategies, focused mainly on early diagnosis and effective treatment, as these measures can prevent millions of new cases. This conference subsequently resulted in the Moscow Declaration, which is a global commitment to take urgent action to combat TB, including enough financial mobilization in research aimed at prevention, diagnosis and treatment. At the World Health Assembly in May 2018, WHO member states pledged to accelerate action against TB based on the Moscow Declaration (WHO, 2018). In Brazil, the Ministry of Health has developed a national plan to suppress tuberculosis as a public health problem. The document was published in 2017 and its main objective is the early diagnosis and the guarantee of continuous treatment without interruption in the first six months.

In order to provide support for the development of actions in combat and its prevention, related to the high mortality rate associated with TB, there is an urgent need to predict and monitor the epidemiology of this disease. Aiming at actions, it is necessary the epidemiological approach through time series, which consists of the ordered observations of a variable, following a regular and successive time interval (ATKINSON, et al., 2015; PAULINO, et al., 2017), that allow for elaboration of predictive models to monitor the epidemiological evolution of TB, and in the study of these temporal alterations different data series models have been used (NASEHI, BAHRAMPOUR, et al., 2014; KILICMAN and ROSLAN, 2009; ZHENG, ZHANG , et al., 2015; CAO, WANG, et al., 2013; DUBE, 2015). Moreover, the determination of the best model for forecasting will depend directly on the nature and behavior of the data, however, since the disease presents different forms of temporal distribution around the world, different models are able to perform the prognosis with relative precision quality. For example, Abdullah et al., 2012, showed that the double exponential smoothing technique is the best model for predicting TB in the state of Kelantan - Malaysia. However, Zheng, et. al., 2015, modeled the TB forecast in the Xinjiang - China region using the autoregressive integrated moving average (ARIMA) method as the basis.

This text describes what we consider to be the best univariate model against three proposed methods, based on the characteristics of TB diagnosis in Brazil. Data were collected on the platform of the informatics department at Brazilian unified health system (DATASUS) from January 2001 to June 2018. After tabulating the information, an application has been used by three prediction models, consisting of: Simple exponential smoothing (SES), Holt-Winters exponential smoothing (HWES) and the ARIMA method, we also present an analysis of the significant errors contained in these models and the importance of obtaining

minimal errors. Finally, the data adjusted for the first half of 2019 were predicted by the model observing the highest prediction capacity.

2. Methodology

2.1 Date Collection

Data for the monthly incidence of TB were obtained from DATASUS from January 2001 to June 2018, totaling 210 markings. In approximately 25 years of operation, DATASUS has developed over 200 systems that directly assist the Ministry of Health in the process of building and strengthening the Brazilian Unified Health System (SUS). Its data storage structure can store the health information for the entire Brazilian population due to its connection with all 27 state health secretariats and other SUS related centers, agencies and institutions. All cases of TB were verified by clinical or laboratory diagnosis. So, it is believed that the TB case reporting data from this department is relatively reliable for modeling and obtaining the results contained in this research. Table 1 presents the historical data obtained and used in this work.

Table 1. Cases diagnosed with TB in Brazil from January 2001 to June 2018.

Year	Month											
	Jan.	Feb	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct	Nov.	Dec.
2001	8.088	6.542	8.095	7.305	7.656	6.805	6.987	8.065	6.697	7.524	6.874	6.627
2002	8.013	7.346	7.961	8.771	7.784	6.713	7.746	8.330	7.654	8.200	7.532	6.809
2003	8.115	7.985	7.474	7.975	8.024	7.082	7.949	7.585	8.136	8.521	7.624	7.303
2004	7.574	6.743	8.574	8.089	7.763	7.314	7.825	8.232	7.901	8.016	7.753	7.196
2005	7.432	6.748	8.441	7.958	8.019	7.781	7.282	8.391	7.690	7.186	7.587	7.541
2006	7.466	6.767	8.256	6.901	7.699	7.094	7.220	7.835	6.873	7.089	6.751	6.209
2007	7.436	6.294	8.214	7.373	7.481	6.714	7.283	7.669	6.801	7.550	6.786	6.178
2008	7.459	6.729	7.359	7.717	6.992	7.001	7.777	7.912	7.720	7.643	6.863	6.650
2009	7.180	6.507	8.231	7.584	7.245	6.799	7.513	7.450	7.478	7.359	7.088	6.793
2010	6.987	6.471	8.373	7.113	7.039	6.701	7.178	7.463	7.216	7.273	7.096	7.236
2011	7.173	7.335	7.548	7.619	7.765	7.008	7.138	8.062	7.427	7.052	7.439	6.994
2012	7.435	6.830	7.936	6.981	7.649	6.861	7.317	8.060	6.785	7.679	7.010	6.362
2013	7.502	6.209	7.102	7.696	6.996	6.953	7.379	7.931	7.377	7.789	6.939	6.335
2014	7.641	7.027	6.743	7.256	7.169	6.320	7.511	7.118	7.502	7.465	6.903	6.469
2015	7.118	6.161	7.840	6.877	6.880	6.916	7.527	7.468	7.197	7.344	7.280	6.847
2016	7.037	6.772	8.054	7.363	7.320	7.548	7.029	7.750	7.101	6.663	7.187	6.993
2017	7.460	6.799	8.693	6.776	8.094	7.408	7.220	8.099	7.440	7.793	7.445	7.014
2018	7.815	6.774	7.887	8.122	7.848	7.625						

Source: DATASUS, 2019.

2.2 Simple Exponential Smoothing Model (SES)

The SES Method is a formalization of Machine Learning based on similarity and involves smoothing out

random fluctuations of time series data. The use of this technique is significant to predict data without trend or seasonal pattern, i.e.: When the data pattern found is close to horizontality (JERE, KASENSE and CHILYABANYAMA, 2017). The mathematical formulation SES model for time series data ($\bar{L}_t$), is shown below:

$\bar{L}_t = \alpha_1 L_t + (1-\alpha_1)\bar{L}_{t-1}$, $0 < \alpha < 1$ and $t > 0$.

Where α is the smoothing constant, L_t is the raw data of the series and $\bar{L}_t$ is the smoothed or output data. For the h-step-ahead prediction equation, we have:

$$\hat{L}_{t+h} = \bar{L}_t.$$

And h assumes values: h = 1,2,3.. (TULARAM & SAEED, 2016).

2.3 Autoregressive Integrated Moving Average Model (ARIMA)

The stochastic models popularized by Box-Jenkins in the early 1970s, known as ARIMA, involve a transformation of data to stabilize variance. The "I" in ARIMA indicates that the dataset is transformed through differentiation culminating in the stationarity of time series that, after the completion of modeling, will be the results integrated in order to make predictions and final estimates. (DRITSAKIS & KLAZOGLOU, 2019).

The function that represents this model is called ARIMA (p, d, q), constituted by the order of the autoregressive model (AR) (p), order of differentiation (d) and the moving average structure order (MA) (q). Thus, we have as expressions: AR, MA e ARMA:

$$\text{AR model: } \hat{L}_t = \theta_1 L_{t-1} + \theta_2 L_{t-2} + \cdots + \theta_p L_{t-p} + \mathcal{E}_t = \sum_{i=1}^{p} \theta_i L_{t-i} + \mathcal{E}_t$$

$$\text{MA model: } \hat{L}_t = \phi_1 \mathcal{E}_{t-1} + \phi_2 \mathcal{E}_{t-2} + \cdots + \phi_q \mathcal{E}_{t-q} = \sum_{i=1}^{q} \phi_i \mathcal{E}_{t-i} \ ,$$

and

$$\text{ARMA model: } \hat{L}_t = \sum_{i=1}^{p} \theta_i L_{t-i} + \mathcal{E}_t + \sum_{i=1}^{q} \phi_i \mathcal{E}_{t-i}.$$

Where θ_t is the autoregression parameter at time t, $\mathcal{E}_t$ is the error term at time *t*, and ϕ_t is the moving average parameter at time t.

2.4 Holt-Winters Exponential Smoothing Model (HWES)

The model HWES considers three smoothing equations, in which one comprises the level and the tendency and the other to the seasonality (RIBEIRO, et al., 2019). When an increase in the seasonal amplitude is required, the series presents a difference between the highest and the lowest demand point in the cycles grows with time, and the multiplicative model becomes adequate. Thus, when the seasonal amplitude is constant, it means that the largest and smallest points in the cycles are independent of the temporal variation, and the model to be used is the additive (HOLT, 2004; WINTERS, 1960).

Table 2. Comparative equations for the multiplicative and additive Holt-Winters models.

	Additive Holt-Winters	Multiplicative Holt-Winters
Level	$\bar{L}_t = \alpha(Y_t - \hat{S}_{t-s}) + (1-\alpha)(\bar{L}_{t-1} + \hat{B}_{t-1})$	$\bar{L}_t = \alpha\frac{Y_t}{\hat{S}_{t-s}} + (1-\alpha)(\bar{L}_{t-1} + \hat{B}_{t-1})$
Trend	$\hat{B}_t = \beta(\bar{L}_t - \bar{L}_{t-1}) + (1-\beta)\hat{B}_{t-1}$	$\hat{B}_t = \beta(\bar{L}_t - \bar{L}_{t-1}) + (1-\beta)\hat{B}_{t-1}$
Seasonality	$\hat{S}_t = \gamma(Y_t - L_t) + (1-\gamma)\hat{S}_{t-s}$	$\hat{S}_t = \gamma\left(\frac{Y_t}{L_t}\right) + (1-\gamma)\hat{S}_{t-s}$
Forecast	$F_{t+m} = (\bar{L}_t + \hat{B}_t m) + \hat{S}_{t-s+m}$	$F_{t+m} = (\bar{L}_t + \hat{B}_t m)\hat{S}_{t-s+m}$

In Table 2, S is the seasonality length, $\bar{L}_t$ is the series level, $\hat{B}_t$ is the trend, $\hat{S}_t$ is the seasonal component, F_{t+m} is the forecast for period m, Y_t is the observed value and α, β and γ are exponential parameters of the level, trend and seasonality, respectively.

2.5 Model-Selection Criteria

Although a predictive technique may occasionally be appropriate for any database, univariate analysis of time series models, requires simultaneous evaluation to identify which provides one of the best results for error minimization. (TULARAM & SAEED, 2016; BILLAH, KING, SNYDER, & KOEHLER, 2006). Thus, we applied six metrics for model selection. A common assumption among many such selection criteria requires the following parameters to be considered the most appropriate: Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percent Error (MAPE) and Theil's U statistic. Two Theil U statistics named U1 and U2 were defined and, like all selection criteria, these metrics exhibit advantages and disadvantages as well as specific conditions for applicability. Table 3 shows the calculation of each criterion exposed.

Table 3. Model Evaluation Metrics.

Criteria	Formula	Criteria	Formula
MSE	$\frac{1}{n}\sum_{i=1}^{n}\mathcal{E}_i^2$	RMSE	$\sqrt{\text{MSE}}$
MAE	$\frac{1}{n}\sum_{i=1}^{n}\lvert\mathcal{E}_i\rvert$	MAPE	$\frac{1}{n}\sum_{i=1}^{n}\left(\left\lvert\frac{\mathcal{E}_i}{x_i}\right\rvert\right) * 100$
U_1	$\frac{\text{RMSE}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}x_i^2} + \sqrt{\frac{1}{T}\sum_{i=1}^{n}\hat{x}_i^2}}$	U_2	$\frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n-1}\left(\frac{\hat{x}_{i+1} - x_{i+1}}{x_i}\right)^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n-1}\left(\frac{x_{i+1} - x_i}{x_i}\right)^2}}$

In Table 3, $\mathcal{E}_i = x_i - \hat{x}_i$, where x_i represents the observed actual value at the moment i, $\hat{x}_i$ is the predicted value at the moment i and n is the observation number used in the calculation.

The first evaluation criterion is the mean squared error, or MSE, for the entire set of data. The MSE attaches more weight to significant errors and the main limitation of this approach is that it overstates substantial errors. This valuation criterion also provides limited information about an overestimation or underestimation of actual forecast value. The second evaluation criterion, or RMSE, preserves the units in the estimation variable and, to some extent, this approach is more sensitive to a large number of errors occurred. However, the ability to compare different time series is limited by this criterion. In contrast, the third criterion, the MAE, determines the magnitude of the error and is an important issue for a precise set of predictions, which defines how close the predictions are to actual results, but does not consider the current direction on predictions. Elsewhere, the fourth criterion, or MAPE, allows the comparison of distinct time series data without defining the relationship or percentage error. This last information is significant in instances where the measured variables are too large.

The fifth and sixth criteria, U1 and U2, are more difficult metrics to use than MAPE. The first, or U1, provides a range of values that varies from 0 to 1. The closer U1 is to 0, the more accurate the forecast will be. When confronted with alternative predictions, the model with the lowest U1 value is considered best and thus selected. On the other hand, U2 makes relative comparisons based on random walk models (NEWAZ, 2008) and prediction models (Naive model). The Naive model (TAHERI & MAMMADOV, 2013) can be described as the current prediction model applied based on an indiscriminate walking process, i.e. it assumes that demand in the next period will be equal to demand in the most recent period. When U2 stabilizes in the unit, the Naive method is considered equally useful for forecasting and U2> 1 indicates that the prediction model would work better than the Naive approach.

3. Results and Discussion

3.1 Preliminary data analysis

Data analysis was performed using Minitab®v.18 computer software and commercial Microsoft Excel®2016. Minitab has built-in functions which can determine the best model parameters spontaneously and the data series being the only necessary correspondent for this system. Figure 1 shows that the distribution pattern indicates that data assume a low trend over the years, but the seasonality is quite clear in the visual observation.

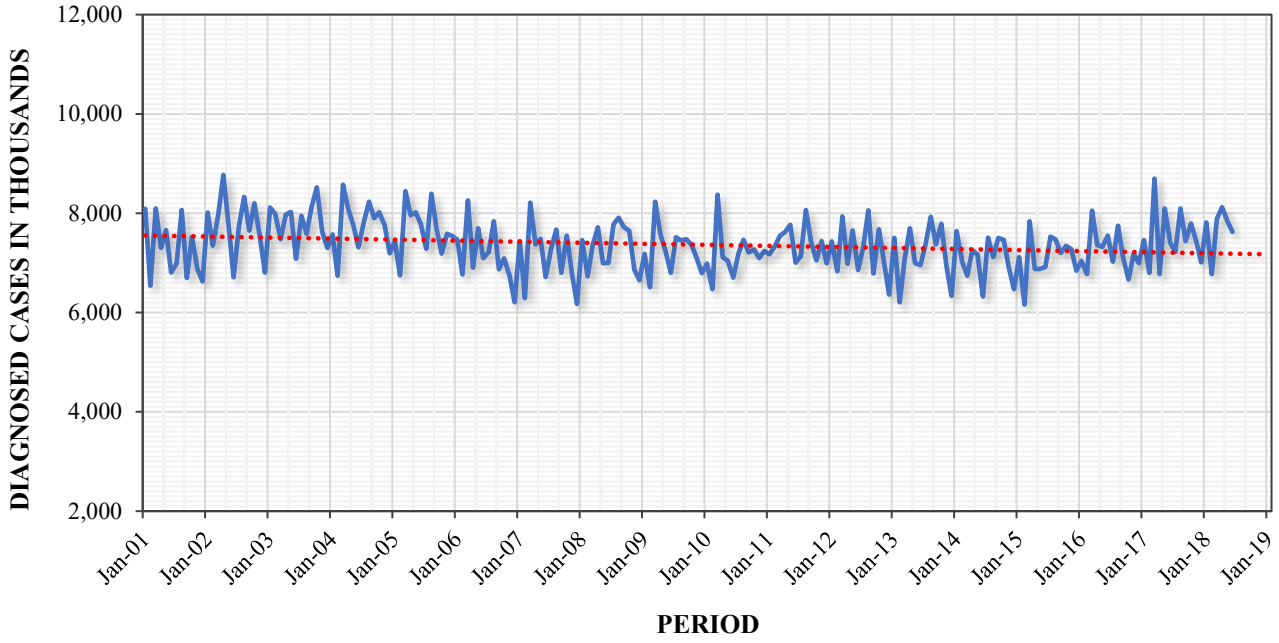


Figure 1. Primary data series from January 2001 to June 2018.

Regarding the cases analyzed, the highest annual percentage increase of diagnosed cases compared to the previous year was 6.41% between 2001 and 2002. This percentage of growth observed consists of 5,594 cases diagnosed in 2002 more than in 2001. However, between 2005 and 2006 a negative evolution was found, -6.40%, which means that in 2006 the number of people diagnosed with TB decreased, this percentage is equivalent to 5,896 fewer than the previous year, and this was the year with the greatest difference in case reduction compared to the years studied. The monthly average of diagnoses was 7,369, with a standard deviation of approximately 528.83. The month with the highest diagnosis rate was in April 2002 with 8,771, and the lowest was February 2015 with 6,161.

3.2 Modeling Results (SES, ARIMA e HWES)

The results from the application of the SES, ARIMA and HWES methods are shown in Figures 2, 5 and 6, respectively. These Figures contain only part of the original data series (from January 2015), also have the adjustments made by the models, the forecasts accompanied by the 95% confidence intervals and the real data. The results of the different models are substantial, regardless of which the metrics is used to qualify the accuracy of their predictions.

The SES model uses just one parameter α_1, therefore, the appropriate response value is determined by minimizing the error with respect to α_1. Results indicated that the value of $\alpha_1 = 0.07362$ is the best parameter measure for this prediction model. Therefore, the equation governing this first modeling scenario takes the following form: $\bar{L}_t = 0.07362\, L_t + 0.9264\, \bar{L}_{t-1}$.

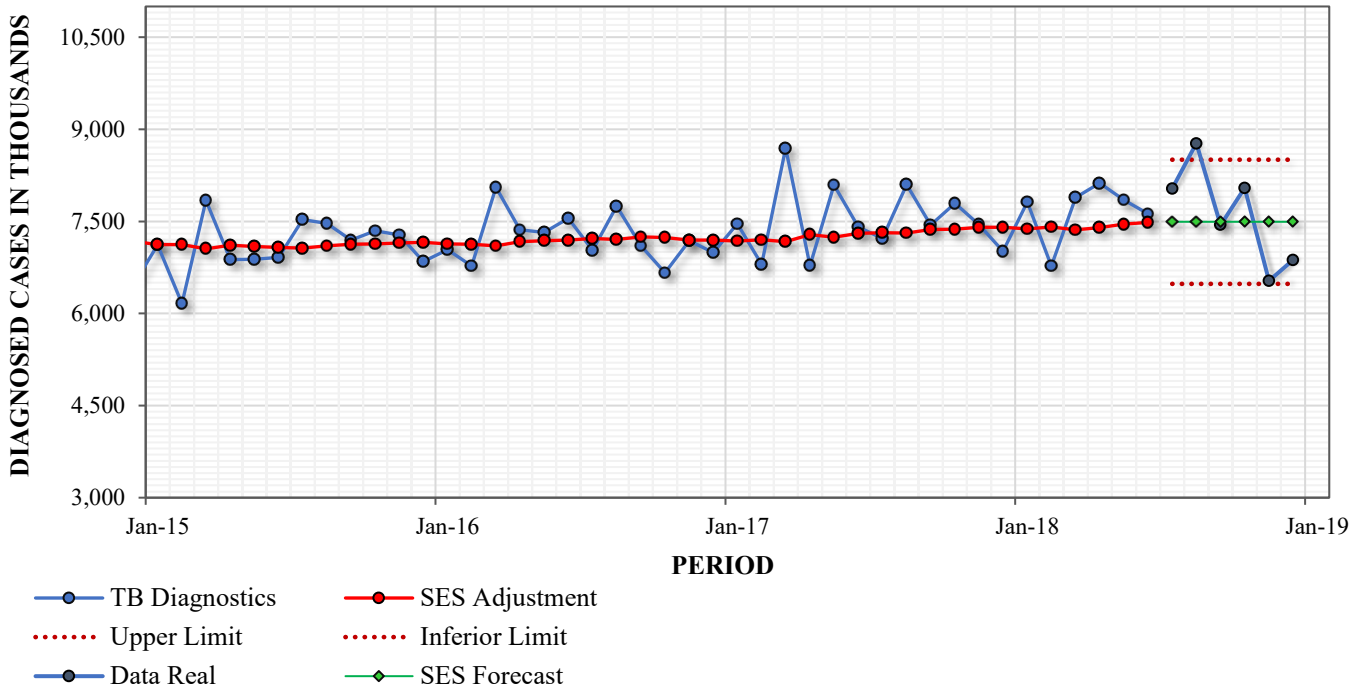


Figure 2. The results of the SES model forecast for TB cases diagnosed in Brazil from July 2018 to December 2018.

Figure 2 presents the result obtained using the SES model. It is observed that the forecast (Green Line) consistently does not follow the behavior for the actual data of the period studied (Blue Line). It is also noted that the real value for the month of August was outside the 95% CI, so that in this preliminary visual analysis the SES model does not satisfactorily predict the actual TB data.

In relation to the SES model, ARIMA includes an explicit statistical model for the irregular component of a time series, which allows non-zero autocorrelations in the irregular component, revealing the potential of this data processing for predictions. ARIMA consists of three main steps: the first focuses on model identification; the second on parameter estimation; and, lastly on diagnostic verification through predictions. However, it is considered that the initial phase of identification of the ARIMA model happens through the visual verification of the stationary behavior of the series. When the need for conversion from a non-stationary to a stationary time series is certified, the differentiation process consisting of an important part of the adaptation method of an ARIMA model is submitted (DOBRE & ALEXANDRU, 2008). In this sense, a time graph is plotted in Figure 3(a) where d=0 is equivalent to the series data without differentiation and in Figure 3(b) d=1 to the differentiated data. By displaying the Autocorrelation (ACF) and Partial Autocorrelation (PACF) graphs in Figure 4, it is noted that the TB data are stable at d=1, which is a need for series differentiation.

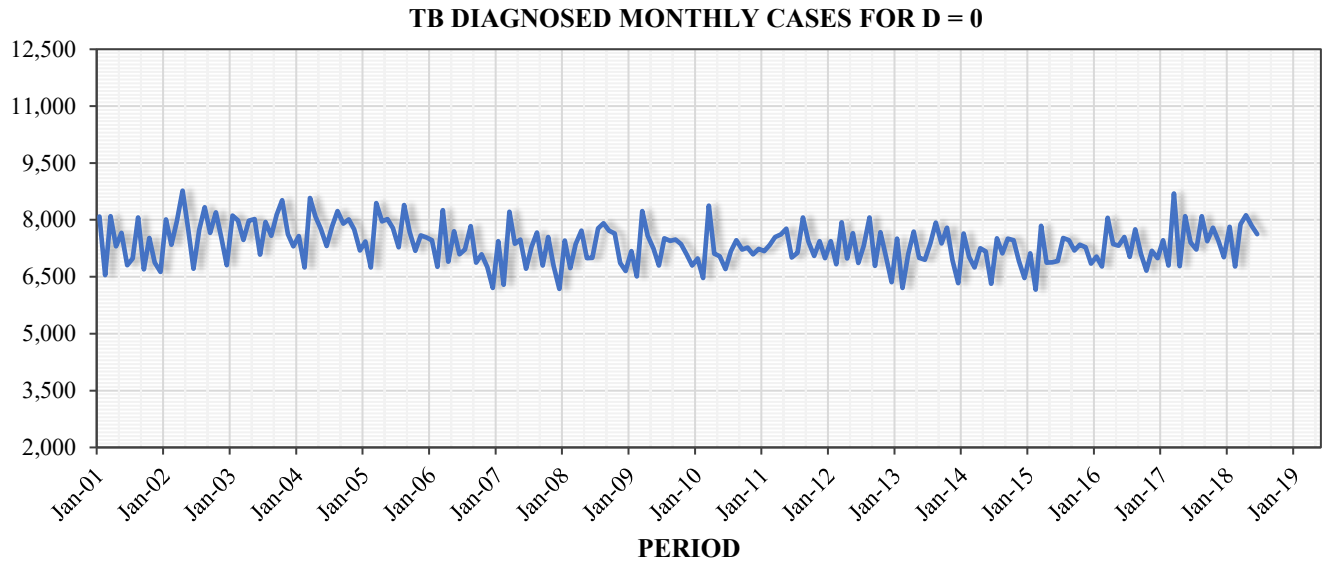


Figure 3 (a). TB diagnostic time data at d=0.

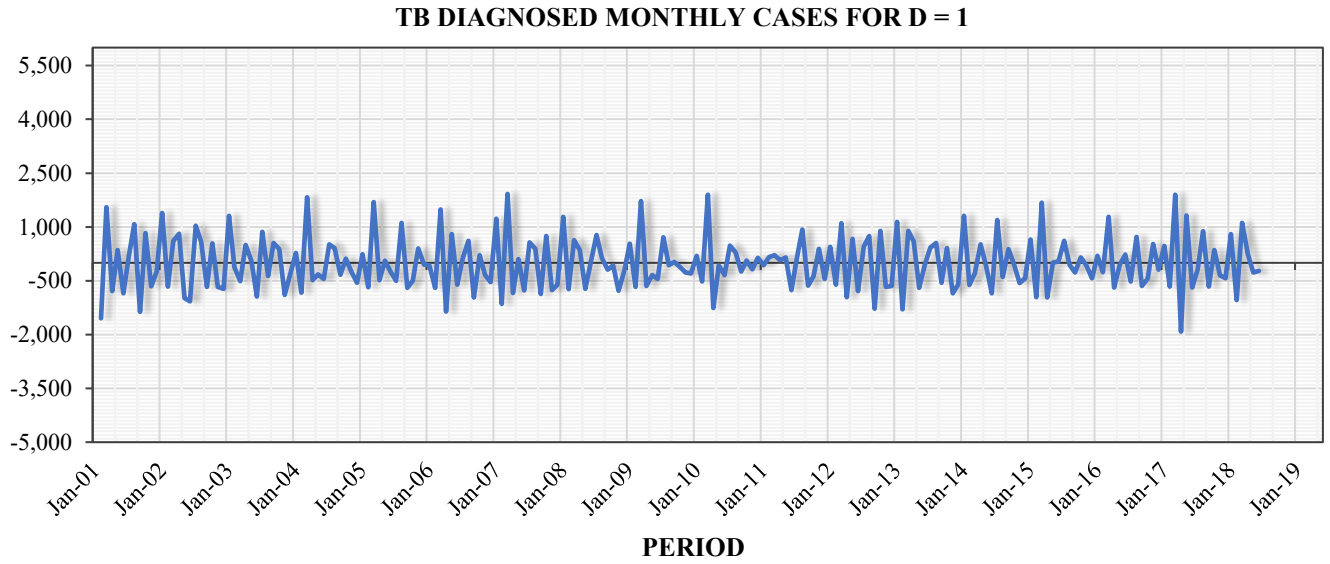


Figure 3(b). TB diagnostic time data at d=1.

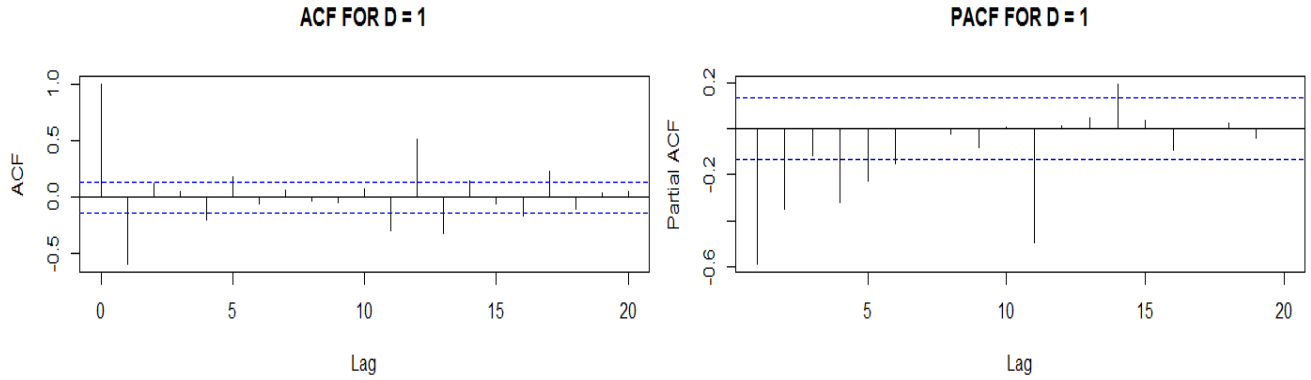


Figure 4. ACF and PACF graphs for d=1.

The time series of differences (Figure 3b) and the ACF and PACF graphs at d = 1 confirm that there is a

need to assign a stationary pattern to the mean and variance of the series by differentiation, thus an ARIMA model (p, 1, q) is probably the most appropriate, so proper verification is required to establish which AR and MA terms are appropriate. We see from the correlogram that the self-correlation in lag 1 (-0.591) exceeds the limits of significance and is negative, after this delay the autocorrelations decrease to zero, although perhaps too abruptly for an ARIMA model (0,1,1) is to be satisfactory. The partial correlogram shows that the partial autocorrelations in lags 4 (-0.319) and 5 (-0.228), are negative delays that exceed the limits of significance before the partial autocorrelations decrease to zero. These observations allow to visualize what would represent an approximation of a suitable model, in this case it would be an ARIMA (5,1,1). Moreover, it should be considered, at this point, that the ARIMA model with the smallest measurement error specific to the Akaike Information Criterion (AIC) be the best model for forecasting (SILUYELE & JERE, 2016). Thus, Table 4 shows the comparison of AIC errors between the proposed models.

Table 4. AIC statistical measures for selected ARIMA models.

Attempt Model	(4,1,5)	(0,1,5)	(1,1,1)	(5,1,1)	(1,1,5)	(0,1,2)	(0,1,3)	(1,1,2)
AIC	3171.86	3199.88	3204.01	3201.84	3201.1	3204.47	3205.85	3205.86
Attempt Model	(0,1,4)	(2,1,2)	(0,1,1)	(1,1,3)	(5,1,0)	(4,1,0)	(3,1,0)	(2,1,0)
AIC	3206.05	3207.48	3207.63	3208.43	3212.93	3223.87	3244.79	3245.56

Table 4 highlights the ARIMA model (4,1,5) which contains the lowest value for the (AIC). It is noteworthy the importance of this selection criterion, which considers both the graphical behavior of the autocorrelations and the error parameter common to the proposed model. The RStudio Software version (1.1.463) has been used as a statistical tool to obtain the main metrics and parameters of this model (Table 5). The coefficients and *p* values of the terms were used, as well as the equation that governs this second modeling scenario, highlighting (in bold) the corresponding high significance terms (*p*-value).

$$\hat{L}_t = 2{,}7 - 0{,}296\, L_{t-1} - 0{,}2954\, L_{t-2} - 0{,}7066\, L_{t-3} - 0{,}571\, L_{t-4} + 0{,}840\, \mathcal{E}_{t-1} - 0{,}351\, \mathcal{E}_{t-2} - 0{,}377\, \mathcal{E}_{t-3} + 0{,}361\, \mathcal{E}_{t-4} + 0{,}199\, \mathcal{E}_{t-5}$$

Table 5. ARIMA (4,1,5).

Variable	Coeficient	*p*-value
Constant	2,7	0,797
AR (1)	-0,296	0,011*
AR (2)	-0,2954	0,001*
AR (3)	-0,7066	0,000*
AR (4)	-0,571	0,000*

MA (1)	0,840	0,000*
MA (2)	-0,351	0,015*
MA (3)	-0,377	0,076
MA (4)	0,361	0,110
MA (5)	0,199	0,186
Sigma^ estimated	208354	-
log likelihood	-1575.93	-

*Note: *p*-value < 0.05.

Table 5 shows information on the significance of the parameters used in this model, it is observed that all AR terms are significant and the MA (1) and MA (2) also have an appreciated significance value in view of the *p*-values of these terms, found below 0.05%. Therefore, to model identification and parameter estimation, the model can then be checked by means of predictions (Figure 5).

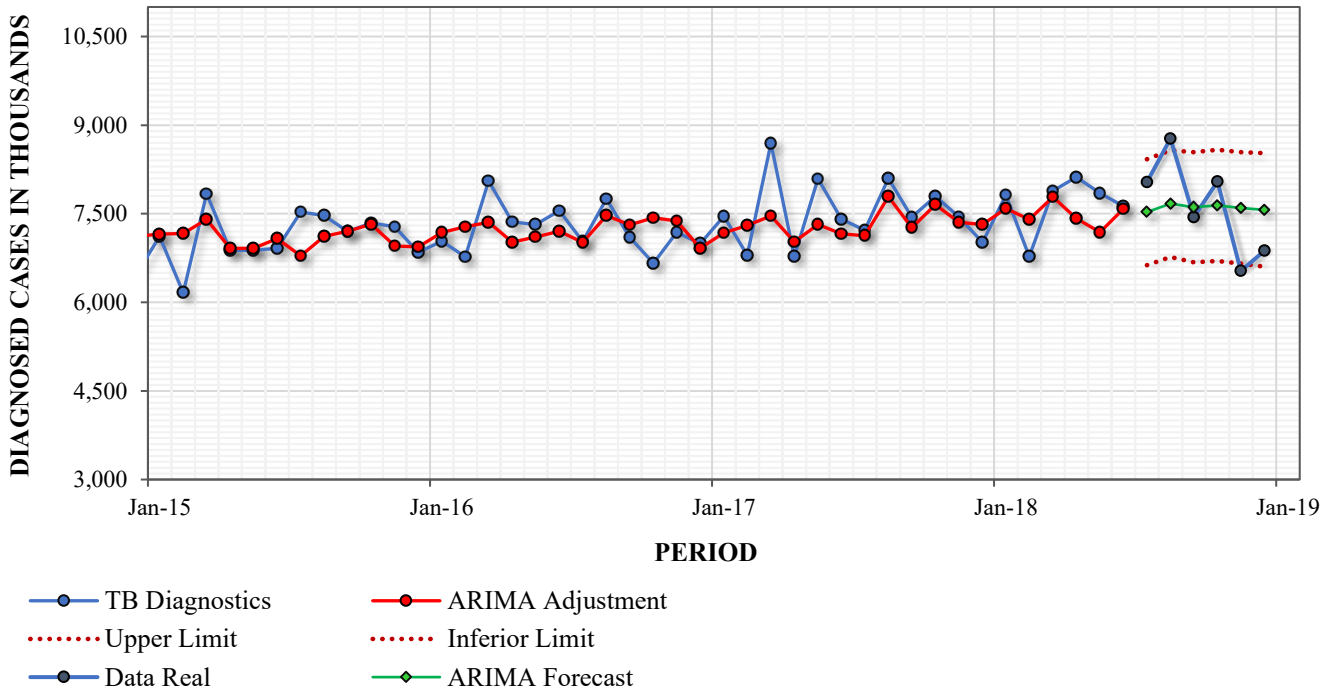


Figure 5. ARIMA (4,1,5) forecast results for TB cases diagnosed in Brazil from July 2018 to December 2018.

When compared with the ARIMA (4,1,5) prediction model, the HWES model performs better. Both additive and multiplicative HWES cases were evaluated and all parameters were stipulated and not estimated, which ranged from 0.4 to 0.1. The lower weights produce a smoother line and the larger ones a sharper line. Thus, using lower weights for noisy data, we obtain smoothed values that do not fluctuate along with noise (RIBEIRO, et al., 2019). In addition, a precision measure was chosen to compare the twenty-four HWES models obtained and find the one that best fits the TB data. Therefore, the measure

chosen was MSE and in Table 6 is showed all models and their MSE measurements.

Table 6. MSE Precision Parameters for Selecting the Best HWES Model.

HWES Additive Models						
Attempt Model	(0.2;0.1;0.1)	(0.2;0.2;0.1)	(0.3;0.1;0.1)	(0.2;0.1;0.2)	(0.3;0.2;0.1)	(0.2;0.2;0.2)
MSE	148,689	152,466	153,722	158,173	159,771	162,880
Attempt Model	(0.4;0.1;0.1)	(0.3;0.1;0.2)	(0.3;0.2;0.2)	(0.4;0.2;0.1)	(0.4;0.1;0.2)	(0.4;0.2;0.2)
MSE	163,068	163,432	170,540	170,741	172,593	181,247
HWES Multiplicative Models						
Attempt Model	(0.2;0.1;0.1)	(0.2;0.2;0.1)	(0.3;0.1;0.1)	(0.2;0.1;0.2)	(0.3;0.2;0.1)	(0.2;0.2;0.2)
MSE	150,141	154,356	155,511	159,816	161,613	164,824
Attempt Model	(0.3;0.1;0.2)	(0.4;0.1;0.1)	(0.3;0.2;0.2)	(0.4;0.2;0.1)	(0.4;0.1;0.2)	(0.4;0.2;0.2)
MSE	165,352	165,382	172,528	173,184	175,091	183,902

In Table 6, is highlighted (in bold) the HWES model that presented the lowest MSE. According to this selection criterion, the case of HW chosen is the additive and the parameters for predicting TB diagnoses should be α=0.2, β=0.1 and γ=0.1. This α value is relatively low, indicating that the model produces a current moment level estimate based on recent observations and some observations in the more distant past. The β value indicates that the slope estimate is constantly updated during the series and differs from its initial value in an intuitive form, as the level varies greatly over the time series, this value suggests that the slope β of the trend has also changed constantly. Furthermore, the low value of γ allows estimating the seasonal component at the moment is based on relatively recent observations and on more distant ones. Therefore, the equations constituting the model and governing this third modeling scenario culminate in:

$$\bar{L}_t = 0.2\left(Y_t - \hat{S}_{t-s}\right) + 0.8\left(\bar{L}_{t-1} + \hat{B}_{t-1}\right),$$

$$\hat{B}_t = 0.1\left(\bar{L}_t - \bar{L}_{t-1}\right) + 0.9\,\hat{B}_{t-1},$$

and

$$\hat{S}_t = 0.1\left(Y_t - L_t\right) + 0.9\,\hat{S}_{t-s}.$$

Consequently, the model described above was used to generate the predictions contained in Figure 6. It is observed that HWES is superior to SES and ARIMA (4,1,5) at a visual analysis of the prediction and adjustment results. The projected forecast line tends to follow the actual data and even satisfactorily forecasts the value for October 2018.

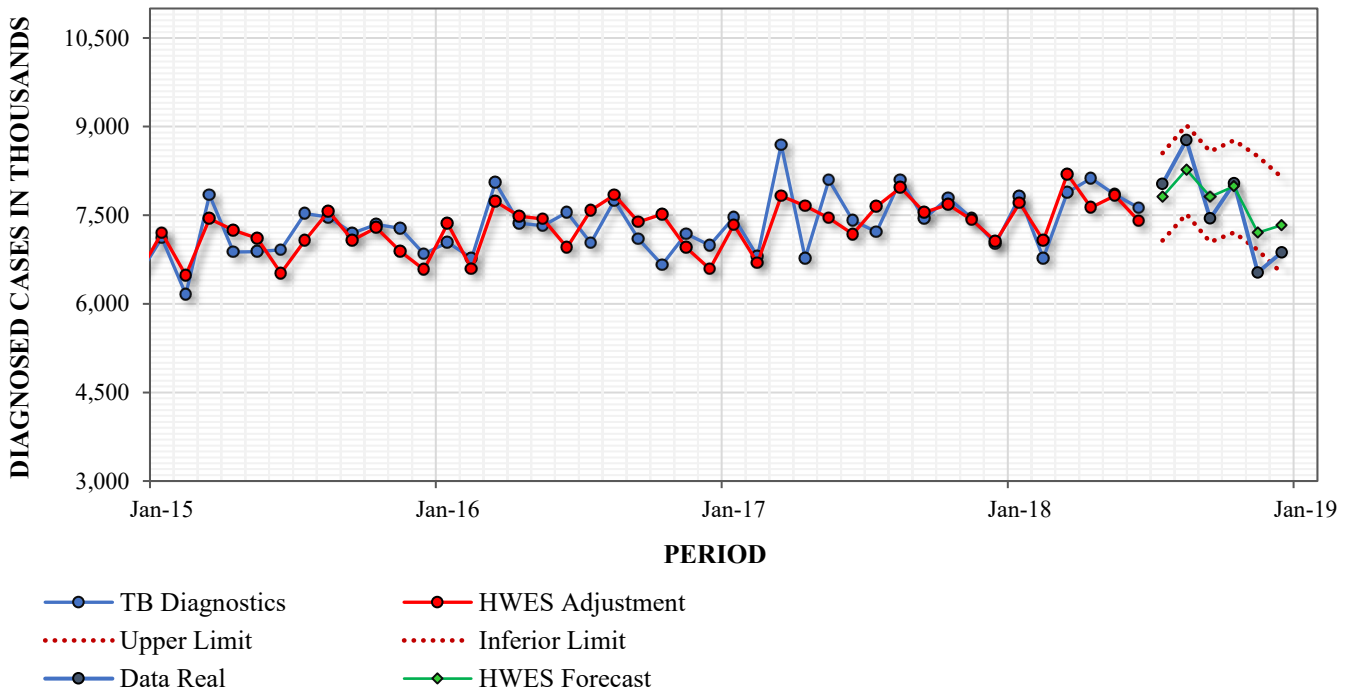


Figure 6. HWES model prediction results for TB cases diagnosed in Brazil from July 2018 to December 2018.

Although exponential smoothing methods are useful for forecasting, without considering assumptions about correlations between successive time series values, HWES showed better performance against the other two methodologies. This shows that only in some cases is it possible to make a better predictive model taking into account the correlation of data. This difference becomes clearer when is observed in Table 7 which contains the six model precision measurements and the HWES (0.2, 0.1, 0.1) is superior to the others.

Table 7. Selection criteria of the best model among the three used in this study (SES, ARIMA and HWES).

Measures of accuracy	SES	ARIMA	HWES
MSE	262,131	198,381	148,689
RMSE	512	445.4	385.6
MAE	413	352.4	302
MAPE	6	4.84	4
U_1	0.013	0.012	0.010
U_2	0.983	0.998	1.016
Model Ranking	3	2	1

Table 7 summarizes the three models for the precision measurements each presented. The results show that HWES (0.2, 0.1, 0.1) obtained the best performance against this precision evaluation. The ARIMA method is theoretically more robust from a mathematical point of view, so that a model meets important requirements regarding errors such as non-correlation and normal distribution with zero mean and constant

variance. However, although exponential smoothing methods do not use assumptions about correlations between consecutive time series values, in some cases it is possible to find a more predictive exponential smoothing model that best fits the original data, as in the present case.

In general, forecasts play an indispensable role in the entire policymaking process of public policy makers. Two perspectives are visualized when changes are achieved in the face of a decision-making process: current events and predictions of future events (TULARAM & SAEED, 2016). With this bias, a country's public health decision-makers rely on accurate forecasts to push their policies so that the end results are different from those predicted. Forecasts can also play a vital role in the development and expansion of control and intervention programs, as well as in the allocation of optimal material for such mechanisms (AKHTAR & MOHAMMAD, 2008).

The diagnosis of the temporal distribution of TB cases around the world is quite diverse, in some countries and regions TB that presents high seasonality of occurrence (MOHAMMED, AHMED, AL MOUSAWI, & AZEEZ, 2018; WUBULI, et al., 2017; KHALIQ, BATOOL, & CHAUDHRY, 2015). This results in the development of models that are capable of assessing peaks of occurrence and seasonal trends, such as the integrated seasonal moving average autoregressive (SARIMA), neural network autoregression (SARIMA-NNAR), heteroscedasticity conditioned autoregressive (ARCH) models, among others (AZEEZ, OBAROMI, ODEYEMI, NDEGE, & MUNTABAYI, 2016; ZHENG, ZHANG, ZHANG, WANG, & ZHENG, Forecast Model Analysis for the Morbidity of Tuberculosis in Xinjiang, China, 2015; MAO, ZHANG, YAN, & CHENG, 2018). Thus, we have a model for each kind of data behavior. A similar study was conducted by Nothabo Dube in Zimbabwe in 2015, a country still considered by the WHO with a high incidence rate of TB. In this case study, we analyzed the ARIMA, ARIMA-ARCH and HW models, and the performance of the ARIMA (2,1,1) model proved to be far more superior to others, becoming an ideal model for predicting the annual incidence of TB in Zimbabwe.

4. Final Considerations

In this work, the observed results show that, despite efforts by the Brazilian ministry of health to fight the disease, there will be no apparent improvement in the high incidence of diagnosed TB cases in Brazil, for the near future. TB is still a major global public health problem and is one of the most fatal infectious diseases in the world. In Brazil, the increase in patients coinfected with TB and HIV, as well as the emergence of drug-resistant strains such as MDR-TB and XDR-TB, increase the difficulty in preventing the disease. According to the results obtained in the modeling, the Holt-Winters Exponential Smoothing method can be used to forecast the cases of TB diagnoses in Brazil, due to the high performance found in relation to error metrics. As a result, the present study is an apparatus relevant for strategic planning involving detection of outbreaks, epidemics or substantial increases in TB cases at an early stage, in parallel with reducing treatment costs and optimizing the decision-making process in controlling this disease.

6. Acknowledgement

The authors are thankful to Brazilian National Council for Scientific and Technological Development for making it possible through provision of resources to come up with this research work.

5. References

[1] ABDULLAH, S. et al. Application of Univariate Forecasting Models of Tuberculosis Cases in Kelantan. ICSSBE, 2012.

[2] AKHTAR, S.; MOHAMMAD, H. G. Seasonality in pulmonary tuberculosis among migrant workers entering Kuwait. BMC Infectious Diseases, v. 8, n. 3, 2008.

[3] ATKINSON, R. W. et al. Fine particle components and health – a systematic review and meta-analysis of epidemiological time series studies of daily mortality and hospital admissions. J Expo Sci Environ Epidemiol. v. 25, pp. 208-214, 2015.

[4] AZEEZ, A. et al. Seasonality and Trend Forecasting of Tuberculosis Prevalence Data in Eastern Cape, South Africa, Using a Hybrid Model. International Journal of Environmental Research and Public Health, n. 13, p. 757, 2016.

[5] BILLAH, B. et al. Exponential Smoothing Model Selection for Forecasting. International Journal of Forecasting, n. 22, p. 239-247, 2006.

[6] BORISOV, S. E. et al. Effectiveness and safety of bedaquiline-containing regimens in the treatment of MDR- and XDR-TB: a multicentre study. Eur Respir J. v. 49, ed. 5, 2017.

[7] CAO, S. et al. A hybrid seasonal prediction model for tuberculosis incidence in China. BMC Medical Informatics and Decision Making, v. 13, n. 56, p. 1-7, 2013.

[8] DOBRE, I.; ALEXANDRU, A. A. Modelling unemployment rate using Box-Jenkins procedure. Journal of Applied Quantitative Methods, v. 3, n. 2, p. 156-166, 2008.

[9] DRAIN, P. K. et al. Incipient and Subclinical Tuberculosis: a Clinical Review of Early Stages and Progression of Infection. Clinical Microbiology Reviews, v. 31, n. 4, p. 1-24, 2018.

[10] DRITSAKIS, N.; KLAZOGLOU, P. Time series analysis using ARIMA models: an approach to forecasting health expenditures in USA. ECONOMIA INTERNAZIONALE / INTERNATIONAL ECONOMICS , Genova (Italy), v. 72, n. 1, p. 77-106, 2019. ISSN 2499-8265.

[11] DUBE, N. Application and Comparison of Time Series Methods on Tuberculosis Incidence Data: A case study of Zimbabwe 1990-2013. Faculty of Texas Tech University, 2015.

[12] FALZON, D. et al. World Health Organization treatment guidelines for drug-resistant tuberculosis, 2016 update. Eur Respir J. v. 49, ed. 3, 2017.

[13] HOLT, C. C. Forecasting seasonals and trends by exponentially weighted moving averages. International Journal of Forecasting, v. 20, p. 5-10, 2004.

[14] JERE, S.; KASENSE, B.; CHILYABANYAMA, O. Forecasting Foreign Direct Investment to Zambia: A Time Series Analysis. Open Journal of Statistics, v. 7, p. 122-131, Fvereiro 2017. <https://doi.org/10.4236/ojs.2017.71010>.

[15] KHALIQ, A.; BATOOL, S. A.; CHAUDHRY, M. N. Seasonality and trend analysis of tuberculosis in Lahore, Pakistan from 2006 to 2013. Journal of Epidemiology and Global Health, n. 5, p. 397 403, 2015.

[16] KILICMAN, A.; ROSLAN, U. Tuberculosis in the Terengganu region: Forecast and data analysis. Science Asia, v. 35, p. 392–395, 2009.

[17] MAO, Q. et al. Forecasting the Incidence of Tuberculosis in China Using the Seasonal Auto-regressive Integrated Moving Average (SARIMA) Model. Journal of Infection and Public Health, n. 11, p. 707-712,

2018.
[18] MERKER, M. et al. Transmission of Extensively Drug-Resistant Tuberculosis in South África. Nature Genetics. v. 47, 2015.
[19] MINISTRY OF HEALTH. Tuberculosis Free Brazil: National Plan to End Tuberculosis as a Public Health Problem. Health Surveillance Secretariat, Communicable Disease Surveillance Department - Brasilia, 2017.
[20] MOHAMMED, S. H. et al. Seasonal Behavior and Forecasting Trends of Tuberculosis Incidence in Holy Kerbala, Iraq. International Journal of Mycobacteriology, v. 7, n. 4, p. 361-367, 2018.
[21] NASEHI, M. et al. Forecasting tuberculosis incidence in iran using box-jenkins models. Iran Red Crescent Med J, v. 5, n. 16, p. 1-6, 2014.
[22] NEWAZ, M. K. Comparing the Performance of Time Series Models for Forecasting Exchange Rate. BRAC University Journal, v. 5, n. 2, pp. 55-65, 2008.
[23] PAULINO, J. S. et al. Predictive Models and Health Sciences: A Brief Analysis. International Archives Of Medicine, v. 10, 2017. <http://imedicalsociety.org/ojs/index.php/iam/article/view/2271>.
[24] PIETERSEN, E. et al. Long-term outcomes of patients with extensively drug-resistant tuberculosis in South Africa: a cohort study. The Lancet, v. 383, 5–11, April, 2014.
[25] RIBEIRO, R. C. M. et al. Holt-Winters Forecasting for Brazilian Natural Gas Production. International Journal for Innovation Education and Research, v. 7, n. 6, p. 119-129, 2019.
[26] SILUYELE, I.; JERE, S. Using Box-Jenkins Models to Forecast Mobile Cellular. Open Journal of Statistics, v. 6, p. 303-309, 2016.
[27] STEIN, C. M. et al. Resistance and Susceptibility to Mycobacterium tuberculosis Infection and Disease in Tuberculosis Households in Kampala, Uganda. American Journal of Epidemiology, v. 7, n. 187, p. 1477–1489, 2018.
[28] TAHERI, S.; MAMMADOV, M. Learning the Naive Bayes classifier with optimization models. International Journal of Applied Mathematics and Computer Science, v. 23, n. 4, p. 787–795, 2013. <https://doi.org/10.2478/amcs-2013-0059>
[29] TULARAM, G. A.; SAEED, T. Oil-Price Forecasting Based on Various Univariate Time-Series Models. American Journal of Operations Research, v. 6, p. 226-235, 2016. <http://dx.doi.org/10.4236/ajor.2016.63023>.
[30] WINTERS, P. R. Forecasting sales by exponentially weighted moving averages. Management Science, v. 6, p. 324– 342, 1960.
[31] WORLD HEALTH ORGANIZATION. Global Tuberculosis Report. World Health Organization. Geneva. 2018.
[32] WUBULI, A. et al. Seasonality of active tuberculosis notification from 2005 to 2014 in Xinjiang, China. PLoS ONE, v. 12, n. 7, p. 1-12, 2017.
[34] ZHENG, Y. et al. Forecast Model Analysis for the Morbidity of Tuberculosis in Xinjiang, China. PloS ONE, v. 10, n. 3, p. 1-13, 2015.

Manaus Public Port Logistics a Case Study of Boarding and Landing at Passenger Station (ROADWAY)

Dorailson dos Santos Leitão
dorailsonsantos@hotmail.com
Centro Universitário FAMETRO – Brasil

Rafaela Maciel Passos
rafaelapassos250@gmail.com
Centro Universitário FAMETRO – Brasil

Frank Henrique Santos Fontineles
fontineles.fs@gmail.com
Coordenação de Engenharia do Centro Universitário FAMETRO – Brasil

David Barbosa de Alencar
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Igor Felipe Oliveira Bezerra
Igorfelipe.dss@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Abstract

Logistics for boarding and disembarking at the passenger terminal (roadway) is the organization of all existing operations. This research aimed to analyze and propose improvements in logistics methods in the public port of the city of Manaus – AM that influence the boarding and disembarkation of passengers and goods, taking into account a modern and useful adaptation to the roadway, enabling na efficient handling operation for that meets all who use the port, based on the fact that the movement of passengers must be done safely, and can take into account factors that allow both access to users, as well as goods.
Keywords: Logistics; Boarding and Landing at the Passenger Station (roadway);

1. Introduction

Brazilian ports need rules, laws and systems that enable the development of the port sector. Changes to carry out loading and unloading in a practical way by putting efficient measures, thus bringing solutions through on-site study that reorganizes logistics operations.

Ching (2010) states that the improvement of logistics activities has a positive impact on customers and,

consequently, on sales, such as having efficient transportation, having the minimum levels of inventory needed, taking little time to process orders and offering delivery service. No loss. The use of this logistics philosophy contributes to the functioning of the assembly, as it can react more quickly to changes and customer requests by offering greater reliability and stability in the delivery of the requested goods.

Regardless of the size and type of organization, logistic performance assessment has become an important tool for measuring and analyzing the results of operations, as it provides the manager with information and data that assists decision making, enabling control and improvement in logistics results, corroborating the efficiency of the service offered (SANTOS, 2015).

Today logistics is understood as the integration of both materials management and physical distribution. It requires skillful management, because the level of uncertainty for logistics planning and operation has changes such as transport deregulation, emerging competition from Third World countries in the end goods markets and competition for raw materials, making the scope of logistics broaden by enriching the concepts on which it is based (BALLOU, 2010).

According to the Manaus River Port Master Plan, the port operations in Manaus are quite peculiar due to the fact that the city has no land connections with other states of the country, except Roraima, so that the capital is almost supported. entirely on the waterways for the transportation of cargo and the transportation of passengers to and from other municipalities of Amazonas and neighboring states.

According to the National Waterway Transportation Agency (Antaq), which has been given the competence to regulate, supervise and supervise waterway transport services. Among the agency's duties are:

Propose to the Ministry of Transport the general plan for waterway infrastructure exploration and waterway services;

Develop and edit rules and regulations relating to the provision of transport services and the operation of waterway and port infrastructure;

Promote port tariff reviews and readjustments;

Establish norms and standards to be complied with by port administrations, concessionaires, lessees, authorization holders and port operators;

Supervise the operation and provision of services of long-distance shipping, cabotage, maritime support, port, river and lake support companies.

According to CADE, a port can be analyzed as a system where several units operate interdependently, as well as the port itself can be understood as part of a larger system, the logistics system, where integrates and maintains interdependent relationship with other units, such as: commodity production, exporters and importers, transportation (road, rail and sea), storage, customs, etc.

2. Methodology

This research aims to develop a project with logistics changes in the public port of Manaus (Roadway), the same seeks to implement modifications ranging from signs, structures and demarcation of roads, to facilitate passenger access.

Because there is a demand for users and goods, which circulate in large quantities throughout the annual period, there is a need for improvement. Because it is a heritage site, the correct analysis not to modify the

façade is essential, so this will be the starting point for developing a useful and efficient project.

During the analytical-explanatory study, it was observed that the lack of access road options leaves users with few alternatives, so even minimal interventions are needed to remedy traffic shortages around the waterway complex. As passenger access to vessels suffers from a lack of guidance and low visual signage, thus causing difficulties for people coming from the interior and especially for tourists arriving at the port. Thus, the research constituted a case study of qualitative nature, focusing on data of qualitative nature. The study locus comprised the public port of Manaus (Roadway). The research universe corresponded to the great need of a demand of users that access the port, but suffer for basic orientation needs.

3. Case Study

The case study of the research was developed subjectively, based on aspects of the daily movement of the public port of Manaus, defining from the characteristics of the physical space, the circulation of pedestrians and passengers through the main roads, showing the difficulties within or near the port.

Key points for improvement will be studied in a technical way to associate the conditions that meet the needs of mobility, emphasizing the most relevant aspects, thus facilitating users their journey..

Instrumentals and research techniques

A standard satisfaction survey questionnaire was applied, in which passengers were asked about the difficulties and ease to make boarding and disembarking in the port, thus elaborating a profile of these users.

A direct participant observation was made of the displacement made by the passengers, who followed from arrival at the port to their accommodation inside the boats, and analyzed the difficulties of orientation and access since the purchase of the ticket, its check-in and finally the boarding.

For didactic exposition of the research development process, the project has the following phases of execution:

3.1 Phase I: Exploratory

In this phase, the research project was elaborated, as well as the preparation of materials and instruments for the development of the study, accompanied by bibliographic research and field research, followed by previous contact with the managers of the public port of Manaus, to obtain the institutional authorization to conduct the research in the port.

3.2 Phase II: Fieldwork

This phase consisted of field research, in which the researchers were able to go on site to apply the technical-operational research instruments, which will demonstrate the actual situation of the port, making clear its precariousness and especially its need for improvement. . The study is also not detached from the bibliographic and documentary survey, being fundamental for the theoretical and documentary basis of the research for the elaboration of the course conclusion work.

Regarding the assessment of activities at the public port of Manaus (Roadway), it was observed the daily routine of pedestrians using the passenger terminal, and what are their biggest difficulties, main roads used,

guidance signs, and they are registered for study, as can be seen from Table 01:

Table 01: Evaluation of activities in the public port of Manaus (Roadway)

Data recorded at the port	
Main Access Roads.	Lourenço da Silva Braga Avenue; Eduardo Ribeiro Avenue; Luiz Antony Street; Marques de Santa Cruz Avenue;
Stop and accessibility retreats.	There are two setbacks in place; Permitted use for taxi only;
Entry and exit to access the port.	Only one car access; Only pedestrian access;
Orientation Plates.	On rare and inefficient roads; In the inner area of the port, rare and with low information;

3.3 Phase III: Data Processing and Analysis

In this phase, the data obtained were tabulated by applying the standard satisfaction form, the interview and the documentary records through the participant observations. After this data organization occurred the analysis of the results of the data collected in the field, having as main reference the theoretical reference, which guided the entire research, until its final execution..

4. Research Subject Inclusion And Exclusion Criteria

4.1 Critérios de inclusão

Resource investments in improvements to port structures,
Profile of users;
Parking lots;
Pedestrian movements to reach the port;
Conditions and main access routes;
Goods sector;
Ticket purchases;
Check in

4.2 Exclusion Criteria

Large-scale loading and unloading (Containers);
Transportation of goods by truck;
Routine arrival and departure of vessels;
Rivers and waterways;

5. Problems and Solutions

In this part will be worked the results and discussions about the data obtained from the on-site study, as well as the movement of pedestrians who travel daily in the public port of Manaus. (Roadway).

To understand the performance of these users, it was necessary to present their profile, since their life dynamics are not dissociated from social dynamics in view of the great demand of people who frequent the port, either to go to other municipalities or to use space for tourism.

Resource investments in improvements to port structures suffer from the high tax rates paid by the private sector to the state. In 2011 the federal government took over the port and annulled the lease contracts, removing the existing stores and signposts on site, doing a poorly designed revitalization, leaving some aspects of the internal structure in need for lack of a good design.

Figure 1: Guidance Plates Taken by Federal Revitalization
Source: Author, 2019

From March of last year (2018), the private initiative resumed a new lease of the public port of Manaus, and today it is being managed and supervised by the state government.

Strengths:

Internal environment: good natural navigation conditions in the region, Areas available for port capacity expansion along the shore, Medium high batches in container handling, Physical spaces for stores, local tourism.

External environment: Manaus Free Zone as a load generator, Incentive of cabotage in Brazil; domestic growth perspective, Warehouse facade with good view.

Negative points: Internal environment: structural problems at the public port wharf, restricting it to the operation of heavy loads, Impossibility of installing large capacity fixed cranes at public port quay, Unstructured port authority with few staff; lease agreements with legal problems, as well as lagged port rates, Tipping of the public port quay, making it difficult to modernize.

External environment: lack of regulation in intercity regional navigation, TUPs with potential competition in container handling when compared to the public port, Distant location from major national producing centers, Saturated connection routes between public port and industrial district.

5.1 Parking lots and placeholders for users

The public port of Manaus has three private parking lots, leased to permit holders, who are responsible for maintaining and charging fees.

They are being used in a rotating way, but free for all users who access the center of Manaus, thus not making it restricted to people who use the port, considering the large amount of vehicles that circulate in the historic center.

Figure 2: Parking at the public port of Manaus
Source: Author, 2019.

The maximum vehicle capacity for the three parking lots and 250 alternating spaces in the existing areas between them is a great option for users.

5.2 Main routes for traveling passengers to the port

With population growth, and the warming of the economy in the state, a great demand for vehicles has been circulating in the streets around the port of Manaus in the last ten years. This situation led to a very large flow of cars and trucks moving around the main thoroughfares of the historic center at all times.

Due to the mediation of the modern Manaus fair, the Adolfo Lisboa market and the modern Manaus port (yellow ferry), traffic was severely damaged, causing huge queues and irregular stops.

Figure 3: Av. Lourenço da Silva Braga
Source: Author, 2019.

In early 2019, there was a road recovery which favored the main avenues around the public port of Manaus, improving the circulation of vehicles, as we can see in table 2:

Table 02: Revitalization of streets and avenues around Manaus public port (Roadway)

Avenues and streets	Main interventions
Lourenço da Silva Braga	• Full road recovery; • Road demarcation; • Recovery of curbs and sidewalks; • Crosswalks
Marquês de Santa Cruz	• Full road recovery; • Road demarcation; • Crosswalks;
Luiz Antony	• Partial recovery of the road; • Road demarcation; • Crosswalks;
Eduardo Ribeiro	• Full road recovery; • Road demarcation; • Recovery of curbs and sidewalks; • Crosswalks;

As the recovery of roads and parking points, they have undergone some changes, leaving the place with fewer parking spaces thus showing a greater lack of options for users.
The municipal agency has been operating with the mission of trying to inhibit double queues or parking lots incorrectly, but this form of enforcement has put passengers in difficulties of access, causing bigger problems, and what would be a solution around the activities of the public agency. fines the population.

Figure 4: Double Landing

Source: Author, 2019.

5.3 Viable solutions for Manaus public port (Roadway)

Among the main solutions to remedy shortages to reach the port, is the access by the avenue Marquês de Santa Cruz. The perimeter that can connect this route to the port would give more fluidity to the vehicles, besides facilitating the users who come today by this route and cannot enter the port, leaving the avenue somewhat cloistered, since in order to be able to access the direct way.

This perimeter has around 60 meters and is currently being used by parking, and this route was already used as access until 2015. As a solution would be used only for small car respecting road demarcation, giving preferential to Av. Lourenço da Silva Braga as we demonstrated in the following project.

Figure 5: Road project, with alteration in Avenida Marquês de Santa Cruz

Source: Author, 2019.

This intervention will make it easier for users who are destined for the inner part of the port, making it a great flow option for passengers, who today suffer from having only Lourenço da Silva Braga Av.

6. Conclusion

Having a historic port is a privilege for few states, the public port of Manaus (Roadway), is the gateway to the Amazonian capital, it is part of the history of the capital, and has a direct influence on the state economy. Because it is a historic heritage site, its modernization became unviable, which left the port with several problems not only structural but also administrative.

With the resumption of the port in 2011, the federal government left many failures in structural revitalization, one of the main changes was the removal of the original floor of the main warehouse, disregarding the historical pattern of construction.

The main river and tourist routes are directed to the port, giving it credibility to be one of the most important in the country. This large demand from users who embark and disembark at the waterway terminal is hampered, by few alternatives, with regard to the routes that allow access, as well as mandatory guidance signs on both near and inland. Solutions that are not being carried out by the private initiative that resumed

the lease agreements in early 2018, with the responsibility of improvements.

Among the points of relevance, the port has a physical structure that give its users amenities, and security. It has employees who work from the loading of luggage, information, stopping of boats on the floating ferry and guidance on the mooring of vessels. But it is clear that there is a degree of unpreparedness of some of these professionals, who end up treating people with lack of education, leaving a bad impression to the port administration.

The interventions in the port-related avenue traffic reported in the project will give users a great choice for passengers using vehicles to travel to their boats faster. Since users coming to the port for the first time thus have more options on the route thus avoiding delays, or even leaving the vessel.

The analysis thus developed presents the limits and possibilities of the practice not only of the use of the port for the region, but mainly in tourism in the face of reality in a context that unifies, in its possibilities, almost all sectors of the economy, making it more complex and arduous, also allowing for a broader, more complete and lasting work, thus having, in the capitalist context in which it operates, the contradiction in itself.

The objectives proposed by the research consider that it is the state's responsibility to technically monitor and support administrative activities regarding the provision of services offered to passengers, seeking to comply with the direct responsibility of the port.

Thus, the state's responsibility for social policy to break ineffective actions stands out, and it is essential that passengers know their rights, leading them to many challenges in order to break with the actions that lead to the basic problems of the economy. port to a solution.

As for the demands presented as direct alternatives for change, there was a need to take actions that give passengers the easiness to travel with greater security..

Regarding the responses of the interviewed passengers, they realized that there was a consonance, all referred to the need for improvements in the physical space, on the roads and especially in information, thus leading to believe in the existing difficulties, but which should be solved by the proposal presented..

Given the objectives achieved with the research was essential to ensure that many people who use the port throughout the year, is received in the best possible way. We believe that this has led to a better assessment of the waterway terminal, and that alternatives to using the port as the main tourism tool will give users convenience.

7. Bibliographic References

Agência Nacional Transporte Aquaviário (ANTAQ). ESTUDO DE MACROLOCALIZAÇÃO DE TERMINAIS HIDROVIÁRIOS NO BRASIL. Plano Nacional de Integração Hidroviária. Disponível em:< http://www.antaq.gov.br/Portal/PNIH/PropostaMacrolocalizacaoTerminais2.pdf> Acesso em:22 jan.2015

ILOS-Instituto de Logística e Supply Chain. Custos Logísticos no Brasil - 2014 – Disponível em: < http://www.ilos.com.br/ilos_2014/wp-content/uploads/PANORAMAS/PANORAMA_brochura_custos.pdf> Acesso em: 20 jun. 2019

BALLOU, R. H. Logística Empresarial, Transportes, Administração de Materiais, Distribuição Física. São Paulo: 1ª Ed. Atlas, 2010.

CHING, Hong Yuh. Gestão de estoques na cadeia de logística integrada: supply chain. 4. ed. São Paulo: Atlas, 2010. 238 p

ARAÚJO, Paulo César Diniz de et al. Indicadores de desempenho em operações, logística e cadeia de suprimentos numa multinacional do polo industrial de Manaus. In: Gestão e Sociedade, Belo Horizonte, v. 7, n. 18, p.327-342, dez. 2013.

SANTOS, Erica Moreira dos. Análise da efetividade da avaliação de desempenho logístico: estudo de caso numa loja virtual de vestuário. In: ENEGEP, 2015, Fortaleza. Enegep, 2015. p. 0 - 16.

The Causes of School Evasion in A Private Higher Education Institution: Case Study

Marcelo Albuquerque de Oliveira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
marcelooliveira@ufam.edu.br
https://orcid.org/0000-0003-2496-646X

Francirlene Belo Mendes de Santana (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
francirlene.santana@gmail.com
Phone: +55 69 99987-0619
Address: 6200, Rodrigo Octávio Ave., Manaus – Amazonas
Zip Code: 69080-900

Dércio Luiz Reis (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
dercioreis@ufam.edu.br
https://orcid.org/0000-0001-8175-3212

Raimundo Kennedy Vieira (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
kennedy71@gmail.com
https://orcid.org/0000-0003-3685-0034

Gabriela de Mattos Veroneze (Corresponding author)
Postgraduate Program in Production Engineering, Federal University of Amazonas, Amazonas, Brazil.
gveroneze@ufam.edu.br
https://orcid.org/0000-0002-1978-9190

Abstract

The objective of this research was to identify the causes that motivated the students to evade the courses of a private Higher-Education Institution - IES, in the city of Porto Velho-RO. It was intended to raise the number of students evaded by periods and courses in recent years to assess the impact of school evasion

on HEI management decisions. To obtain results, we used the interpretation of data obtained through quantitative and qualitative research, questionnaires and interviews.

Keywords: School evasion; University education; Causes of evasion; University management.

1. Introduction

In recent decades, there has been a significant growth in Private Higher-Education Institutions and new students. Similarly, there was also a growth in dropout. In the face of the problems faced, there is a need to know the phenomenon to ensure an intervention, to bring qualitative changes to avoid a complex situation that presents causal multifactor that negatively influence the strategic results in a highly competitive environment, by the presence in the educational market of new colleges with different types of demand and trends in creating innovative courses.

Higher-education institutions are going through a process of great competitiveness, and the expansion of enrollment does not represent the retention of students. School evasion in Brazilian colleges is a problem that private education entities face and must develop strategies to ensure management based on internal control and relationship management focused on dropout problems. The research problem points to the following question: *What are the main causes of school evasion in the Higher-Education Institution surveyed?*

The study hypothesis points out that there are multiple causes of school evasion in educational institutions, becoming a problem that cannot be completely addressed. However, managing student retention through internal measures aimed at efficient management to address the causes of student dropout may reduce the financial impact on organizations. It is justified to conduct the study based on the assumption of the specific point of management, being very important to know the various realities that causes the dropout, so that the creation and effective strategies in the face of financial problems that impose aspects of academic and administrative nature.

To achieve the objectives of the study, it was decided to conduct a case study in a private higher-education institution, with the purpose of conducting a data survey, in order to corroborate the research hypotheses, identify the most common variables, and propose actions to reduce or eliminate dropout.

2. Theoretical Referential

The incentive to create strategic actions to address the problem has shown that higher-education institutions need to establish an action plan to stimulate student retention, seeking greater adherence between courses through a reassessment of curricula bringing issues that are according to the students' wishes and identifying the strengths and weaknesses of the institution. The following is the theoretical basis for this study, regarding the management strategies, dropout and growth of educational institutions.

2.1 Strategic Management

Martins (2007) evaluated that this moment of crisis is a key point that HEI management must pursue in order to create efficient strategies. Thus, this greater understanding about the preponderant factors of dropout in undergraduate courses and their relationship with a range of variables still little known. According to the author, strategies to reduce school dropout have their benchmark in the training of professionals who work as teachers, the improvement and access to teaching materials, encouraging actions that determine educational experiences for teachers who can determine skills that can support the challenges of the profession.

According to Duarte and Bertelli (2013), to identify the problems of higher education in Brazil, it is necessary to show that the low quality of education and the factors that interact with the student's perceptions, favor the dropout. Miranda *et al.* (2015) assess that the strategic management should act from the problem of student permanence, identifying the affinity that the student has with the course, from this perception, it will be understood that much of the cause of dropout is lacked of interest in the course. For many reasons, students do not score well enough to earn a place during their dream. This condition is limiting, as it is a deactivation process that can trigger evasion. As can be seen there are several reasons for student dropout, and one factor that needs to be assessed is the macroeconomic aspects of higher-education institutions.

2.2 Macroeconomic Aspects of Higher-Education Institution Expansion

In the macroeconomic aspects that favored the expansion of HEIs in the Brazilian economy, the main factor is the partnership with the State in the transfer of Student Financing (FIES), enabling organizations to manage many yields on profitability indicators. In this regard, in terms of capital structure, HEIs benefited from two situations that led to the expansion of their investments: Firstly, the process of open capital of educational companies in the financial market, which favored a significant amount of capital for the application of financial strategies. and second, the effective financial impact of the State passing on to maintain the conditions of educational funding that began in 2010 with the implementation of the National Education Development Fund (FNDE), which favored a large expansion of education supply for Higher Education (FREITAS, 2015).

From 2010 to 2015, the Brazilian government favored the profitability of several HEIs, based on the positive impact of FIES. In this sense, there was a high rate of income favorable to private higher-education institutions. Currently, HEIs have a smaller number of underprivileged students who are enrolled in scholarships through the Student Finance Fund Program (FIES) offered by the Ministry of Education (MEC) to students in private institutions. However, there has been an effective decrease, as evidenced by the result's analysis between 2015 and 2017, which recorded a reduction of -20% from 2015 to 2016 and a -24% reduction in stock exchange offers for the year 2015. 2017. This drastic reduction has been justified by unstable government policies and the difficulty of the government to reduce public spending generating a major impact on Brazilian HEIs with the reduction of state transfers.

According to Duarte and Bertelli (2013), against the background of the great stagnation of the Brazilian economy in the last four years, they produced changes that drastically reduced FIES as a social program. In this context, the great majority of the HEIs had a great impact with the 50% reduction of state transfers in their cash. Miranda et al (2015) sustains that the federal government had an impact close to 50% in terms of default compared to FIES. To remedy the problem, the state's strategy was to drastically reduce supply, shifting responsibility to private sector funding, creating the conditions for expanding many higher-education offerings at low prices, which represents a reduction in investment in educational quality, passing on only the basic teaching, without the presence of research and extension opportunities that enrich the training courses.

In this context, what is evident in the reality of HEIs is that there are much supply and little demand for enrollment, in addition to the problem of dropout who generates financial impacts on the management of private entities. With the State's drastic reduction in educational funding, as a result of changes in legislation, there was a negative impact on the profitability of HEIs. Normative Ordinance 23 provides for the semiannual renewal of the Student Financing Fund (Fies) financing agreements, an effective change in the amendment guidelines regarding students. This change had a major impact on HEIs, associated to the problem of student delinquency and dropout.

2.3 Dropout in Higher-Education Institutions

The term school / university dropout reflects the phenomenon that characterizes the dropout of the school period before its end. This characteristic phenomenon in Brazil and Latin America has as cause's factors that favor this situation in education. The dropout in higher education in Brazilian institutions is a management challenge, and the HEIs have been facing passively and without alternatives to solve the problem in a time of crisis of great competitiveness. From the perspective of Dias Sobrinho (2002), there are many corporations operating in the higher-education market, and this has resulted in idleness of vacancies and delinquency in private higher-education institutions. Therefore, the reality was already foreshadowed: too much supply and too little demand resulting from the impact of the exhaustion of the system in the face of students' financial difficulties.

The problem becomes even more complex due to the lack of sources of information and knowledge about the phenomenon of dropout, understanding its causes and consequences for the student and his family. The financial impact on HEI emerges as a problem that requires alternatives, considering that it is a worrying social framework that is part of the current debates and reflections. This phenomenon in the educational field encompasses a wide range of factors that are beyond the responsibility of HEIs, but at the same time, it is relevant to identify internal conditions that may be contributing to students' dropout. Thus, knowing the aspects of the phenomenon of dropout in Brazilian HEI is fundamental to define the profile of educational problems in the Brazilian reality, especially in relation to higher education, assessing as an assumption that this constitutes the most important teaching modality to meet young people and adults in the labor market. Therefore, this reality proposes a critical reflection to highlight concrete alternatives in

the face of a problem that directly affects revenues and puts in uncertainty the sustainability of the educational institution.

Analyzing from the focus of research on the subject, it appears that the national literature reflects a concern with the causalities of dropout in HEI in a quantitative view, taking into account the need for greater stimulation and investments in the infrastructure of colleges. . However, it is pressing to know the real issues that pervade as influencers of higher-education dropout. In the view of Duarte and Bertelli (2013), the socioeconomic factor is one of the main factors that make up the Brazilian reality, but it still needs a thorough study to analyze the socioeconomic profile of students evaded in undergraduate courses at private institutions.

In this regard, Freitas (2015) considers that the phenomenon of university dropout is not only explained by the economic bias, although the crisis is considered an important factor, given the difficulty of low-income students to obtain scholarships. Indeed, other motivational issues should also be considered in relation to the lack of opportunities to choose a specific course. However, the motivations and vocations do not match the financial conditions, and preparation needs to get a place in courses of great market interest, so these conditions have a great weight in choosing the course that generally does not represent the real student's desire.

Understanding this phenomenon in HEIs triggers various situations in the educational, social, economic and cultural process that deserve proper study, taking into account the different social contexts that involve the management of private colleges. Therefore, according to Freitas (2015), the evasion of private HEIs is one of the constitutive elements that can be explained in terms of affective, sociocultural, economic, motivational and especially self-aware situations in the world and in relation to the individual's state with the world.

Martins (2007) analyzed that reflecting on dropout in the context of higher education is a way to recognize that higher education is lacking in motivating aspects in the educational process in its various methodologies, content and curriculum basis, as in all database's management structure for student permanence.

In Santos (2014) approach, relationship marketing should be implemented as a critical success factor, where HEIs should rethink their capture strategies. In contrast, Rodriguez (2014) states that the increasing number of dropouts in the higher-education sector is a threat to private HEIs, considering the impact on their revenues, which can be considered as an opportunity for HEIs to assess the permanence of the private sector student is as important as their uptake. At this juncture, the HEIs as educators must seek strategies to obtain the necessary subsidies to understand the evasion, the conditions that can form a power conjuncture that excludes the popular classes, through mechanisms of action that expose social inequalities, making it difficult them the extent of educational opportunities.

3. Materials and Methods

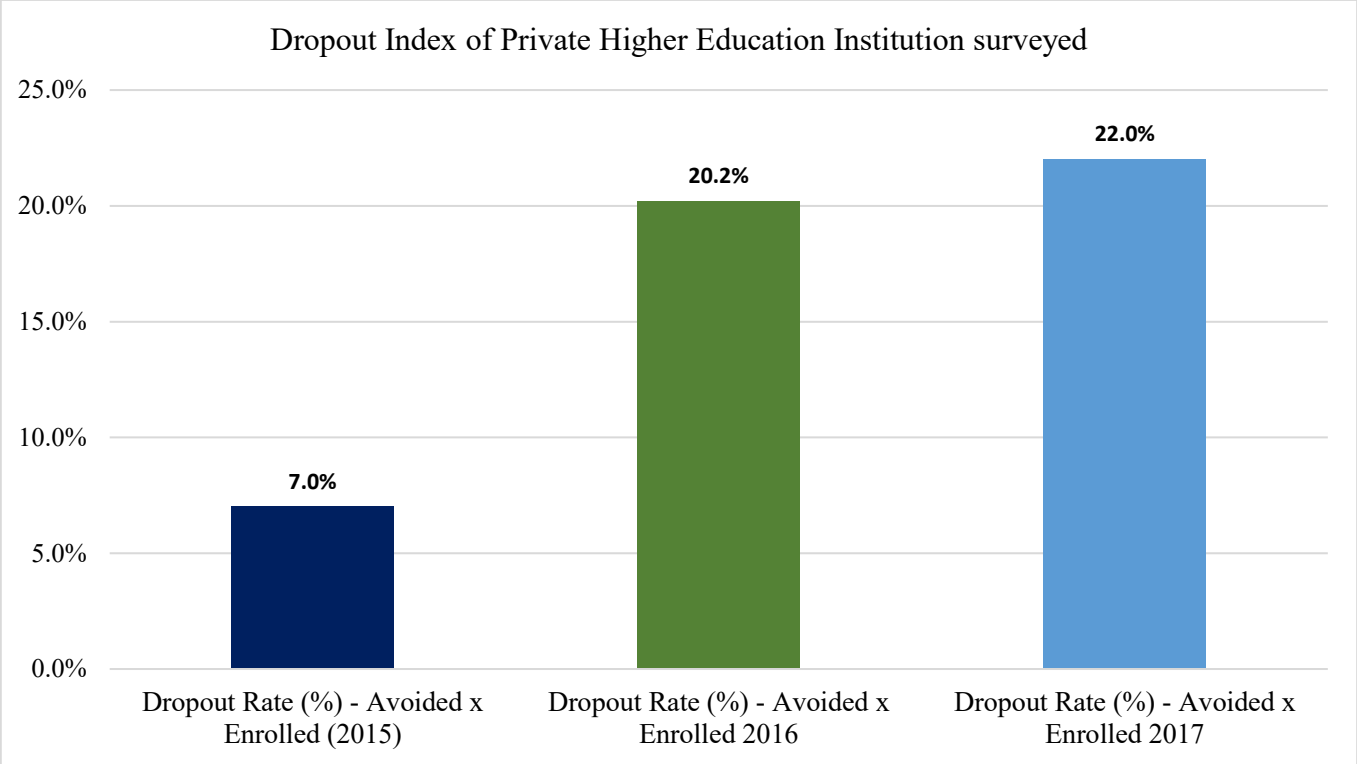
The researched IES currently has five courses in operation, which are *Administration, Accounting, Civil Engineering, Environment Engineering and Law School*. A non-profit institution has been operating in the Educational market for over 30 years. Firstly, we sought data regarding dropout in the educational system of the educational institution for the last 3 years.

The collection of data used in this research was documentary analysis through the systems of the institution researched, questionnaire applied to the evaded students sent by e-mail, messaging application (SMS) and telephone, as well as interviews with the main managers of the institution (Directors General, Academic and Financial), given a qualitative approach to this study. The approach was quantitative, due to the exploration of the dropout data available. The qualitative approach is related to data analysis, considering the response to questionnaires applied during the present study.

4. Case Study

The Institution studied has been in the market for over 20 years, and for much of that period has achieved significant revenue that slackly covers all its costs and still has reserves. In the survey conducted through the INEP Census, the surveyed institution obtained the following result with respect to dropout in 2015, 2016 and 2017, as evidenced in Figure 1.

Figure 1 - Dropout Index of Private Higher Education Institution surveyed.



As can be seen, the index in 2016 and 2017 rose exponentially, but the percentage of 2016 remained in 2017. The total evasion of the State of Rondônia, in the same years above, according to INEP, was 17% in

2015. This shows that the educational institution surveyed had a lower rate than the state average, where the average dropout rate was 16% for 2016 and 20% for 2017, with the institution surveyed above the state dropout average in these two years. Table 1 detail the dropout rate that occurred in the institution in its main courses offered.

Table 1 - Course dropout data.

COURSES	2015	2016	2017
Administration	5	8	11
Accounting sciences	9	13	15
Law school	35	82	126
Civil Engineering	25	70	90
Environmental engineering	27	15	40

As expected, there were a large number of students evaded in recent years, highlighting the need to search for the causes. After analyzing the characteristics of the educational institution and the interviewees, it was decided to investigate the causes that led the students to evade the institution. With this information, a survey was started to find out what causes the dropout of students from the researched institution in recent years. It was initially based on the evasion of the year 2018, because it is more current data, which can contribute to the strategic decisions made by the senior management of the educational institution. After applying the questionnaire to students evaded in 2018, the results are presented in Table 2, which demonstrates the motivations for dropout. The number of students evaded in 2018 was 148. Of these, 03 had outdated data in the system, with incorrect email address and telephone and 22 did not answer the calls and did not answer the survey. The research sample consisted of 71 evaded students, representing a percentage of 47.97% of the total. It is observed that the main causes of dropout are *unavailability of time, which represents 27.70%; opting for another educational institution, which has a result of 14.86%; change of city, which represents 12.16%.* As can be seen in Table 2, the other causes presented represent 45.28% of the total surveyed.

Table 2 - Main Cause for Evasion 2018 Reference.

Main Causes	2018.1	2018.2
Approved in the PROUNI program	1	0
Approved in the University for All Program (Porto Velho City Hall)	0	1
Unemployed	1	1
Distance to the institution	3	5
Divide HEIs	12	0
IES does not have the new course option	0	2
Unavailability of time	22	19
Dissatisfaction with the researched institution	0	2
Monthly payment does not fit the budget	10	4
Personal reasons / declined to respond	7	2
City change	8	10

Student did not find the course it were looking for	5	2
It did not adapt to the course	0	0
Opted for another educational institution	3	19
Health problems (personal or third party)	4	1
Transferred to Federal University	0	0
High monthly fee	0	2
Travel (vacation, business or study, but will return)	1	0
Grand Total	**77**	**71**

5. Conclusion

There is no denying that student dropout rates are a major social and economic problem in Brazil. The multiple causes and complex nature of the dropout problem require a variety of approaches to help at-risk students and dropouts.

Clearly, several factors lead the student to evade higher-education institutions. It is believed it is essential that educational institutions make investments to maintain the quality of service provision, since it is evident, it costs more to recover a student than to guarantee their permanence.

As a future study, it is proposed to implement a permanence management program to attract new students and keep already enrolled students satisfied.

7. References

[1] _____. Ministério da Educação. **Portaria Normativa n.º 23, de 29 de dezembro de 2014**. Altera dispositivos das Portarias Normativas MEC nº 1, de 22 de janeiro de 2010, nº 15, de 8 de julho de 2011, e nº 21, de 26 de dezembro de 2014, que dispõem sobre o Fundo de Financiamento Estudantil - Fies. Diário Oficial da União 30 dez 2014; Seção 1.

[2] _____. Ministério da Educação. Instituto Nacional de Estudos e Pesquisas Educacionais. **Evolução do Ensino Superior – Graduação 1980 – 1998**. Brasilia 2000. Disponível em: http://download.inep.gov.br/download/censo/1998/superior/evolucao_1980-1998.pdf. Acesso em: fev. 2019.

[3] _____. Ministério da Educação. **Portaria Normativa n.º 21, de 26 de dezembro de 2014.** Altera dispositivos das Portarias Normativas MEC nº 2, de 31 de agosto de 2008; nº 1, de 22 de janeiro de 2010; nº 10, de 30 de abril de 2010; nº 15, de 8 de julho de 2011; nº 23, de 10 de novembro de 2011; nº 25, de 22 de dezembro de 2011; nº 16, de 4 de setembro de 2012; nº 19, de 31 de outubro de 2012; e nº 28, de 28 de dezembro de 2012, que dispõem sobre o Fundo de Financiamento Estudantil - FIES. Diário Oficial da União 29 dez 2014; Seção 1.

[4] BRASIL. Ministério da Educação. Instituto Nacional de Estudos e Pesquisas Educacionais. **Censo da Educação Superior. Notas Estatísticas 2017**. Disponível em:portal.inep.gov.br/web/guest/censo-da-educacao-superior. Acesso em: fev.2019.

[5] DIAS SOBRINHO, José. Campo e caminhos da avaliação: a avaliação da educação superior no Brasil. **Avaliação: construindo o campo e a crítica. Florianópolis: Insular**, p. 13-62, 2002.

[6] DUARTE, Walquíria Fonseca; BERTELLI, Sandra Benevento. **Universitários em pontes: A problemática da evasão no ensino superior e caminhos em orientação profissional.** 1. Ed. São Paulo: casa do Psicólogo, 2013.

[7] FREITAS, Lucimar Novais. **Evasão e permanência na educação profissional**. 1. Ed. São Paulo: Novas Edições Acadêmicas, 2015.

[8] MARTINS, Cleide Beatriz Nogueira. **Evasão de alunos de graduação em uma instituição de ensino superior.** 116 fls. Dissertação de Mestrado em Administração. Fundação Dr. Pedro Leopoldo, Pedro Leopoldo, 2007.

[9] MIRANDA, Gilberto José; LEAL, Ednalda Araújo; CASA NOVA, Sílvia de Castro. **Revolucionando à docência Universitária - Orientações, Experiências e Teorias Para a Prática Docente em Negócios.** 1. Ed. São Paulo: Atlas, 2015.

[10] SANTOS, Grasiele Aparecida Lourenço et al. A evasão no ensino superior privado: um estudo de caso em uma instituição de ensino brasileira**. Revista Ciências Administrativas ou Journal of Administrative Sciences**, v. 17, n. 1, 2014.

Potential Effectiveness of TED talks in developing listening: Reflections of Jordanian Participants in United Nations Police Monitors Courses

Adel Alrefai
Doctorate (PHD) in TEFL(teaching English as a foreign language)
Yarmouk university, Jordan

Ruba Bataineh
professor of TESOL Yarmouk university, Jordan

Abstract

This study examinesthe perceptions of participants in UN police monitors courses about the effectiveness of TED (technology, entertainment and design) talksin developing their listening. The researchersused a qualitative research design on25 purposefully-selected participants in the police monitor course held at the Jordanian police peacekeeping institute.

The TED talks-based program aimed at offering the participants opportunities for practicing listening and raising their awareness of the benefits of using TED talks for academic purposes. The training lasted for four weeks during the first police monitor course of 2018. The findings show that TED talks were reported to positively affect the participants' perceptions of the effectiveness of these talks in improving their listening. The participants were reportedly highly satisfied with the content, method and time of training as well as their interaction, motivation and benefit from it. The study concludes with several recommendations and implications for EFL teachers, educational policy makers, and textbook designers.

Key words: listening; UN Police Monitors Courses;TED talks

Introduction and Background

English has become a lingua franca across the modern world in trade, travel, science, technology and international relations. For many, English is a means to a wide range of opportunities. As the world moves further into globalization, mastering English has become a necessary commodity (Wong &Jhaveri, 2015). English is instrumental for many careers, one of which is police. As policeprotect people, fight crime, and handle emergencies, they ask and answer questions (often in English), write down statements and testimonies, and participate in United Nations missions for peace-keeping around the globe. Peace-keepingmissions from over a hundred countries are deployed annually to monitor and observe peace processes in post-conflict areas (Fréchette, 2012). Jordanian police have been one of the early participants in preserving international peace and security through peace-keeping missions around the world (PETRA, 2014).

As requisite for participation in UN missions, a police officer must pass the United Nations English Language Proficiency Test (henceforth, UN Test). The UN Test consists of four sections: reading comprehension, listening comprehension, report writing, and oral interview. To pass, a participants need to score a minimum of 70%.

In the listening comprehension and report writing sections of the test, the participants listen to an audio script concerning a mission-related topic. The script is followed by a dialog between two individuals which is heard only once. The participants take notes on the script and dialog to either answer ten questions in fifteen minutes or complete a written report in thirty minutes.

Listening comprehension is defined asa process which involves the interpretation of intentionally-transmitted messages to understand those messages and respond to them appropriately (Burleson, 2011, p. 27).Listening is believed to be more complicated than other skills, as it is more difficult to practice listening when the learner does not live in an English-speaking environment (Rodri'guez, 2012), especially that learners are almost never deliberately taught how to listen (Schmidt, 2016). Teachers generally assume that listening is taught for non-listening purposes such as grammar, vocabulary, and comprehension (Thorn, 2009).

Research on communication skills mostly focuses on intrapersonal skills. The intelligibility in communication refers to the degree to which speech can be understood, it takes place through receptive skills such as listening and reading. Listening is essential for starting any communication. Listening is not just hearing, but interpreting with focusing on the ideas or words produced by the speaker. Therefore, teaching listening needs to become the foundation for imparting knowledge of all other communicative skills (Cheung, 2010; Pasupathi, 2013; Rost, 2005; Valeeva, Aitov & Bulatbayeva, 2016). Calls (e, g. O'Connor, 1998, Yunkul, 2010) have been made for teaching listening first to improve the learner's ability to communicate both orally and in writing.

Teaching listening has gained mounting interest in recent years, as a plethora of research (e.g., Rubin, 2011, Smidt & Hegelheimer, 2004, Vandergrift, 1999) claims that it is a requisite for communicative ability. Nevertheless, language programs still lack curricular support for developing listening which aims more atchecking comprehension than active listening (Khuziakhmetov & Porchesku, 2016).

There has been a mounting interest in the use of authentic materials in teaching listening (Field, 2002; Flowerdew & Miller, 2005) to better simulate real-life input with features like hesitations, hedging, false starts, and long, loosely structured sentences (Field, 2002) inherently absent in scripted speech.

Addressing the relative dearth of attention to listening practice in the foreign language classroom, Nunan (2002, p.238) claims that "listening is the Cinderella skill in second language learning. All too often, it has been overlooked by its elder sister—speaking". Despite a growing interest in listening (e.g., Field, 2002; Nunan, 2002; Wallace, 2010). It has historically been considered secondary to other skills.

Technology has catalyzed teaching listening (Gottlieb, 2006), as it allows language learners to monitor and analyze information and simultaneously maintain interest and enjoyment (Bernard, 1996(.Technology has been reported to increase achievement and motivation, develop higher order thinking, reduce learning time, and increase knowledge retention (Hill & Slater, 1998; Yaniawati, 2013). Technology integration into teaching and learning has been reported to improve lesson effectiveness, save teacher time and effort, and

create positive impressions about the educational environment managed by technology (Ruthern, Hennesy & Deany, 2005; Kurt, 2010; Keser, Huseyin & Ozdamli, 2011).

Technology has also been reported to improve teachers' work, as teachers can use it to assess and monitor students' behavior, follow-up of knowledge and skill acquisition, carry out administrative tasks and record-keeping; and improve students' work (Ottenbreit, Glazewski, Newby &Ertmer, 2010).

As technology is a catalyst for learning , lessons are presented in a more attractive manner (Jaradat, 2008).Technology also caters for individual differences and stimulates students' interest and motivation and provides them with an opportunity to learn more about the subject and to prepare well for the lesson(Alnaouachi, 2010(.

Technology has made it easier to teach and learn in groups or clusters. It is an integral part of education in the twenty-first century. When used properly in the classroom, technology allows students to experience situations that students of twenty years ago could only dream about (Rodinadze & Zarbazoia, 2012). Using technology properly, especially when blending it with traditional approaches, students' ability potentially improves and enhances the appeal of both teaching and learning (Xiaojun & Leshan 2015).

There is a plethora of research (e.g., Bataineh, Al-hamad & Al-Jamal, 2018; Baniabdelrahman, Bataineh & Bataineh, 2007, Bataineh, &Baniabdelrahman, 2006) which suggest that language educators should take advantage of the capabilities afforded by technology for teaching language skills. However, the use of technology is still matter of controversy. Research (see, for example, Amory, 2007; Miller & Lake, 2012; Turgut, 2011) alluded to resistance to technology integration in education due to consideration such as costly maintenance and limited accessibility.

Some of the major benefits of technology in learning are as follows: Supporting self-learning, increasing motivation for learning and achievement, retention of Knowledge for a long period of time, and increasing the learners' interest in the educational content and alleviatepotential boredom resulting from traditional methods.

Advancementsin technology and online services have catalyzed the provision of authentic learning materials forteaching and learning language, as for other disciplines. TED talks has been one of these broadly used online sources.

TED, a non-profit organization dedicated to spreading ideas in the form of short and strong conversations, started in 1984 as a conference for meshing technology, entertainment, and design. Since they were made available online in 2007, they have been broadcasted in more than a hundred languages. Free transcripts and subtitles in over 40 languages accompany most of the talks, given by both native and nonnative speakers ofEnglish.

TED talks are believed to be of use not only for learners at large (Karia, 2013) but also for school teachers (Chawla, Dietze, Marenzi & Fetahu, 2015; Rank& Patrick, 2014). Not only can TED talks be used to stimulate learners' awareness and critical thinking, but they can also be used to honteachers’delivery of information and communication with learners.

The educational value of TED Talks (Li, Gao & Zhang, 2015; Ludewig, 2017) can be attributed to a host of factors: the availability of linguistic support, the innovative and engaging content, and the clarity of presentation. Add to that the availability of subtitles and transcripts in native and target languages and speech rate adjustment to help learners better understand the talk. Research (e.g., Chang & Millett 2014;

Woodall, 2010) reports favorable effects for using subtitles on listening comprehension and vocabulary learning and for speech rate controlon listening comprehension (Griffiths, 1992; Wingfield, 2000).

The use of TED talks in language instruction in general, and teaching listening in particular, is still a relatively young field, but evidence abounds for their effect on improving language proficiency over traditional instruction. Obari and Lambacher (2014) reported a positive effect of TED-based blended learning on Japanese EFL students' overall English proficiency. Similarly, Hye and Kyung (2015) reported that shadowing with authentic material such as TED talks brought about marked improvement in70 Korean EFL students' listening comprehension. Takaesu (2013) examined the effect of TED talks on college students' listening. The findings revealed that TED talks improved the students' listening comprehension, fostered their motivation to independently pursue their own interests and familiarized them with multiple English accents. Similarly, Schmidt (2016) found that not only did TED talks and listening journals positively affect the listening skill development, but students viewed them as interesting and beneficial opportunity for authentic listening practice and a catalyst for real-world listening skills.

Li, Gao and Zhang (2015), who examined the effect of TED talks in Chinese EFL courses, reported positive participant response to TED Talks and satisfaction with their ensuing gain in language skills, as they shifted their roles from knowledge receivers to explorers which, in turn, fostered their listening and thinking abilities. Similarly, Hashimoto, Fukuda,andOkazaki (2015) reported positive effectsfor using TED talks on Japanese students' writing skills. The found that providing more explicit instruction on summary writing, through the TED talks website, was not only helpful but also appreciated by the students.

To the best of these researchers' knowledge, this may be the first research on developing listening among prospective participants in UN police missions. In the interest of time and convenience, the scope of this research is limited to the enrollees in the first UN police monitor course for 2018. The research is also limited to a set of 15 TED talks which are relevant to police work, participants' proficiency, and potential interests.

Sample instrumentation and data collection

The participants comprised a convenient sample of the twenty-five police officers enrolled in the International Police Monitors course held at the Jordanian Peacekeeping Institute in January 2018. A reflection and semi-structured interview schedules, whose validity and reliability were established, were used to gauge the participants' perception of the effectiveness of TED talks in developing their listening performance.

The researchers designed an instructional TED talks-based program which comprised two major types of activities. In the first type of activities the participants were given three pens, each of a different color (e.g., black, blue, and red). They were asked to watch the TED talks video without subtitles or pauses and take notes in the notes section. They then watched the video with English subtitles without pauses, adding more information to their notes using a pen with a different color. Finally, they watched the video with subtitles in their first language, adding more information to their notes using the third pen.

These steps were repeated at normal and slower speed according to the learners' levels and needs. Following the activity, the participants responded to reflection questions.

In the second type of activities, a section of the one-to-two-minute-transcript was chosen and copied. The participants went to the cloze test creator at http://l.georges.online.fr/tools/cloze.html, pasted the text in the yellow box, and selected ‘Interactive' and ‘No clues' below the yellow box. From the right sidebar, they chose the number of words to be removed by replacing ‘n’ with a number. Once they clicked ‘Submit’, they were given an interactive gap fill.

The participants watched the TED Talk video again and did a fill-in-the-gap task without looking at the clues. They repeated the activity at least twice and wrote their score each time. The advantages of this type of task in developing listening skill was emphasized by Lewkowicz (1991) and El-koumy (1997) who reported that its use in developing listening comprehension is a promising practice and has a positive effect on teaching and learning.

Problem and Question of the Study

Their collective experience as language teaching practitioners, both at large and to police, the researchers noticed the consistently poor performance by the participants in the UN English proficiency tests and the significantlysmall success rates in listening and note-taking skills, which urged them to seek potential solutions to develop listening skills for the participants in United Nations police monitors courses.

The researchers believe that police personnel, like all other EFL learners, face difficulties in listening, which is an urgent problem for learners in general and for police in particular. Aldohon (2014) reported that Jordanian police officers have serious problems in English in general and listening in particular and called for developing their speaking and listening to raise police work efficiency.

Many police participants fail the UN test and, thus, disqualify from the participation in the missions for two reasons: poor listening ability and poor stress and time management. The researchers witnessed many proficient police participants fail the UN test and attributed their failure to their inability to understand spoken language, stress, and poor time management.

Since the participants in United Nation police monitors courses vary in age, background and language proficiency; technology, as represented in TED talks is potentially a good choice to develop their listening, especially with the added advantages of subtitled listening talks and transcripts in both native and target language, and the option of speed adjustment.

Thus, the study seeks to answer the question, *what are the participants' perceptions of the potential effectiveness of TED talks in developing their listening?*

Finding and Discussion

The research sought the participants' perception about the effectiveness of TED talks in developing their listening. The participants' responses to the reflection schedule were tallied and presented in percentage forms, as shown in Table 1 below:

Table 1: Percentages of the Participants’ Reflections

No.	Item	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %
1	The content of TED talks is appropriate	60	36	4	0	0
2	TED talks deliver clear message.	44	48	8	0	0
3	TED talks deliver concise message.	48	48	4	0	0
4	TED talks are appropriate for various participant levels.	53	36	8	3	0
5	TED talks are effective in teaching listening.	48	44	8	0	0
6	TED talks have potential as self 0learning opportunities.	48	48	4	0	0
7	TED talks have potential for fostering self 0confidence.	36	52	12	0	0
8	The English subtitles facilitate my comprehension of the talks.	26	68	4	2	0
9	The Arabic subtitles facilitate my comprehension of the talks.	36	60	4	0	0
10	The speed adjustment option in TED talks potentially fosters listening skill development.	32	68	0	0	0
11	The multiple accents in TED talks (parallel to those in the UN tests) contribute to better understanding of the listening section in the test.	28	64	8	0	0
12	With practice, understanding TED talks and the listening section in the UN test is made easier.	24	64	8	4	0
13	TED talks help learning the pronunciation of specialized police 0related words.	24	72	4	0	0
14	TED talks have the potential to make learning listening more enjoyable.	27	68	4	1	0
15	TED talks have the potential to develop listening faster and more effectively.	36	56	8	0	0
16	With practice, I no longer fear listening to foreigners and native speakers.	28	60	12	0	0
17	With practice, my note 0taking skills have improved considerably.	32	56	12	0	0
18	With practice, I am experiencing more success in listening comprehension.	47	48	2	3	0

No.	Item	Strongly Agree %	Agree %	Undecided %	Disagree %	Strongly Disagree %
19	I can generally understand the main points of extended discussion around me.	20	72	4	4	0
20	I can understand everyday conversations with relative ease.	28	64	8	0	0
21	I can generally understand the main points of a TV program on a familiar topic.	20	68	12	0	0
22	With practice, I am better able to distinguish the main from supporting ideas.	36	48	16	0	0
23	With practice, I am experiencing less tension in the listening section of the UN test.	28	64	8	0	0
24	The effective delivery of TED talks creates positive attitudes towards listening.	28	60	12	0	0
	OVERALL	34.87	57.16	7.25	0.70	0

Table 1 shows that the mass of the responses is concentrated on *strongly agree* and *agree* points of the scale, as the participants reported that the program has significantly improved their listening. They described it as interesting, effective, and useful, which may be seen as an indication of the utility of the program, especially with the absence of *strongly disagree* and *disagree* in their responses.

The results revealed that the participants were satisfied with the content, type, clarity, and utility of the program, which has both facilitated their understanding and fostered their vocabulary. The talks under study was relevant to UN and police-related content along with incidents and police-related vocabulary (e.g., drugs and gun violence, cybercrime, car accidents, cluster bombs, landmines).

The fact that each talk was on a single subject (e.g., if cars could talk, car accidents might be avoidable, the deadly legacy of cluster bombs) may have not only facilitated the participants' understanding but also provided them with a rich repertoire of specialized vocabulary on the particular topic (e.g., dead stop, slammed on brakes, the air bag deployed, the car is totaled, partially seen roads, lane and velocity, cluster bombs, limb, repercussion, displaced people, cluster sub-munitions, endure, physical trauma, Prosthetic leg, indiscriminate weapon, testimony and physiotherapy). The lack of prior knowledge in police-related vocabulary initially inhibited the participants' understanding of thescripts, but the program has reportedly helped them enrich their police vocabulary and improve their listening, as evident in the following excerpts:

> *Before, I know nothing about TED talks, but now, I can watch and listen to any topic not just police. The content is clear; I use subtitles when I don't catch the meaning. I knew a lot of police vocabulary (Participant9).*
>
> *I have learnt a lot of police vocabulary that I did not know before and how to use them in real-life situation not just memorizing them (participant5).*
>
> *The talks have increased my police vocabulary. I feel that my listening skill is better (Participant 17).*

These findings are consistent with Wang (2015) who maintained that listening scores were affected significantly by vocabulary knowledge since vocabulary is one of the obstacles to successful listening comprehension. The participants reportedly found TED talks appropriate in terms of level and content, which is also consistent with previous research findings (e.g., Buck, 2001; Dallinger, Jonkmann, Hollm&Fiege, 2016) which assert that appropriate content is a catalyst for listening development.

Furthermore, the participants reported that the instructional program catalyzed their self-study and independent learning beyond the classroom. This, coupled with the reports by most that the comprehensibility of the content has helped them not only enjoy learning but also build and foster their self-confidence in their ability and motivation to learn, may have contributed to their much–improved listening performance. The researchers claim that self-learning process ensures the quality of life-long learning and makes the learners more active, enthusiastic, and focused on their needs. The researchers observed that the participants' engagement in the listening activities and response to the reflections questions on each talk have prompted them toward diligence and further learning.

Watching TED talks, allowed the participants to do, learn, accomplish and persist to improve their listening, which positively reflected on their self-confidence and progress.

The participants also reflected on the merit of bilingual subtitles in facilitating their listening. The option of English and Arabic subtitles has reportedly not only given the participants more linguistic support butallowed them to monitor their comprehension and focus on details while the Arabic subtitles enabled them to check their understanding and make connection between Arabic and English.

These findings are consistent with research evidence (e.g., Hosogoshi, 2016) on the merit of subtitles as a potential scaffold for learning which reduces the learners' cognitive load and provides them with opportunities to analyze information and take advantage of the intended meaning in the target language. The adoption of subtitles was overtly recommended by most of the participants not only in police monitors courses but also in EFL courses, as shown in the following excerpts:

> *I think these subtitles must be used in all English courses and apply for all participants not only for police monitors courses (participants22).*
>
> *Before, listening to scripts without using the English and Arabic subtitles negatively affected my listening and note-taking skill, as I could not fully understand, but using the options available on TED talks made the scripts easy to comprehend. (Participant2).*

Similarly, the participants reported on the utility of the speed control option in developing their listening ability through practice customized to their own level and pace of learning. Most reported that at the early stages of program, they often repeated at slower speed to better grasp the ideas and difficult vocabulary, increasing the speech rate as they made progress, as shown infollowing excerpt:

> *The control of speech rate helped me a lot in listening and note-taking skill. I feel that I could control the text to suit my level(participants10).*
>
> *I have learnt a lot of police vocabulary and I knew their correct pronunciation which improved my listening skill and score. I used topronounce the word espionage with /a/ not with /a:/. (participant 9).*

This is consistent with substantial research evidence (e.g., Fushun, 2006; Robinson, Sterling,Skinner & Robinson, 1997; Wong, 1997) on the facilitative effect of speech rate on developing the second language listening comprehension and proper pronunciation.

Along the same lines, the multiple accents in the TED talks used in the program provided the participants with a slice of reality with both native and non-native accents, which would improve their chances of listening comprehension and, in turn, of passing the listening component of the UN test which is not recorded only in the American or British accents but rather in a host of other accents (e.g. Africans, Asians, Indians). Consider the following excerpt:

> *I think the accents that I listened to in TED talks helped me a lot in understanding what is said in UN listening tests (participant 4).*

This is consistent with Buck (2001) who indicated that listeners encounter critical difficulties in listening to unfamiliar accents. Pronunciation and listening are interdependent skills and go hand in hand (Celce-Murcia, 1987). The more the pronunciation of the words improved, the more is understood is the text. Through practicing listening toTED talks, the participants' listening improved as they became familiar with the pronunciation of more police-related terminology.There were a lot of police and UN-related vocabulary included in TED talks (e.g. drugs, gun violence, cybercrime, eyewitnesses, cluster bombs, mass violence, land mines, sex slavery, modern slavery) that the participants may have pronounced incorrectly, especially since many words are not pronounced the way they look (e.g., crime scene, caliber, malicious).

The researchers believe that the low success rate in UN listening test may be attributed to the mispronunciation of the police terminology which were taught incorrectly in previous education and inevitably became fossilized. In addition, the presence of many unfamiliar words in a text may inevitably lead to difficulties in comprehension. Watching TED talks has contributed to the development of the participants' listening through the recognition of the correct pronunciation of these vocabulary, hence improving the participants' listening and focusing on the correct pronunciation.

The participants reportedly found that TED talks, with the added features of subtitles and speed adjustment, relevant topics, and clarity of message delivery made listening more enjoyable, as their performance improved significantly and reflected positively on their self-confidence, as stated in the following excerpts:

> *Watching TED talks brought me enormous enjoyment as I could understand more through stopping and repeating the subtitles, going back to the context and adjusting the speech rate. (participant 3). The more I understand, the more I enjoy (participant 2).*
>
> *Watching TED talks makes listening and note-taking easier and enjoyable. I could answer more than half of the reflection question on each talk (Participant 7).*

Furthermore, tension plays a considerable role in UN listening test. The researchers believe that participants may not do well in the UN listening test because of the lack of ability to listen, lack of experience to manage time and stress. The repeated exposure to TED talks potentially reduced tension and created a relaxed, non-threatening atmosphere, as the participants practiced listening and, simultaneously, practiced test taking and time-management. The participants reported that they no longer experienced panic after practicing TED talks, as shown in the following excerpt:

> *In the UN test I am always worried as I think my future is based on the outcome of this test. We rarely listen to new police and UN topics narrated by foreign and native speakers. But now I feel better and more confident and the sense of panic has deceased. (Participant 5).*

This is consistent with Fang (2011) who reported that tension is quite possibly a deterrent of listening comprehension and a major obstacle facing the learning process in the EFL context.

Furthermore, the analysis of participants' responses to the interview questions provides further support for the findings of the reflection form.The first question in the interview addressed the participants' opinions about the contribution of TED talks in developing their listening skills. The analysis of their responses showed a consensus among the participants that the program has contributed to developing their listening. The novelty of TED talks may have contributed to the participants' favorable reflections, as most reported that this is their first introduction to TED talks, as shown in the following excerpts:

Watching TED talks is new and very meaningful I watch the talk with great interest and that improve my listening and note-taking skills (participant17)."

At first it was very difficult for me to understand English script. However, as I watched more TED talks, I came to understand them much better(participant7).

The talks cater for individual differences, as the participants were able to watch the content they like, use the instructional technology they prefer and proceed according to their own pace, which reflected positively on their understanding, satisfaction, and interest in listening, as shown in following excerpts:

Using TED is the best way for me to learn how to listen to English. I practiced watching TED talks alone at home; it is so exciting and gave me more interest and motivation. (participant 11).

Furthermore, the effective speech delivery and the multiple accents used in the talks played an important role in sparking the participants' interest since these accents were similar to those used in the UN listening tests, as shown in the excerpt below:

TED talks gave me many police topics and UNvocabulary and that attracted me greatly. This site helped me pick up the meaning of different accents which I could not understand before (participant7).

The second question in the interview addressed how the participants described their experience with TED talks, and if they recommend them to others. The participants reported that TED talks not only fostered their self-confidence but also helped them develop their listening, as shown in the excerpts below:

My listening skill developed because in the past I couldn't understand native speakers or even just listen to them. But now, I can watch these talks and use them effectively (participant7).

The program was useful and interesting because I touched that my listening has improved for the first time (participant 9).

In the past, I used to repeat the scripts too many times to understand what is said. But now, I can use the English and Arabic subtitles, the original script and the slower speech to understand or look for specific details (participant 25).

TED talks program is very good because it provides us with practical experience and specific procedures to understand the listening script (participant23).

The program is useful because it helps me to practice the listening skill to be a better listener (participant 20).

The third question in the interview addressed the participants' suggestions for improving the treatment and increasing its effectiveness in potential replication in other police monitors courses. The analysis of their responses showed that most of the participants were completely satisfied with the amount of instruction in which they were involved. They offered no suggestions for further improvement of the program. Even though, some asserted their need for more training on TED talks, as shown in the following excerpts:

We should have more training sessions on TED talks to improve the listening skill (participant 4).

We need more courses on TED talks to master listening skill, one month is not enough (participant 13).

The participants' keenness to receive further training may be attributed to the fact that training provided by The Peacekeeping Institute is generally based on limited, learned by heart listening scripts, which does not measure the participants' listening. Alternatively, TED talks include new topics, contents, new police- and UN- related vocabulary, narrated by multiple accents to meet the participants' needs, which made the talks more appealing, as the adoption of TED talks was overtly recommended by the participants not only in police monitors courses but also in English language course, as shown in these excerpts:

I think this training must be in general and apply for all levels of English language courses (participant19).

TED talks should be used with otherparticipants not only who involved in police monitors courses (participant8).

To summarize, the following themes were evident in the participants' responses to both the reflection and interview schedules:

1. The use of TED talks has contributed significantly to developing the participants' listening.
2. The use of TED talks has improved the participants' listening which may have reflected in increasing the participants' self-confidence.
3. The use of TED talks has helped to decrease the participants' anxiety toward listening to native speech, which may have reflected in improving listening needed to pass UN test.
4. The use of TED talks has increased the participants' motivation for listening.
5. The option of speed adjustment has been reported as instrumental in enhancing their understanding of the text.
6. The use of subtitles in both English and Arabic languages has been reported to affect positively the participants' listening. This has reportedly made their listening easier and more enjoyable and has positively affected their self-confidence.
7. The participants described the program as interesting, effective, and useful, and their experience as novel and successful. They recommended EFL learners, not only the participants in the police monitors courses, who want to develop their English in general and listening in particular to utilize these talks as they have been in the treatment.

Conclusions and Pedagogical Implications

Based on the findings, TED talks may very well be a catalyst for developing the listening performance of police participants on the UN listening test, as the findings suggest a positive effect on prospective UN police monitors listening performance and overall satisfaction with the treatment.

TED talks seem to be a viable source of content for EFL listening instruction in police circles, which may be extended to other fields and disciplines. The researchers claim that utilizing TED talks in teaching listening should be included in EFL curricula of English language learners in general and police monitors

courses in particular. It is worth mentioning that supplementing the police monitors courses with relevant TED talks may enable the participants to achieve better in listening.

Factors of increasing police personnel's motivation for learning English in general and listening in particular should be promoted through alternative instructional treatment such as the one used in this research which may need to be supplemented by further research on other language skills and over a longer period of time (e.g., a whole course in the police language institute or peacekeeping institute).

References

Aldohon, H.I. (2014). English for specific purposes (ESP) for Jordanian tourist police in their workplace: Needs and problems. *International Education Studies,* 7(11), 56-67. Retrieved 30 June 2018 from https://files.eric.ed.gov/fulltext/ EJ1071024.pdf.

Alnaouachi, Q. (2010).*TheUse of Information Technology and Communication in Education*. Amman: Dar Wael for Publication.

Amory, A. (2007). It's not about the tool, it's about the ideology. *South African Journal of Higher Educatio*n, 21(6), 657-673.

Baniabdelrahman, A.A., Bataineh, R.F., &Bataineh, R.F. (2007). An exploratory study of Jordanian EFL students' perceptions of their use of the Internet. *Teaching English with Technology,* 7(3). Retrieved 2 July 2018 from http://tewtjournal.org/issues/past-issue-2007/past-issue-2007-issue-3.

Bataineh, R.F., &Baniabdelrahman, A.A. (2006). Jordanian EFL students' perceptions of their computer literacy. *International Journal of Education and Development Using Information and Communication Technology*, 2(2), 35-50. Retrieved 2 July 2018 from http://ijedict.dec.uwi.edu/viewarticle.php?id=169&layout=html.

Bataineh, R.F., Al-Hamad, R.F., & Al-Jamal, D. (2018). Gender and EFL writing: Does WhatsApp make a difference? *Teaching English with Technology*, 18(2), 21-33.

Bernard, E. (1996). *Teacher Education Redesign Competencies in Educational Technology.* [Washington, D.C.] : Distributed by ERIC Clearinghouse, http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED192770.

Buck, G. (2001). *Assessing Listening*. Cambridge: Cambridge University Press.

Burleson, B. (2011). A Constructivist Approach to Listening. *International Journal of Listening*, 25 (1), 27-46.Retrieved10March2019 fromhttps://www.tandfonline.com/doi/abs/10.1080/10904018.2011.536470.

Celce-Murcia, M. (1987), Teaching Pronunciation as Communication. In J. Morley (Ed.), Current Perspectives on Pronunciation (5-12). Washington, D.C.: TESOL.

Chang, A.C. &Millett, S. (2014). The Effect of Extensive Listening on Developing L2 Listening Fluency: Some hard evidence. *ELT Journal*, 68 (1), 31–40.

Chawla, S., Dietze, S., Marenzi, I. &Fetahu, B. (2015). Exploring TED Talks as Linked Data for Education. *British Journal of Educational Technology*, 46, (5), 1092–1096.

Cheung, Y. (2010).The Importance of Teaching Listening in the EFL Classroom. Retrieved3 April 2018 from https://files.eric.ed.gov/fulltext/ED512082.pdf.

Dallinger, S., Jonkmann, K., Hollm, J. & Fiege, C. (2016). The Effect of Content and Language Integrated Learning on Students' English and History Competences – Killing two birds with one stone. *Learning and Instruction*, 41, 23-31.

El-Koumy, A.(1997). Effect of Cloze Instruction in EFL Listening Comprehension. *ERIC Clearinghouse*. Retrieved 12 June 2018 fromhttp://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED411702.

Fang, X. (2011). Anxiety in EFL Listening Comprehension. *Theory and Practice in Language Studies*, 1(12), 1-3.

Field, J. (2002). The Changing Face of Listening. In J. C. Richards & W. A. Renandya (Eds.), *Methodology in Language Teaching: An Anthology of Current Practice* (242-247). Cambridge, England: Cambridge University Press.

Flowerdew, J. & Miller, L. (2005) *Second Language Listening: Theory and Practice*. Cambridge: Cambridge University Press.

Fréchette, L. (2012). UN peacekeeping, twenty years of reform. CIGI papers. Retrieved 20 March 2019 from:https://www.cigionline.org/sites/default/files/un_peacekeeping_1.pdf.

Fushun, L. (2006). *Faster, Normal or Slower? The Effects of Speech Rates on High-Intermediate ESL Learners' Listening Comprehension of Academic Lectures*.Retrospectivetheses and Dissertations.

Gottlieb, M. H. (2006). *Assessing English Language Learners: Bridges from Language Proficiency to Academic Achievement*. Thousand oaks', California: Corwin press.

Griffiths, R. (1992). Speech rate and listening comprehension: Further evidence of the relationship. *TESOL Quarterly*, 26(2), 385-390.

Hashimoto, S., Fukuda, E. & Okazaki, H. (2015). Improving summarizing skills with TED talks: An account of a teaching lesson using explicit instruction. In F. Helm, L. Bradley, M. Guarda, & S. Thouësny (Eds.), *Critical CALL – Proceedings of the 2015 EUROCALL conference, Padova, Italy, 228-234.* Research-publishing.net. http://dx.doi.org/10.14705/rpnet.2015.000338

Hill, B. & Slater, P. (1998). Network technology and language learning. *Education Technology*, 40(8), 374-379.

Hosogoshi, K. (2016). Effects of captions and subtitles on the listening process: Insights from EFL learners' listening strategies. *The JALT Call Journal*, 12 (3), 153–178.

Hye, Y. & Kyung, W. (2015). Effects of shadowing using TED on EFL learners'.

Jaradat, K. (2008). *The Role of Islamic Education in the Rationalizing of the Effects of Communication and Information Revolution.* Unpublished doctoral dissertation: YarmoukUniversity. Irbid, Jordan.

Karia, A. (2013). How to open and close a TED talk. Retrieved 20 July 2018 from:https://akashkaria.com/wp-ontent/uploads/2014/01/HowtoOpenandCloseaTEDTalk.pdf

Keser, H., Huseyin, U. &Ozdamli, F. (2011). The trends in technology supported collaborative learning studies in 21st century. *World Journal on Educational Technology*, 3(2), 103-119.

Khuziakhmetov, A.N., &Porchesku, G.V. (2016). Teaching listening comprehension: Bottom-Up Approach. *International Journal of Environmental and Science Education*. 11(8), 1989-2001.

Koren, S. (1997). Listening to lectures in L2: Taking notes in L1. *TESL-EJ*, 2(4).Retrieved 30 June 2018 from: http://www.tesl-ej.org/wordpress/issues/volume2/ ej08/ej08a1/.

Kurt, S. (2010). Technology use in elementary education in Turkey: A case study. *New Horizons in Education*, 58(1), 65-76.

Lewkowicz, J. (1991). Testing listening comprehension: A new approach. Hongkong. *Papers in Linguistics and Language Teaching*, 14, 25-31.

Li, Y., Gao, Y., & Zhang, D. (2015). To speak like a TED speaker. A case study of TED motivated English public speaking study in EFL teaching. *Higher Education Studies*. 6(1), 53-59.

Ludewig, J. (2017). TED talks as an emergent genre. Comparative Literature and Culture 19 (1), 1-9. Retrieved 20 July 2018 from: https://docs.lib.purdue.edu/clcweb/vol19/iss1/2/

Miller, R., & Lake, R. (2012). Federal barriers to innovation. Seattle University of Washington Center on Reinventing Public Education. Retrieved 10 September 2017from http://www.crpe.org.

Nunan, D. (2002). Listening in language learning. In J. C. Richards & W. A. Renandya (Eds.), *Methodology in Language Teaching: An Anthology of Current Practice*, (238-241). Cambridge: Cambridge University Press.

O'Connor, J. D. (1998). *Better English pronunciation*.Cambridge: Cambridge University Press.

Obari, H., &Lambacher, S. (2014). Impact of a blended environment with m-learning on EFL skills. *Proceedings of the 2014 EUROCALL Conference* (pp.267-272), University of Groningen, The Netherlands. Retrieved 30 June 2018 from https://files.eric.ed.gov/fulltext/ED565115.pdf

Ottenbreit, A., Glazewski, K.D., Newby, T.J., &Ertmer, P.A. (2010). Teacher value beliefs associated with using technology: Addressing professional and student needs. *Computers & Education*, 55(3), (1321-1335).

Pasupathi, M. (2013). Analyzing the effect of technology-based intervention in language laboratory to improve listening of first year engineering students. Profile: Issues in Teachers´ professional Development, 15(1), 125-138. Retrieved 4 April from https://revistas.unal.edu.co/index.php/profile/article/view/37873/40580

PETRA. (2014). Envoy highlights Jordan's peacekeepingcontributions. The Jordan Times. Retrieved 10 October 2017 fromhttp://www.jordantimes.com/news/ local/un-envoy-highlights jordan%E2%80%99s-peacekeeping-contributions

Rank, R., Jef, C.& Patrick, J. (2014). Should TED talks be teaching us something*? American Journal of Pharmaceutical Education. 78, 6,* Article 113.Retrieved 11 March 2018 fromhttps://www.ajpe.org/doi/abs/10.5688/ajpe786113.

Richards, J. C. (2008). *Teaching Listening and Speaking*. Cambridge: Cambridge University Press.

Robinson, S.L., Sterling, H.E., Skinner, C. H. & Robinson, D.H. (1997). Effects of lecture rate on students' comprehension and ratings of topic importance. *Contemporary Educational Psychology*, 22, 260-267.

Rodinadze, S. &Zarbazoia, K. (2012).The advantages of information technology in teaching English language. *Frontiers of Language and Teaching*, 3, 271-274.

Rodri'guez, M. (2012). The importance of teaching speaking and listening skills. Retrieved 18 September 2017 from https://www.ucm.es/data/cont/docs/119-2015-03-17-12.RocioSeguraAlonso2013.pdf.

Rost, M. (2005). L2 listening. In E. Hinkel (Ed.), *Handbook of Research inSecond Language Teaching and Learning* (503-527). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Rubin, J. (2011). A review of second language listening comprehension research. *The Modern Language Journal*, 78(2), 199-221.

Ruthern, K.,Hennesy, S.,&Deany, R. (2005). Incorporation of Internet resources into classroom practice. *Computers& Education*, 44(1), 1-34.

Schmidt, A. (2016). Listening journals for extensive and intensive listening practice. *English Teaching Forum*, 54(2), 2-11. Retrieved 30 June 2018 from https://files.eric.ed.gov/fulltext/EJ1104020.pdf.

Skills you need (n, d). Listening. Retrieved 15 March 2019 from https://www.skillsyouneed.com/ips/listening-skills.html#ixzz3HCNoQGlL.

Smidt, E. &Hegelheimer, V. (2004). Effects of online academic lectures on ESL listening comprehension, incidental vocabulary acquisition, and strategy use. *Computer-Assisted Language Learning*, 17(5), 517-556.

Takaesu, A. (2013). TED talks as an extensive listening resource for EAP students. *Language Education in Asia*, 4(2), 150-162.

TED talks (2014). Our organization. Retrieved 10 September 2017 from https://www.ted.com/about/our-organization

Thorn, S. (2009). Mining listening texts. Modern English Teacher, 18(2): 5–13.

Turgut, G. (2011). A case study on the use of one-to-one laptops in English as second language classrooms. *Turkish Online Journal of Qualitative Inquiry*, 3(4), 28-47. Retrieved 10 December 2016 from http://www.eric.ed.gov/ERICWebPortal/ detail?accno=ED537755.

Valeeva, R.A., Aitov, V.F., &Bulatbayeva, A.A. (2016). The levels of English language acquisition on the basis of problem-solving and product-oriented tasks in the multilingualsocial medium. *Mathematics Education,* 11(1), 255-262.

Vandergrift, L. (1999). Facilitating second language listening comprehension: Acquiring successful strategies. ELT journal, 53(3), 168-176.

Wang, S. (2015). An empirical study on the role of vocabulary knowledge in EFL listening comprehension. *Theory and Practice in Language Studies, 5*, (5), 989-995.

Wallace, M. (2010). Searching for a new approach to listening. *Accents Asia*, 5(1), 8-22. Retrieved13 March 2018 fromhttp://www.issues.accentsasia.org/issues/5-1/wallace.pdf.

Wingfield, A. (2000). Speech perception and the comprehension of spoken language in adult aging. In D. Park & N. Schwarz (Eds.), *Cognitive Aging: A Primer*, (175–195). Philadelphia, Pennsylvania: Psychology press.

Woodall, B. (2010). Simultaneous listening and reading in ESL: Helping second language learners lead (and enjoy reading) more efficiently. *TESOL Journal*, 1(2), 186-205.

Wong, R. (1997). *Teaching Pronunciation: Focus on English Rhythm and Intonation*. Englewood Cliffs, New Jersey: Prentice Hall Regent

Wong, D., Jhaveri, A. (2015). *English Language Education in a Global World: Practices, Issues and Challenges*. Nova Science Publishers, Inc.

Xiaojun, H. &Leshan, N. (2015). CAI and its application in rural junior English class.*English Language Teaching*, 8(11) 11-16.

Xiaoqiong, H. &Xianxing, J. (2008). Using film to teach EFL students English language skills. *Changing English*, 15(2) 235-240.

Yaniawati, P. (2013). E-Learning to improve higher order thinking skills (HOTS) of Students. *Journal of Education and Learning*, 7(2) 109- 120.

Yunkul, C. (2010). The importance of teaching listening in EFL classroom. Retrieved 20 December 2016 from http://files.eric.ed.gov/fulltext/ED512082.pdf.

Collaborative virtual community to share class plans for STEAM education

Isabela Silva, Simone Bilessimo, Gustavo Alves, Josiel Pereira, Juarez Silva, João Bosco Alves

Abstract

This research presents an international community of practice for teachers using the VISIR remote lab. Throughout the research, it was necessary to study about communities of practice and their potential use in remote laboratories; identify practices with collaborative potential in the institutions and with the participating teachers; develop the necessary technological environment to support the proposed community of practice; validate the proposal with four institutions (four countries - Brazil, Portugal, Spain and Argentina) to evaluate the proposed model. The motivation for developing this research came from the history of the Remote Experimentation Laboratory (REXLAB) with the project VISIR+: Educational Modules for Electric and Electronic Circuits Theory and Practice following an Enquiry based Teaching and Learning Methodology supported by VISIR+". The VISIR + project is an international cooperation project with the participation of 21 Ibero-American partner institutions between October 2015 and April 2018. The platform, called Labs4STEAM, was developed using Dokuwiki, an open source wiki software that contains a large number of plugins. From the data collection it was possible to receive a mostly positive feedback, but several improvement opportunities were pointed out, which will be performed soon. Thus, from the developed platform one can plan future work, taking into account the results obtained and experience and partnerships with the VISIR + project.

Keywords: Community of practices. Remote Laboratories. Virtual Online Environment. STEAM.

1. Introduction

The popularization of Information and Communication Technologies allows the creation and discovery of new tools and possibilities previously difficult to explore, as digital resources break down barriers such as distance, time and space (SILVA ET AL, 2019). One of the biggest opportunities was the opening of new online applications in network environments (DIONIZIO ET AL, 2018). The Internet is today the most widely accessed platform that millions of people today, anywhere, anytime access daily (RODRIGUES, 2018).

Tools that provide teacher-focused collaborative environments enable teachers to work together to share classroom experiences. Therefore, participation in a community expands the innovative potential of a teacher who already has access to technology and facilitates the process of adapting a lay teacher in relation to these resources, as there is a whole new possibility for discussion, exchange of tips and learning (FERREIRA E SILVA, 2014).

One of the clearest definitions of the concept of Community of Practice (CoP), which is widely

cited, was elaborated in a research by Étienne Wenger (2002), creator of the concept. This definition states that communities of practice are groups of people who share an opinion, a set of problems, or an admiration for a topic in order to deepen their knowledge and experience in this area through interactions with others. (WENGER, MCDERMOTT E SNYDER, 2002). Thus, the concept of communities of practice covers a peer work perspective, as opposed to an individualistic perspective.

For Mikkelson (2016), the establishment of communities of practice allows the socialization of knowledge in order to positively modify the performance of organizations. In addition, this type of practice enables all members of a team to be able to understand the roles of other members in order to avoid miscommunication, which often happens when an individual does not know who to contact during a moment of doubt (QUIGLEY, 2015).

For Williams (2016), communities of practice are groups of people who share a skill or profession and are created specifically for the purpose of gaining knowledge and improving practices related to their area of knowledge. Smith, Hayes, and Shea (2017) define community of practice as a knowledge management approach applicable to a variety of contexts, including organizations, organizational design, government, education, and civic life.

The construction of the concept of communities of practice is based on learning and its dimensions and can be seen as a social learning system (FERNANDES ET AL, 2016). For Wenger (2010), social scientists have used versions of the concept of communities of practice for a variety of analytical purposes, even though their origin and use of the concept are found in the area of learning theory.

Therefore, the concept of community of practice fits in well with the development of a collaborative online environment suitable for teachers, since the framework allows teachers to interact both teaching and learning, allowing them to share their own experiences, also understand your colleague's experience and know how to replicate it, advise it, and work not only in a team but in a community way.

Participation in a community expands the innovative potential of a teacher who already has access to technology and facilitates the process of adapting a lay teacher in relation to these resources, as there is every possibility of discussion, exchange of tips and learning. Registered teachers can submit their classroom practices to the environment and other teachers can access them and talk about their application.

From the research, we sought to develop a tool for teacher interaction, allowing teachers to share lesson plans with partners from different parts of the world, and sharing experiences. Initially, the platform was designed to house lesson plans that made use of the remote VISIR laboratory, a tool aimed at supporting the teaching of theory and practice in electrical and electronic circuits. However, it became more interesting to expand the platform's audience, making room for lesson plans that made use of not only other remote labs, but also simulations.

A remote laboratory is a type of experimentation in which the experimental apparatus and the user are physically separated, and the execution of the experiment depends on a means of communication (Internet) between the user and the remote laboratory, usually through a user interface (FIDALGO ET AL, 2014). Therefore, a student accessing a remote laboratory will have an experience very similar to that of accessing a traditional laboratory, since the result of his experimentation will vary depending on the current conditions of the environment where it is applied.

The remote laboratory, which aims to support the teaching of theory and practice of electrical and

electronic circuits, was widespread throughout Europe, so teachers using the tool had a lot of experience to add to new teachers. From this assumption came the idea of spreading the use of VISIR in Latin America.

The VISIR + project was an international collaboration project supported by the European Commission under contract 561735-EPP-1-2015-1-EN-EPPKA2-CBHE-JP in the Erasmus + program during 2015 to 2018. The project was started at the Blekinge Institute of Technology (Sweden) to disseminate the use of the VISIR remote laboratory to Latin America.

Among the institutions selected for participation in the project were the European Polytechnic Institute of Porto (IPP) in Portugal; Blekinge Institute of Technology (BTH), Sweden; National University of Distance Education (UNED) and University of Deusto, Spain. Among the Latin American institutions were the Brazilian Federal University of Santa Catarina (UFSC), the Federal Institute of Santa Catarina (IFSC) and the Pontifical Catholic University of Rio de Janeiro (PUCRJ) and the Argentine National University of Rosario (UNR).

At the Federal University of Santa Catarina, work on VISIR + was carried out within the Remote Experimentation Laboratory (RExLab), a research group founded in 1997 to promote the use of educational technologies and digital inclusion.

This research aims to present the development and testing of a virtual practice community aimed at teachers of STEAM (Science, Technology, Engineering and Mathematics) disciplines in order to promote discussion and sharing of lesson plans among teachers. On this platform, called Labs4STEAM (Labs for STEAM), teachers from around the world can submit their lesson plans, download class plans from classmates and discuss online. The elaboration of the platform allows the sharing of lesson plans that make use of both VISIR and other remote labs and even simulations. The tool allows knowledge and practice sharing, allowing a bridge between several educational institutions around the planet. Therefore, such a tool opens an opportunity for sustainability of the VISIR + project.

2. Methodological procedures

This section aims to present the methodological procedures taken to carry out the present research.

2.1 Classification of the Research

The table below presents the procedures adopted. Thus, it is expected that, with the information presented here, the study will be understood more clearly and can be replicated more easily by other researchers:

ASPECTS	CLASSIFICATION
Nature	Applied research
Problem Approach	Qualitative research
Objectives	Exploratory research
Technical Procedures	Bibliographic research and case study

Table 1. Classification of the Research

Considering the nature of this research, it fits in as applied because it is concerned with the generation of knowledge to solve real-life problems, involving local truths and interests (PRODANOV E FREITAS, 2013).

Qualitative research somehow establishes "a dynamic relationship between the real world and the subject, that is, an inseparable link between the objective world and the subjectivity of the subject that cannot be translated into numbers" (SILVA E MENEZES, 2005, p.20). In this category, the environment itself is considered a direct source for data generation and the researcher, a key instrument (PRONADOV E FREITAS, 2013).

Regarding the classification of the research according to its objectives, Gil (2002) and Silva and Menezes (2005) classify the research into three major groups: exploratory, descriptive and explanatory. According to Gil (2002), the explorations aim to make the problem more familiar, making it more explicit to the researcher. Freire (2013) agrees by explaining that this type of research promotes a first contact with the theme, seeking to clarify the related facts and phenomena. Usually this type of research is performed when there is little knowledge about the subject (ALMEIDA, 2011).

Corroborating with the authors Marconi and Lakatos (2010, p.158), the bibliographic research is seen as "a general overview of the main works already carried out, of important importance, for being able to provide current and relevant related data". In Freire's (2013) view, the bibliographic survey is intrinsic in scientific research, thus, all academic works are somehow framed as bibliographic. In this sense, this work is intrinsically linked to this procedure.

Given the profile of the activities developed, it is possible to define the research regarding the technical procedures as "case study", although the research provides interaction between the researchers involved in the investigated situations, which could also allow its classification as a "participant research". According to Yin (2010), a case study is an empirical research that investigates a contemporary phenomenon within its real life context, especially when the boundaries between the phenomenon and the context are not clearly defined.

2.2 Research steps

The following figure presents the search steps:

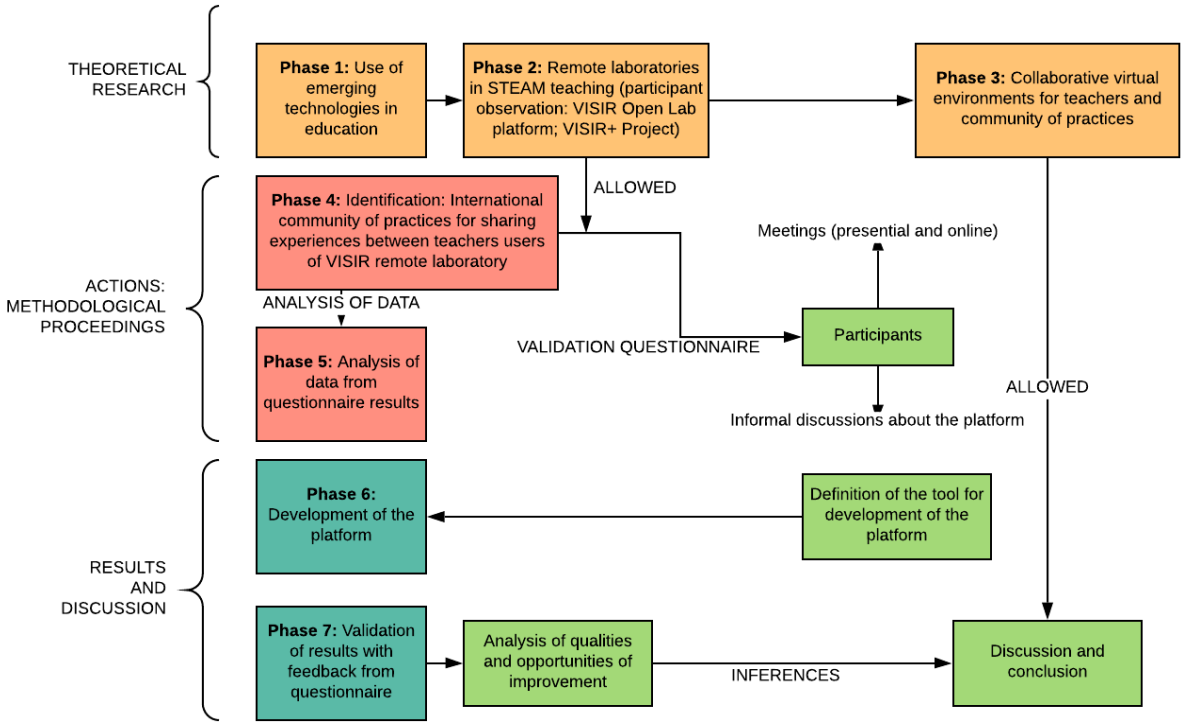


Figure 1. Research Steps

The first stage was dedicated to prepare a bibliographic foundation for the research base. Research was conducted on the main concepts related to this work, such as Communities of Practices, Remote Laboratories, Collaborative Virtual Platforms, among others.

Simultaneously, it was time to begin the elaboration of academic works related to the process of development of this work, reporting from the results of the bibliographic research, to the development of the platform, among other themes identified as relevant for publication.

After the bibliographic research was elaborated, it was possible to start the development process of Labs4STEAM.

Right after having this initial idea of the platform, it was time to make an initial contact with potential partners. To this end, a series of field research was carried out in order to hold meetings on the sustainability of the VISIR + project, where the need to create a platform for sharing practices with the remote VISIR laboratory was fitted.

After the development of the platform and initial contact with partners, it was time to apply the platform test questionnaire sent to all experts involved with its use. Soon after receiving all the answers, it was time to analyze and tabulate them.

With the conception of the results, it was time to write the conclusion of this work. After the conclusion of the conclusion, it was possible to prepare academic papers for publication based on the results of this study.

2.3 Procedures: Data Collection

The data collected for the research were collected from the case study. Thus, the data were analyzed in the qualitative analysis style.

According to Gil (2007), the analysis process allows the researcher to understand the phenomenon

by examining the situations that involve it.

Thus, to achieve the objectives proposed in this research, a questionnaire was prepared based on the work "Guidelines for the Evaluation of the Learning Objects Usability" (SILVEIRA E CARNEIRO, 2012). The authors of this paper have developed guidelines based on theoretical studies and learning object analysis by a technical team and teachers involved in the production of learning objects. From a theoretical framework study and case study with teacher training, a list of guidelines for the evaluation of the usability of learning objects was elaborated (SILVEIRA E CARNEIRO, 2012).

Silveira and Carneiro (2012) on the elaboration of the guidelines:

> The production of Oas can be performed using various conceptual, pedagogical or operational models, depending on the scope and institutional arrangements of the producing entity. In the context of this work, seven conditions are considered for a given educational resource to be considered a learning object and, based on these essential conditions, the guidelines for evaluating proposed learning objects were organized.
>
> (SILVEIRA E CARNEIRO, 2012, p.4)

The "Clearly explain a pedagogical objective" guidelines provide clear guidelines for the student to know what they are expected to learn to use the learning object and the teacher (unlike who produced the object) to know how to use it (SILVEIRA AND CARNEIRO, 2012).

The following are the guidelines:Apresentar uma contextualização inicial, descrevendo o tema/conteúdo tratado no objeto

- Present the pedagogical objective related to the use of the object
- Present the expected usage context for the object
- Highlight how the object could be pedagogically explored
- Provide supplemental material, preferably from the authoring team
- Among others

The guidelines related to "Prioritize the digital" prioritize the development of learning objects that do not need, for their use, application or program that is not freely available on the web (SILVEIRA E CARNEIRO, 2012). The following are the guidelines:

- Explain what software is required for object execution
- Take accessibility issues into account, enabling keyboard navigation
- Take accessibility issues into account, allowing the object to work in different browsers (or alerting the user if it does not)
- Avoid making available files (only) in PDF format, for presentation of the object and / or material complementary to its use, which are inaccessible via screen readers.
- Avoid providing external links that are not authored by the production team and thus cannot guarantee their permanence over time.
- Among others

The guidelines related to "Providing assistance to users" provide user assistance via the interface and easily accessible instructions (SILVEIRA E CARNEIRO, 2012). The following are the guidelines:

- Provide clear indications on how the object is used, indications available on the user interface itself and / or easily accessible from it.
- Use language appropriate to the user type and object application domain
- List specific (domain) terms when the objective is to broadly diffuse the object and it can be used in different areas.
- Provide short and explanatory statements
- Present constructive error messages that allow the user to redo their choices without interrupting the use of the object.
- Among others

The guidelines related to "Providing interactivity" provide error prevention (disabling what cannot be done, presenting specific data entry formats when necessary) (SILVEIRA AND CARNEIRO, 2012). The following are the guidelines:

- Provide error prevention (disable what you cannot do, display specific data entry formats when needed)
- Provide easy-to-remember forms of use / interaction, not excluding the need for accessible instructions at all times
- Explore the resources of the technologies employed (hypertext, flash, video, etc.)
- Use a standardized and easy-to-understand sequence of actions.
- Use resolution and format of web-compatible images and videos
- Among others

"Providing interaction" guidelines Allow actions among users (students, teachers, tutors, etc.) from and /or on the object (SILVEIRA E CARNEIRO, 2012). The following are the guidelines:

- Provide options for sharing results with teachers, peers, or the wider community (for example, using a blog to make it available and maintain)
- Provide discussion channels among your users
- Specify interaction activities among students among the activities intended for the use of the object.

The guidelines related to "Provide constant feedback" keep the user always informed of the current state of their interaction with OA (SILVEIRA E CARNEIRO, 2012). The following are the guidelines:

- Provide clear indications of what the user should do to proceed to next steps of object use (next step messages)
- Open files external to the object context in new tabs, warning the user that this will happen before they perform the action.
- Always keep the object name visible
- Allow the user to fully view questions that were hit / miss when using quizzes and / or exercises and allow them to go back and try again and / or restart

- Explain in case of questionnaires and / or exercises resolution how the assessment
- Among others

The guidelines related to "Being self-contained" require that the object must focus on a particular subject and explain it without necessarily relying on other objects and / or materials (SILVEIRA E CARNEIRO, 2012). The following are the guidelines:

- Select the appropriate amount of information that represents the specific content of the object.
- Present content in a way that does not address other subjects and distract student attention
- Not require the search for external information to understand the activities and contents presented in the object.

To adapt to the case study questionnaire developed in this paper, each set of guidelines has been separated into sections using the free Google Forms platform (https://www.google.com/forms/).

The questionnaire was emailed to a list of 11 experts with experience in the VISIR + project. These specialists should be researchers with experience in the VISIR + project. They could be teachers or professionals in the field of educational technologies and could live in any of the countries where the project was applied.

4. Results

4.1 Results: The Labs4STEAM Platform

The Labs 4 STEAM platform was developed using Dokuwiki, an open source wiki software containing a large number of plugins (GOHR, 2017). According to Dokuwiki's official website homepage (2018), the software is admired by its users for its clean and easy-to-read syntax, as well as its easy maintenance, backup and integration. Built-in access control and authentication connectors make Dokuwiki especially useful in the corporate context and the high number of plugins built collaboratively by your community (DOKUWIKI, 2018).

Initially, the platform would only provide access to lesson plans related to the use of the remote VISIR lab. However, in thinking about the platform's expansion and greater popularity among its future users, it was decided that the platform would also accept other remote labs, and in the future even simulations.

The platform was developed during the first half of 2018 and is available for access in September 2019 and is available at: http://labs4steam.rexlab.ufsc.br/

A difference in permissions has been established between registered users and visitors to strengthen the platform's security and to prevent possible interventions by an unselected audience to use it. Only teachers may discuss and submit new practices. The administrator checks each platform registration request.

The platform is available in English, Portuguese and Spanish. However, for purposes of limitation, not all practices are available in all languages. The platform allows the translation of its interface, but not the content posted manually by the user. Therefore, it was proposed to users that the platform is willing to

receive volunteers who can translate the practices into other languages. The following flow chart presents the activities that a teacher can perform when using the platform.

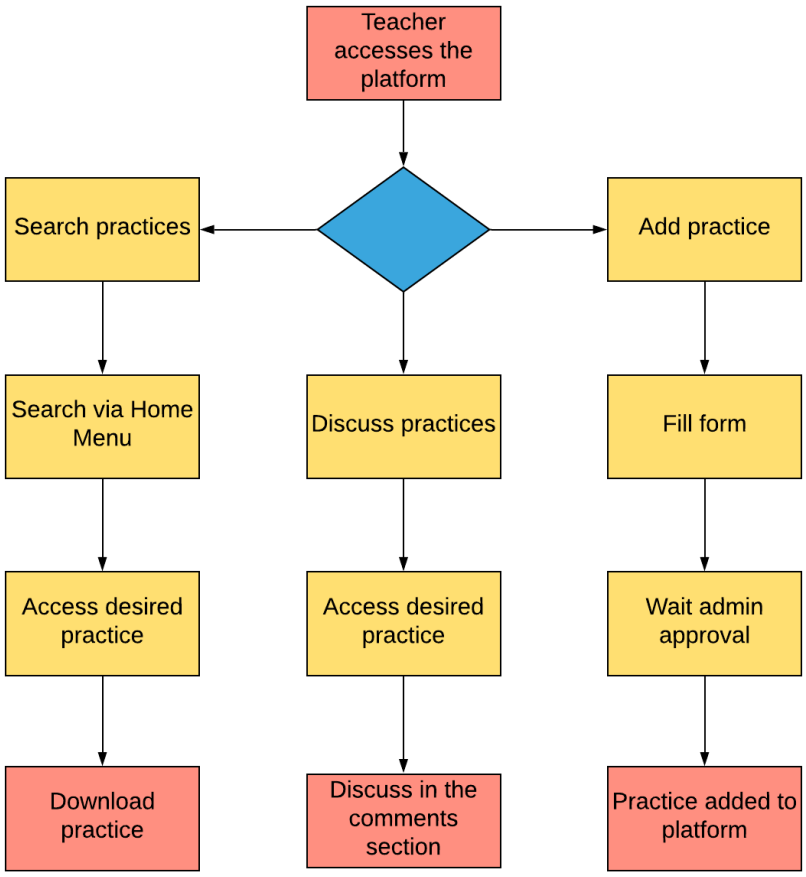


Figure 2. Roles that the teacher can perform on the platform

Following are some screenshots of the platform. Below is the Portuguese home screen, with introductory text, links to the official REXLAB website and its products, and information on how to submit practices for publication on the site, as well as instructions for registering on the platform.

The following figure shows the Labs4STEAM home screen in Portuguese. Alternatives to other languages are still open as translation will be done voluntarily by platform users. The home page displays the following introductory text:

"Labs 4 STEAM: Collaborative Virtual Environment for Sharing Teaching Experiences for STEAM Disciplines

Hello teacher! Welcome to Labs 4 STEAM, the ideal place to share STEAM lesson plans for free. Do you know what STEAM is?

STEAM: Acronym for Science, Technology, Engineering, Arts and Mathematics - or Science, Technology, Engineering, Arts and Mathematics

In this way, the teacher of Mathematics, Arts, Physics, Chemistry, Informatics, Robotics, Sciences, among others can find in Labs 4 STEM a place to discuss lesson plans.

On this platform you can:

Share lesson plans

Download lesson plans from others (to download the desired lesson plan, click on “ODT EXPORT” in the black sidebar)

Dialogue and meet fellow teachers

Start browsing:

Create Registration (You can browse the platform without a registration, but you will need one to participate in discussions)

Search by course

Submit lesson plan

About Labs4STEM "

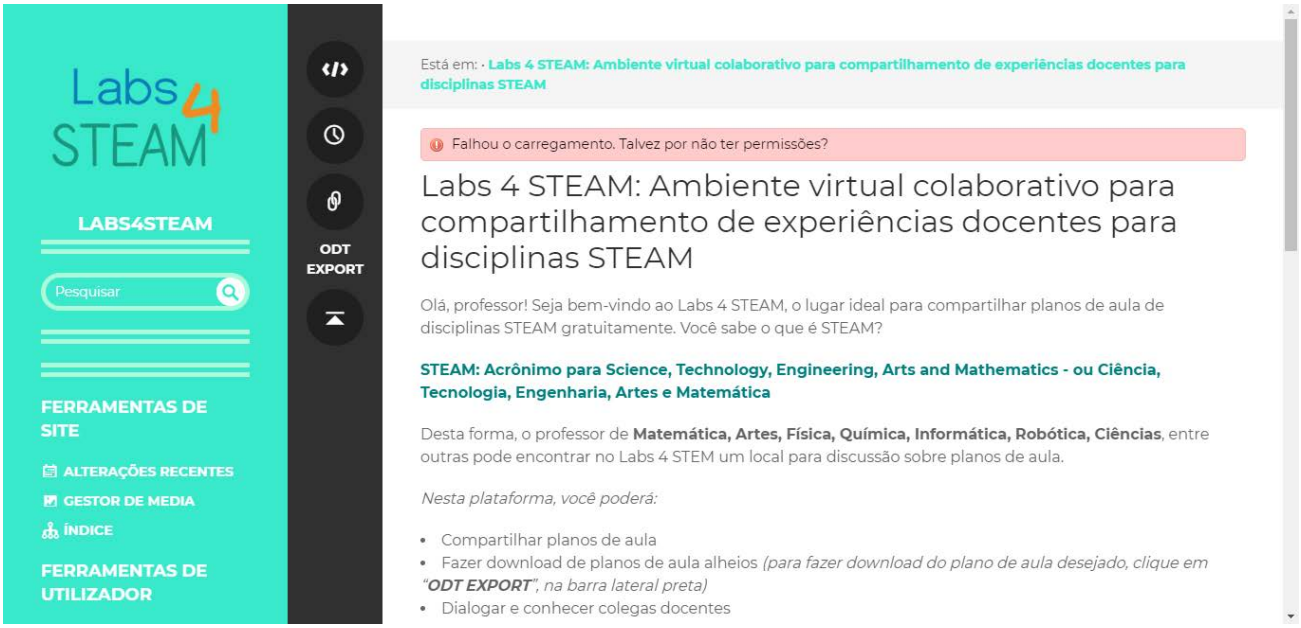


Figure 3. Platform home screen

The following screen presents the Labs4STEAM comment section. This is a space for discussion where teachers can ask questions and compliment and improve opportunities to the lesson plans exposed on the platform. This section is present on all pages of the platform, featuring comments intended for each of these pages.

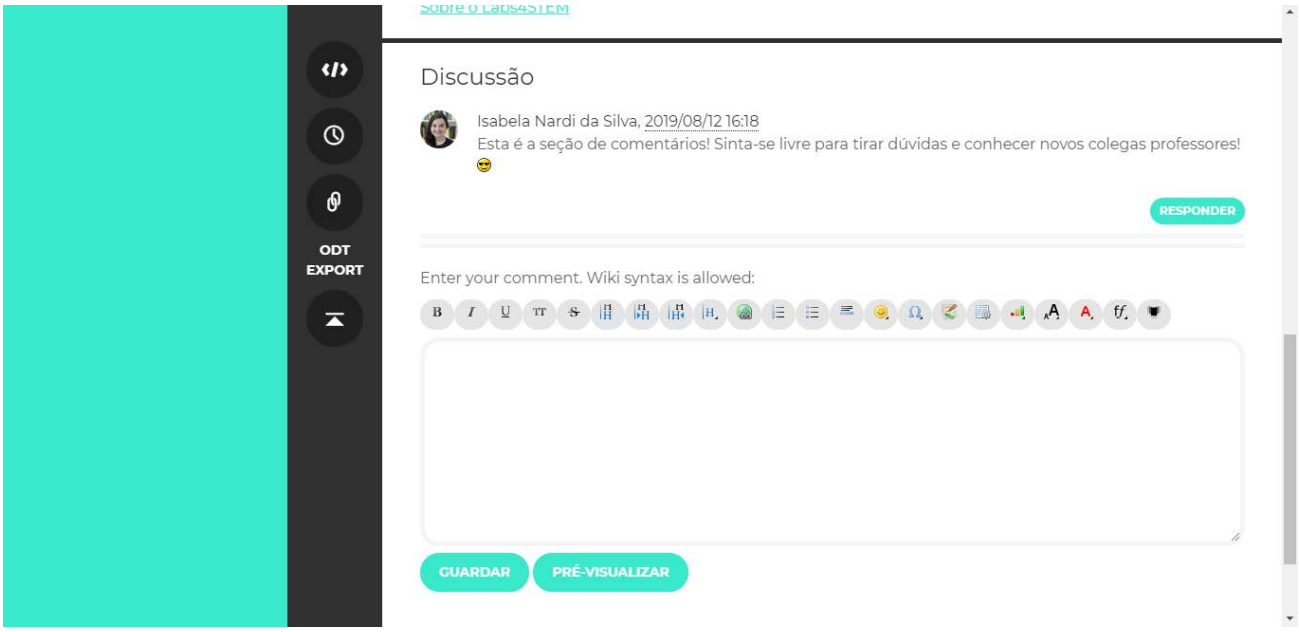
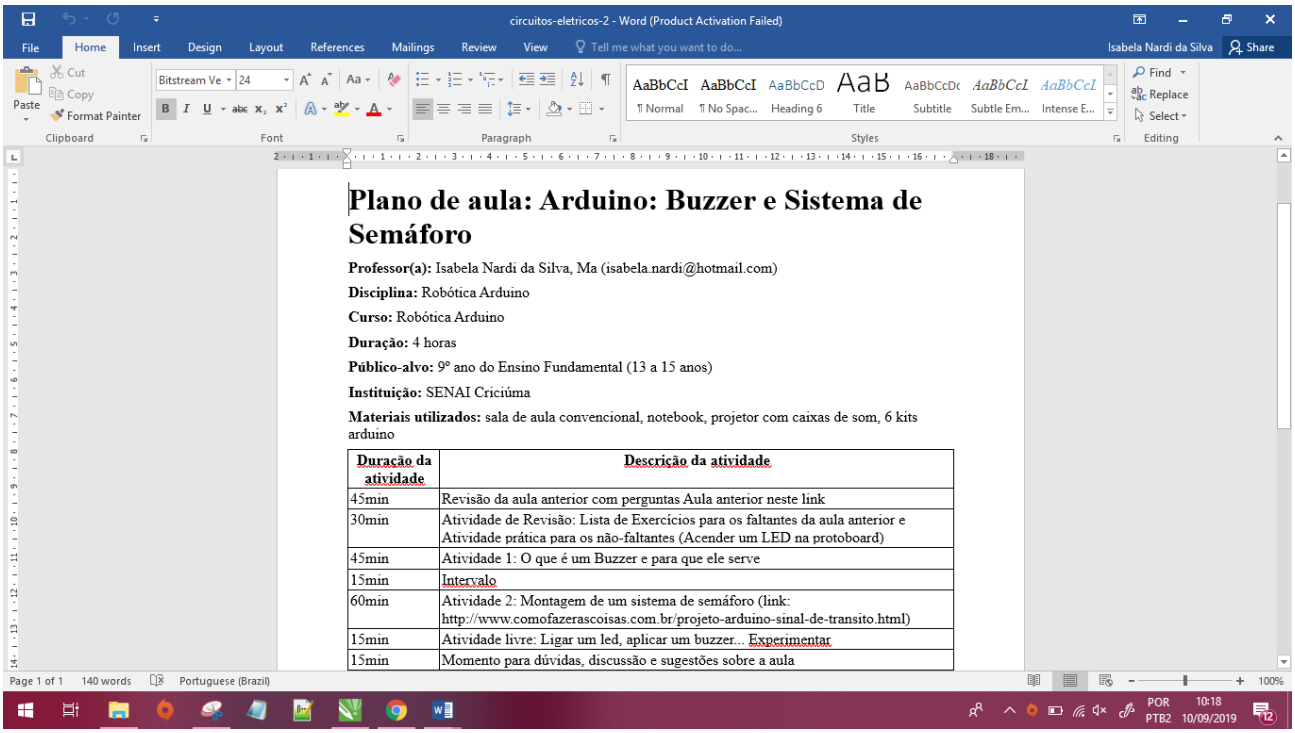


Figure 4. Comment Section

The figure below presents an example of a lesson plan registered in Labs4STEAM. The lesson plan consists of a title, the name of the teacher, the name of the subject, the course within which the subject was taught, the duration of the lesson, the target audience, the educational institution and the materials used. After this information, there is a kind of programming to explain when each class activity took place.

Figure 5. Example of lesson plan registered in the platform

The platform also has a feature for its users to download each lesson plan registered in .ODT file, after clicking the "ODT EXPORT" button. This feature allows, in addition to the printing of the lesson plan, its offline use and the possibility of editing to adapt to the reality of the teacher who wants to replicate it.



Plano de aula: Arduino: Buzzer e Sistema de Semáforo

Professor(a): Isabela Nardi da Silva, Ma (isabela.nardi@hotmail.com)

Disciplina: Robótica Arduino

Curso: Robótica Arduino

Duração: 4 horas

Público-alvo: 9º ano do Ensino Fundamental (13 a 15 anos)

Instituição: SENAI Criciúma

Materiais utilizados: sala de aula convencional, notebook, projetor com caixas de som, 6 kits arduino

Duração da atividade	Descrição da atividade
45min	Revisão da aula anterior com perguntas Aula anterior neste link
30min	Atividade de Revisão: Lista de Exercícios para os faltantes da aula anterior e Atividade prática para os não-faltantes (Acender um LED na protoboard)
45min	Atividade 1: O que é um Buzzer e para que ele serve
15min	Intervalo
60min	Atividade 2: Montagem de um sistema de semáforo (link: http://www.comofazerascoisas.com.br/projeto-arduino-sinal-de-transito.html)
15min	Atividade livre: Ligar um led, aplicar um buzzer... Experimentar
15min	Momento para dúvidas, discussão e sugestões sobre a aula

Figure 6. User downloaded lesson plan example

The platform registration form was developed using the Google Forms tool and consists of the following questions: full name, date of birth, email, training and subjects you teach. After completing the form, the applicant will receive their username and password by email within 24 hours. From the moment they are registered, the user is allowed to comment on the platform. If not registered, the user can still download lesson plans and research them, however, for security reasons it was determined that only registered users could make comments.

Figure 7. Registration Form

The form for submitting lesson plans to Labs4STEAM was also developed using the Google Forms tool. It includes: full name, education, e-mail, lesson plan course, other subjects you teach, and upload lesson plan to .PDF, .DOC or .PPT, and the like. It was defined that the plans would be sent via form, not entered directly by users to the platform, to control the material to be posted on the platform.

Figure 9. Lesson Plan Submission Form

A section called "About Labs4STEAM" has also been inserted with information about Labs4STEAM to explain its origin. The section, presented below, also features some platform outreach videos.

Figure 10. "About Labs4STEAM" Section

4.2 Results: Questionnaire Expert Responses

This subsection will present the answers of the experts to the questionnaire. In order to make the research more succinct, 2-4 questions were selected from each category of the questionnaire for presentation at work.

It can be seen that many experts pointed out the "indifferent" alternative on some issues. This is because the platform is hosted on a server located in REXLAB, at UFSC Araranguá, Mato Alto Unit. The Unit has suffered from many power outages due to a series of storms that occurred during January 2018.

Thus, the platform was unavailable and the only way for experts to view it was through an explanatory video. This video had been made prior to the platform deactivation and would only complement the introduction of the questionnaire, so it was not equipped with the answers to all the questions. However, many of the answers could not be answered just by watching the video, so the experts could not agree or disagree with some of the statements presented.

4.2.1 PEDAGOGICAL PURPOSE OF THE PLATFORM

In their study, Silveira and Carneiro (2012) stipulate some guidelines for the evaluation of learning objects. The first of these guidelines is called the Platform Pedagogical Objective. This guideline should provide clear guidance so that the student knows what he is expected to learn by using the learning object and the teacher (different from who produced the object) knows how to use it (SILVEIRA E CARNEIRO, 2012).

Listed below are some of the questions related to this guideline, as well as presentation of the outcome of these questions:

As can be seen from the graph presented below, the ninth question was related to the user's introduction to the platform, in order to verify if it was properly presented in order to know the purpose of the platform and the content to be treated.

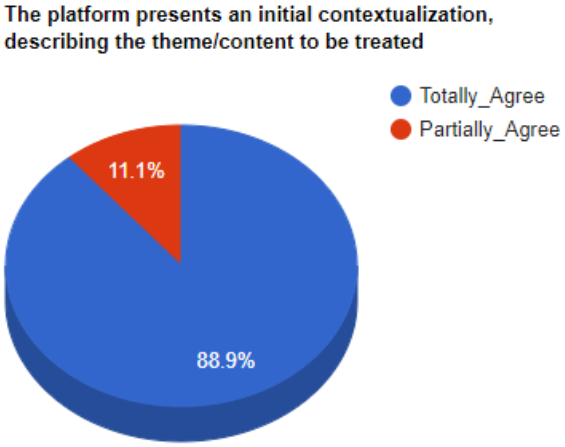


Figure 11. Results for the ninth question: "The platform presents an initial contextualization, describing the theme/content to be treated"

Most experts (88.9%) confirmed that the platform presents an initial contextualization in order to describe the content to be treated; 11.1% partially agreed.

The following chart presents the answers to the tenth question, which asked the expert to select his position in relation to the statement "The platform presents its pedagogical objective".

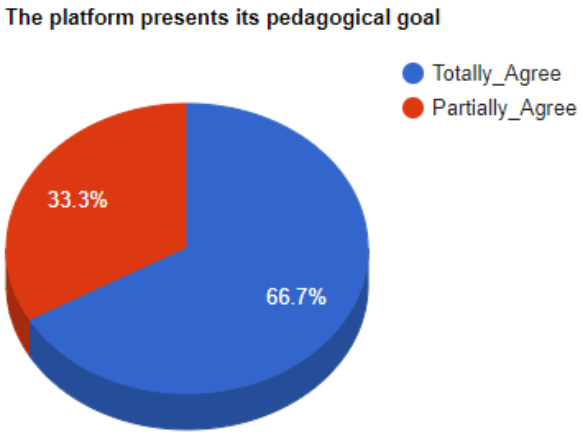


Figure 12. Results for question 10: "The platform presents its pedagogical goal"

As can be seen, most experts (66.7%) fully agreed with the statement, while 33.3% partially agreed.
The following chart presents the results for the fifteenth question, related to the platform's emphasis on the possibilities of use for various user roles.

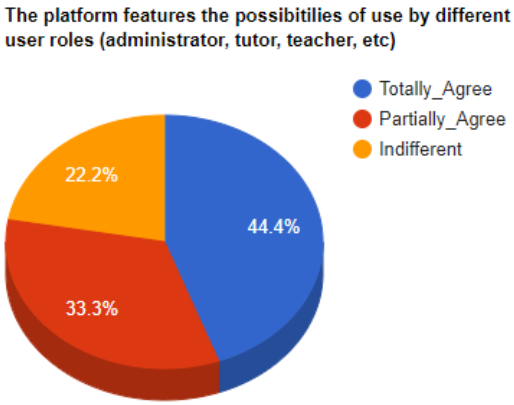


Figure 13. Results for the fifteenth question: "The platform features the possibilities of use by different user roles (administrator, tutor, teacher, etc)"

4.2.2 PRIORIZING DIGITAL

The second guideline, called "Prioritize the digital", should prioritize the development of learning objects that do not need, for their use, application or program that is not available for free on the web (SILVEIRA E CARNEIRO, 2012).

The seventeenth question asked the expert if the platform enabled keyboard navigation, considering accessibility issues, such as visual impairment. The chart below gives the answers to this question:

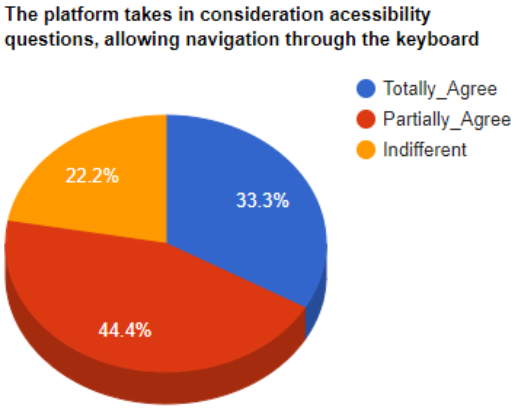


Figure 14. Results for question seventeen: "The platform takes in consideration acessibility questions, allowing navigation through the keyboard"

Most experts agreed with the statement (77.7%), but 22.2% of respondents were indifferent.

The nineteenth question was also related to the accessibility of the platform, so that users with disabilities could access its content. The question presented the statement "The platform avoids the availability of files (only) in PDF format, for presentation of the object and / or material complementary to its use, which are inaccessible via screen readers." The following chart presents the results for this question.

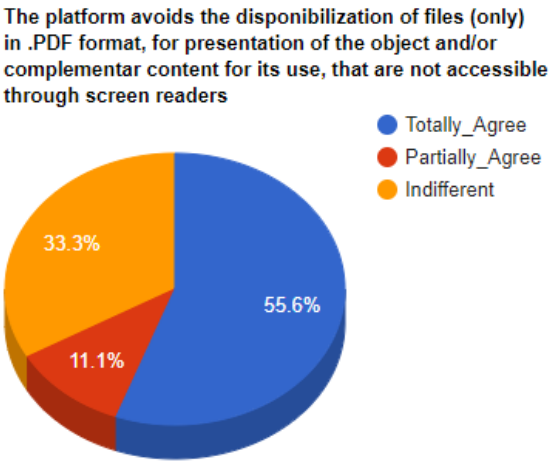


Figure 15. Results for question nineteen: "The platform avoids the disponibilization of files (only) in .PDF format, for presentation of the object and/or complemental content for its use, that are not accessible through screen readers"

It can be observed that most respondents (66.7%) agreed with the statement; However, 33.3% manifested themselves with the alternative "Indifferent".

4.2.3 PROVIDING AID TO USERS

According to Silveira and Carneiro (2012), the third guideline is called "Providing assistance to users", and should offer user assistance via easily accessible interface and instructions.

The twenty-second question was related to the indications regarding the use of the platform by users, presenting the statement "The platform presents clear information for its mode of use, indications provided

in the interface and/or easily provided through the interface". The graph below presents the results for the question:

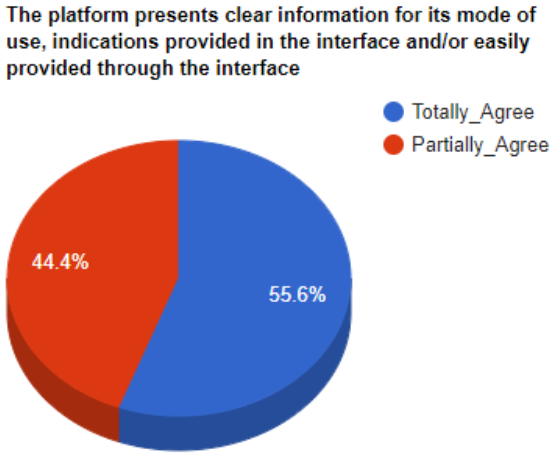


Figure 16. Results for the twenty-second question: "The platform presents clear information for its mode of use, indications provided in the interface and/or easily provided through the interface"

As can be seen, all experts agreed with the statement, but 44.4% agreed only partially.

The twenty-ninth question asked the expert about the standardization of instructions on the platform. The following chart presents the results for this question:

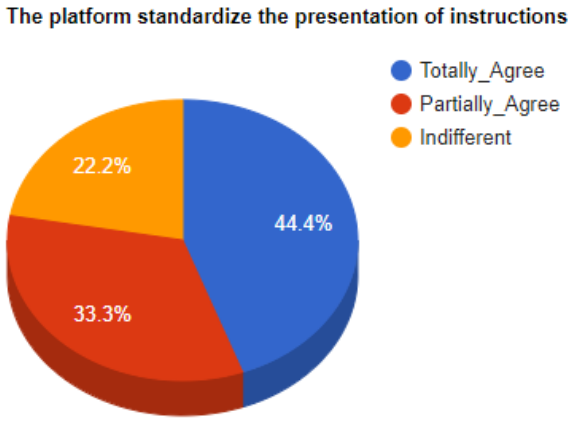


Figure 17. Results for question twenty-ninth question: "The platform standardize the presentation of instructions"

Most experts (77.7%) agreed with the statement (44.4% agreed completely and 33.3% partially), but 22.2% marked the statement "indifferent".

4.2.4 PROVIDING INTERACTIVITY

Silveira and Carneiro define the fourth guideline "Providing interactivity", as "providing the user can interact by performing actions with the object". This guideline is closely related to the aesthetics and layout of the learning object.

The forty-fifth question had the following statement: "The platform maintains a standardization of its layout (use of colors, fonts, etc.)." The following chart presents the results for the question:

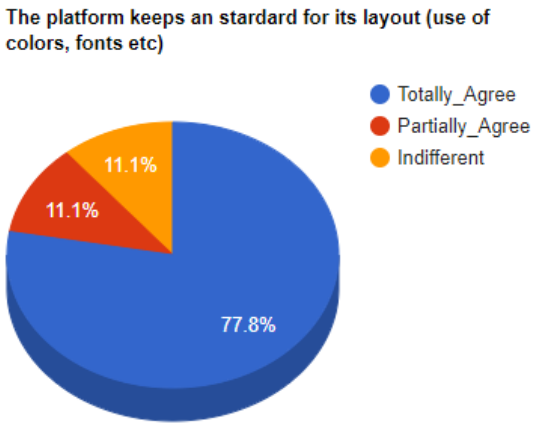


Figure 18. Results for the forty-fifth question: "The platform keeps a standard of its layout (use of colors, fonts, etc.)"

It can be seen from the graph that most experts (77.8%) totally agreed with the statement; however, 11.1% partially agreed and 11.1% were indifferent to it.

4.2.5 PROVIDE INTERACTION

The fifth guideline is called "Providing interaction", and consists of allowing actions between users (students, teachers, tutors, etc.) from and / or on the object (SILVEIRA E CARNEIRO, 2012).

The forty-eighth question asked the experts whether the platform came from sharing results with other members. The results for this question are as follows:

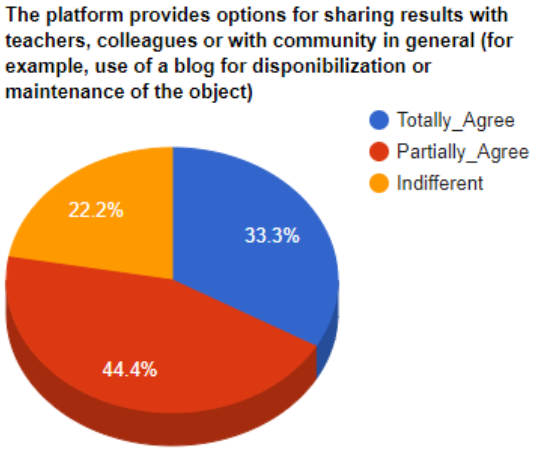


Figure 19. Results for the Forty-eighth Question: "The platform provides options for sharing results with teachers, colleagues or with community in general (for example, use of a blog for disponibilization or maintenance of the object)"

Most experts (77.7%) agreed with the statement (33.3% fully and 44.4% partially), and only 22.2% were indifferent.

The forty-ninth question contained the statement "The platform provides discussion channels among its users." The results for this question are shown in the following chart:

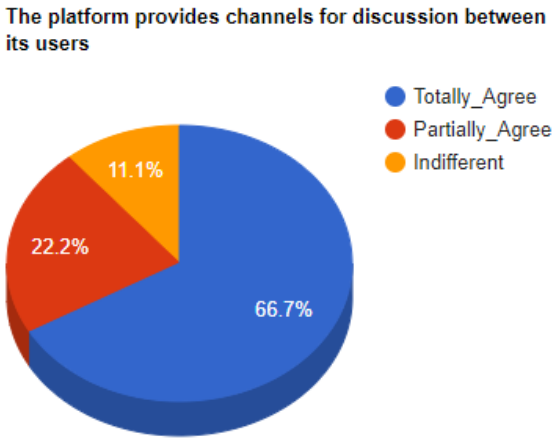


Figure 20. Results for the forty-ninth question: “The platform provides channels for discussion between its users”

Most experts agreed with the statement (66.7% strongly agreed and 22.2% partially agreed) and 11.1% were indifferent.

4.2.6 PROVIDE CONSTANT FEEDBACK

The sixth guideline, “Provide constant feedback”, should keep the user always informed of the current state of their interaction with OA (SILVEIRA E CARNEIRO, 2012).

The fifty-first question presented the statement "The platform provides clear indications of what the user must do to proceed to the next steps of its use (next step messages)." The following chart presents the results for this question:

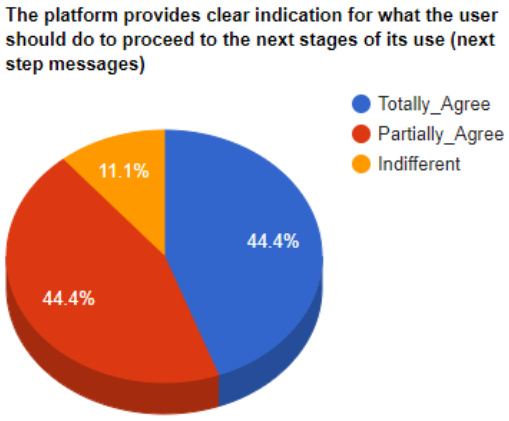


Figure 21. Results for the fifty-first question: “The platform provides clear indication for what the user should do to proceed to the next stages of its use (next step messages)”

Most experts (88.8%) agreed with the statement (44.4% fully and 44.4% partially), but 11.1% were indifferent.

The fifty-third question asked the expert if the platform always kept its name visible. The results for this question are shown in the chart below:

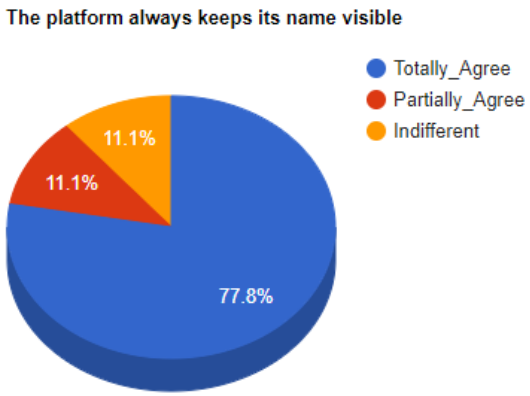


Figure 22. Results for the fifty-third question: "The platform always keep its name visible"

Most experts totally agreed with the statement (77.8%); 11.1% partially agreed and 11.1% were indifferent.

4.2.7 BE SELF-CONTAINED

According to Silveira and Carneiro (2012), the seventh guideline is called "Being self-contained", in which the object must focus on a particular subject and explain it without necessarily depending on other objects and / or materials.

The fifty-eighth question presented the statement "The platform does not require the search for external information to understand the activities and contents presented in the object". The following graph presents the results for the fifty-eighth question:

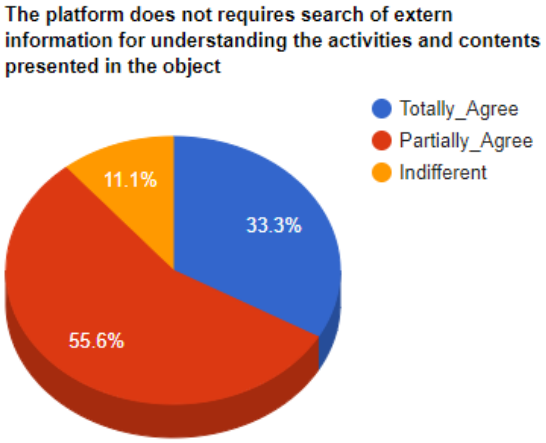


Figure 23. Results for the fifty-eighth question: "The platform does not requires search of extern information for understanding the activities and contents presented in the object"

For the results of this question, 55.6% of the experts partially agreed with the statement, while 33.3% totally agreed and only 11.1% selected the "Indifferent" alternative.

4.2.8 OTHER COMMENTS ON THE PLATFORM

In addition to the previously presented sections, a section called "Other Platform Comments" has been prepared. This section had two questions to be answered optionally. The questions were called

"Platform Strengths" for the expert to comment on platform qualities, and "Improvement Opportunities" for the expert to comment on platform failures and ways to address them.

The following list outlines the platform's strengths, according to experts:

- It is an interesting tool for allowing access to educational resources and sharing resources that can enrich teachers' lessons, such as using virtual and remote labs. The platform provides easy access to materials, and it is interesting to be able to contribute by sending materials to increase the repository of practices;
- offers a very useful feature;
- accessibility and usability;
- simple and appealing visual aspect;
- excellent initiative, congratulations!;
- innovation.

The following list presents the platform improvement opportunities, according to the experts:

- Some usability issues I didn't find so necessary because they are easy to interact with, but for a lay user it can be a hindrance. One usability issue that could be improved was that I couldn't find where to change the language the platform is available on (I couldn't identify where this is done);
- only by using longer could improvements be suggested;
- From what I saw in the demo video it seems to be a very interesting feature and it is clear what its purpose is. however, the associated pedagogical objective is not so clear;
- The demo video is very good for advertising purposes, but it is too short to answer such a comprehensive survey. For this reason, I checked the "indifferent" option when I had no information to refer to certain items.

From the testimony of the experts, it becomes possible to identify what should be done to improve the platform, as well as recognize its qualities.

5. Conclusion

The present research had as proposal to present a collaborative virtual community proposal for teachers using remote laboratories.

From the data collection performed by applying a platform verification questionnaire to a group of experienced experts regarding the VISIR + project, we could receive feedback from the platform. Most of the answers were positive, but there are some details to adjust here, such as better clarity of instructions for the user to understand how to use platform tools such as discussion channels.

This comment presented on the "Improvement Opportunities" discursive question also provides a good critique for future platform enhancements: "Some usability issues I didn't find so necessary because they are easy to interact with, but for a lay user it can be a hindrance [...] ".

Through this research it was possible to realize that the developed platform was welcomed by the specialists, who, during the field visits, even suggested partnerships to elaborate future works. After all, as

presented in the Results chapter, the platform has great potential and only needs a few modifications to be suitable for use by teachers in general.

Next steps will be in terms of dissemination and effective use of the platform.

Thus, from the research developed, future publications can be planned, taking into account the results obtained and experience and partnerships with the VISIR + international cooperation project. Related to the VISIR + project, the platform also functions as a sustainability tool for the project.

6. Acknowledgement

The research was financed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

7. References

DIONIZIO, Fátima Aparecida Queiroz et al. Um Design Metodológico para Analisar as Concepções dos Docentes em Relação à Produção Discente a partir de Representação Semiótica e Dimensões do Conhecimento Docente. Bolema: Boletim de Educação Matemática, [s.l.], v. 32, n. 61, p.727-748, ago. 2018. FapUNIFESP (SciELO). http://dx.doi.org/10.1590/1980-4415v32n61a20.

DOKUWIKI. Homepage. Disponível em: <https://www.dokuwiki.org/pt-br:dokuwiki>. Acesso em: 18 jan. 2019.

FERNANDES, Flávia Roberta et al. Comunidades de prática: uma revisão bibliográfica sistemática sobre casos de aplicação organizacional. Atoz: novas práticas em informação e conhecimento, [s.l.], v. 5, n. 1, p.44-52, 31 jul. 2016. Universidade Federal do Parana. http://dx.doi.org/10.5380/atoz.v5i1.46691.

FERREIRA, Andreia de Assis; SILVA, Bento Duarte da. COMUNIDADE DE PRÁTICA ON-LINE: UMA ESTRATÉGIA PARA O DESENVOLVIMENTO PROFISSIONAL DOS PROFESSORES DE HISTÓRIA. Educação em Revista, Belo Horizonte/mg, v. 30, n. 1, p.37-64, mar. 2014.

FIDALGO, André V et al. Adapting Remote Labs to Learning Scenarios: Case Studies Using VISIR and RemotElectLab. Ieee Revista Iberoamericana de Tecnologias del Aprendizaje, Madrid/espanha, v. 1, n. 9, p.33-39, fev. 2014.

GIL, A. C. Como elaborar projetos de pesquisa. 4. ed. São Paulo: Atlas, 2007.

GOHR, A. (22 de Maio de 2017). DokuWiki. [S.I], [S.I], [S.I]. Fonte: https://www.dokuwiki.org/dokuwiki

MARCONI, Marina de Andrade; LAKATOS, Eva Maria. Fundamentos de Metodologia Científica. 5. ed. São Paulo: Editora Atlas, 2003. 310 p.

MIKKELSON, Christopher. Social Learning Remixed: Peer-Based Learning and Social Status in an Online Community of Practice. 2016. 107 f. Dissertação (Mestrado) - Curso de Master Of Arts In Communication, University Of Arkansas, Ann Arbor/michigan, Usa, 2016.

PRODANOV, Cleber Cristiano; FREITAS, Ernani Cesar de Metodologia do Trabalho Científico: Métodos e Técnicas da Pesquisa e do Trabalho Acadêmico. 2. ed. Novo Hamburgo/rs: Universidade Feevale, 2013. 277 p.

QUIGLEY, Polly. INFORMAL LEARNING AND MOTIVATION IN A VIRTUAL COMMUNITY OF PRACTICE: A STUDY OF EMAIL LIST COMMUNICATIONS AMONG K-12 TECHNOLOGY

COORDINATORS IN THE STATE OF HAWAII. 2015. 100 f. Tese (Doutorado) - Curso de Doctor Of Philosophy In Education, University Of Hawai‘i At MĀnoa, Ann Arbor/michigan, Usa, 2015.

SILVA, Isabela et al. Social innovation in public schools: a case study on the Remote Experimentation Laboratory of the Federal University of Santa Catarina. In: BARUCH, Alona Forkosh; TAL, Hagit Meishar. Mobile Technologies for Organizational Learning. Tel Aviv: Igi Global, 2019. p. 1-25.

SILVA ET AL. Laboratório Remoto VISIR: estudo de caso da integração na plataforma RELLE. Disponível em: <https://www.aacademica.org/congreso.aahd2018/tabs/abstracts>. Acesso em: 19 dez. 2018.

SILVA, Edna Lúcia da; MENEZES, Estera Muszkat. Metodologia da Pesquisa e Elaboração de Dissertação. 4. ed. Florianópolis: Universidade Federal de Santa Catarina, 2005. 139 p.

SILVEIRA, M.S. and CARNEIRO, M.L.F., 2012, November. Diretrizes para a Avaliação da Usabilidade de Objetos de Aprendizagem. In Proc of. SBIE 2012 (Vol. 23, No. 1).

SMITH, Sedef Uzumer; HAYES, Suzanne; SHEA, Peter. A Critical Review of the Use ofWenger's Community of Practice (CoP) Theoretical Framework in Online and Blended Learning Research, 2000-2014. Online Learning, Usa, v. 21, n. 1, p.209-2017, mar. 2017.

WENGER, Étienne. Cultivating communities of practice: a quick start-up guide. Disponível em: <http://wenger-trayner.com/wp-content/uploads/2015/03/Start-up-guide-EN1.pdf>. Acesso em: 2002.

WENGER, Etienne. Communities of Practice and Social Learning Systems: the Career of a Concept. Social Learning Systems And Communities Of Practice, [s.l.], p.179-198, 2010. Springer London. http://dx.doi.org/10.1007/978-1-84996-133-2_11.

WENGER, e; MCDERMOTT, R; SNYDER, W M. Cultivating communities of practice. Boston, Ma: Harvard Business School Press, 2002.

WILLIAMS, Maryshannon. ASSESSING THE IMPACT OF AN INNOVATIVE COMMUNITY OF PRACTICE ON TEACHER EFFICACY, LEADERSHIP AND PRACTICE. 2016. 323 f. Tese (Doutorado) - Curso de Doctor Of Philosophy, University Of Missouri, Columbia - Usa, 2016

YU, Dengke; ZHOU, Rong. Intellectual Management: An Integrative Theory. Journal Of The Knowledge Economy, [s.l.], v. 8, n. 3, p.929-956, 10 out. 2015. Springer Nature. http://dx.doi.org/10.1007/s13132-015-0305-0.

RODRIGUES, AL (2016). A integração pedagógica das tecnologias digitais na foração ativa de professores. Atas do IV Congresso Internacional das TIC na Educação: Tecnologias digitais e a Escola do Futuro, 1320-1333.

RODRIGUES, Ana Luisa. A integração pedagógica das tecnologias digitais na formação ativa de professores. In: LISBOA, Instituto de Educação da Universidade de (Ed.). Atas do IV Congresso Internacional das TIC na Educação: Tecnologias digitais e a Escola do Futuro. Lisboa: Instituto de Educação da Universidade de Lisboa, 2016. p. 1320-1333. Disponível em: <http://ticeduca2016.ie.ulisboa.pt/?page_id=1369>. Acesso em: 18 set. 2018

Copyright Disclaimer

Factory Location Decision Making Based on the FUZZY Inference Model

Alexandre Vieira de Oliveira
contatoalexandrevo@gmail.com
Centro Universitário FAMETRO - Brasil

David Barbosa de Alencar
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM - Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Manoel Henrique Reis Nascimento
hreys@itegam.org.br
Instituto de Tecnologia e Educação Galileo da Amazônia – ITEGAM – Brasil

Carlos Alberto Oliveira de Freitas
caofreitas@yahoo.com.br
Instituto de Ciências Exatas e Tecnologia - Ufam - ICET – UFAM- Brasil

Abstract

This paper introduces the concept of fuzzy logic, some terms used in this kind of logic, and uses it to evaluate and choose where to deploy factories and other enterprises. In addition, a model is made using the InFuzzy program to evaluate a choice of a location within the Manaus Industrial Pole - PIM, using objective and subjective criteria within the fuzzy logic. This article aims to present the fuzzy logic in the context of production engineering, select the parameters that define the best location, develop models that represent the subject in the study and verify the applicability by simulating other case studies and comparing results.

Keywords: Fuzzy logic; Factory location, Inference model;

1. Introduction

Choices in times of globalized and increasingly interconnected economies need speed and precision, hence the need to use all available decision-making tools. Choosing a deployment location is a resource-intensive, time-consuming decision that can bring many benefits or be responsible for the failure of a corporate decision. [19] apud [3], highlight criteria such as: market, transportation, labor, raw material and government regulation when deciding where to locate a facility. There are still criteria such as cost minimization, distance minimization, local taxes, legal requirements, community attitudes and living

conditions as important for site location.

[8] classify two types of factors in locality choices, quantitative factors, those that can be measured, such as fixed costs, personnel costs, and qualitative factors, which cannot be quantified, such as staff attitude and unions, Environmental constraints, political scenario, for these unquantifiable factors, are given grades of grading by the local assessor based on the points defined by the strategic planning.

The concept of the fuzzy set was introduced by Lofti A. Zadeh at Berkeley University in 1965. Zadeh noted that for certain problems that contained ambiguous variables, classical logic and available technological resources were not sufficient to solve problems of a diffuse nature. In search of a solution to this problem, he published an article summarizing the concepts of the fuzzy system, which proposed an extension of classical logic that would act on the real number range [21]. Unlike conventional logic, fuzzy logic admits that values have a degree of relevance, trying to simulate roughly human thinking, which functions differently from the binary form of conventional logic. Taking into account the use of fuzzy logic in the analysis of ambiguous linguistic variables, the analysis of qualitative factors for choosing a locality can be made from the perspective of fuzzy logic to find the best solution for decision making.

This paper aims to present the concept of fuzzy logic introduced by Zadeh, some current applications, as this tool can be used in the context of production engineering and decision making aimed at choosing a location for a factory deployment, also has to objective, assemble a model using the InFuzzy program for demonstration.

2. Theoretical Review

2.1 Geographic localization

[17] states that location is the geographical position in which the operation interacts with other operations or resources. [2] brings the concept of driving force that according to the type of operation the driving force for moulting, is given as an example the location of factories and warehouses that the driving force would be, predominantly, the economic factors, when the operation is directed at retail the driving forces are focused on costs minus the revenue that gives the determination of profit. When the operation is geared to providing a service, public or private, ease of access is a driving force even when it is not easy to determine the revenues and costs of these operations.

2.1.1 Locale-relevant factors

For location of industrial companies [9] states that these companies base their location where resources are most readily available, such as water, raw materials, energy and labor. [11] add tax incentives to factors in choosing a location, highlight the ICMS tax, land donation and paving projects granted by municipalities and states.

Each industrial segment has different characteristics in the production of its product, so each choice of location takes into account the factors that have the best advantage for choosing each company, raw material, electricity, water, labor, tax incentives and proximity. to the consumer market are determining factors for these ventures.

2.2 Methods for choosing location

When selecting location alternatives for operations installation, two types of data are analyzed: quantitative and qualitative [11]. [8] highlight as quantitative data or objective costs with personnel, equipment, land, water, electricity, transportation, gas, fees and taxes, that is, all that can be quantified. Qualitative data or factors are those that cannot be attributed value, they can only be observed and analyzed. The following stand out: attitude of staff, unions and the community, environmental and governmental restrictions, quality of life, among others. Still regarding qualitative data, they say: it is data about the place that needs to be measured more subjectively, such as climate aspects, quality of life, education level and quality of the workforce and other subjective information.

As a solution for choosing the location based on quantitative data the following methods are used: center of gravity method and break-even method

2.2.1 Center of Gravity Method

It consists of choosing the location taking into account the existing location of customers and key inputs that will determine the costs of transportation and distribution of finished products. The point found represents the geographical point where transportation costs are the lowest possible. If the number of suppliers and customers is very high, it is recommended to use the Pareto chart tool, using the 20/80 ratio in which 20% of customers and suppliers account for 80% of profit, using only 20%. in the location within the generated map. The second step is to survey the volume of inputs / goods transported from the most representative suppliers and customers for the intended location by analyzing the cost of movement. The next step is to apply a grid over the map to assign Cartesian coordinates. The fourth step is the calculation of the center of gravity which represents the ideal location for the installation having two coordinates, one vertical and one horizontal.

2.2.2 Balance Point Method

This model aims to assist in the choice of locality through CLV analysis (cost, value and profit) for each locality being the best alternative to the locality with the highest profit. For the assembly of the model, first is made the separation between fixed and variable costs, being the fixed costs those that remain constant, regardless of the quantity produced already the variable costs are expenses that vary according to the volume produced. The next step is to calculate the contribution or profit margin, after making the cost projections and estimating the price the calculation can be made. The locality with the best profitability index stands out.

The calculation of the breakeven point is important for the production expectation to be analyzed at several chosen points and to compare them with each other based on the different production levels.

2.3 Evaluation of qualitative factors

This method proposes to value subjective characteristics that cannot be quantifiable. In this method the opinion of the evaluators and the subjective data are part of the decision making process so that the choice of locality is fair and rational [11] and [10]. Previously selected sites receive scores according to the criteria selected by the evaluators based on the most important characteristics for the project. The first step is to

identify the factors that are relevant, listed in criteria lists. The list can be very long, so the need to consult technical experts to make the list of criteria as objective as possible and that no relevant items are left out. Then, with the factors already selected, a degree of importance is assigned to each item, the sum of these degrees or weight given to the factors should total 1.0, if not done another step must be taken that is the division by the sum of the weights. The most relevant factors receive lower weights and the less relevant factors receive lower weight. The choice of given weights requires the participation of professionals from different areas of the company, so that the different views are taken into account as the factors have different weight depending on the area that assigns the value. The next step is to rate the pre-selected locations by looking at the factors previously defined, a common scoring scale is given for all factors, ranging from zero to ten or zero to one hundred, with zero being the least favorable location and one hundred or ten most favorable to the goal. The last step consists of weighting the grades, multiplying the weight of each factor by the grade assigned and adding the product to have the grade of the possible location. The location that gets the highest grade will be the location chosen to set up the venture.

3. Using Fuzzy Logic to Choose Locale

3.1 Fuzzy Logic

[4] states that in fuzzy logic a premise has a degree of truth ranging from 0 (zero) to 1 (one), leading the premise to be partially false or partially true, differing from Aristotelian logic that allows only one premise. be either totally true or totally false.

[18] state that the fuzzy concept was presented in the works of Professor Lofti A. Zadeh, with the objective of giving mathematical treatment to subjective linguistic terms such as "very hot", "little cold", "approximately", among others. Zadeh noted that at the time the most modern technological resources were unable to automate ambiguous situations related to problems of an industrial, biological or chemical nature. The versatility of fuzzy logic is given by the ability to mathematically model and manipulate information that is vague or inaccurate, which is natural to human language [1].

3.2 Applications of fuzzy logic in production engineering

[15] highlights the use of fuzzy logic in the areas of productive system simulation, inventory control, evaluation, optimization, decision making, control, diagnosis and information. [4] shows the application of fuzzy logic in expert systems, process identification and control, robotics, partially open systems modeling and decision pattern recognition. [6] highlights the application of fuzzy models in mean-time-between-failure (MTBF) reduction and mean-to-repair (MTTR) improvement within companies that have used these systems.

In his dissertation [5] brings some studies made using fuzzy logic applied to the area of logistic processes as the article by [20] who made an article with application of fuzzy logic for supplier selection. [18] write an article presenting a multi-criteria decision-making approach to supplier selection problems. [7] in his paper presents performance measurement through fuzzy logic within a manufacturing company's supply chain for decision making using MATLAB.

3.3 Concept of fuzzy logic

The expression that denotes fuzzy logic can be represented by:

$A = \{x, \mu_a(x) \mid x \in X\}$

Where $\mu_a(x)$ is the membership function of x in A. Where x ∈ X and $0 \leqslant \mu A(x) \leqslant 1$. If $\mu A(x) = 0$ represents no relevance and $\mu A(x) = 1$ represents total relevance.

The fuzzy logic is characterized by the use of the membership function, where unlike the usual logic (crisp) that a feature belongs (1) or does not belong (0) to an element, how much approximately element x1 belongs to A:

$A = \{(x, \mu_a(x)) \mid x \in A, \mu_a(x) \in [0,1]\}$

That is, in fuzzy classification the higher the value assigned to $\mu_a(x)$, the greater the relevance to A. The relevance function within fuzzy logic represents the expert's perception reflecting the technical knowledge in the analyzed subject [5]. The relevance functions can be classified into:

Triangular function

$trimf(x; a, b, c) = \max(\min(x - a\ b - a, c - x\ c - b), 0)$

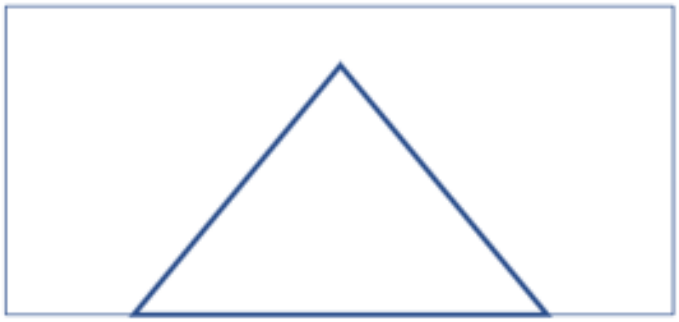


Figure 1-Triangular Function.

Source: Author

Trapezoidal function

$trapmf(x; a, b, c, d) = \max(\min(x - a\ b - a, 1, d - x\ d - c), 0)$

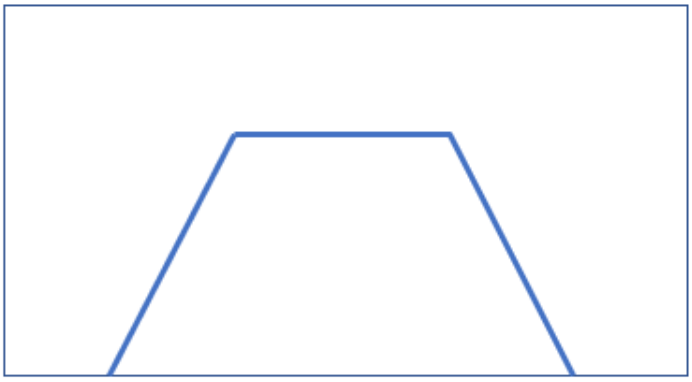


Figure 2- Trapezoidal Function.

Source: Author

Gaussian Function

$gaussmf\ (x; a, b, c) = e - 1\ 2\ (x - c\ \delta)^{2}$

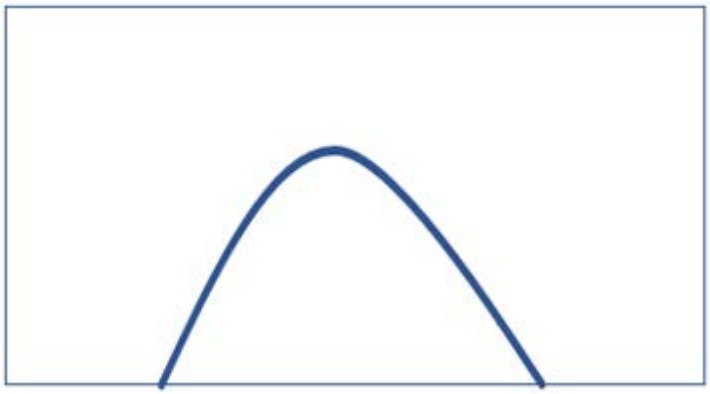


Figure 3- Gaussian Function.
Source: Author

Generalized Bell Function

$gbellmf\ (x; a, b, c) = 1\ 1 + |\ x - c\ b\ |^{2b}$

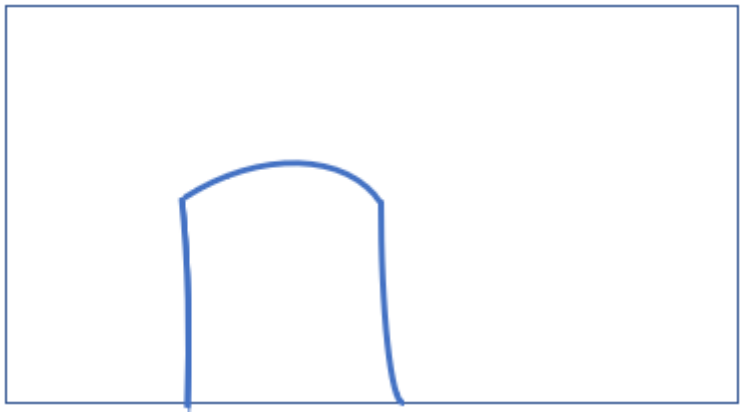


Figure 4- Bell Function. Source: Author

Fuzzy sets can have discrete expressions with the finite universe or continuous with the infinite universe, their expressions are defined as:

Discrete Expression:

$A = \mu_A\ (x_1) / x_1 + \mu_A\ (x_1) / x_2\ \ + \mu_A\ (x_n) / x_n = \ \Sigma\ \mu_A NI = 1\ (x_i) / x_i$

Continuous Expression:

$A = \ \int\ \ \mu_A\ X\ (x_i) / x_i$

4. Tools and Methods

The research method used for this work is the exploratory with quantitative approach. The survey of the

techniques used to choose the location of a productive plant was made through bibliographic research in books, scientific journals, articles and dissertations. The simulations and analyzes were made using the software InFuzzy, a software developed for modeling fuzzy systems, with simple interface and easy to handle and having its main functionalities related to definitions of input and output variables, rule blocks, linguistic terms and simulations. Manaus airport was chosen because most of the electro-electronic companies, according to research by [13], use this mode to transport their inputs and products.

5. Application of the study

Through bibliographic search and search sites were collected distance data between the main airport of the city of Manaus and the value of the square meter of land within the city, its surroundings and a city within the metropolitan area of Manaus.

The application began by establishing the input variables, the rule block and the output variables, as shown below.

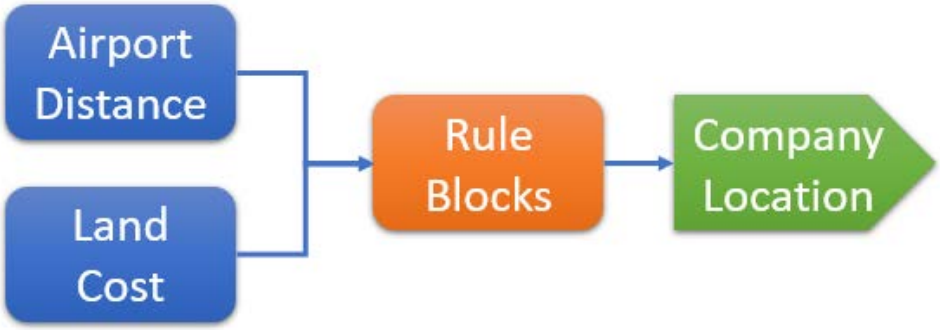


Figure 5- Relationship between input variables, rule blocks, and output variable.
Source: Author

Next, the input variable Distance from the Airport was set in a universe set from 5 kilometers to 70 kilometers from the starting point that was chosen, being as the international airport of Manaus and the linguistic variables.

Next, the input variable Cost of Land with universe of 5 to 1800 reais per square meter was set, data collected from the Manaus City Hall website. The next step was the establishment of correlation rules between the antecedent (if) and consequent (then) variables with AND connective (AND) variables. The table below shows the correlation between terms.

Table 1-Table of relationship of rules. Source: Author

Nº	if	Background		then	Consequent
		Airport Distance	Land Cost		Location
1	if	Very far	expensive	then	terrible
2	if	Very far	Medium	then	terrible
3	if	Very far	Cheap	then	terrible

4	if	Far	expensive	then	terrible
5	if	Far	Medium	then	bad
6	if	Far	Cheap	then	bad
7	if	Medium	expensive	then	regular
8	if	Medium	Medium	then	regular
9	if	Medium	Cheap	then	regular
10	if	Close	expensive	then	regular
11	if	Close	Medium	then	good
12	SE	Close	Cheap	then	great

Next was set the output variable Location, which had its universe set from 0 (zero) to 10 (ten) points and its linguistic terms being: bad, bad, good, great and excellent.
Then the simulation was made using the distance and land cost variables in the neighborhoods as shown in the table below. The defuzzyfication method in this simulation was the center of gravity.

Table 2- Table with distance values and land price. Source: Author

Neighborhood	**Distance (Km)**	**Land Cost (R $ / m2)**
Distrito Ind. I	26	138,67
Tarumã	5	125,46
Tarumã Açu	10	17,13
Puraquequara	29,4	8,80
AM 010	23	5,05
BR 174	18,8	5,88
Iranduba	42	10
Distrito Ind. II	21,7	18,82
Jorge Teixeira	24,6	80,33
Av. Torquato Tapajós	11,5	306,26

The figure below illustrates the simulations table and the results.

Time in m / s	Airport departure	Land cost	Location
46	26,00	138,67	6,77
49	5,00	125,46	9,85
43	10,00	17,13	9,85
45	29,40	8,80	6,79
46	23,00	5,05	6,74
44	18,80	5,88	9,80
45	42,00	10,00	3,50
42	21,70	18,82	6,73
45	24,06	80,33	6,75
46	11,50	306,26	9,81

Figure 6- Table with simulations. Source: Author

6. Results and discussions

The following table shows the names of neighborhoods and adjacent areas of Manaus with the distance, the value of the land and the grade obtained in the simulation.

Neighborhood	Distance	Ground	Note
Distrito Ind. I	26	138,67	6,77
Tarumã	5	125,46	9,85
Tarumã Açu	10	17,13	9,85
Puraquequara	29,4	8,80	6,79
AM 010	23	5,05	6,74
BR 174	18,8	5,88	9,80
Iranduba	42	10	3,50
Distrito Ind. II	21,7	18,82	6,73
Jorge Teixeira	24,6	80,33	6,75
Av. Torquato Tapajós	11,5	306,26	9,81

Table 3- Table with values of the simulations.
Source: Author

Note from 9.85 that the neighborhood Tarumã and Tarumã Açu are the best location choices using only these two variables. The second best location would be Avenida Torquato Tapajós with a grade of 9.81, even with the value of the land being the largest among the values used. The results of grade 6 were scored close to each other because the distances relatively differ little, and the value of the square meter is the

differential for obtaining the grades. The result of grade 3.5 was obtained due to the distance being much larger than the others although the value of the terrain is small.

It is then realized the usefulness of fuzzy logic as a tool for choosing a location, merit this tool for its accuracy in the results. The application of other variables could give more accuracy to the selection process and the study done by experts.

7. Final Considerations

This paper proposes to present fuzzy logic as a decision making tool through its use to create a model for locality choice. During this article it was necessary to use multidisciplinarity, using mathematical and production engineering knowledge focused on the choice of location. A basic theoretical summary was presented about Fuzzy Logic, a brief history of its origins and applications.

The use of fuzzy logic as a location choice tool can be used as demonstrated by the simulations performed. With the right and most variable professionals, you can improve the use of this logic as a precision tool for decision making in companies of various sizes and segments.

8. Bibliography

[1] AMENDOLA, Mariangela; SOUZA, Anderson Luiz; BARROS, Laécio Carvalho. Manual do uso dos Conjuntos Fuzzy no MATLAB 6.5. 2ª versão. Unicamp,2005.

[2] BALLOU, Ronald H. Gerenciamento da Cadeia de Suprimentos. 5ª ed. Editora: Bookman, Porto Alegre, 2006.

[3] BRIOZO, Rodrigo Amancio; MUSETTI, Marcel Andreotti. Método multicritério de tomada de decisão: aplicação ao caso da localização espacial de uma Unidade de Pronto Atendimento – UPA 24 Método multicritério de tomada de decisão: aplicação ao caso da localização espacial de uma Unidade de Pronto Atendimento – UPA 24h. Gest. Prod. vol.22 no.4 São Carlos out./dez. 2015.

[4] CAVALCANTI et al. Lógica Fuzzy Aplicada às Engenharias. João Pessoa, 2012.

[5] CORREIA, Maria Fernanda Zelaya. Proposta de aplicação da lógica fuzzy nos materiais cirúrgicos do almoxarifado central do HUCFF para auxiliar a tomada de decisão concernente ao controle de estoques. Rio de Janeiro: UFRJ/COPPE, 2016.

[6] COX, Earl. The fuzzy systems handbook: a practitioner's guide to building, using, and maintaining fuzzy systems. New York: Academic Press, 1994.

[7] EL-BAZ, M. A. Fuzzy performance measurement of a supply chain in manufacturing companies. Expert Systems with Applications. vol. 38, pp. 6681– 6688. 2011.

[8] MARTINS, Petrônio G.; LAUGENI, Fernando Piero. Administração da Produção.2ª ed. São Paulo: Saraiva, 2005.

[9] MOREIRA, Daniel Augusto. Administração da produção e operações. Editora Saraiva, 2017.

[10] NEUMANN, Clóvis; SCALICE, Régis Kovacs. Projeto de Fábrica e Layout. Rio de Janeiro. 2015.

[11] PEINADO, Jurandir; GRAEML, Alexandre Reis. Administração da Produção. 1ª ed. Curitiba: UnicenP, 2007.

[12] POSSELT, E. L.; FROZZA, R.; Molz, R. F. Software Infuzzy 2011. Programa de Mestrado em

Sistemas e Processos Industriais PPGSPI, UNISC, 2011. Disponível em: http://www.unisc.br/ppgspi

[13] ROCHA, Laura Lima da et al. A gestão Logística no Polo Industrial de Manaus: uma abordagem sob a perspectiva das equipes de logística das organizações. Disponível em: <https//www.even3.com.br/anais/xisamep/122482-A-GESTAO-LOGISTICA-NO-POLO-INDUSTRIAL-DE-MANAUS--UMA-ABORDAGEM-SOB-A-PERSPECTIVA-DAS-EQUIPES-DE-LOGISTICA-DAS-ORG>. Acesso em: 19/10/2019

[14] ROSS, Timothy J. Fuzzy Logic With Engineering Applications. 3ª ed. Editora: Wiley. 2010.

[15] SARAIVA, Gerardo José de Pontes. Lógica Fuzzy-Conceitos Básicos. Rio de Janeiro: Fundação COPPETEC, 2000.

[16] SFREDO, Janine Mattana et al. Análise de fatores relevantes quanto à localização de empresas: comparativo entre uma indústria e uma prestadora de serviços com base nos pressupostos teóricos. Anais do XXVI ENEGEP (Encontro Nacional de Engenharia de Produção). Fortaleza, outubro de 2006.

[17] SLACK, Nigel et al. Administração da Produção.8ª ed. São Paulo: Atlas, 2018.

[18] WEBER, Leo; KLEIN, Pedro Antonio Trierweiler. Aplicação da Lógica Fuzzy em Software e Hardware.1ª ed. Canoas: Ed. ULBRA, 2003.

[19] YANG, J.; LEE, H. An AHP decision model for facility location selection. Facilities, 15(Iss: 9), 241254. Disponível em: http://dx.doi.org/10.1108/ 026327 79710178785.

[20] YANG, Y.; LU, H.; ZHANG, J. A Fuzzy Multi-objective Decision Model Considering Competition for the Logistics Supplier Selection. ICLEM 2010: Logistics for Sustained Economic Development.

[21] ZOUGGARI, A.; BENYOUCEF, L. Simulation based fuzzy TOPSIS approach for group multi-criteria supplier selection problem. Engineering Applications of Artificial Intelligence. vol. 25, pp. 507–519. 2012.

Analysis in materials management processes: case study of the metallurgical production line of Company in Goiás

Jean Marc Nacife (Corresponding author)
Doctor of Agricultural Sciences and Master of Business Administration. Teacher, Dept. of Technical and Technological Education, Goiano Federal Institute – Campus Rio Verde, Rio Verde, Goiás, Brazil.

Albertino Ferreira Neto
Bachelor's degree in business administration, Faculdade Quirinópolis, Quirinópolis, Goiás, Brazil.

Erley Batista Dias
Bachelor's degree in business administration, Faculdade Quirinópolis, Quirinópolis, Goiás, Brazil.

Katiusce Borges Silva
Bachelor's degree in business administration, Faculdade Quirinópolis, Quirinópolis, Goiás, Brazil.

Abstract

Great is the importance of the application of management tools in the context of materials management and its effectiveness highlights the impacts it causes on the production processes of industrial organizations. The objective of the research is analyzing points in the production line in aluminum frames "Practical" that generates lack of done products at the moment of the loading. It is believed that there is a lack of monitoring of the safety stock during the processes. Regarding the methodological section, a case study will examine the use of techniques and methods in the composition of the field research in Haiala Metallurgical Company. The traditional case study investigation strategy is applied in order to understand the unit of analysis as the essence of the case in investigation, focusing on the organization's productive process as a unit of analysis as a determinant of this research project. The operational process of stock market has a high weight in the production; it must be treated with targeted investments in the sector, as in the training of professionals, as in the processes and systems that will gain time in qualifying and quality of products and services. According to the data obtained, the researchers reported the possibility of any flaws relationed with the production line, resupply time of the feedstock in the working point and turnover. It was concluded that the lack of the finished product was due to the lack of an accurate production planning.

Keywords: management materials; production planning; strategy production;

1. Introduction

At the beginning of the twentieth century, from Taylor and Fayol, new forms of administrative management were created that led to other directions, with management focused on large-scale production, in order to develop the product sequentially, where each one produces a certain part until the final result. During this same period there was a study on human behavior to better harness the potential of each employee. Reflecting on the materials management process, one realizes how important it is for organizations to be working on methods and tools based on classical concepts, from a fundamentally control perspective, aiming at the least waste in order to obtain a satisfactory result.

The importance of the application of management tools in the context of materials management shows the seriousness with the process impacts the industrial organizations, knowing that it is from the materials management that the whole production process begins, resulting in a good product. quality and adding value to the final product. Well-structured materials management provides competitive advantages through cost savings, reduced inventory investments, improved purchasing conditions through negotiations with suppliers, and customer and consumer satisfaction with the products offered. by the company (GONÇALVES, 2007; HOSSEINI, 2015).

The interior of a company is invariably the scene of a series of actions applied to the materials or information that enter the production process to be gradually transformed until they result in final products or services rendered. In the long journey through the companies, the materials go through a sequence of steps through a series of machines and equipment along the productive sections, until, finally, it reaches its final result as products or services (GONÇALVES, 2007; DIAS, 2009; LIM et al., 2010; HOSSEINI, 2015).

According to the new directions of Materials Management it can be conceptualized and studied as an Integrated System in which several own subsystems interact to form an organized whole. It is intended to provide the management of the necessary resources to supply materials that are indispensable to the functioning of the organization, complementing the objective, therefore, is to optimize the investment, increasing the efficient use. financial resources, minimizing the capital needs invested in inventories (DIAS, 2009; YANTI et al., 2013; TULVINSCHI, 2015).

The relevance of the work is that it allowed to contribute to materials management and production line in the studied organization "Haiala Metallurgical", collaborating with overwhelming information to aid a better productivity. Considering that the materials management and production line sector is quite wide, allowing its opening and deepening, it also clarifies that there is a vast field to be explored within the research, from new strategies directed to the use of materials and greater productivity, to industry efficiency, always seeking customer satisfaction.

The problem addressed in this research converges the investigation regarding the lack of finished product "Practical Line" at the time of shipment of sales, failing to meet the delivery time, impacting the planning and discomfort with commitment made between seller and end consumer. The implementation of production planning based on the continuous approach is a recurring practice in a dynamic environment (CHAND et al., 2002) and applied by both academia and industry (SAMPAIO et al., 2017). It is of utmost importance to focus on this issue in order to understand the organizational problem regarding the process of sourcing production materials. The research in question sought information about materials management

tools and processes, focusing on the production of windows of the "Practical line in the Haiala Metallurgical industry", aiming to identify in the processes and internal controls, the cause of the lack of finished product at the moment of loading.

2. Methodology

The procedures applied in the present research were based on technical evidence from direct observation and applied interviews, converging field research into the observation of facts as they occur in reality (FACHIN, 2006, p.29).

A case study aims to understand the unit of analysis as the essence of the case under investigation, in which it can be understood as an event, an entity type or some process modality (ROSSI, 2004: 99). The unit of analysis is critical in determining whether the research project will adopt the traditional case study or multiple case study. Yin (2015) points out that the most important thing when choosing case studies is to apply replication logic rather than sampling.

This case study used documentary research, conducted from private, original and non-transferable Haiala Metallurgical archives, and interviews were conducted with managing director, inventory supervisor, production supervisor, human resources supervisor and collaborators.

This general source material is useful not only for bringing knowledge that serve as background to the field of interest, but also to avoid possible duplication and/or unnecessary effort; It may also suggest problems and hypotheses and guide other sources of collection. Questionnaires were also applied in addition to direct observation along the shop floor processes.

It is observed that the direct documentation and data collection were of fundamental importance for the efficiency of the conclusion of a work, but also the application of indirect research, which indicates the collection of data in a documentary and bibliographic way of interest. According to Lakatos and Marconi (2009, p. 176) "the indirect documentation technique is done in two ways: documentary research and bibliographic research". The production supply methods and techniques and their production strategy were the focus of data collection for information from the Material Management and Processes of the Practical production line used in Haiala Metallurgical, in order to strengthen the proposed investigation.

It can be observed that in the search for understanding, it was essential in the field visit before the approach of the processes and services developed for the construction of this article, the participation of the person in charge of the production sector, in which he had an effective participation, demonstrating knowledge and dedication. He described all the steps of the production process of the Haiala Metallurgical Practical line, making a significant contribution to the accurate and detailed information within the visit.

3. Results and analysis

The organizational structure of the studied company is composed of several departments starting with the administrative center and the productive process sectors. Production lines are divided into specific and flexible lines, steel products have their production divided by specific models, where only one model of each product is concentrated in the production line, this form is only possible due to the large warehouse planned for support the large-scale production flow, the aluminum line has the differential of being flexible,

where various product models are developed on the same production line, adapting according to the product to be produced, the physical space is in expansion process so that specific lines are created in order to expand production due to new market trends.

3.1 The space for inventory management

In the collection of data obtained according to interview with Galvão (2014), production supervisor, it was found that the material inventory consisted of products classified as A, B and C as; Steel coils, locks, inks, and various profiles, composing the steel line products in a total of 190 items. Already the raw material of the aluminum line consisted of products "A, B and C, such as profiles, glass, obtaining the aluminum products that together add up to a total of 153 items, totaling 340 items in aluminum and steel."

The organization had an area in the industrial sector of Quirinópolis, with space in the yard for trucks, area for handling cargo and unloading, area built to house the administrative center, large industrial shed, designed to serve all sectors, from the warehouse of raw material, refectory, passing through the production lines, painting, until the finished product stock. The total area, including loading and unloading space as well as parking, is 21,000 m², which incorporates a total built area of 12,924.50 m², and within this space is the aluminum production sector that includes the “Plena” and “ Practical ”, with a space of 1,446.30 m² and already planned to expand the sector (SANTOS, 2014).

3.2 Inventory management operation

According to field research and data extracted from the applied interviews, it was identified that the structural process of the material management operation began by receiving the raw material, checking and storing the material according to its classification and needs. They are stored in strategic locations in order to follow logistics to better serve the departments. For material retirement, the form of open stock is adopted, in which it is directly discharged, using the fact sheet, when the production order is passed, the system itself searches the fact sheet that contains all the items. that are spent for the production of the product, at that moment it is made low through the system, the leftovers of cuts and burrs of holes, are weighed and made the manual low (GALVÃO, 2014).

According to data collected, both in the raw material and accessories, the stock replacement was made through the technique of determination of minimum and maximum stock, delimiting the replacement time from the moment of equalization of the minimum stock, was also verified as to stock replenishment according to its control tools, developed by the Information Technology (IT) sector, where the order of the raw material is triggered from the entry of orders from customers that exceed the limit stock, at this time an automatic e-mail alerting inventory consumption pre-booked by orders that have just entered the commercial sector (GALVÃO, 2014).

The organization worked with open stock, that is, the material write-off occurs when the Production Planning and Control (PCP) launched the production order, the system recognized the required quantity through the fact sheet, where all the items were registered in the system. items used for each product produced, and automatically occurred as requested. There were also cuts left in the production process that were collected and weighed, thus being lowered from the total weight (GALVÃO, 2014).

There was no specific employee to monitor the safety stock, the control was performed through the

PCP, in which the aluminum frames were duly inventoried fortnightly and subsequently analyzed their lead time. The form used was the rotating inventory, according to the organization's schedule was done fortnightly, always on the first business day of the month and on the first business day of the second fortnight, for the finished products were made monthly, as the raw material and accessories, always on the first business day of the month (PALMEIRA, 2014). The organization of the operation and its proper inventory management provides an optimization of resources (LIM et al., 2010), especially financial which is healthy, in this perspective it is clear that the integrated CFP becomes essential for an industrial organization (TULVINSCHI, 2015).

3.3 Production process of the Practical line

With the data collected in the field research, Galvão (2014) explains about the realization of the production process in the Practical line, starting with the production order, following for cutting and machining, later consulted. the technical data sheet and drawings, proceeding the next day the assembly of components and then the joining of parts, closing and adjustment was done ending with the inspection and packaging. The daily production reached 70 total aluminum pieces between Practical and Plena line, this production tended to grow with the expansion of the new space that was being developed, intending to reach 250 pieces per day to serve the market, according to the new project. sales under development.

3.4 Cutting waste and its impact on remuneration

According to Palmeira (2014), the company, aiming to avoid waste and improve inventory control, adopted the policy of benefits to employees directly involved in production, where the measurement of cutting waste impacts on the final salary, when these exceed the allowable limit, that is, in front of a weighting table established by the company itself, there was a permissible limit for them, when it was exceeded, the employees of the sector lose the bonus, and consequently, they no longer receive this benefit, which was added to the final remuneration (Figure 1). When production planning is not performed for the entire planning horizon, but only for a few periods or only one period, huge waste of resources occurs (HOSSEINI, 2015; SAMPAIO et al., 2017).

Figure 1. Waste deposits of the production process

3.5 Sales impacting the lack of finished product

The aluminum window and door line was launched in 20l2, “Full Line”, being more sophisticated, directed to a higher purchasing power audience, while the Practical line was launched. later, also with a

formidable quality, aimed at a middle-class public, however failures emerged during the process, facing a market still under construction, in which the Practice frame line exceeded sales expectations, causing delays in sales. deliveries due to low production flow (PALMEIRA, 2014).

The problem was identified when orders started to come in at this time as planning failure begins to appear, because with the variety of products in the Practical line it was necessary to adjust the templates as requests to produce, having to stop other productions so that the same physical space is used, and this process has been causing delays in deliveries and consequently lack of product at the time of loading (PALMEIRA, 2014).

Organizations to serve their customers and maintain their competitiveness must possess the means of production that include various resources and capabilities, and these purchasing decisions include spatial, temporal and productive location aspects (JAKUBOVSKIS, 2017). The fault was identified, and a project was planned to expand the physical space and improve the sector's productivity (PALMEIRA, 2014).

3.6 The production process

During a field visit to Haiala Metallurgical, several steps were raised for the production of the Practical line, which began by receiving and checking the raw material, coding according to the date of receipt, which was later made. a separation according to the expected amount of average spent in the last 3 months, and the sending for chemical bath process and painting to be performed by specialized companies located in Brasilia and Goiania, with return time of 15 days (GALVÃO, 2014).

When the goods arrived, a second measurement conference was made to verify the conformity of the service performed, since the product was already in a specific profile to assemble the Practical and Full line, and then the items were separated by means of From the production order issued by the PCP, the production process later began by cutting the profiles and moving to another phase in which holes and cut-outs were made to be screwed and fitted.

Soon a new separation and preparation for mounting with the sealing fittings was made, moving to the frame, following for adjustment, then to the template where the functionality tests are made, not being conformed again to correct the faults. Being in compliance was made the final quality inspection starting for packaging and mooring and ending with the palletization of finished product (PA) (GALVÃO, 2014).

3.7 Process analysis

According to the collected data it can be inferred that the lack of the finished product is due to the delivery time of the processed raw material, since the acquired one arrives at the company in its form fresh after 90 days from the beginning. having to go through two other processes of chemical treatment and painting of aluminum profiles to start the production process, on the other hand suffers from a growing demand in the aluminum sector, not being fully prepared for meet the flow (Figure 2).

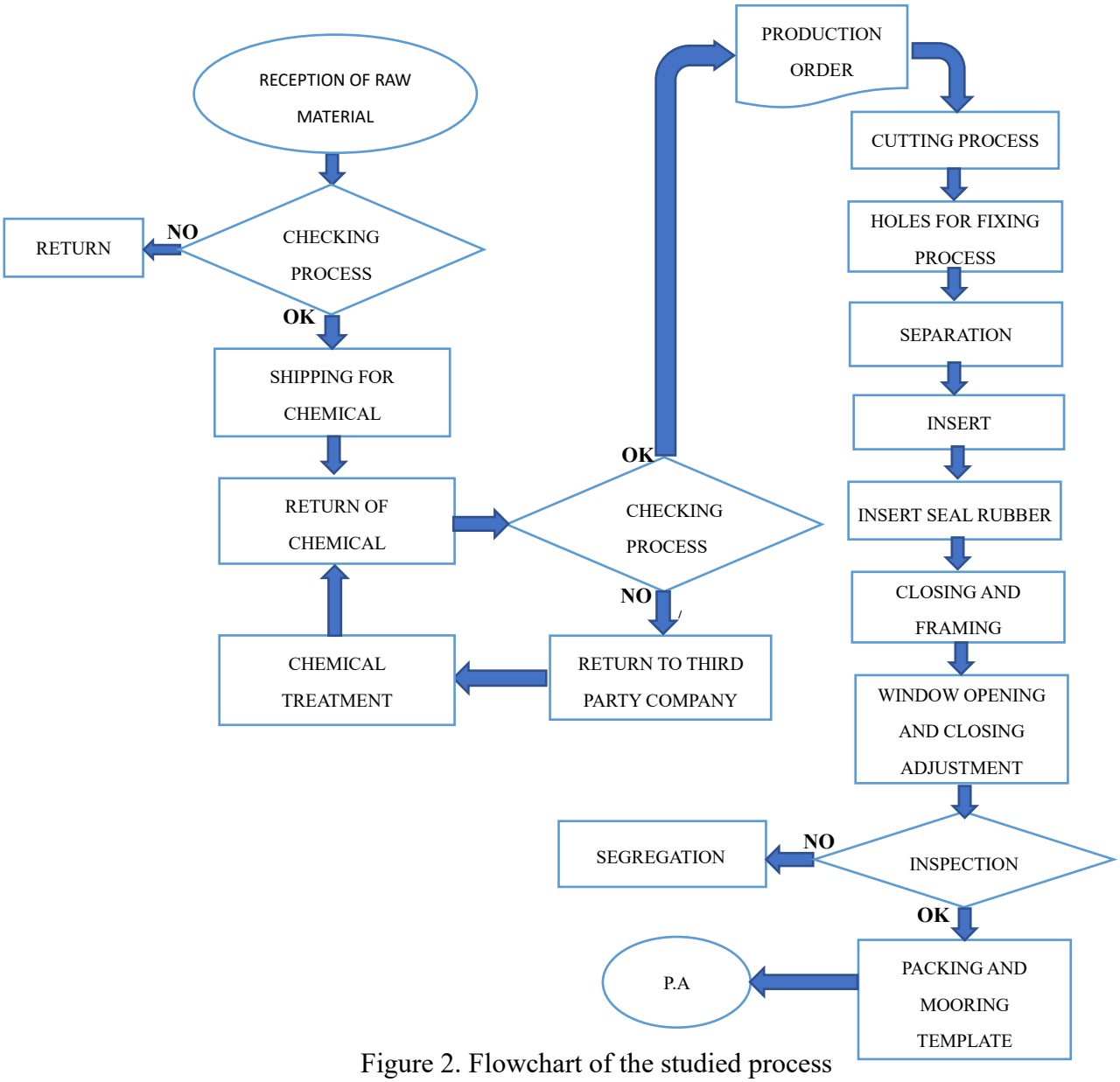


Figure 2. Flowchart of the studied process

So that there was manufacturing goods and services, there was always the need to process raw materials that would be transformed into finished products or services throughout the production process, in its first step with regard to the application of the raw material in natura takes 90 days to reach the company, due to its cut and exclusive measures for the organization. However, it was found that this was not the critical point as there was sufficient stock to meet demand, but in chemical treatment processes where it was separated by quantity and measures to be sent to the partner organization for treatment. chemical and paint for corrosion protection.

On average, the time taken for this process was 15 days, on its return was held a new conference and measurement is in compliance follows the production process, non-compliance leads to return to redo the process (PALMEIRA, 2014), impacting directly in the delivery of the finished product (KUMAR & AOUAM, 2018). Regarding the amount of raw material to be sent for chemical treatment and painting, it was found that it was based on the analysis of sales over the past three months and may vary from sporadic orders with high quantity out of forecast, resulting in scarcity of the raw material to be used (Figure 3).

Performance of production systems is strongly affected long before capacity is fully available, increasing average delivery time in a nonlinear manner (SAMPAIO et al., 2017).

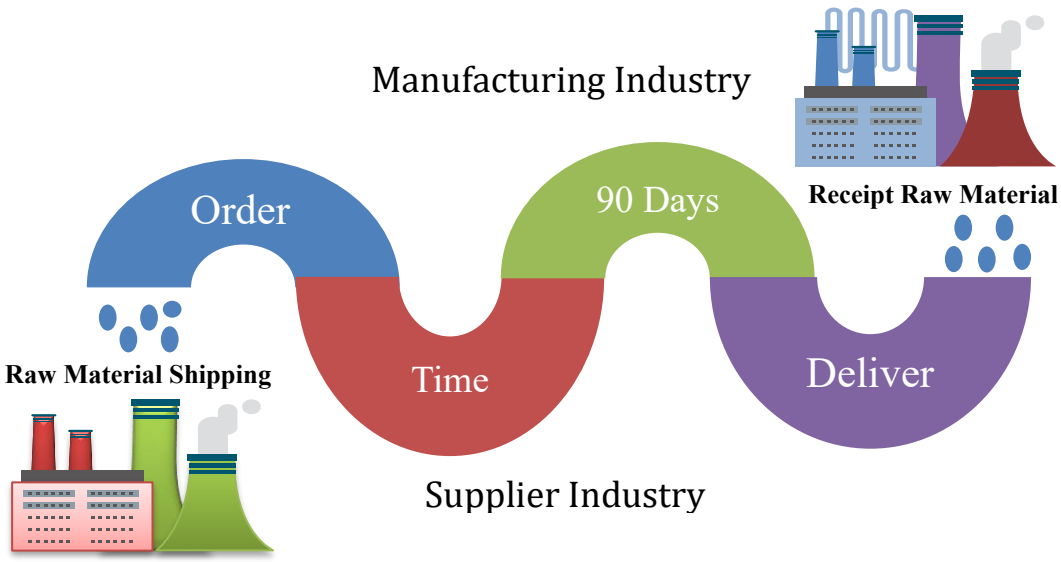


Figure 3. Raw material supply process

To plan and monitor the production system to keep it always dynamic, healthy and fluent, the PCP needed to gather data and information from all parties. Data and information must be gathered to provide an integrated approach to operation and the entire system, particularly where their bottlenecks or bottlenecks were located (KUMAR & AOUAM, 2018). For effective production planning, it is necessary to keep up-to-date information on demand estimates, estimates of production capacity, estimates of available resources, among others, in order to provide the action horizon, which is important for successful planning. and control of current production (CHAND et al., 2002; SAMPAIO et al., 2017).

Another identified bottleneck was the turnover of employees, losing professionals already with an advanced technical level of the production line, it is inferred that this fact was due to the high demand of the workforce. The ambiguity between people's expectations of the job and what the organization feels should be done causes uncertainty about what the role of the employee should be and this type of problem can be the result of a poor understanding of what is expected and also provoke the turnover (GUIMARÃES, 1998; FERNANDES & ROSA, 2013). With this, one must also consider the time demand for qualification and training of new employees to perform the function (PALMEIRA, 2014).

One of the aggravating factors that was also a reason for lost productivity was the lack of physical space for the Practical production line, since several models were developed in the same space, “flexible production lines”, wasting time in exchange and jig setting. The PCP has its efficiency reduced due to the adopted production model and directly impacts the productivity in the production line (CHAND et al., 2002; SAMPAIO et al., 2017).

4. Conclusion

In an analysis made in relation to field research, it was found that an aggravating point was the lack

of monitoring of market demand, that there was no history that could compare product demand in the same period of previous years, only stated It is concluded that the sale of this product was a trend for significant growth in the market. Based on this information, it is concluded that the lack of the finished product was due to the lack of an accurate production planning and control method impacted by the seasonality of demand in certain markets. periods that did not have an adequate forecasting equation.

5. Acknowledgement

Special thanks to the Faculdade Quirinópolis - FAQUI for the opportunity and conditions of development of the project. We would also like to thank the Goiano Federal Institute - IF Goiano, Campus Rio Verde.

6. References

[1] CHAND, S., HSU, V. N., SETHI, F. S. Solution, and rolling horizons in operations management problems: a classified bibliography. *Manuf. Serv. Oper. Manag.*, 4(1):25-43, 2002. https://doi.org/10.1287/msom.4.1.25.287

[2] CHIAVENATO, I. *Administração de materiais uma abordagem introdutória*. Rio de Janeiro. Elsevier, 2005.

[3] DIAS, M. A. P. *Administração de Materiais*. 4.ed. São Paulo. Atlas, 2009.

[4] FACHIN, O. *Fundamentos de metodologia*. 5.ed. São Pulo. Saraiva, 2006.

[5] FERNANDES, J. T. & ROSA, C. R. O clima organizacional: um conceito motivador para redução do Turnover*, Contribuciones a la Economía*, agosto 2013, en www.eumed.net/ce/2013/turnover.html

[6] GALVÃO, R. dos S., *Entrevista com o encarregado de produção e estoque da Haiala Metalúrgica Ltda*, 2014.

[7] GONÇALVES, P. S. *Administração de materiais*. 2. ed. Rio de Janeiro: Elsevier, 2007.

[8] GUIMARAES, T. Assessing employee turnover intentions before/after TQM. *Gestão e Produção*, São Carlos, 5(3):187-205, Dec. 1998. http://dx.doi.org/10.1590/S0104-530X1998000300003

[9] HAIALA METALÚRGICA LTDA. *Haiala, uma empresa comprometida com você, o mercado e o país*. Disponível em: http://www.haiala.com.br/?link=institucional. Acesso em: 7 jun. 2019.

[10] HOSSEINI, H. Aging and the Rising Costs of Healthcare in the United States: Can There be a Solution? *Ageing International*, [s. l.], 40(3):229–247, 2015.

[11] JAKUBOVSKIS, A. Flexible production resources and capacity utilization rates: A robust optimization perspective. *International Journal of Production Economics*. 189:77-85, 2017. https://doi.org/10.1016/j.ijpe.2017.03.011

[12] KUMAR, K., AOUAM, T. Integrated lot sizing and safety stock placement in a network of production facilities. *International Journal of Production Economics*, 195(1):74-95, 2018.

[13] LAKATOS, M. de A. & MARCONI, E. M. *Fundamentos de metodologia científica*. 6. ed. São Paulo: Atlas, 2009.

[14] LIM, J. N.; SCHULTMANN, F. & OFORI, G. Tailoring Competitive Advantages Derived from Innovation to the Needs of Construction Firms. *Journal of Construction Engineering & Management*, [s. l.], 136(5):568–580, 2010.

[15] PALMEIRA, S. *Entrevista com o Gestor da Controladoria da Haiala Metalúrgica Ltda*, 2014.

[16] ROSSI, R. F. R. *Modelo de governança de TI para organizações Brasileiras*. Florianópolis, 1 v. Tese (Doutorado). Universidade Federal de Santa Catarina, Centro Tecnológico. Programa de Pós-Graduação em Engenharia de Produção. 2004.

[17] SAMPAIO, R. J. B., WOLLMANN, R. R. G., VIEIRA P. F. G. A flexible production planning for rolling-horizons. International Journal of Production Economics. 190:31-36. 2017. https://doi.org/10.1016/j.ijpe.2017.01.003

[18] SANTOS, J. M. *Entrevista com o Encarregado Setor contábil da Haiala Metalúrgica Ltda*, 2014.

[19] TULVINSCHI, M. Supporting economic efficiency by optimizing the stocks management. *The USV Annals of Economics and Public Administration*. 5(2(22)):166-174, 2015.

[20] YANTI, Y., et al. Evaluasi Proses Bisnis Material Management Berbasis Sap: Studi Kasus pada Perusahaan Consumer Goods. *ComTech*, 4(2):1301-1310, 2013.

[21] YIN, R. K.. *Estudo de caso: planejamento e métodos*. 5. ed. Porto Alegre: Bookman, 320 p. 2005.

Mobile Application for Gas Prices and Locations Inquiry in Manaus Amazonas

Bruno Pereira Gonçalves (Advisor)
golcalves.bruno@gmail.com
Centro Universitário Metropolitano de Manaus – FAMETRO

Bruno Lopes Rios
bruno.lopesrios@hotmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Keneson Liniker Farias de Abreu
kenesonliniker@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

Jean Mark Lobo de Oliveira
jeanlobolive@gmail.com
Centro Universitário Metropolitano de Manaus - FAMETRO

David Barbosa de Alencar
david002870@hotmail.com
Instituto de Tecnologia e Educação Galileo da Amazônia - ITEGAM

Abstract

The original features the prototype of an application that allows drivers to locate and compare fuel prices in the city of Manaus. Regarding the applied methodology approaches, this research is quantitative, field, survey and applied. It uses data and statistics from national surveys with population indices. It also brings data from an online questionnaire to measure drivers' opinions and information about the context of Manaus in relation to the stations. After analysis, it is noted that the application that helps drivers is not only necessary in a city with more and more vehicles as well accepted by potential users.

Keywords: Gas stations; Prototype; Mobile app;

1. Introduction

The Amazon vehicle fleet grows every year, especially in the capital, Manaus. The state has 62 municipalities in an approximate area of 1,559,146,876 km², with an estimated population of 4,144,597 inhabitants, of which 2.18 million in Manaus alone (IBGE, 2019). In possession of this population there is a fleet of 883,083 vehicles, of which 718,205 circulate in the capital of Amazonas (IBGE, 2018).

Vehicles circulating in Manaus grew 6.7% in two years, from 668 thousand in January 2015 to 713 thousand in March 2017. A total of 45 thousand new vehicles started to run on the city streets during this period. The data are from the Amazonas State Performance Indicators (Idea), released by the State Government in the first quarter of 2017. Manaus closes 2016 with almost 300 gas stations in operation. The number, according to the Fuel Union (Sindicam), is considered exorbitant and beyond what is necessary for the capital. According to the National Agency of Petroleum, Natural Gas and Biofuel (ANP), many drivers try to search for the lowest price that suits you.

According to statistics, with this increase, the number of stations tends to multiply and, consequently, the price of gasoline will always be fluctuating from one establishment to another. Many consumers have no idea where they will be supplying because they do not know where the price is most affordable, as they only come across values when they arrive. Because of this, the customer supplies the vehicle without knowing that later there may be a station that covers cheaper by the product.

However, the technological advance with smartphones may be a way out of the question. In recent years, there has been an increase in the number of mobile devices. According to the 30th annual survey of the Applied Information Technology Center of the Getulio Vargas Foundation School of Business Administration of São Paulo (FGV-EAESP) of 2019, there are 230 million smart phones in use in Brazil. Adding notebooks and tablets are 324 million handheld devices as of May 2019, ie 1.6 handheld device per inhabitant.

As a result, the smart phone application development market expands. Due to the large number of smartphone users and the growing number of vehicles, an app market is created for this audience that needs to be served.

In this work, a prototype for mobile devices will be created to help consumers research and compare the prices of the cheapest gas stations. The prototype will collect data from the app's users, such as model and make of vehicles. Later, the data can be sold to parts dealers in the region to let them know which car models are prevalent in the capital.

2. Methods

The research adopted in this work, regarding the approach, is classified as quantitative, based on data and statistics of national surveys with population, vehicle and mobile phone usage, accessed through the site. It also brings quantitative data from its own research to measure the opinions of drivers and information about the context of Manaus in relation to the stations. The collection of material in this survey was performed through an online questionnaire.

Regarding the procedures employed, this is a case study research, as it involved obtaining data through consultation with sources other than websites and articles, that is, the drivers who responded to the form in order to know which their opinion about the prototype developed in this work. Still within the procedures, it can be said that it is also a quantitative survey, as it used a questionnaire to conduct a survey of a specific audience, a census of drivers, in which the information gathered was in turn grouped into graphs that allowed an analysis. statistics on the subject.

As for nature, research is applied as it seeks to solve a specific problem. In this case, the problem is the

difficulty that drivers find to find places to supply with cheaper prices, the practical issue that precisely the application wants to solve. In this sense, the research is classified as descriptive objectives, because it seeks to describe a fact of a certain reality, in this case, the problems that drivers from Manaus have to locate nearby and affordable values.

The application will have two versions, one for the owners of the posts and one for customers. It will be updated by the owner of the establishment to maintain the integrity of the amount charged, as users will not be able to constantly monitor fuel price increases at the pumps. The geographic area contemplated will be Manaus, as it concentrates the largest amount of vehicles, besides the time and financial limitations of those involved to consider other municipalities besides the capital.

3. Materials

A prototype has been developed to work on the Android operating system (Google OS for smartphones) using the Android Studio development environment (V 3.4.1) to make the application for that system. The IDE (Integrated Development Environment) is where the application was created and the programming language used was Java (JDK 13.0.1). The Mysql Server manager (V 8.0.18) was used as a tool to edit and query the database.

The public consultation form was made using Google's own Google Forms tool for creating forms. The questionnaire was shared via link or via a QR Code.

4. Results

4.1. Application Health

The application created was developed to present a simple and intuitive interface, for easy access for drivers of all ages. It works as follows:

Figure 1 - First Login Screen
Source: Reproduction

When the user clicks where they already have access, they will be directed to a small blank window under the login screen.

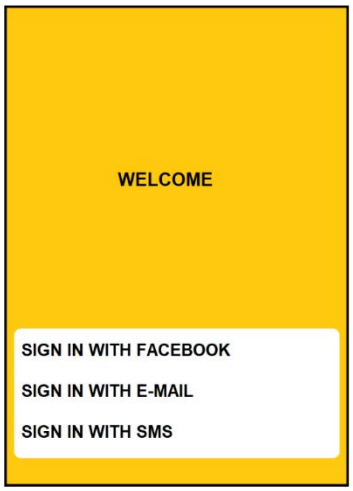


Figure 2 - Second Login Screen
Source: Reproduction

In this screen the user will be presented with three ways to login:
Through Facebook;
Through the email;
Via SMS (mobile number).

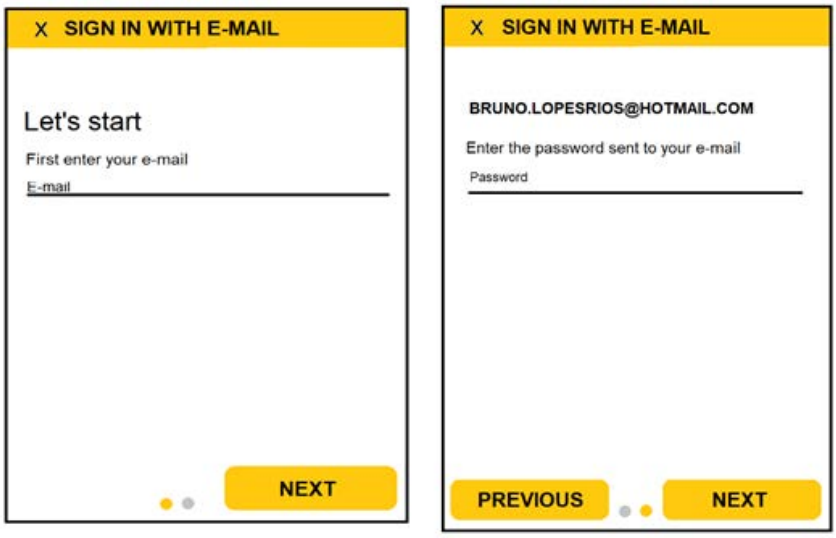


Figure 3 - Email Login Screen
Source: Reproduction

By entering the email and clicking the forward button, the application will verify that the email is registered. If not, a password will be sent to the email address entered, as shown in figure 3.

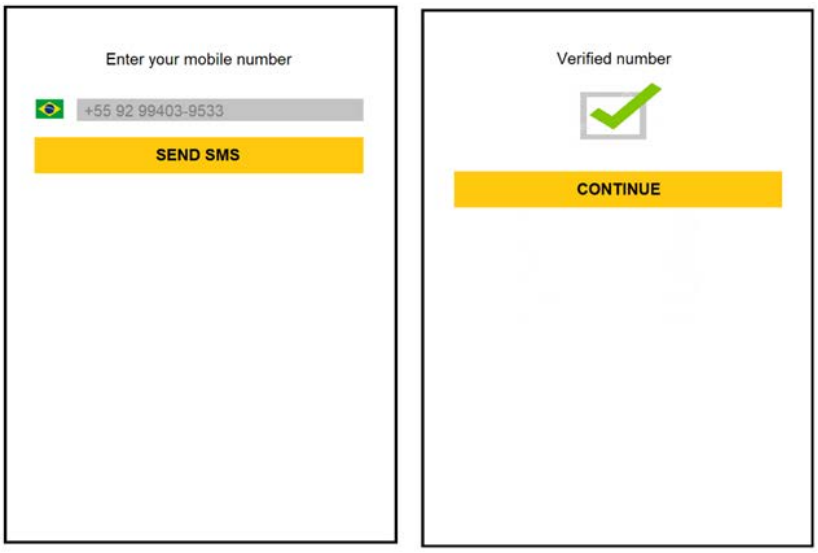


Figure 4 - SMS Login Screen
Source: Reproduction

In this screen, the user will enter his mobile number, through which the application will send an access code to it, automatically identify and will be logged in.

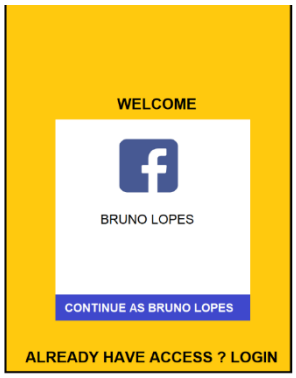


Figure 5 - Login screen via Facebook
Source: Reproduction

In this screen, the user logs in via Facebook, where the application will open the social network on the smartphone in the account that is in use. This will be automatically linked to the post app.

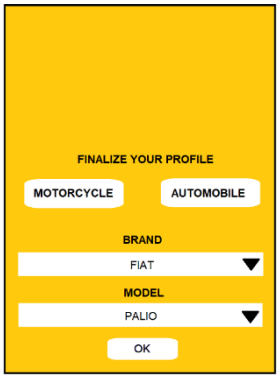


Figure 6 - Registration Screen

Source: Reproduction

The registration screen will be displayed at the first login of the user. The following information will be registered:

• Name;
• Type of vehicle (motorcycle or car);
• Brand (the driver will only need to select one of the brands presented, which will already be pre-registered);
• Model (the driver will only select one of the models, which will be pre-registered);
• Ok - finalizes the registration.

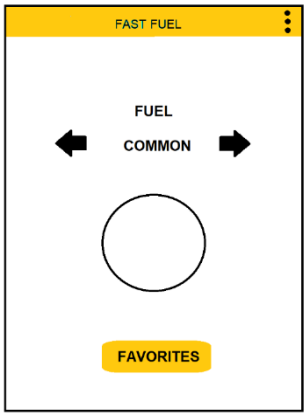


Figure 7 - Application Home Screen
Source: Reproduction

This is the app's home screen where:

• In the arrows the driver chooses the type of fuel (ordinary gasoline, additive, ethanol, diesel and etc.)
• The circle represents the app icon, which is still in the process of elaboration, and the same will be the search button that will show the nearest posts of the user;
• Favorites is the button that will bring the properties listed as main by the user.

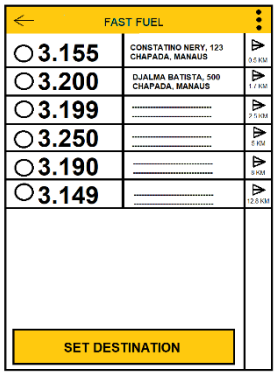


Figure 8 - Search Screen
Source: Reproduction

This screen appears after selecting the fuel and clicking the search button. In it are all the nearest stations of the driver, showing address, distance and fuel value. Just the user presses the desired station, a window

of the station will open containing the information of fuels sold along with address.
With the yellow button the driver will be able to set a route and the app will show the best-priced stations on the route.

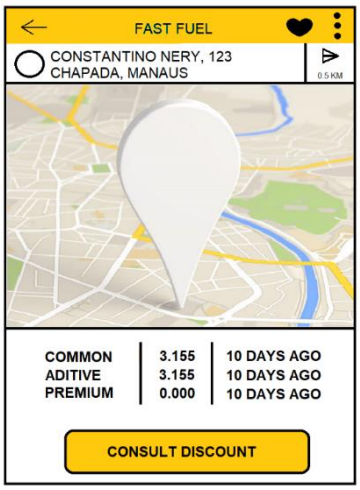


Figure 9 - Screen displaying the selected post in the search screen
Source: Reproduction

This screen shows about the rank and available fuel prices. In the images (MAPS) will be shown the location of the post on the map, and clicking on it, the app will open the map application on the user's mobile phone, playing the location of the post and tracing the route from where the driver is to the establishment. The button "consult discount" will only be visible if the post offers discount when filling with this application. In the top menu there is a heart, which allows you to save the post as a favorite.

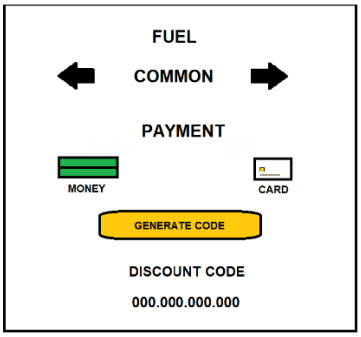


Figure 10 - If available, the discount will open this small window.
Source: Reproduction

In it the driver selects the fuel type, making the change of fuel by the black arrows; choose the type of payment (cash or card); presses the yellow button, where a code will be generated, which the user will show to the attendant when filling up.

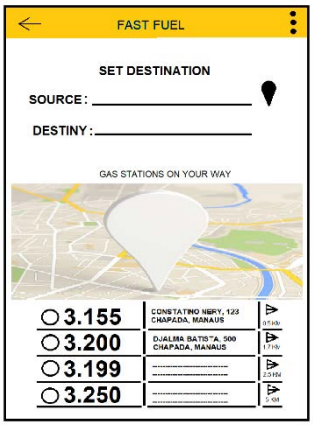


Figure 11 - Route Screen
Source: Reproduction

• In ‘Origin’ the driver enters the starting address or presses the adjacent black image, which will identify the location by the mobile phone;
• In 'Destination' is placed the end point of the route;
• In the image (MAPS) the app will show various stations that will be on or near the route;
• Below the image (MAPS) will be displayed a list of rank on the route with the best prices.

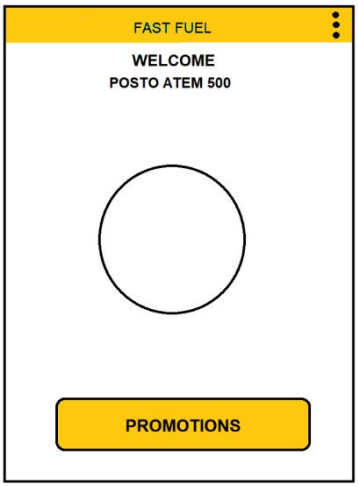


Figure 12 - Home screen of homeowner app
Source: Reproduction

• It shows the name of the station;
• The round image is where will be the brand of the establishment, which clicked will show the window with prices and option of editing them;
• Also contains the 'Promotions' button.

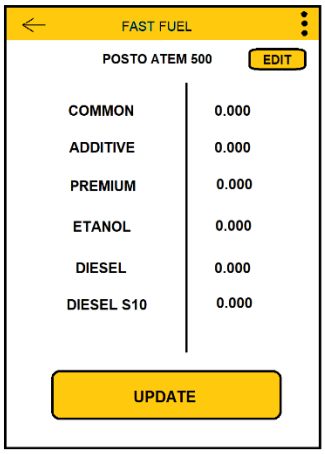


Figure 13 - Pricing Screen
Source: Reproduction

Shows all types of fuel and their prices.
Pressing the edit button enables the field where prices can be changed. Also enables the refresh button, which saves the changes.

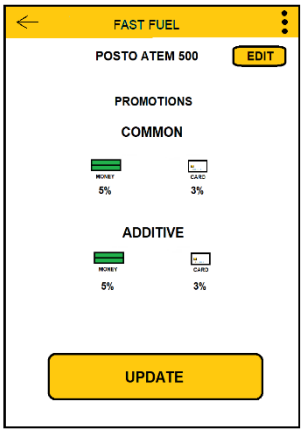


Figure 14 - Promotions screen for the post owner
Source: Reproduction

In this screen will be displayed all fuels that the owner can offer discount or not, putting the percentage of discount that will be given. Press By clicking edit the owner can put the% off and then, pressing update, the changes are saved.

4.2 Audience Survey

The questionnaire was applied to drivers with National Driver's License (CNH) types A, B, C, D and E in Manaus. The questions designed for the driver aim to draw a profile of the people interviewed and to know the public opinion about the application in question. The procedure performed for data collection was applied by an online questionnaire with 11 questions in Google Forms.

In total, 101 people participated in the survey, 65.3% men and 34.7% women.

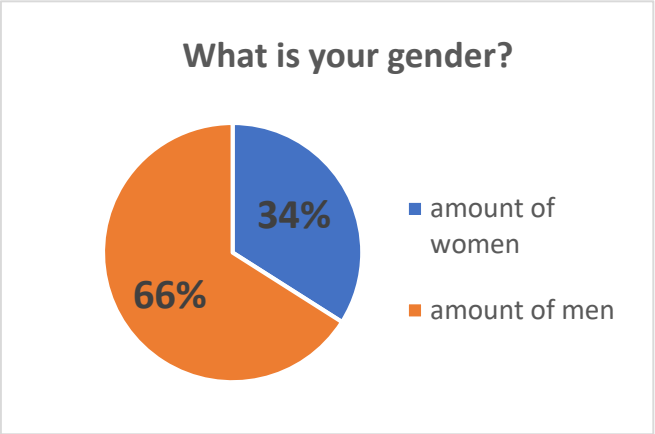


Figure 18 - Percentage of Audience Participation
Source: Reproduction

The age range of the public is varied, being well distributed between 18 and 60 years, although the largest amount is concentrated in the range between 22 and 45 years.

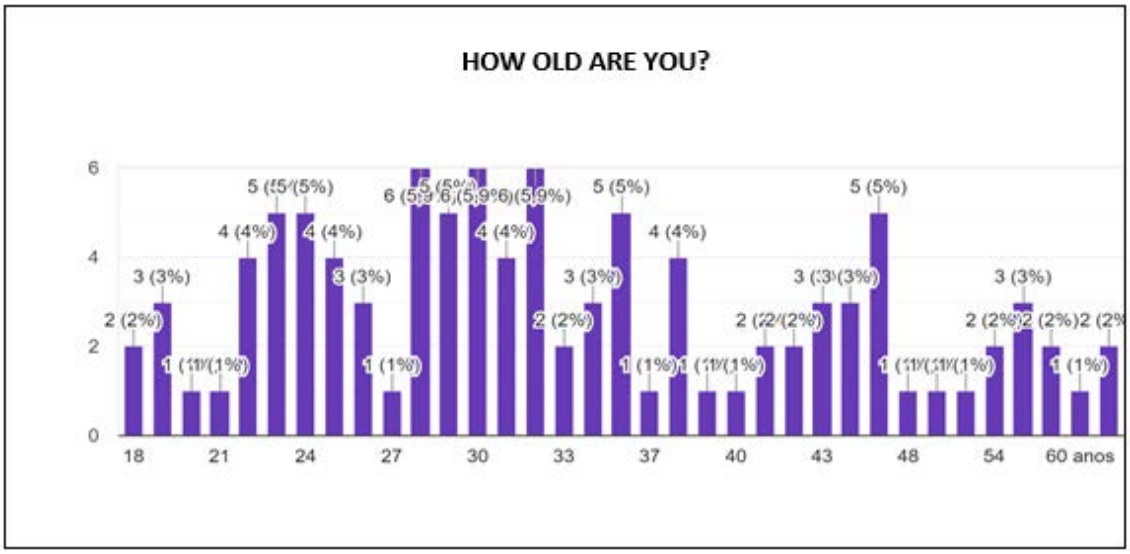


Figure 19 - Age range of survey audience
Source: Reproduction

Most participants have CNH B (57.4%) and A (45.5%). Already the number of people who do not have a portfolio and participated is greater than the sum of those with qualifications C, D and E, as shown in the graph.

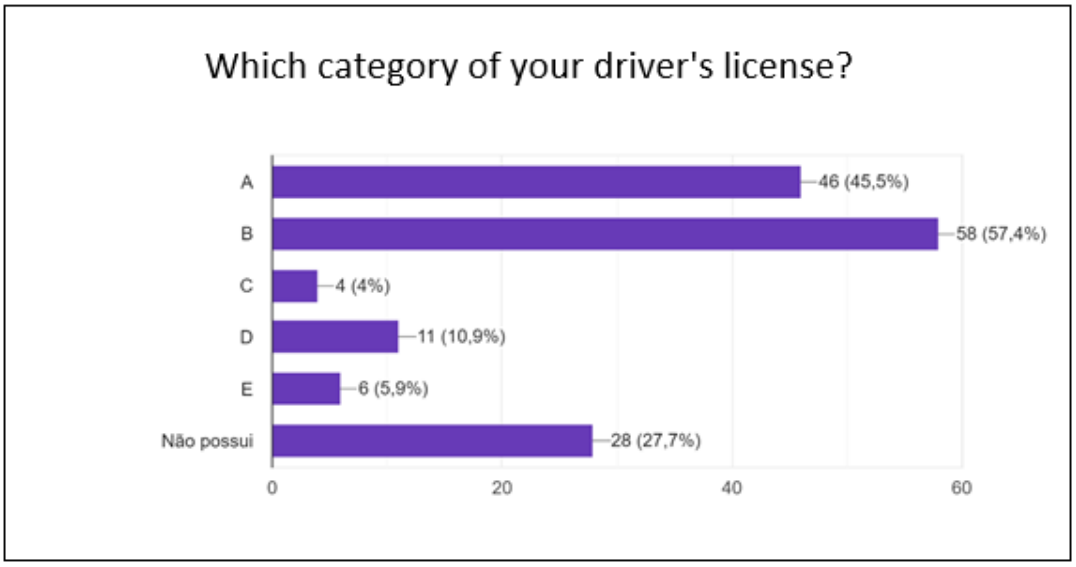


Figure 20 - Number of drivers in each type of driver
Source: Reproduction

An important data raised is the percentage of people who use smartphones, a percentage of 94.1%, a relevant factor considering that this tool is important for application use.

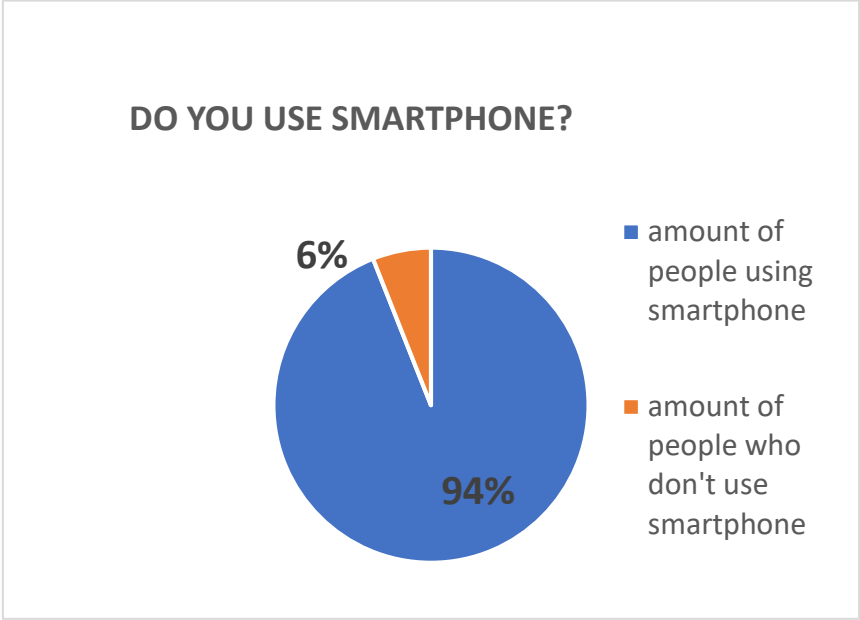


Figure 21 - Most audiences use smartphones
Source: Reproduction

In a second moment of the research, questions were presented for participants to express their opinion about the situation in Manaus regarding the supply at local stations. Regarding the price of fuels, the dissatisfaction rate is high, 63.4% consider the values charged terrible. No participant rated the prices as good or great, as the chart indicates.

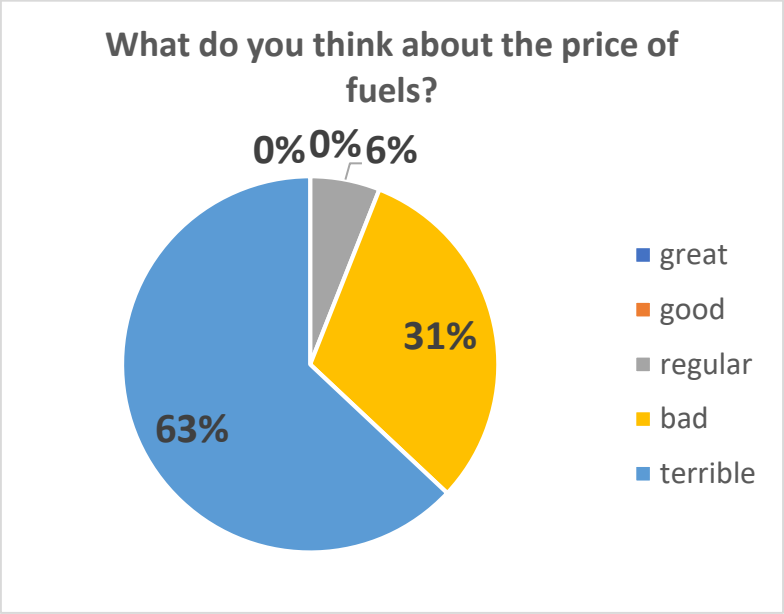


Figure 22 - Most public disapproves of fuel prices
Source: Reproduction

Of the 101 people, 70.3% consider it difficult to access gas stations that cover affordable prices. Only 7.9% said they had no difficulty finding budget-priced establishments.

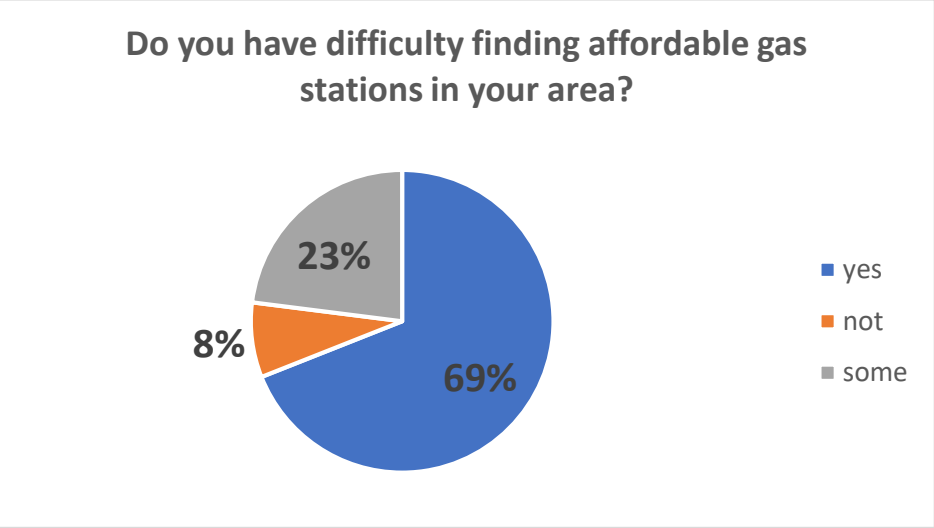


Figure 23 - Most cannot easily find good-priced jobs
Source: Reproduction

Based on this, the majority of the public states that they would like to receive information from other drivers about outlets in Manaus (90.1%) and to be notified about promotions at the stations (95%), as shown in the following graphs.

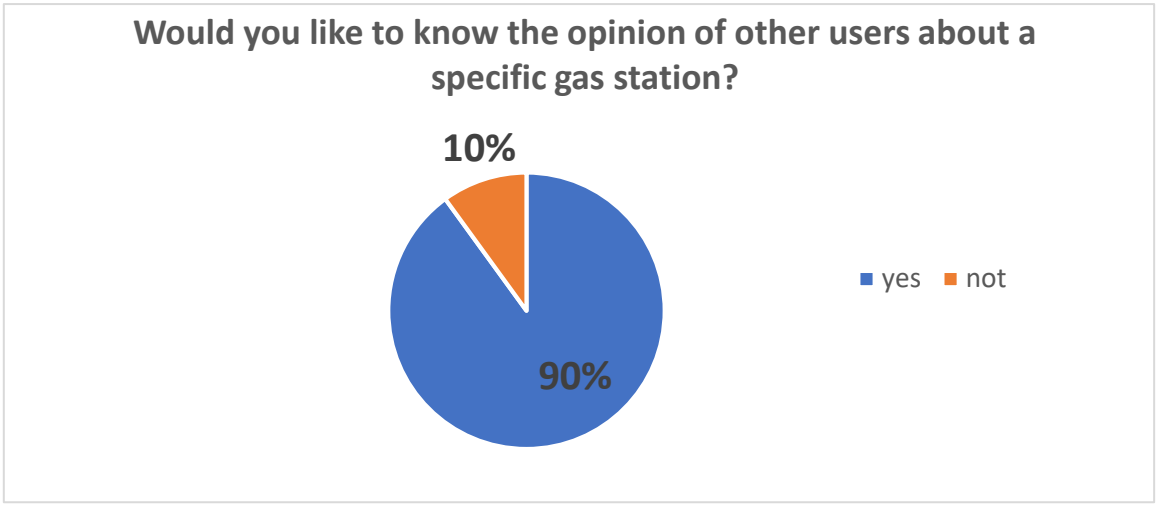


Figure 24 - Opinion on driver's exchange of ideas
Source: Reproduction

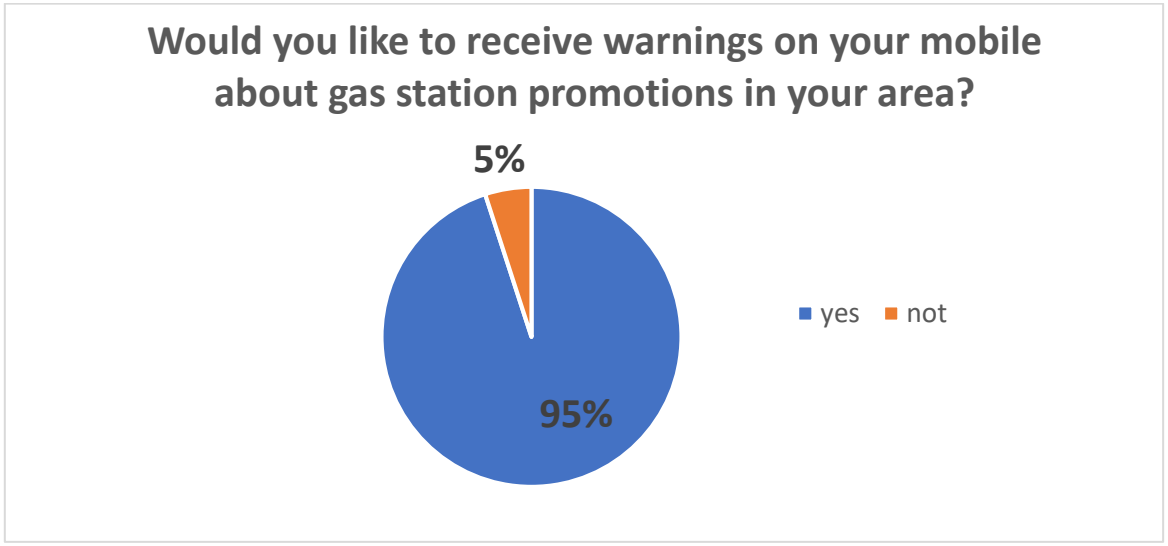


Figure 25 - Opinion on promotion sharing via mobile
Source: Reproduction

In order to know about the acceptance of the prototype by the potential users, a scale of optimal, good, fair, bad and very bad was made about the idea of the application to measure the possibility of using the developed prototype. It is possible to observe that the public concentrated the answers in excellent (76.2%) and good (23.8%).

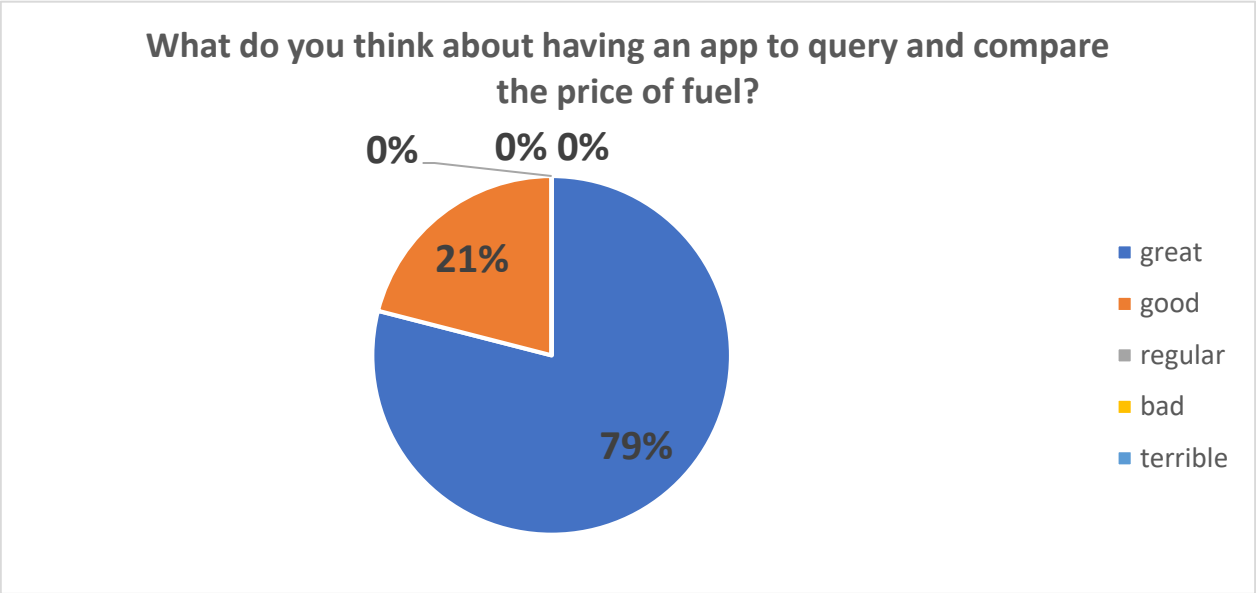


Figure 26 - Application reception by audience is positive
Source: Reproduction

5. Discussion

After conducting a survey on the situation of Manaus in relation to the number of vehicles and stations and analyzing the answers obtained through the online questionnaire, it is observed that the idea of launching an application that helps drivers is not only necessary but well accepted by the possible ones. users.

As stated, 63.4% of respondents think the prices charged for fuel and 30.7% bad. Of the 101 people who participated, 70.3% consider it difficult to access gas stations that cover affordable prices. There is high dissatisfaction among the population regarding this service. On the other hand, 90.1% of the public stated that they would like to receive information from other drivers about establishments that supply in Manaus and 95% would like to be notified about promotions at the stations. Considering that 94.1% use smartphone and the varied age of the audience, so most are able to have the app.

Based on the audience's opinion of the questionnaire, application acceptance is positive. On an optimum to very poor scale of the app idea, most responses were great (76.2%) and good (23.8%), with zero for fair, poor, and very poor. This indicates that there will be people interested in using the application, which will have a relevant practical utility to meet a need that is part of the daily life of the population.

6. Conclusion

With rising fuel prices, especially gasoline, and more cars and other types of vehicles on the city's streets, people are looking for places where they can fuel so as not to escape the monthly budget. However, as they have no place to consult prices on a unified basis, drivers often choose to pay for the product from the nearest place or on their way to work, for example.

With an app, that can change. Quickly, the user can check the values and location of where to go to supply, and this safely, since the data will come directly from the administration of the establishment. On the other hand, entrepreneurs can also benefit. The owner can simply attract customers by entering promotions in

the form of discounts, as shown earlier on the screen where will be displayed all fuels that the owner can offer discount or not, by entering the percentage of discount that will be given.

The simple and accessible application interface available for Android and IOS systems may not be a way to solve the fuel price problem, as this involves government issues, but it can make life easier for drivers on a daily basis.

7. Bibliographical References

CIDADES IBGE BRASIL/AMAZONAS. IBGE, 2019. Disponível em: < https://cidades.ibge.gov.br/brasil/am/panorama> Acesso em: 23.09.2019;

MANAUS É A SÉTIMA CIDADE MAIS POPULOSA DO PAÍS COM 2,18 MILHÕES DE HABITANTES. Amazonas Atual, 2019. Disponível em: < https://amazonasatual.com.br/manaus-e-a-setima-cidade-mais-populosa-do-pais-com-218-milhoes-de-habitantes-diz-ibge/ > Acesso em: 23.09.2019;

MERCADO BRASILEIRO DE TI E USO NAS EMPRESAS. FGV EAESP, 2019. Disponível em: <https://eaesp.fgv.br/sites/eaesp.fgv.br/files/pesti2018gvciappt.pdf> Acesso em: 23.09.2019;

GERHARDT, Tatiana Engel; SILVEIRA, Denise Tolfo. Métodos de Pesquisa. Porto Alegre: Editora da UFRGS, 2009. Disponível em: < http://www.ufrgs.br/cursopgdr/downloadsSerie/derad005.pdf > Acesso em: 30.09.2019;

SOUZA, Silane. Frota de Manaus em circulação supera marca de 713 mil veículos. Acrítica, 2017. Disponível em: < https://www.acritica.com/channels/manaus/news/frota-de-manaus-supera-marca-de-713-mil-veiculos > Acesso em: 10.09.2019.

Administrative Empowerment as an Approach to Total Quality Management in Kindergarten

Enas Ragab Abdelkareem Minia University, Egypt
Elsayed Abdelkader Sherif Cairo University, Egypt
Somia Ali Ahmed Minia University, Egypt

Abstract

The current research aimed to diagnose the current reality of administrative empowerment in kindergarten, to diagnose the current reality of total quality management as well, in addition to identify the nature of the relationship between the level of administrative empowerment and the level of practicing total quality management in Kindergarten, and finally to monitor the obstacles facing administrative empowerment in kindergarten so as to develop some recommendations to overcome these obstacles and to achieve total quality management in kindergarten. Data collection tools were two questionnaires - prepared by the researcher -. The research sample consisted of (110) kindergarten leaders of Directors, Deputy Directors and Head teachers from kindergarten, Minia Educational Administrations, from the nine centers of Minia Governorate. Findings of the study revealed the following: administrative empowerment in kindergarten was achieved at a low level and total quality management was achieved at a low level as well; in addition, there was a statistically significant positive correlation between administrative empowerment and total quality management in kindergarten; moreover, the research sample mentioned a set of obstacles facing administrative empowerment in kindergarten. Then the research sample suggested a number of suggestions to overcome these obstacles in order to achieve total quality management and a number of suggestions to activate total quality management in kindergarten.

Keywords: Administrative Empowerment, Total Quality Management, Kindergarten

Introduction:

The era we live in witnesses great and rapid changes into almost aspects of life. As technology has developed, the level of production has evolved with its' methods and means of service delivery. Moreover, huge organizations have grown which have recently taken on even greater importance. As much as the organization has become important to an individual's life, the organizations now consider the individual as the basis upon which they depend on to achieve its various objectives. So that, they are doing their best as well as spending money and tie to choose the best efficient ones and work to empower them.

Emphasis on empowerment is a prerequisite for modern institutions, especially in the light of the trends towards adopting and applying participatory management concepts such as Total Quality Management. This approach mainly based on a new philosophy that concentrates on the focus of managers should not be on competing regulations, but rather on his staff in the first place. Furthermore, it is closely

linked to the prevailing developmental trends related to human development within an organization. **(Experts of the Arab Group for Training and Publishing, 2014, 11)**

Empowerment forms an integral part of the Total Quality Management process. It aims to make a change in work by providing many opportunities in its various dimensions. It reflects a necessary requirement for the management of all institutions nowadays, and an important approach to achieve Total Quality Management especially in educational institutions as it depends greatly on training and development, the delegation of authority and creative thinking.

Research Problem:

Many rapid and renewed political, economic and environmental conditions and developments have led to radical changes in the frameworks and structures of the various educational institutions in general and kindergartens in particular, which made it necessary for kindergarten workers to develop their skills and attitudes in order to react to such conditions and developments.

The researcher noticed through her working as a kindergarten teacher that there are problems with kindergarten administration. This was inconsistent with previous studies the researcher reviewed which indicated that there are problems related to kindergarten administration as the results of **Hanafy, D. (2004)** which referred to the lack of administration experiences in kindergarten institutions with modern administration methods and techniques and how to use them, in addition to the study of **El-Azab, H. (2009)** which indicated the low level of good human relations between employees within kindergarten as well as between them and the kindergarten administration.

Traditional administration methods have become ineffective and its results are limited to the subordinate's implementation of the minimum level of work, while excellence and creativity in work require other nontraditional methods. Employee empowerment in the organization represents the most recent outputs of modern administrative culture at the beginning of the 21st century. It supports total quality, change, innovation, information management and management of event locations as one of the most important modern trends in management intellectually, organizationally and practically.

Accordingly, empowerment can be a strategy if it is adopted as a key dimension of Total Quality Management and continuous improvement for its cumulative impact on quality and improvement. Hence, the problem of the current research was identified in the following key question:

How can administrative empowerment be used as an approach to achieve Total Quality Management in kindergarten?

1. What is the reality of administrative empowerment in kindergarten from the point of view of the research sample?
2. What is the reality of total quality management in kindergarten from the point of view of the research sample?
3. What is the nature of the relationship between the level of administrative empowerment and the degree of total quality management practice?
4. What are the obstacles to administrative empowerment in kindergarten?

5. How to overcome the obstacles of administrative empowerment to achieve total quality management in kindergarten?
6. What are the suggestions to activate the total quality management in kindergarten?

Research Objective: The current research aimed to:

1. diagnose the current reality of administrative empowerment in kindergarten.
2. diagnose the current reality of total quality management in kindergarten.
3. identify the nature of the relationship between the level of administrative empowerment and the level of practicing total quality management in Kindergarten.
4. monitor the obstacles facing administrative empowerment in kindergarten.
5. identify some recommendations to overcome these obstacles in order to achieve total quality management in kindergarten.
6. identify suggestions for activating total quality management in kindergarten.

Research Significance: The significance of the current research is as follows:

1. **Theoretical Significance**
   - That it addresses a relatively recent administrative approach, administrative empowerment as it is an important approach for developing kindergarten administrative system and a key factor for its success and excellence.
   - The issue of administrative empowerment is the issues that the Arabic library suffers from its scarcity; that the current research represents an addition to kindergarten research as it deals with administrative empowerment as an approach to total quality management in kindergarten.
2. **Practical Significance:**
   - The results of the research may help in drawing the attention of those who interested in administration, planners and decision makers to stand on the current reality of administrative empowerment and total quality management in kindergarten.
   - Proposed recommendations may be useful in providing kindergarten stakeholders directions that help them to formulate labor policies, achieve work objectives and increase administrative efficiency.

Research Methodology: The current research used the descriptive approach.

The Research Sample: The research sample consisted of (110) kindergarten leaders of Directors, Deputy Directors and Head teachers from kindergartens in Minia Educational Administrations, from the nine centers of Minia Governorate.

Research Tools: Current research tools are:

- **The first tool-** The reality of administrative empowerment in kindergarten questionnaire, which included five dimensions: recognizing the meaning of work and its value five items, training and development five items, participation in decision making and taking four items, communication and

dissemination of information five items and self-Motivation four items. The questionnaire also included an open question about the obstacles of administrative empowerment in kindergarten and an open question about how to overcome obstacles of administrative empowerment.

- **The second tool-** The reality of total quality management in kindergarten questionnaire which included four dimensions: continuous improvement six items, training and development six items, kindergarten teachers four items, focusing on the beneficiary (Child, parents and community) five items. The questionnaire also included an open question about the suggestions to activate total quality management in kindergartens.

Scientific parameters of Research Tools: The scientific parameters of the research tools were calculated as follows:

- **Validity of research tools:**

- **Content Validity:** The researcher presented the two questionnaires in their initial form to a group of experts in the fields of education and kindergartens consisting of (11) experts.

- **Validity of internal consistency**: The researcher applied the questionnaires to a sample of (20) twenty kindergarten leaders.

- **Determine the reliability of the research tools**: The researcher used the alpha coefficient of Cronbach by applying it to a sample of (20) kindergarten leaders.

- **Validity of the first tool (The reality of administrative empowerment in kindergarten questionnaire)**:

- Content Validity: as indicated in table no. (1)

Table (1)
Percentage of Expert Viewpoints on the reality
of Administration Empowerment Questionnaire (n = 11)

Dimensions	items					
Recognizing the meaning of work and its value	Item	1	2	3	4	5
	Frequency	11	10	10	10	11
	percentage	100%	91%	91%	91%	100%
Training and Development	Item	6	7	8	9	10
	Frequency	9	11	10	10	9
	percentage	82%	100%	91%	91%	82%
Participation in decision making and taking	Item	11	12	13	14	15
	Frequency	9	9	11	10	5
	percentage	82%	82%	100%	91%	45%
Communication and dissemination of information	Item	16	17	18	19	20
	Frequency	11	10	11	9	9
	percentage	100%	91%	100%	82%	82%
Self-Motivation	Item	21	22	23	24	25
	Frequency	9	6	9	9	11
	percentage	82%	55%	82%	82%	100%

As shown in Table (1): The percentage of expert viewpoints on the questionnaire ranged from (45% : 100%) Thus, all terms were approved for obtaining more than 70% of the expert agreement, and the two phrases (n.)15,22 were omitted for having less than 70%.

- Internal Consistency Validity: As tables 2, 3 and 4 respectively indicated.

Table (2)

The Correlation Coefficients between the Degree of Each Statement and the Total Degree of The Dimension Belonging (n = 20)

Dimensions	items					
Recognizing the meaning of work and its value	Item number	1	2	3	4	5
	Correlation Coefficient	0.81	0.76	0.67	0.81	0.68
Training and Development	Item number	6	7	8	9	10
	Correlation Coefficient	0.87	0.73	0.69	0.74	0.84
Participation in decision making and taking	Item number	11	12	13	14	
	Correlation Coefficient	0.72	0.58	0.50	0.78	
Communication and dissemination of information	Item number	15	16	17	18	19
	Correlation Coefficient	0.78	0.57	0.74	0.76	0.79
Self-Motivation	Item number	20	21	22	23	
	Correlation Coefficient	0.76	0.66	0.53	0.72	

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (2): The correlation coefficients between the degree of each statement and the total degree of the dimension belonging to ranged from (0.50 : 0.86), which were statistically significant referring to the questionnaire internal consistency validity.

Table (3)

Correlation Coefficients between the Degree of each Statement and the Total Score of the Questionnaire (n = 20)

Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient
1	0.69	6	0.82	11	0.60	16	0.67	21	0.65
2	0.68	7	0.74	12	0.62	17	0.72	22	0.60

3	**0.74**	**8**	**0.68**	**13**	**0.56**	**18**	**0.66**	**23**	**0.59**
4	**0.69**	**9**	**0.64**	**14**	**0.63**	**19**	**0.70**		
5	**0.74**	**10**	**0.77**	**15**	**0.74**	**20**	**0.62**		

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (3): Correlation coefficients between the degree of each statement and the total score of the questionnaire ranged from (0.56:0.82), which were statistically significant referring to the questionnaire internal consistency validity.

Table (4)

The Correlation Coefficients between the Total Scores of each Dimension and the Total Questionnaire Score (n = 20)

N	**Dimensions**	**Correlation Coefficient**
1	**Recognizing the meaning of work and its value**	0.94
2	**Training and Development**	0.94
3	**Participation in decision making and taking**	0.91
4	**Communication and dissemination of information**	0.95
5	**Self-Motivation**	0.92

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (4): The correlation coefficients between the total scores of each dimension and the total questionnaire score ranged from (0.91:0.95), which were statistically significant correlation coefficient indicating the internal consistency of the questionnaire.

- **Determine the reliability of the first tool (the reality of administrative empowerment in kindergarten questionnaire):** as in table No. (5).

Table (5)

Reliability Using Cronbach's Alpha Coefficient of Questionnaire (n=20)

Dimensions	**alpha coefficient**
Recognizing the meaning of work and its value	0.79
Training and Development	0.82
Participation in decision making and taking	0.54
Communication and dissemination of information	0.77
Self-Motivation	0.57
Total degree	0.94

As shown in Table (5): The alpha coefficients of the questionnaire ranged from (0.54 : 0.94), which were statistically significant coefficients indicating the reliability of the questionnaire.

• **Validity of the second tool (The reality of Total Quality Management in kindergarten questionnaire):**

Content Validity: as indicated in table no. (6)

Table (6)

Percentage of Expert viewpoints on the Reality of Total Quality Management Questionnaire (n = 11)

Dimensions	items					
Continuous improvement	Item	1	2	3	4	5
	Frequency	11	10	9	10	10
	percentage	100%	91%	82%	91%	91%
Kindergarten Administration	Item	6	7	8	9	10
	Frequency	11	11	11	9	10
	percentage	100%	100%	100%	82%	91%
Kindergarten teachers	Item	11	12	13	14	
	Frequency	10	10	11	9	
	percentage	91%	91%	100%	82%	
Focusing on the beneficiary (Child, parents and community)	Item	15	16	17	18	19
	Frequency	9	11	11	10	11
	percentage	82%	100%	100%	91%	100%

As shown in Table (6): The percentage of expert opinions on the questionnaire ranged from (82% : 100%) Thus, all terms were approved for obtaining more than 70% of the expert agreement who added two items to the dimensions of (Continuous Improvement, Kindergarten Administration).

- Internal Consistency Validity: As tables 7, 8 and 9 respectively indicated.

Table (7)

The Correlation Coefficients between The Degree of each Statement and the Total Degree of the Dimension Belonging (n = 20)

Dimensions	items						
Continuous improvement	Item number	1	2	3	4	5	6
	Correlation Coefficient	0.70	0.67	0.54	0.68	0.78	0.78
Kindergarten Administration	Item number	7	8	9	10	11	12
	Correlation Coefficient	0.73	0.76	0.54	0.64	0.75	0.78
Kindergarten teachers	Item number	13	14	15	16		
	Correlation Coefficient	0.69	0.82	0.77	0.76		
Focusing on the beneficiary (Child, parents and community)	Item number	17	18	19	20	21	
	Correlation Coefficient	0.75	0.73	0.71	0.85	0.51	

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (7): The correlation coefficients between the degree of each statement and the total degree of the dimension belonging to ranged from (0.51 : 0.82), which were statistically significant referring to the questionnaire internal consistency validity.

Table (8)

Correlation coefficients between the Degree of Each Statement and the Total Score of the Questionnaire (n = 20)

Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient
1	0.59	6	0.76	11	0.74	16	0.61	21	0.54
2	0.65	7	0.68	12	0.68	17	0.76		
3	0.65	8	0.58	13	0.76	18	0.74		
4	0.59	9	0.62	14	0.64	19	0.68		
5	0.76	10	0.76	15	0.64	20	0.73		

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (8): Correlation coefficients between the degree of each statement and the total score of the questionnaire ranged from (0.54:0.76), which were statistically significant referring to the questionnaire internal consistency validity.

Table (9)

The Correlation Coefficients between the Total Scores of Each Dimension and the Total Questionnaire Score (n = 20)

N	Dimensions	Correlation Coefficient
1	**Continuous improvement**	0.92
2	**Kindergarten Administration**	0.91
3	**Kindergarten teachers**	0.86
4	**Focusing on the beneficiary (Child, parents and community)**	0.93

(r) tabulated value at the significant level (0.05) = 0.444.

As shown in Table (9): The correlation coefficients between the total scores of each dimension and the total questionnaire score ranged from (0.86:0.93), which were statistically significant correlation coefficient indicating the internal consistency of the questionnaire.

- **Determining the reliability of the second tool (The reality of Total Quality Management in kindergarten questionnaire):** as in table No. (10).

Table (10)

Reliability Using Cronbach's Alpha Coefficient of Questionnaire (n=20)

Dimensions	alpha coefficient
Continuous improvement	0.77
Kindergarten administration	0.79
Kindergarten teachers	0.75
Focusing on the beneficiary (Child, parents and community)	0.75
Total degree	0.93

As shown in Table (10): The alpha coefficients of the questionnaire ranged from (0.75 : 0.93), which are statistically significant coefficients indicating the reliability of the questionnaire.

Statistical methods for processing research results: The researcher used percentage, correlation coefficient, alpha coefficient of Cronbach, estimated degree, average response rate, the researcher satisfied the level of significance at the level (0.05). The researcher used also SPSS to calculate some statistical coefficients.

Discussion and interpretation of the results:

1- Answer the first question: What is the reality of administrative empowerment in kindergarten from the research sample viewpoints?

Table (11)

Estimated degree and Average of Response Ratio for Sample Viewpoints for Questionnaire Items of Administrative Empowerment in kindergarten

(First Dimension: Recognizing the Meaning of Work and its Value) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
1	**Kindergarten administration handles daily workloads easily.**	20	35	55	185	0.56
2	**Employees estimates the meaning and value of a kindergarten job well.**	35	23	52	203	0.62
3	**The nature of the work represents a great value and meaning for the kindergarten staff.**	12	26	72	160	0.48
4	**Kindergarten administration encourages employees to activate different teams.**	19	23	68	171	0.52
5	**Kindergarten administration encourages employees to perform their work efficiently.**	27	19	64	183	0.55
The total degree of the dimension					902	0.55
Minimum Confidence = 0.58			**Maximum Confidence = 0.76**			

As shown in Table (11): The average of response ratio of the research sample on first dimension items: Recognizing the meaning of work and its value ranged between (0.48 : 0.62).

Where the a total ratio of item n.(2) ranged between the minimum and maximum confidence Interval, indicating that it was achieved moderately, and this may be due to the feeling of most employee that work is of great value, in addition the total ratio of items n.(1, 3, 4, 5) were less than minimum confidence interval indicating that they achieved at a low level and this may be due to the large number of work decisions and bulletins. Thus, this was mainly a result of poor administrative empowerment in kindergarten.

The total ratio of the dimension was (0.55), which was less than minimum confidence interval, indicating that it was achieved at a low level in the reality of recognizing the meaning of work and its value.

These results are in consistent with the results of the study of **Al-Shetaihi, E. (2016, 42-101)** which showed a low level of encouragement of the heads of team work; Work diverse and strengthen teamwork, while differs with the results of the study of **Hiba, Z.& Ahmed, K. (2009, 430-509)** that showed the achievement of team work and the formation of kindergarten administration diverse teams work and strengthen teamwork.

Table (12)

Estimated Degree and Average of Response Ratio for Sample viewpoints for Questionnaire Items Administrative Empowerment in Kindergarten

(Second Dimension: Training and Development) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
6	**The Kindergarten administration encourages the continuous training and development of its staff.**	25	68	17	228	0.69
7	**The kindergarten administration adopts a clear plan for training employees.**	5	47	58	167	0.51
8	**All kindergarten employees participate in various training courses; on an ongoing basis.**	23	70	17	226	0.68
9	**Kindergarten administration organizes programs to exchange visits and experiences of teachers with other kindergartens.**	27	42	41	206	0.62
10	**The Kindergarten administration provides its staff with the latest**	4	36	70	154	0.47

	references and research related to kindergarten.					
The total degree of the dimension					981	0.59
Minimum Confidence = 0.58				**Maximum Confidence = 0.76**		

As shown in Table (12): The average of response ratio of the research sample on second dimension items: training and development ranged between (0.47 : 0.69).

Where the a total ratio of items n.(6, 8, 9) ranged between the minimum and maximum confidence interval, indicating that they were achieved moderately, and this may be due to the large number of training programs and the importance of exchanging experiences, in addition the total ratio of items n.(7, 10) were less than minimum confidence interval indicating that they were achieved at a low level and this may be due to the existence of a training department of the Professional Academy of Teachers that responsible for training as well as employees fully engaged in work. Thus, this was mainly a result of poor administrative empowerment in kindergarten.

The total ratio of the dimension was (0.59), which ranged between the minimum and maximum confidence interval indicating that it was achieved moderately in the reality of training and development.

These results are in consistent with the results of the study of **Hiba, Z.& Ahmed, K. (2009, 430-509**), which showed keenness to spread the ideas of professional development, acceptance of employees to training programs, kindergarten exchanges information with other nearby kindergartens, and poor access to information by the kindergarten manager; While differs with the results of the study of **Al-Shetaihi, E. (2016, 42-101**) which showed that kindergarten leaders adopt a clear training plan and provide training opportunities It was moderate.

Table (13)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for Questionnaire items Administrative Empowerment in Kindergarten

(Third Dimension: Participation in Decision Making and Taking) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significa	Achieved Moderat	Achieved at a Low		
11	**The kindergarten administration explains to employees the areas of participation in decision-making and taking.**	20	46	44	196	0.59
12	**Kindergarten employees participate in work decision-making.**	14	70	26	208	0.63
13	**The kindergarten administration instills responsibility for the decision making among employees.**	13	44	53	180	0.55

14	**The kindergarten administration works to decentralize decision-making and taking.**	12	39	59	173	0.52
The total degree of the dimension					757	0.57
Minimum Confidence = 0.58			**Maximum Confidence = 0.76**			

As shown in Table (13): The average of response ratio of the research sample on third dimension: Participation in decision making and taking ranged between (0.52 : 0.63).

Where the a total ratio of items n.(11, 12) ranged between the minimum and maximum confidence interval indicating that they were achieved moderately, and this may be due to the large number of workloads in kindergarten, in addition the total ratio of items n.(13, 14) were less than the minimum confidence interval indicating that they were achieved at a low level and this may be due to the extreme centralization by the kindergarten administration in decision making and taking, and this was mainly a result of poor administrative empowerment in kindergarten.

The total ratio of the dimension was (0.57) and this was less than minimum confidence interval, which indicating that it was achieved at a low level in the reality of decision making and taking.

These results are in consistent with the results of the study of **Hiba, Z.& Ahmed, K. (2009, 430-509)**, which showed that the kindergarten staff participated in decision-making and emphasized the values of shared responsibility and participation among employees; The administrative staff of the kindergarten should support the effective participation of employees in decision-making; While differs with the results of the study of **El-Azab, H. (2009)**, which showed a lack of interest in the administrative staff of the kindergarten to support the effective participation of decision-making employees.

Table (14)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for Questionnaire Items Administrative Empowerment in Kindergarten

(Fourth Dimension: Communication and Dissemination of Information) (n = 110)

N	items	Response			Estimated degree	Average of response ratio
		Achieved Significa	Achieved Moderat	Achieved at a Low		
15	**Kindergarten staff communicate effectively and continuously.**	31	41	38	213	0.65
16	**Kindergarten staff exchange information easily**	21	51	38	203	0.62
17	**Kindergarten administration applies all types of communication (formal and informal / vertical and horizontal / up and down).**	7	42	61	166	0.50

18	**Communication and dissemination of information in kindergarten is achieved by all methods (verbal, written, visual).**	9	39	62	167	0.51
19	**The kindergarten administration continuously promotes social and human relations between employees.**	35	40	35	220	0.67
The total degree of the dimension					969	0.59
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (14): The average of response ratio of the research sample on fourth dimension: communication and dissemination of information ranged between (0.50 : 0.67).

Where the a total ratio of items n.(15, 16, 19) ranged between the minimum and maximum confidence interval, which indicated that they were achieved moderately, and this may be due the encouragement of the kindergarten administration to effective communication and information exchange between employees, moreover the total ratio of items n.(17, 18) were less than minimum confidence interval indicating that they were achieved at a low level, this may be due to the lack of awareness of kindergarten Administration about types and methods of communication, and this mainly was a result of poor administrative empowerment in kindergarten.

The total ratio of the dimension (0.59), which ranged between the minimum and maximum confidence Interval indicating that it was achieved moderately in the reality of communication and dissemination of information.

These results are in consistent with the results of the study of **Hiba, Z.& Ahmed, K. (2009, 430-509)**, which showed that information flowing easily within the kindergarten, and the study of **Al-Madhi, A. (2018, 71-114)** which recommended that good relations in the kindergarten should be kenned.

Table (15)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for Questionnaire Items Administrative Empowerment in Kindergarten

(Fifth Dimension: Self-Motivation) (n = 110)

N	Items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
20	**Kindergarten administration supports employees to achieve work goals.**	36	57	17	239	0.72
21	**The kindergarten administration adopts a system to motivate employees (moral / material).**	17	19	74	163	0.49

22	**There are rules and standards for promotion in kindergarten, depending on performance.**	20	23	67	173	0.52
23	**The kindergarten incentive system is objective.**	34	24	52	202	0.61
The total degree of the dimension					777	0.59
The total degree of the questionnaire					4386	0.57
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (15): The average of response ratio of the research sample on fifth dimension: self-motivation ranged between (0.49 : 0.72).

Where the a total ratio of items n.(20, 23) ranged between the minimum and maximum confidence interval, indicating that they were achieved moderately, and this may be due to the encouragement leaders to employees to achieve work goals, in addition the total ratio of items n.(21, 22) which were less than the minimum confidence interval indicating that they were achieved at a low level, and this may be due to the lack of motivation for employee, and this was mainly a result of poor administrative empowerment kindergarten.

The total ratio of the dimension was (0.59), which ranges between the minimum and maximum confidence interval; indicating that it was achieved moderately in the reality of self-motivation.

These results are in consistent with the results of the study of **Al-Shetaihi, E. (2016, 42-101)** which showed a low level of provision of financial incentives and the participation of leaders in the development of incentives; While differing with the results of the study of **Hiba, Z.& Ahmed, K. (2009, 430-509)**, which resulted in the granting of kindergarten literary incentives for employees interested in improving their performance.

The total ratio of the questionnaire was (0.57), which is less than Minimum Interval, which achieved at a low level in the reality of administrative empowerment in kindergarten.

Liszt, A. (2008, 392) explained the importance of empowerment for school administrators and all staff; furhermore **Overton& Jenny (2009, 1-10)** study also emphasized the importance of empowerment for teachers; moreover **Zhang, X.& Bartol, K. (2010, 107-128)** also found that empowerment of leaders positively affects self-motivation and creative practical participation of employees.

Table (16)

Estimated Degree and Average of Response Ratio for Sample Viewpoints in Administrative Empowerment Dimensions (n = 110)

N	Dimension	Estimated degree	Average of response ratio	Rank
1	**Recognizing the meaning of work and its value**	**902**	**0.55**	**5**

2	**Training and Development**	**981**	**0.59**	**1**
3	**Participation in decision making and taking**	**757**	**0.57**	**4**
4	**Communication and dissemination of information**	**969**	**0.59**	**2**
5	**Self-Motivation**	**777**	**0.59**	**3**
The total degree of the questionnaire		**4386**	**0.57**	
Minimum Confidence = 0.58 Maximum Confidence = 0.76				

As shown in table (16): The average of response ratio of the research sample on administrative empowerment in kindergarten dimensions ranged between (0.55 : 0.59), that in the first rank was the dimension of (Training and Development), while in the last rank was (Recognizing the meaning of work and its value).

2- Answer the second question: What is the reality of total quality management in kindergarten from from the research sample viewpoints?

Table (17)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for questionnaire items Total Quality Management in Kindergarten

(First dimension: Continuous Improvement) (n = 110)

N	items	Response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
1	**Kindergarten administration is keen to meet the training needs of employees constantly**	12	41	57	175	0.53
2	**The Kindergarten administration conducts training programs for employees on total quality management.**	7	14	89	138	0.42
3	**Kindergarten administration encourages employees to contribute with their ideas to develop work.**	11	24	75	156	0.47
4	**Employees utilize all the tools, equipment and material resources available in kindergarten efficiently**	12	28	70	162	0.49

5	**Kindergarten administration adopts a culture of continuous improvement in work.**	4	29	77	147	0.45
6	**Kindergarten staff apply the latest global management trends to improve work.**	9	21	80	149	0.45
The total degree of the dimension					927	0.47
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (17): The average of response ratio of the research sample on the first dimension: Continuous improvement ranged between (0.42 : 0.53).

Thus the a total ratio of all items were less than the minimum confidence interval indicating that they were achieved at a low level, and this may be due to the many burdens and pressures of work for all kindergarten employees, and this was mainly a result of poor Total quality management in kindergarten.

The total ratio of the dimension was (0.47), which was less than the minimum interval, indicating it was achieved at a low level in the reality of Continuous improvement.

These results are consistent with the results of the study of **Farag, A.& Moammar, L. (2013, 242-300)**, which showed a lack of conviction in the application of total quality standards and dissemination of their culture; while they differ with the results of the study of **El-Azab, H. (2009)**, which showed the kindergarten administration interest in encouraging innovation Improving work within the kindergarten is one of the foundations of successful administration methods.

Table (18)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for questionnaire items Total Quality Management in Kindergarten

(Second dimension: Kindergarten Administration) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
7	**Kindergarten administration adopts a clear vision and mission.**	11	45	54	177	0.54
8	**Kindergarten administration clearly defines the functions, responsibilities, tasks and roles of all kindergarten staff.**	3	33	74	149	0.45
9	**The kindergarten administration is keen to apply the laws, regulations, and**	14	50	46	188	0.57

	legislations governing kindergarten work.					
10	**The kindergarten administration follows up the budget utilization and disbursements on an ongoing basis.**	17	42	51	186	0.56
11	**Kindergarten administration discusses all work complaints for employees continuously**	–	11	99	121	0.37
12	**A kindergarten database is available for [staff / children / parents / community institutions].**	9	29	72	157	0.48
The total degree of the dimension					978	0.50
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (18): The average of response ratio of the research sample on second dimension: Kindergarten administration ranged between (0.37 : 0.57).

Thus the a a total ratio of all items were less than the minimum confidence interval indictaing that they were achieved at a low level, and this may be due to the lack of specialization in kindergarten administration, lack of knowledge of job descriptions, and poor budget, and this was mainly was a result of poor Total quality management in kindergarten.

The total ratio of the dimension (0.50), which is less than Minimum Interval, which indicated that it was achieved at a low level in the reality of Kindergarten administration.

These results are consistent with the results of the study of **Aqeel, A. (2012)** which resulted in non-compliance with the regulations, laws and legislations for kindergartens; Quality of child rearing; while they differ with the results of the study of **El-Azab, H. (2009)** showed that some kindergarten managers are interested in adopting a clear vision and a supportive message for quality child education processes.

Table (19)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for questionnaire items Total Quality Management in Kindergarten

(Third dimension: Kindergarten Teachers) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
13	**Teachers prepare various plans to facilitate work.**	20	41	49	191	0.58

14	**Teachers are keen on the continued diversity of activities offered to children.**	16	62	32	204	0.62
15	**Teachers involve the child's families in various activities (concerts, trips, exhibitions ..).**	2	9	99	123	0.37
16	**Teachers follow the modern techniques and strategies to be applied in the work.**	14	37	59	175	0.53
The total degree of the dimension					693	0.53
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (19): The average of response ratio of the research sample on third dimension: Kindergarten teachers ranged between (0.37 : 0.62).

Where the a total ratio of items n.(13, 14) range between the minimum and maximum confidence interval, indicating that they were achieved moderately, and this may be due to the importance of plans and diversity in kindergarten activities, in addition the total ratio of items n.(15, 16) were less than the minimum confidence interval indicating that they were achieved at a low level, may be due to: Frequent burdens placed on the parameters, and this was mainly was a result of poor Total quality management in kindergarten.

The total ratio of the dimension (0.53), which is less than Minimum Interval, which indicated that it was achieved at a low level in the reality of Kindergarten teachers.

These results are in consistent with results of the study of **El-Azab, H. (2009)** study, which resulted in the lack of interest of the kindergarten administration to involve parents in the activities of kindergarten inside and outside, and the lack of interest in kindergarten management to hold parties in the kindergarten and invite parents to participate; while they differ with the results of the study of **Farag, A.& Moammar, L. (2013, 242-300)**, which showed the lack of plans and programs to improve the structure and capabilities of the kindergarten, and the lack of the use of teachers of modern technologies.

Table (20)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for questionnaire items Total Quality Management in Kindergarten

(Fourth dimension: Focusing on the beneficiary

(Child, parents and Community)) (n = 110)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
17	**The relationship between kindergarten staff, children and parents is**	73	32	5	288	0.87

	characterized by understanding, trust and mutual respect.					
18	**The kindergarten administration establishes a culture of community service among employees; periodically.**	2	11	97	125	0.38
19	**The kindergarten held the meeting of the Board of Trustees periodically.**	7	52	51	176	0.53
20	**The kindergarten administration is keen on the continuous activation of community participation; through seminars, meetings and conferences.**	10	44	56	174	0.53
21	**The Kindergarten administration organizes exchange programs with local community organizations.**	20	14	76	164	0.50
The total degree of the dimension					927	0.56
The total degree of the questionnaire					3525	0.51
Minimum Confidence = 0.58 Maximum Confidence = 0.76						

As shown in Table (20): The average of response ratio of the research sample on fourth dimension: fourth dimension: Focusing on the beneficiary (Child, parents and community) ranged between (0.38 : 0.87).

Where the a total ratio of of item n.(17) which is high Maximum Interval which indictaing that it was achieved significantly and this may be due to: The Importance of understanding, trust, mutual respect between employees, children and parents, and a total ratio of of items n.(18, 19, 20, 21) which is less than Minimum Interval which indictaing that they were achieved at a low level, may be due to: Larg number of work task and functions, and this was mainly was a result of poor Total quality management in kindergarten.

The total ratio of the dimension (0.56), which is less than Minimum Interval, which achieved at a low level in the reality of Focusing on the beneficiary (Child, parents and community).

These results are consistent with the results of the study of **El-Azab, H. (2009)** that resulted in poor relation between kindergarten and community; While differing with the results of the study of **Farag, A.& Moammar, L. (2013, 242-300)** that showed the contribution of children in programs to serve the community.

The total ratio of the The questionnaire (0.51), which is less than Minimum Interval, which achieved at a low level in the reality of total quality management in kindergarten.

The study of **Wani, I.& Mehraj, (H., 2014, 71-78)** noted the importance of Total Quality Management management for employees.

Table (21)

Estimated Degree and Average of Response Ratio for Sample Viewpoints in Total Quality Management Dimensions (n = 110)

N	Dimension	Estimated degree	Average of response ratio	Rank
1	Continuous improvement	927	0.47	4
2	Kindergarten administration	978	0.50	3
3	Kindergarten teachers	693	0.53	2
4	Focusing on the beneficiary (Child, parents and community)	927	0.56	1
The total degree of the questionnaire		3525	0.51	
Minimum Confidence = 0.58		Maximum Confidence = 0.76		

As shown in table (21): The average of response ratio of the research sample on total quality management in kindergarten questionnaire dimensions ranged between (0.47 : 0.56) that in the first rank was the dimension of (Focusing on the beneficiary (Child, parents and community)), while in the last rank was (Continuous improvement)

3- Answer the third question: What is the nature of the relationship between the level of administrative empowerment and the degree of Total Quality Management practice in kindergarten?

Table (22)

Correlation Coefficients between Administrative Empowerment and Total Quality Management in Kindergarten from the Research Sample viewpoints (n = 110)

questionnaires		Total Quality Management in Kindergarten				
		Continuous improvement	Kindergarten administration	Kindergarten teachers	Focusing on the beneficiary (Child, parents and community)	Total degree
Administrative Empowerment in Kindergarten	Recognizing the meaning of work and its value	0.51	0.20	0.28	0.37	0.44
	Training and Development	0.37	0.32	0.22	0.41	0.42
	Participation in decision making and taking	0.35	0.29	0.33	0.39	0.43

	Communication and dissemination of information	0.29	0.25	0.23	0.50	0.39
	Self-Motivation	0.28	0.24	0.28	0.28	0.35
	Total degree	0.47	0.33	0.35	0.51	0.53

(r) tabulated value at the significant level (0.05) = 0.250.

As shown in table (22): There was a statistically significant positive correlation between administrative empowerment and total quality management in kindergarten.

3. **Answer the fourth question: What are the obstacles to administrative empowerment in kindergarten?**

Table (23)

Frequency and Percentage of Sample Viewpoints for Obstacles that Object of Administrative Empowerment in Kindergarten (n = 110)

N	obstacles	Frequency	percentage
1	**There are special problems in kindergarten administration**	**104**	**94.55%**
2	**Lack of flexibility from kindergarten administration with employees.**	**98**	**89.09%**
3	**Lack of specialization of many managers, which causes a lot of problems.**	**92**	**83.64%**
4	**Lack of clear understanding of the managers about the nature of work in kindergarten.**	**82**	**74.55%**
5	**Strong centralization in decision-making by managers.**	**74**	**67.27%**
6	**Severe shortage of female teachers and the use of non-specialized teachers.**	**68**	**61.82%**
7	**Poor budget and problems in the kind of disbursement in kindergartens.**	**60**	**54.55%**
8	**The large number of children in the room and frequent daily workloads.**	**58**	**52.73%**
9	**Interruption by parents who do not understand the importance of kindergarten.**	**51**	**46.36%**
10	**The absence of a social and psychological employee in kindergarten.**	**50**	**45.45%**

As shown in table (23): The percentage of the sample of the research sample in the obstacles facing the administrative empowerment in kindergartens ranged between (45.45% : 94.55%); It came in the first rank (the problems of kindergarten administration); while in the last rank was (the absence of a social employee or psychological kindergarten).

5- Answer the Fifth question: How to overcome the obstacles of administrative empowerment to achieve Total Quality Management in kindergarten?

Table (24)

Frequency and Percentage of Sample Viewpoints Suggestions for Overcoming Obstacles of Administrative Empowerment to Achieve Total Quality Management in Kindergarten (n = 110)

N	suggestions	Frequency	percentage
1	**Encouraging employees to activate the different work teams.**	**102**	**92.73%**
2	**Deep concern for the continuous training of employees.**	**92**	**83.64%**
3	**Encourage effective communication between employees.**	**93**	**84.55%**
4	**Providing the human and material resources necessary to work continuously.**	**95**	**86.36%**
5	**Continuous encouragement of employees to achieve work objectives.**	**82**	**74.55%**

As shown in Table (24): The percentage of opinions of the research sample in the proposals to overcome the obstacles of administrative empowerment to achieve total quality management in kindergarten ranged between (74.55% : 92.73%); It came in the first rank (encouraging employees to activate different teams); while in the last rank was (encouraging continuous communication between employees).

6. Answer the sixth question: What are the suggestions to activate the total quality management in kindergarten?

Table (25)

Frequency and percentage of sample Viewpoints suggestions to activate Total Quality Management in Kindergarten (n = 110)

N	suggestions	Frequency	percentage
1	**Sharing the successful experiences (developed countries) and recent trends in kindergarten.**	**106**	**96.36%**
2	**The keenness of the administrators of the kindergarten on continuous improvement.**	**102**	**92.73%**
3	**Take advantage of cadres and encourage them to take over the leadership of kindergartens.**	**99**	**90.00%**
4	**Providing the human and material resources necessary to work continuously.**	**95**	**86.36%**
5	**Striving to achieve the goals of kindergartens while committing the application of laws, regulations and legislations governing the work of kindergartens.**	**93**	**84.55%**

6	**The need to activate community participation in all kindergartens on an ongoing basis.**	**89**	**80.91%**

As shown in Table (25): The percentage of opinions of the research sample for activate total quality management in kindergarten ranged between (80.91% : 96.36%); It came in the first rank (See the successful experiences (developed countries) and recent trends in kindergarten); while in the last rank was (The need to activate community participation in all kindergartens on an ongoing basis).

Research Recommendations:

- Raising the awareness of the kindergarten employees about the importance and value of work and activating the different work teams.
- Emphasis on activating the participation of all employees in decision-making taking, as well as supporting employees towards assuming responsibility and leadership roles.
- Emphasize the importance of training and development to keep pace with contemporary administrative trends, exchange experiences with other kindergartens, and provide the latest references and research related to kindergarten.
- Establish an electronic network for communication and dissemination of information; making it available of each kindergarten continuously
- Self-motivation of employees objectively and appreciate them, in addition develop rules and standards for promotions.
- Select qualified and specialized leaders in the field of kindergartens to manage kindergartens.
- Encourage continuous kindergarten administration for teachers to excellence in work.
- Familiarize teachers with the latest contemporary educational trends and know how to benefit from them.
- Participating all children stakeholders in supporting kindergarten and local community institutions.

References

Al-Madhi, A. (2018). The Role of Kindergarten Managers in Disseminating the Culture of Total Quality in Kindergartens West of Riyadh City. **Journal of Scientific Research in Education**, Girls' College of Arts, Sciences and Education, Ain Shams University, 19(2), 71-114.

Al-Shetaihi, E. (2016). Administrative Empowerment of Educational Leaders and their Relationship with the Practice of Knowledge Management Processes, **Journal of the Federation of Arab Universities for Education and Psychology**, 4 (3), 42-101.

Aqeel, A. (2012). **A Proposal for Developing the Management of Kindergarten Institutions in the Republic of Yemen in the Light of the Total Quality Management Approach**. Master Thesis, Faculty of Kindergarten, Cairo University.

El-Azab, H. (2009). **Developing Kindergarten Management in Egypt in the Light of Total Quality Management**, PhD Thesis, Faculty of Kindergarten, Cairo University.

Experts of the Arab Group for Training and Publishing. (2014). **Administrative Empowerment and the Industry of Future Leaders - Leadership Skills**, Cairo, Arab Group for Training and Publishing.

Farag, A.& Moammar, L. (2011). Obstacles to Achieving Total Quality Standards in Kindergartens from my Principals' Point of View in Riyadh. **Journal of the Faculty of Education**, Ain Shams University, 37 (1), 242-300.

Hanafy, D. (2004). **Developing Kindergarten Management in the Arab Republic of Egypt in the Light of Contemporary Global Trends.** Master Thesis, Faculty of Education, Ismailia, Suez Canal University.

Hiba, Z.& Ahmed, K. (2009). Transforming Kindergartens in Egypt into Educated Organizations, Field Study. **Culture Society for Development and Suhag University**, Vol. 2, 430-509.

Liszt, A. (2008). Perceiving empowered leadership: A qualitative exploration of New York City principals' experience with decision -making authority in empowerment schools. **Early Child Development and Care journal**, ISSN: 0300-4430, 1476-8275.

Overton& Jenny. (2009). Early Childhood Teachers in Context of Power: Empowerment and a Voice. **Australasian Journal of early childhood**, 39(2), 1-10.

Wani, I.& Mehraj, H. (2014). Total quality management in education: An analysis. **International Journal of Humanities and Social Science Invention,** *3*(6), 71-78.

Zhang, X.& Bartol, K. (2010). Linking empowerment leadership and employee creativity: the influence of psychological empowerment, intrinsic motivation, and creative process engagement. **The academy of Management Journal**, 53(1), 107-128.

Organizational Justice among Kindergarten Leaders from the Perspective of teachers

Shaymaa Khalaf Ibrahim, Minia University, Egypt
Mona Gad, Cairo University, Egypt
Salma Hamdy Ghoraba, Minia University, Egypt

Abstract

The current research aimed to identify the extent to which kindergarten leaders (administrators and supervisors) practicing organizational justice and propose some recommendations for applying organizational justice by kindergarten leaders. Data collection tool was a questionnaire - prepared by the researcher -. The research sample consisted of (284) kindergarten teachers from kindergarten, Minia Educational Administrations, from the nine centers of Minia Governorate. Findings of the study revealed that organizational justice among kindergarten leaders from the Perspective of teachers was achieved at a low level. The research sample suggested a number of suggestions for achieving organizational justice among kindergarten leaders, In addition the research proposed some recommendations for achieving organizational justice among kindergarten leaders.

Keywords: Organizational Justice, Kindergarten Leaders.

Introduction

Organizational justice is one of the most important organizational variables affecting on one hand, the efficiency of the employee's job performance and on the other hand, the performance of the organization as a whole. Thus, when employees lack justice, job satisfaction will be decreased, organizational citizenship behaviors and organizational commitment will be low and consequently leads to low job performance in general. In contrast, a higher sense of justice among employees increases their confidence in the management of the organization and in role increases their conviction of accessing their rights; further elevating an individual's behavior after assuring the rule of justice and in consequence trusting the organization**. (Zaied, A., 2006, 12)**

Accordingly, the current research will investigate the degree of practicing organizational justice among kindergarten leaders and will propose some recommendations to be applied practically into the kindergarten working environment.

Research Problem:

Concerning this, the application of justice, values of integrity and impartiality in the organization represents the most important prerequisites for forming staff positive attitudes and behaviors. Moreover, it is a necessary basis for raising the capacity of this organization to be more adapted to the surrounding changes and events. Accordingly, achieving justice among employees is one of the most important

challenges facing contemporary organizations because of the diversity of their human resources, their different cultures, knowledge, and economic backgrounds. **(Abu Tayeh, B., 2012, 147)**

So that, through the work of the researcher as a kindergarten teacher, she noticed that teachers feel a low sense of kindergarten leaders' justice- managers and supervisors- with them whether in dealing or in the distribution of burdens, costs, tasks and rewards (material or moral); or in decision making and procedures. In this context, studies as **Radi, B. (2008)** and **Al- Sukkar, A. (2013)** have shown that employees' sense of organizational justice affects their job performance and its' improvement. Additionally, the study of **Bostanci, A. (2013)** and **Buluc, B.& Gunes, M. (2014)** and **Çoğaltay, N.& Karadağ, E. (2016)** also confirmed that it affects employees' organizational commitment as well as their performance of organizational citizenship behaviors. This is also obvious through the results of **Podaskoff, N. P, et al (2009)**, as well as working to develop the institutional work as illustrated by the study of **Mohamed, S. (2015)**.

Concerning the importance of applying kindergarten leaders organizational justice, because of its impact on teachers' performance, the researcher reviewed the literature and related studies that dealt with organizational justice and noted the scarcity of studies which addressed this issue in kindergarten stage- according to the researcher knowledge- instead some studies dealt with other stages such as **Erkutlu, H. (2011)** and **Gafari, P.& Bidarian, S. (2012)** which addressed the university stage as well as **El-Hendawy**, Y. **(2006)**which concentrated on the secondary stage, in addition to **Yilmaz, K& Tasdan, M. (2009)** study that dealt with the primary stage.

Hence, the problem of the current research was identified in the following questions:

1. What is the reality of practicing organizational justice among kindergarten leaders (administrators- supervisors) in its three dimensions (distributive, procedural, interactional) from the perspective of teachers?
2. What are the suggestions for achieving organizational justice among kindergarten (administrators and supervisors) leaders from the perspective of teachers?

Research Objective: The current research aims to identify the extent to which kindergarten leaders (administrators and supervisors) practicing organizational justice and propose some recommendations for applying organizational justice by kindergarten leaders.

Research Significance: The significance of the current research lies in the following:

- Organizational justice is one of the most prominent administrative issues that have seen interest recently, given its profound impact on the development of organizations - especially kindergartens - and achieving their goals efficiently and effectively; as in order for kindergartens to develop, kindergarten leaders should practice organizational justice and teacher should feel it; as it reflects on the performance of kindergarten teachers in the work environment.
- The scarcity of researches addressing organizational justice in the educational field, especially in kindergarten, according to the researcher knowledge, that it will open prospects for researchers and those who interesting this field to conduct future studies in this area.

- Come up with suggestions for achieving organizational justice among kindergarten leaders from the perspective of her teachers.

Research Terms:

- **Organizational Justice:** "is the method followed by kindergarten leaders(administrators and supervisors), which is characterized by integrity, fairness, and equality whether in terms of distributing roles, tasks, assignments and rewards (material/ moral) " distributive justice"; or the procedures associated with the work " Procedural justice" ; or personal interactions and dealings " interactional justice, which is reflected in practicing teachers organizational citizenship behaviors.
- **Distributive Justice:** "The degree to which kindergarten teachers feel fair about their outputs, which may be in the form of (distribution of resources, decisions, wages, promotion, incentives, rewards…), for their efforts at work, in comparison of her peers."
- **Procedural Justice:** "The degree to which kindergarten teachers feel fairness of the procedures followed by the kindergarten leaders in making decisions related to determining the outputs (evaluation of teachers' performance, appointment, promotion, transfer, assignment, sanctions, rewards, conflict resolution among teachers ...")
- **Interactional Justice:** "The degree to which kindergarten teachers feel fairness about the treatment they receive from their leaders when applying procedures and making decisions about work."
- **Kindergarten leaders:** "Categories of educators who hold the following functions: kindergarten manager and acting on her behalf of (school manager of her kindergarten, or the kindergarten deputy manager, or the first kindergarten teacher), and kindergarten supervisor.

Research Methodology: The current research used the descriptive approach.

The Research Sample: The research sample consisted of (284) kindergarten teachers, from kindergartens in Minia Educational Administrations, from the nine centers of Minia Governorate.

Research Tool: Current research tool is a questionnaire - prepared by the researcher - which included three dimensions: distributive justice and taking six items, procedural justice and taking ten items, interactional justice and taking ten items. The questionnaire also included an open question about the suggestions for achieving organizational justice among kindergarten leaders from the perspective of her teachers.

Scientific parameters of Research Tool: The scientific parameters of the research tools were calculated as follows:

- **Validity of research tool:**

- Content Validity: The researcher presented the questionnaire in their initial form to a group of experts in the fields of education and kindergartens consisting of (17) experts, as indicated in table no. (1).

Table (1)

Percentage of Expert Viewpoints on the reality of Organizational justice Questionnaire (n = 17)

Dimensions	items								
Distributive justice	Item number	1	2	3	4	5	6	7	
	Frequency	16	17	15	15	9	17	16	
	percentage	94%	100%	88%	88%	53%	100%	94%	
Procedural justice	Item number	8	9	10	11	12	13	14	15
	Frequency	9	16	17	15	14	14	15	14
	percentage	53%	94%	100%	88%	82%	82%	88%	82%
	Item number	16	17	18	19				
	Frequency	7	14	16	17				
	percentage	41%	82%	94%	100%				
Interactional justice	Item number	20	21	22	23	24	25	26	27
	Frequency	14	15	14	16	17	15	14	17
	percentage	82%	88%	82%	94%	100%	88%	82%	100%
	Item number	28	29	30					
	Frequency	15	7	16					
	percentage	88%	41%	94%					

As shown in Table (1): The percentage of expert viewpoints on the questionnaire ranged from (41% : 100%) Thus, all terms were approved for obtaining more than 70% of the expert agreement, and the phrases (n.)5,8,16,29 were omitted for having less than 70%.

Validity of internal consistency: The researcher applied the questionnaire to a sample of (30) thirty kindergarten teachers, as tables 2, 3 and 4 respectively indicated.

Table (2)

The Correlation Coefficients between the Degree of Each Statement and the Total Degree of The Dimension Belonging (n = 30)

Dimensions	items							
Distributive justice	**Item number**	**1**	**2**	**3**	**4**	**5**	**6**	
	Frequency	0.75	0.68	0.69	0.70	0.89	0.89	
Procedural justice	**Item number**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	Frequency	0.72	0.67	0.64	0.72	0.72	0.79	0.82
	Item number	**14**	**15**	**16**				
	Frequency	0.87	0.87	0.73				
Interactional justice	**Item number**	**17**	**18**	**19**	**20**	**21**	**22**	**23**
	Frequency	0.86	0.87	0.83	0.86	0.78	0.87	0.83
	Item number	**24**	**25**	**26**				
	Frequency	0.86	0.83	0.83				

(r) tabulated value at the significant level (0.05) = 0.361.

- **As shown in Table (2):** The correlation coefficients between the degree of each statement and the total degree of the dimension belonging to ranged from (0.64 : 0.89), which were statistically significant referring to the questionnaire internal consistency validity.

Table (3)

Correlation Coefficients between the Degree of each Statement and the Total Score of the Questionnaire (n = 30)

Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient	Item number	Correlation Coefficient
1	0.62	**6**	0.89	**11**	0.70	**16**	0.80	**21**	0.78
2	0.54	**7**	0.61	**12**	0.77	**17**	0.89	**22**	0.84
3	0.60	**8**	0.60	**13**	0.84	**18**	0.84	**23**	0.75
4	0.84	**9**	0.59	**14**	0.89	**19**	0.75	**24**	0.89
5	0.89	**10**	0.70	**15**	0.89	**20**	0.77	**25**	0.89
26	0.88								

(r) tabulated value at the significant level (0.05) = 0.361.

- **As shown in Table (3):** Correlation coefficients between the degree of each statement and the total score of the questionnaire ranged from (0.54 : 0.89), which were statistically significant referring to the questionnaire internal consistency validity.

Table (4)

The Correlation Coefficients between the Total Scores of each Dimension and the Total Questionnaire Score (n = 30)

N	Dimensions	Correlation Coefficient
1	**Distributive justice**	0.94
2	**Procedural justice**	0.97
3	**Interactional justice**	0.97

(r) tabulated value at the significant level (0.05) = 0.361.

- **As shown in Table (4):** The correlation coefficients between the total scores of each dimension and the total questionnaire score ranged from (0.94:0.97), which were statistically significant correlation coefficient indicating the internal consistency of the questionnaire.

• **Determine the reliability of the first tool (the reality of organizational justice questionnaire):** as in table No. (5**).**

Table (5)

Reliability Using Cronbach's Alpha Coefficient of Questionnaire(n=30)

Dimensions	alpha coefficient
Distributive justice	0.84
Procedural justice	0.90
Interactional justice	0.95
Total degree	0.96

As shown in Table (5): The alpha coefficients of the questionnaire ranged from (0.84 : 0.96), which were statistically significant coefficients indicating the reliability of the questionnaire.

Statistical methods for processing research results: The researcher used percentage, correlation coefficient, alpha coefficient of Cronbach, estimated degree, average response rate, the researcher satisfied the level of significance at the level (0.05). The researcher used also SPSS to calculate some statistical coefficients.

Discussion and interpretation of the results:

1- Answer the first question: What is the reality of practicing organizational justice among kindergarten leaders (administrators- supervisors) in its three dimensions (distributive, procedural, interactional) from the perspective of teachers?

Table (6)

Estimated degree and Average of Response Ratio for Sample Viewpoints for Questionnaire Items of Organizational Justice

(First Dimension: Distributive Justice) (n = 284)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
kindergarten leaders (administrators and supervisors) playing the following:						
1	considering the appropriateness of rewards and incentives to the teacher's experience.	2	174	108	462	0.54
2	Determining the incentives is related to the efforts of the teachers in job performance.	5	160	119	454	0.53
3	Distributing responsibilities and duties to teachers with justice.	4	180	100	472	0.55
4	Considering teachers' conditions, when allocating the additional workloads and tasks.	2	163	119	451	0.53
5	Involving teachers in kindergarten training courses, fairly.	4	182	98	474	0.56
6	considering the consistence of the functional status of the teacher with the scientific degree obtained.	5	178	101	472	0.55
The total degree of the dimension					2785	0.54
Minimum Confidence = 0.62			**Maximum Confidence = 0.72**			

As shown in Table (6): The average of response ratio of the research sample on first dimension items: distributive justice ranged between (0.53 : 0.56), Where the total ratio of all items were less than minimum confidence interval indicating that they achieved at a low level, in addition The total ratio of the dimension was (0.54), which was less than minimum confidence interval, indicating that it was achieved at a low level in the reality of distributive justice, and this may be due to the small number of kindergarten teachers which may lead to more burden pressure and responsibilities on some teachers, lack of budget that allows for the allocation of rewards and financial incentives for teachers and the lack of follow – up committees by the general department of kindergartens to verify the extent to which kindergarten leaders apply distributive justice. This finding is in consistent with the study of **Mahmoud, H.& Barakat, S.**

(2006), and the study of **Al Harahsheh, M.& Al-Kharbasha, M. (2012)** which concluded that distributive justice is poorly applied.

Table (7)

Estimated Degree and Average of Response Ratio for Sample viewpoints for Questionnaire Items of Organizational Justice

(Second Dimension: procedural justice) (n = 284)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
kindergarten leaders (administrators and supervisors) playing the following:						
7	Allowing teachers to express their opinions before making decisions about work.	2	194	88	482	0.57
8	Make decisions objectively, without bias.	7	146	131	444	0.52
9	Follow-up the subordinates' implementation of decisions on an ongoing basis.	4	191	89	483	0.57
10	Applying administrative procedures and decisions to female teachers in accordance with specific and fair criteria, without prejudice.	5	151	128	445	0.52
11	Flexibility in implementing decisions related to kindergarten work.	1	197	86	483	0.57
12	Following fair standards and criteria when writing the performance reports necessary for the functional upgrade of the teachers.	1	168	115	454	0.53
13	Teach teachers about their performance standards and reports.	6	184	94	480	0.56
14	Encouraging teachers' contributions to improve kindergarten performance.	3	179	102	469	0.55
15	Respecting justice when resolving disputes between teachers.	1	169	114	455	0.53
16	Taking fair action when accounting offenders.	5	179	100	473	0.56
The total degree of the dimension					4668	0.55
Minimum Confidence = 0.62 Maximum Confidence = 0.72						

As shown in Table (7): The average of response ratio of the research sample on second dimension items: procedural justice ranged between (0.52 : 0.57), Where the total ratio of all items were less than minimum confidence interval indicating that they achieved at a low level, in addition The total ratio of the dimension was (0.55), which was less than minimum confidence interval, indicating that it was achieved at a low level in the reality of procedural Justice, and this may be due to poor kindergarten leaders' perception about the significant impact of procedural justice feeling on teacher performance and the lack of interest of the Ministry in field research that addresses procedural justice and the extent to which it is achieved by kindergarten leaders as well as how to achieve it and this result is in consistent with the study of **Ahmed,A. (2003)** , and the study of **Ahmed,A.(2012)**, which showed that procedural justice is poorly applied.

Table (8)

Estimated Degree and Average of Response Ratio for Sample Viewpoints for Questionnaire items Organizational Justice

(Third Dimension: Interactional Justice) (n = 284)

N	items	response			Estimated degree	Average of response ratio
		Achieved Significantly	Achieved Moderately	Achieved at a Low Level		
kindergarten leaders (administrators and supervisors) playing the following:						
17	Treating teachers friendly and with respect, in the work environment.	35	145	104	499	0.59
18	Considering the functional rights and duties of teachers, without discrimination.	5	169	110	463	0.54
19	Building good social relations in kindergarten, based on respect of teachers' feelings.	3	163	118	453	0.53
20	Making decisions in a way that preserves teachers' dignity.	9	173	102	475	0.56
21	Discussing teachers about the effects and consequences of decisions related to kindergarten work.	3	179	102	469	0.55
22	Democratically deal with all teachers, without discrimination.	6	158	120	454	0.53
23	Clarify standards and working rules for all teachers, without exception or discrimination.	3	188	93	478	0.56

24	Considering teachers' needs of, when making decisions related to work.	8	164	112	464	0.54
25	Informing teachers of any formal or social activities, prior to their implementation.	11	184	89	490	0.58
26	Encourage female teachers to conduct and publish scientific research and work-related studies.	10	195	79	499	0.59
The total degree of the dimension					4744	0.56
Minimum Confidence = 0.62 Maximum Confidence = 0.72						

As shown in Table (8): The average of response ratio of the research sample on third dimension: Interactional Justice ranged between (0.53 : 0.59), Where the total ratio of all items were less than minimum confidence interval indicating that they achieved at a low level, in addition The total ratio of the dimension was (0.56), which was less than minimum confidence interval, indicating that it was achieved at a low level in the reality of Interactional Justice, and this may be due to the preoccupation of kindergarten leaders with actions that are more important than the human side (in their view), in addition to the weak training courses offered to kindergarten leaders on interactive justice, and how to achieve them and this result is in consistent with the study of **Mahmoud, H.& Barakat, S. (2006)**, and the study of **Al-Harahsheh, M.& Al-Kharbasha, M. (2012)** which showed that procedural justice is was week.

Through what is presented above about the reality of the organizational justice dimensions; it is clear that the ratio of the organizational justice as a whole was (0.55), which was less than the minimum confidence level. This result is in consistent with the study of **Abu Tayeh, B. (2012)**, the study of **Shetwi, A. (2011)** which confirmed the weakness of organizational justice.

Table (9)

Estimated Degree and Average of Response Ratio for Sample Viewpoints in Organizational Justice (n = 284)

N	Dimension	Estimated degree	Average of response ratio	Rank
1	**Distributive justice**	2785	0.54	**3**
2	**Procedural justice**	4668	0.55	**2**
3	**Interactional justice**	4744	0.56	**1**
The total degree of the questionnaire		12197	0.55	
Minimum Confidence = 0.62 Maximum Confidence = 0.72				

As shown in table (9): The average of response ratio of the research sample on Organizational Justice dimensions ranged between (0.54 : 0.56), that in the first rank was the dimension of (Interactional Justice), while in the last rank was (Distributive Justice).

2- Answer the second question: What are the suggestions for achieving organizational justice among kindergarten leaders from the perspective of teachers?

Table (10)

Frequency and percentage of sample Viewpoints suggestions to achieve Organizational Justice (n = 284)

N	suggestions	Frequency	percentage
1	Providing leadership training courses on organizational justice, and their significance in improving teachers' performance.	201	70.77
2	Producing bulletins on organizational justice for kindergarten leaders on an ongoing basis.	142	50.00
3	Establishing criteria to assess the extent to which kindergarten leaders practice organizational justice.	154	54.23
4	Providing incentives and rewards (material / moral) to kindergarten leaders who apply organizational justice.	176	61.97
5	Setting standards for accountability of offenders of kindergarten leaders and those who fail to implement organizational justice.	162	57.04

As shown in Table (10): The percentage of opinions of the research sample for achieving Organizational Justice ranged between (49.65% : 70.77%); It came in the first rank (Providing leadership training courses on organizational justice, and their significance in improving teachers' performance); while in the last rank was (Producing bulletins on organizational justice for kindergarten leaders on an ongoing basis).

Research Recommendations

- Paying the general administration of kindergartens attention to the extent to which kindergarten leaders apply organizational justice in actual reality.
- Involve kindergarten leaders in training courses, seminars, conferences and organized meetings related to organizational justice, its importance and how to implement it.
- Providing books, magazines and scientific references on organizational justice for kindergarten leaders.
- Encouraging kindergarten leaders to conduct research and scientific studies on organizational justice.
- Providing a system of incentives and rewards to encourage leaders who apply organizational justice in practice.

Setting standards for accountability of offenders of kindergarten leaders and those who fail to implement organizational justice.

References

Abu Tayeh, B. (2012). The Effect of Organizational Justice on Organizational Citizenship Behavior in Government Ministries Centers in Jordan. ***Journal of the Islamic University for Economic and Administrative Studies, Scientific Research and Graduate Studies, Islamic University, Gaza, Palestine***, 20(2), 145-187.

Ahmed, A. (2012). Organizational justice and its impact on the exacerbation of the phenomenon of financial and administrative corruption in state institutions in the province of Taiz field study. ***Journal of Administrative and Economic Sciences, Yemen***, 9(10), 355-410.

Ahmed, A. (2003). Analysis of the organizational justice dimensions: an applied study. ***Journal of Administrative Research, Sadat Academy for Administrative Sciences, Center for Research, Consulting and Development,*** 21(1), 12-46.

Al- Sukkar, A. (2013). The Impact of Interactive Justice on Functional Performance: An Exploratory Study of Managers' Opinions in Jordanian Ministries. ***Journal of Administrative Sciences Studies, Jordan,*** 40(2), 409-429

Al-Harahsheh, M.& Al-Kharbasha, M.(2012). The degree of practicing organizational citizenship behavior and its relation to organizational loyalty among employees in the education directorates in Mafraq governorate. ***Mu'tah Journal for Research and Studies, Humanities and Social Sciences, Jordan,*** 27(2), 57-114.

Bostanci, A. (2013): "The prediction Level of Teacher's organizational citizenship behavior on the Successful Practices of shaved leadership", **Eura Sian journal of Educational Research**, Issue.51, Pp.177-194.

Buluc, B& Gunes, M. (2014):"Relationship Between organizational justices and organizational Commitment in primary school ", ***The Anthropologist Journal,*** Vol.18, no(1), Pp.145-152.

Çoğaltay, N.& Karadağ, E. (2016)."The Effect of Educational Leadership on Organizational Variables: A Meta–Analysis Study in the Sample of Turkey." Educational Sciences: Theory& Practice Journal, Vol.16, n. (2), Pp.603-646

El-Hendawy, Y.(2006). ***Organizational justice and teachers' performance of citizenship behavior in public secondary schools in Egypt.*** PhD Dissertation and Thesis, Faculty of Education, Ain Shams University.

Erkutlu, H. (2011). The moderating role of organizational culture in the relationship between organizational justice and organizational citizenship behaviors, **Leadership& Organization Development Journal**, Vol. 32, No. 6, Pp 532- 554.

Gafari, P.& Bidarian, S. (2012): "The relationship between organizational justice and organizational citizenship behaviors", ***Procedia-Social and Behavioral Sciences,*** Vol. 47, Pp.1815-1820.

Mahmoud, H.& Barakat, S. (2006). The Relationship between the Confidence of Principals and Teachers of General Education Schools in the Accuracy, Objectivity and Effectiveness of the Functional Evaluation System and Their Sense of Organizational Justice. ***Journal of***

Educational Sciences, Faculty of Graduate Studies of Education, Cairo University, 14(2), 2-63

Mohamed, S. (2015). The role of organizational justice in the development of institutional work and management of organizational conflict***. Journal of Education, Al-Azhar University, Egypt,*** 1(164), 521-560.

Podaskoff, N. P., Whiting, W, S.& Blume, D. B.(2009). Individual and Organizational Level Concequences of Organizational Citizenship Behaviors: A Meta Analysis, **Journal of Applied Psychology**, Vol. 94, No. 1, 14- 122.

Radi, B. (2008). Organizational Justice and its Relations with the Quality of Work Life at the National Sports Council. ***Journal of Administrative Research, Egypt,*** 26(6), 6-95.

Shetwi, A. (2011). Organizational Citizenship Behavior at King Khalid University. ***Scientific Journal of King Faisal University, Humanities and Administrative Sciences***, 12(1), 331- 393.

Yilmaz, K: Taşdan ,M. (2009): "organizational citizenship and organizational justice in Turkish primary schools", **journal of Educational Administration**, ,Vol. 47, Issue.1, Pp. 12- 108.

Zaied, A. (2006). ***Organizational Justice: The Next Task of Human Resources Management***. Cairo, Arab Organization for Human Development.