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Application of methodology 5s in an industrial assembly company in the City of Manaus, AM

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ABSTRACT

The 5S Program is used to promote quality management in any business environment that seeks growth in its niche, minimizing process losses, costs and waste, increasing production and product quality. Thus, this article aims to demonstrate the improvements implemented with the application of the 5S Program in the machining sector in an assembly company Manaus Industrial Pole (PIM) that focuses on a pull production system. The research is of an applied nature, consisting of a bibliographical survey and a case study in the assembly company from July to October 2022. In the application of the tolerated meanings, the organization of items that were being used, as well as those that admitted were unused, disposal of worn-out materials that could no longer be used, accommodation of tools and equipment in their proper places, so that everyone could have access. The sense of cleanliness was applied to the use of cleaning kits allocated in supports oriented to the five production lines of the machining sector. The sense of standardization determined the cleaning of the machines in three stages, in a total time of 6 minutes, the sense of self-discipline, requires verification with more time, to identify whether the principles become a company culture. The benefits identified from the implementation of 5S are the elimination of waste, optimization of time and space, teamwork, improvements in health, reduction of accidents etc.

Keywords: 5S Program, Quality, Improvement.

1. INTRODUCTION

Companies in recent years are increasingly competitive, and to remain profitable they have created new strategies to adapt to the constant changes in the market, developing new organizational processes, investing in new technologies, eliminating costs and waste.

With industrial growth it became necessary to use tools to reduce losses in the production process, so that managers can check the risks, frequent errors, productivity levels. Within the companies, the elaboration of changes, when necessary, it is up to managers to analyze and choose the best strategy for problem solving, or when to use them, assessing risks and impacts, in addition to the control of procedures that assist administrators in decision making [1].

The production process can be understood in its functionality as the gathering of resources for the realization of the stages of the production chain, for the allocation and organization of these processes emerged models of productive systems such as Fordism, Taylorism, and Toyotism, or Toyota Production System - TPS, in order to reduce costs and maximize profits, creating the Lean philosophy, with five pillars that guide the entire production chain, increasing productivity, efficiency and reducing costs and avoiding waste [2].

The lean philosophy uses several tools to promote continuous improvement, such as the 5S Program, a set of techniques that promotes quality management, with great discipline, based on five principles/senses from Japan, respectively: seiri, seiton, seiso, seiketsu and shitsuke. The application of the 5S program aims at changing attitudes, habits, and thoughts, improving and seeking quality, reducing losses, besides enabling the application of new quality programs [3].

In view of these premises, the following question-problem was formulated: With the process of implementing the 5S Program in a machining sector in an industrial assembly company, what are the benefits that can be achieved in the quality area?

Thus, quality is one of the most widespread keywords among society and also in companies, the concept of quality control emerged in the United States to improve the war industry during World War II, but the Americans did not visualize or do not apply these systems in other industries, nor did they realize how much this system would leverage their industries and soon abandoned the world conflict [4].

Moreover, it is associated with customer satisfaction as to the suitability of the product to use, that is, quality is the degree to which the product satisfactorily meets the user's needs during use, so customer satisfaction fits the product [5].

In Japan, the control had greater applicability, where it was improved and renamed total quality control (TQC), this system made it possible to reduce the risks of delivering defective products to customers, with this development of the TQC it was possible to enable its significant industrial expansion, motivated by the concern of companies with the increasing pressures of competitors [6].

According to [2], this new management model modernized the pre-established principles by proposing new strategies, such as encouraging training for all functions and at all levels and seeking continuous improvement in the quality of goods and services produced. With this it was possible to establish quality standards, which are a set of requirements and specifications, which provide guidelines for which products, processes or services in a company meet the expected quality [7].

To meet customer requirements, it is necessary to establish a network of market information, development of new products and technologies, monitoring of orders during manufacturing and statistical analysis of production, among other actions, ensuring that customer requirements are foreseen and reviewed, from a market study, where the consumer defines the characteristics analyzed [8].

ISO international standards are the most widely accepted quality standard set, adopted by most companies in all countries. If a company does not meet the quality standard, it may be losing customer confidence and, from then on, its market share. Iso 9001:2015 specific to a quality management system makes companies develop their own quality agenda [9].

Patterns can be many delimited, applying to a specific type of product or general, such as

comprehensive management practices. The use of standards may be voluntary, but certain groups of customers or stakeholders can wait; in addition, some organizations and government agencies may require suppliers and partners to comply with standards as a condition for doing business [5].

Lean is a philosophy developed from the Toyota Production System, created by Womack, the Lean Manufacturing philosophy consists of a continuous improvement of processes and application of methods necessary to implement these improvements adding the reduction of loss in the production process and quality in the product thus increasing an increase in the company's profit [10].

According to [11], waste within a production line generates various costs not adding value to the product, the main waste present in a production line is waiting time, overproduction, unnecessary movement, product defect, excessive inventory, faulty processes and too much transportation.

Lean manufacturing aims to define from the customer's vision the definition of value, the identification of the value chain, establishment of the value stream, pull production and search for perfection. For the use of lean manufacturing are used tools such as: Kaizen, Program 5S, Value Stream Mapping, just in time, Kanban, Lean Six Sigma, SMED and others. These tools and methods are used to promote continuous improvement within a production process [12].

Productivity management has an objective within the organization, such as increasing productive efficiency, reducing costs in a production, increasing the profit of the organization, and for this it is used various types of tools constantly in the daily life of the industry, proposing new ideas and solutions to certain problems [13].

According to [14], the constant search for productivity improvements, stimulated the development of several tools that promoted efficiency, these tools came from TPS. In the context of continuous improvement and the application of the tools, the tool used in the case study, the 5S Program, will be addressed.

The 5S is a methodology derived from Japan in the 1960s, when its creators began to realize the need to improve the work environment, which included local dirt, organization of jobs, equipment, machines, parts and tools, which caused waiting in the production process, as well as work accidents and occupational risks [15].

[16] corroborates with [15], highlighting the objectives of this methodology, which is the reduction of costs, waste, and work accidents, improving productivity. The methodology consists of five words with the initial's "S", Japanese are them: Seiri who corresponds the sense of organization, Seiton as sense of ordination, Seiso as a sense of cleanliness, Seiketsu as a sense of health, and Shitsuke as a sense of self-discipline.

Table 1 identifies the structure of the 5S methodology.

Classification	*Definition*
Sense of use	It consists of separating the necessary items from the unnecessary ones in the workplace and rehandling the unnecessary ones for a sector that will have use, or if not, the appropriate disposal.
Sense of ordination	It consists of storing the objects in the proper place. Objects should occupy standardized positions according to their frequency of use, facilitating their use.
Sense of cleanliness	It consists of keeping the working environment clean. But beyond that, to clean up the dirt-causing spots.
Sense of health	It consists of setting standards to maintain the first 3 senses.
Sense of self-discipline	It consists of creating habit of following the program. According to Rech (2004) "Employees have to be accustomed to comply with the operational, ethical and standards procedures established by the company.

Table 1. Structure of the 5S Program.

Source: Adapted [17].

The process of implementation of the 5S Program respects five phases, being planning, records and photos, meeting, execution, and auditing. The planning phase involves the delimitation of what should be carried out, that is, the actions according to a plan, which contains those responsible for the project, the term and among other process information, already the registration is a mapping phase, of how the environment is before the 5S is applied, in the meeting phase the team must be fully engaged, debating how will be the application of the senses, what methods will be used, and the respective functions and responsibilities of each member, so that the next phase that is the execution of the project can be carried out, the last step is the audit to verify the consolidation of the improvement, going beyond, checking whether these principles become the company's culture, routine and habit of its collaborators [18].

Thus, this article aims to demonstrate the improvements implemented with the application of the 5S Program in the machining sector, in a assembly company Industrial Pole of Manaus (PIM).

3. MATERIALS AND METHODS

The analyzed industry operates in the field of assembly, manufacture of parts and accessories for motor vehicles, with a production schedule of the pulled type. The sector presented difficulties in relation to the constant challenges of daily cleaning of machines, which consequently impacted on the performance and occurrence of work accidents, so the managers of the sector decided to opt for the 5S program, since in theory, its application is considered practical and fast, but depends a lot on the self-discipline of each employee involved in the process. However, it seeks to improve the work environment and total quality, for this reason

the research, and this theme is extremely important for research, for acting in the organization, standardization and cleaning of the work environment, avoiding delays in production.

The research is of an applied nature since it seeks practical application to solve specific problems. As for the objectives, the research is exploratory, investigating and providing information on the subject.

As for the procedures, at first the research is bibliographic that [19] states as being "the one that is effective trying to solve a problem or acquire knowledge from the predominant use of graphic, sound and computerized material information", carried out in articles and dissertations available in Google Scholar.

Subsequently, we used the case study that [20] defines as research of "immediate application of knowledge in a circumstantial reality, raising the development of theories. The case study consists of collecting and analyzing information about a particular fact." Data collection was qualitative to better describe and interpret the data in order to obtain the main objective of the present study.

The case study took place in an assembly company located in the Industrial Pole of Manaus - PIM, active for more than 40 years in the market, has 760 employees in its headquarters in PIM, in the segment manufacturing parts and accessories for motorcycles. The company went through a merger process with three other companies in 2020 to become a global mega supplier, in 2021 the new consolidated company developed a new high-precision technology that improves the driving cab, in addition to more compact drive systems.

Data collection occurred in the machining sector, more precisely in the machining process of production III, investigating the cleaning challenges of the machines in this sector, and the possible solutions taken. Data collection occurred from July 22, 2022, to October 21, 2022, in order to solve the problem, tools such as brainstorming and the 5S methodology itself were used, respecting the five phases.

4. RESULTS AND DISCUSSION

In order to eliminate work accidents and waste, in addition to physical improvements to the parts machining process, the production team III of the machining sector proposed to investigate what impacts could be causing inefficiency to the processes. Production III has five production lines, they are: line (1) temperament, line (2) first thinning, machining line (3), line (4) grinding, and rod line (5).

With all of the team gathered, a brainstorming section was carried out, which culminated in issues such as the lack of organization of tools and the cleaning of the environment, more precisely the machines used in the processes. It was identified that the daily cleaning of machines in the machining sector faced challenges regarding their frequency, which resulted in the efficiency indexes of the equipment, and even delays in production, and increased maintenance activities in the equipment.

The planning phase began, when the need for organization and cleaning of the machines was verified, and it was possible to determine a plan for execution, according to Table 2.

5S Program Planning	
Project	"Use a Machine"SLOGAN: "This Machine is Mine"
Responsible	A team leader for the project as a whole, with knowledge in 5S; One team leader for each line; Execution team: employees of each respective line.
Term	July 2022 to October 2022; Cleaning Day D: October 21, 2022.
Materials Needed	Five complete cleaning kits; Support for cleaning kits

Table 2. Planning Phase, from the 5S Program.

Source: Author (2022)

With the investigation, a critical situation was identified in the machining line (3) regarding the cleaning of the machine, causing the engine / heat exchanger with excess dirt, due to the lack of cleaning, so it was determined the need for cleaning kits for each production line, so that autonomous maintenance is performed, that is, employees working on their respective lines are responsible for performing the cleanup.

With a formalized planning, and the presentation of the diagnosis of the production situation III, the management officials showed interest in the application of the project, since it sought the improvement and reduction of waste in addition to other benefits, especially the productivity of the sector.

In the registration phase, the site was mapped through photos and records as to the materials needed for the formation of cleaning kits. In this phase, the lack of organization of tools was identified, which were arranged outside their respective places, causing time to search, or even finding a certain tool, the environment presented on the floor residues of the processes performed there, papers, gloves without use and among others. In the machining line (3) a large amount of dirt was identified in the machine motor, as recorded in Figure 1.

Figure 1. Pump cover and heat exchanger with excess dirt.

Source: Author (2022)

With the great excess of dirt found in this line, it became evident the implementation of the 5S program, so that in this line the cleaning and oil change service were performed.

In the meeting phase, the leader responsible for the project was presented, and the leaders of each line, the project proposal was explained to the collaborators, and they were enthusiastic and receptive to the implementation of the methodology. First, a 5S program training was carried out, demonstrating each sense, and the proposal with emphasis on the Seiton and Seiso senses, as discussed, the professionals were able to give their opinion on suggestions that would facilitate the execution of the project even more, in addition to reporting difficulties in maintaining old habits, emphasizing that it would take time to adapt to the changes.

The execution step happened in a simple and gradual way, applying the concepts of 5S. In the first sense Seiri, materials that had no use during the processes of the line were discarded, in addition to unused materials, and with a lot of wear, so only necessary items were kept within reach, eliminating useless workspace.

The second and third sense, Seiton and Seiso, were further explored in the project, seeking to organize everything in its proper place, the seiton sense contributes to the practicality of the work environment, tools and raw materials were located near the lines, items without so much use were stored in identifiable cabinets, so that it is accessible to those who use daily, and for third parties.

Senso Seiso contributes directly to the project entitled "Take a Machine", which has the slogan "This Machine is Mine". The team formulated a plan to standardize the complete cleaning kits for each line, this kit consisted of one unit of each (1) broom, (2) squeezing, (3) disinfectant and disgreaser, (4) plastic shovel, (5) floor cloth allocated in a cleaning bracket (Figure 2). For the execution, the proposal required five kits for each line, and thus were requested the requisition for purchase, and the manufacture of two supports of the cleaning kit, and two degreaser drums for two months.

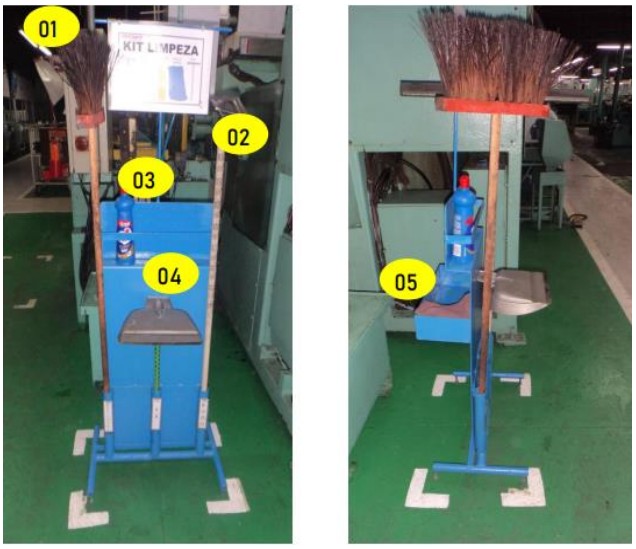

Figure 2. Arrangement of cleaning kits.

Source: Author (2022)

With the preparation of the kits, the best position was determined for the support of the kits, in a visible way to all employees, without hindering the traffic of people, and close to each line, in Figure 3 it is possible to verify the layout of production III, determining the exact location of these kits.

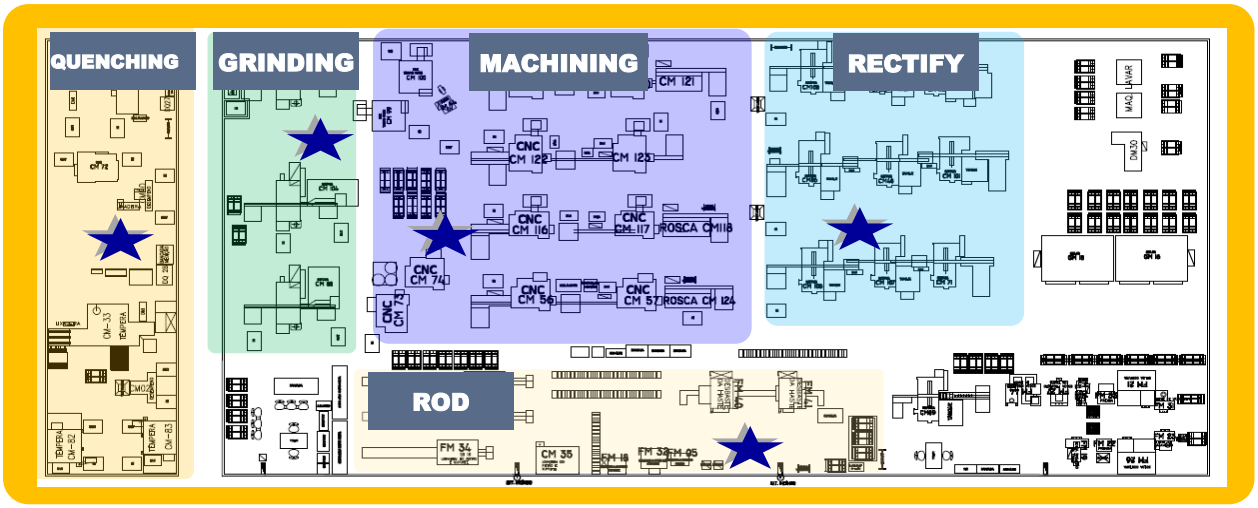

Figure 3. Production layout III - Location of kits.

Source: Author (2022)

The cleaning plan in the machines consists of three stages, with an average time of six (6) minutes in total, with two (2) minutes for each step, respectively. The first step happens with cleaning on top of the machine, with the use of the disinfectant with the floor cloth, the second step is in the middle of the machine, also using the see and floor cloth, while the third step consists of cleaning the machine floor with the broom, shovel and squeech.

In cases, with great excess of dirt, as in the case of the machining line machine (3), shown in Figure 1,

a heavier cleaning is performed, with degreaser, and performing the oil change, as was the case of cleaning the tank, filter, heat exchanger and engine. This situation had the cleaning service run, as shown in Figure 4.

Figure 4. Production layout III - Location of kits.

Source: Author (2022)

With the intention of applying the seiketsu and shitsuke senses, respectively standardization and discipline, the "D-day of cleaning" was held on October 21, 2022, to establish work practices that must be carried out daily, as proposed by the project, cleaning the daily machine, according to the established, in three stages of two minutes each.

On D-day cleaning, the senses of use, organization and cleanliness were applied, which culminated in excellent results, for the work environment, all employees participated as established in the project plan. Self-discipline is a challenge, but the employees show commitment to make cleaning machines a daily routine, although there are difficulties regarding the human factor, it was found the improvement of the physical space in the machining sector, providing better working conditions.

Although the program was carried out in a brief period, the results found are extremely significant in terms of improvement in the process, which contributes to the growth of productivity of the company in its segment of operation, but an audit is necessary to verify the consolidation of the project, and whether the principles are becoming a culture in the company.

From all this transformation, the improvements were numerous. With the execution of the "Take a Machine" project, it is evident that the autonomy of operators must be incorporated into routine activities, such as cleaning, inspection, lubrication, screw tightening, checking for faults and defects for immediate correction of equipment that is used in manufacturing. The continuous improvement should integrate the team to bring improvements to the work environment, the machines that may eventually fail.

As stated earlier, the 5S methodology focuses on wanting maximum participation of employees to seek an efficient production process, not only depending on specialized teams, operators have to have autonomy, but this is facilitated when one has the necessary knowledge and training.

For the purposes of this research, Table 3 presents a list of benefits, related to each sense of the 5S Methodology. As a legend, the green color defines the sense that has the greatest contribution, in the average blue contribution color, and small contribution red.

Benefits	Seiri	Seiton	Seiso	Seiketsu	Shitsuke
Reduction of accidents at work					
Base for Total Quality					
Cost reduction					
Discipline					
Productivity efficiency					
Data reliability					
Improving human relationships					
Improving quality					
Pollution prevention					
Standardization					
Increased machine life					
Prevention of breaks and failures					
Improved health					
Rationalization of time					
Space´s ptimization					
Elimination of waste					

Table 3. Benefits of the 5S Program achieved in the machining industry.

Source: Author (2022)

According to [21], the benefits that the 5S methodology can bring are difficult to delimit, because they depend on the problem that the program will be applied. In the literature, several benefits are identified, such

as the reduction of work accidents, quality and productivity, loss of reduced time and better cost benefit and greater efficiency, reducing defects and errors.

The application of the 5S tool has achieved several benefits as shown in the table above, ensuring the importance of using quality tools in the search for process improvements, since the sector needs attention, due to the operation depending on the machines regular cleaning is essential, because it is possible to identify the internal and external state of the machine, giving the maintenance team to predict failures, and avoid unscheduled downtime, in addition to other problems such as oxidation and oxidation of the machined part, clogging, and reduced service life.

5. CONCLUSION

As seen in the present work, the search for improvements is vital for the daily life of companies, which seek to maintain efficiency and effectiveness in their manufacturing processes, avoiding interruptions that can generate both economic and social disorders, so we sought to demonstrate the application of the 5S methodology, in the machining sector, in the production lines, to meet maintenance needs, the reduction of failures, waste and especially accidents at work.

In the application of the senses, it was verified the organization of items that were being used, as well as those that were kept unused, disposal of worn materials that could no longer be used, accommodation of tools and equipment in their proper places, so that everyone could have access. The sense of cleaning was applied to the use of cleaning kits allocated in supports oriented to the five production lines of the machining sector. The sense of standardization determines the cleaning of the machines in three stages, in a total time of 6 minutes, while the sense of self-discipline, requires more time to investigate if the principles are becoming a culture of the company.

Based on the problem question raised, coma research was possible to identify some benefits of the implementation of 5S, such as waste elimination, optimization of time and space, teamwork, improvements in health, reduction of accidents and others. Although the research was carried out in a short period of time, significant results were found achieved, however the whole process of improvement demand of trained professionals and investment resources to be put into practice.

As a suggestion of future work it is recommended to carry out a 5S program as a tool combined with the TPM (Total Productive Maintenance) methodology that aims to promote a culture, in which equipment

and machinery operators feel responsible for their equipment and can, if necessary, perform small repairs and also give diagnoses on the machines, seeking zero defect, zero failure and zero accident.

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