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Abstract

This article discusses the relevance of implementing a proposal that aims to apply the study of times and methods in the production line of the Mini System, a device that promises a sound with more power, quality and functionality produced by a company from Manaus Industrial Polo. The overall objective is to show that by calculating production times and methods it is possible to increase the company's capacity and reduce labor. The specific objectives are: to map the productive process; measure operation cycles, through time and production lead time; identify bottlenecks and constraints; identify losses; and propose improvement actions. Therefore, the methodology used was a biographical research, carried out through systematic studies in books, articles and websites; This was followed by field research through data collection in the Mini System assembly operation, focusing on the analysis of the total time spent on the production line. The results achieved with the study were put into practice, showing positive changes in efficiency, increased production, reduced labor and financial savings.

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1. Introduction

The present study was conducted in a Manaus Industrial Pole company that is one of the leading manufacturers of consumer electronics in the world and is among the national market leaders for LCD / LED and laser multifunction televisions. In Brazil this company has two industrial complexes located in

Manaus / AM and Campinas / SP and operates in the following areas: mobile telephony, smartphones, audio and video products, white line, air conditioners, monitors, projectors, laptops, printing, hard drives and optical discs; and is the country's pioneer in the manufacture of tablets, LED and 3D technology TVs and the provision of devices with access to Internet content.

The main focus of this work is the Mini System production line in the company's industrial complex in Manaus / AM, located at Avenida dos Oitis, nº 1.460, Industrial District. This pole has a built area of 10,354 m² (34,000 m² total land) and the main economic activity is the manufacture of television sets, mobile phones, tablets, home theater and mini system. To this end, it has a team of 5,000 employees and has revenues of US \$ 500 million to US \$ 2.8 billion.

In times when the economic crisis affects production in all companies in the Manaus Free Zone, it is very important to work with lean production processes. The study of time and methods is becoming increasingly necessary today, due to the great demand imposed by the globalization of production and distribution, being part of a package required by companies, with emphasis on the needs of rationalization, productivity and quality.

In order to become effective and competitive in the market, the company needs a good control of its production processes, reflecting directly on the client its improvements in quality, costs, deadlines, safety, etc. Because one of the main causes of problems in companies' production lines is having multiple employees perform the same task differently without standardization.

We can gain control of process standardization by studying time. According to Slack et al (2002), time study is a work measurement technique for recording the times and work rate for elements of a specialized task performed under specified conditions and for analyzing the data in a timely manner. get the time needed to get the job done with the set level of performance.

The product must meet customer requirements and is produced by a stable or replicable process. More precisely the process should be able to operate with little variability around the target or nominal dimensions of product quality characteristics. Statistical process control is a powerful collection of problem solving tools (this work will primarily use the time and method tool) that is useful for achieving process stability and improving capacity by reducing variability.

Thus, this work deals with process stability by monitoring the production time of each operator for a given operation, identifying the possible influences of common or special causes that may alter the quality and production capacity, regarding their uniformity of production. production.

2. Theoretical framework

2.1 Statistical Process Control

Statistical Process Control is a tool with statistical foundation, used as an aid in both quality control and process steps, especially in repetitive production processes. Stabilizing routine processes is one of the most important items for companies as it ensures that product reliability is achieved.

According to Montgomery (1996) variability is the same as waste of money, time and effort. For this reason, one of the most accepted definitions for quality is precisely the reduction of this variation, that the lower, the better the trust and acceptance of the product or service that makes CEP one of the main tools for solving

this type of quality. problem.

Toledo (2006) lists the fundamental principles for implementation and management of Statistical Process Control, as follows:

- a) Think and make decisions based on data and facts;
- b) Separate cause and effect, always seeking to know the fundamental origin of the problems;
- c) Recognize that variability exists in production by managing it through priority reasoning;
- d) Rotate the control cycles: PDCA Cycle: Plan, Do, Check, Action; permanently and methodically, aiming at continuous performance improvement;
- e) Define the next process / stage / post and the expected quality as the customer of the previous stage.
- f) Create mechanisms to instantly identify foci and sites of dysfunction, correcting them in time to avoid damage.
- g) Create permanent education and training mechanisms for the workforce aimed at participatory management and self-control.

There is no miraculous formula, where their use guarantees immediate solution to all problems of a process, but the use of some methods is the most rational, logical and organized way to define the genesis of these problems, their extension and the best way. to address them, especially by helping to achieve systems that ensure continuous progress in quality and productivity standards at the same time.

2.2 Times and Methods

To talk about the study of time, it is important to mention Taylor's studies, as he was one of the leading theorists to study time in problem solving, proposing that the highest rate of inefficiency in companies was directly related to wasted effort. human (LOPETEGUI et al., 2014; TAYLOR, 1990).

Already the study of movements was started by Gilbreth when using his technique in a film camera with the objective of studying the movements required for the execution of each. He advanced on Taylor's studies and created a set of movements that he listed as fundamental and necessary for the worker to perform operations on manual tasks. (Maynard, 1970).

For Furlani (2011) the study of times and methods is an instrument that has the objective of eliminating the waste of operational effort, adapting the tasks, training and specialization of the team and establishing work execution norms. Barnes (1977) confirms this by ensuring that the study of times and methods aims to improve working methods, increasing the productivity of an operation, lowering costs and improving product quality.

This Statistical Process Control tool can be characterized as a system study that has three factors: identifiable points of entry; transformation and output. establishing standards that facilitate decision making (FURLANI, 2011). This procedure ends up favoring the increase of productivity and supply of information regarding the times, in order to analyze and choose the best method for use in the production process.

3. Methodology

To build this work, a visit was made to the Mini System assembly operation for data collection. involving

the total time spent on the production of these devices. According to the general objective, we propose to obtain quality and productivity indicators, as well as to analyze the balancing and standardization generated in the production process. After the analysis, the results were compared, trying to demonstrate the gains with the process improvement. For that, the Statistical Quality Control was used, mainly the time and methods tool.

4. Problem identification and study application

The Mini System assembly line has a capacity of 2000 devices per day; It had 94 operators and had an efficiency of 70.3%, that is, it had an imbalance in the process of its activities, because its structure did not present adequate conditions for a good production. This can be seen in the figure below.

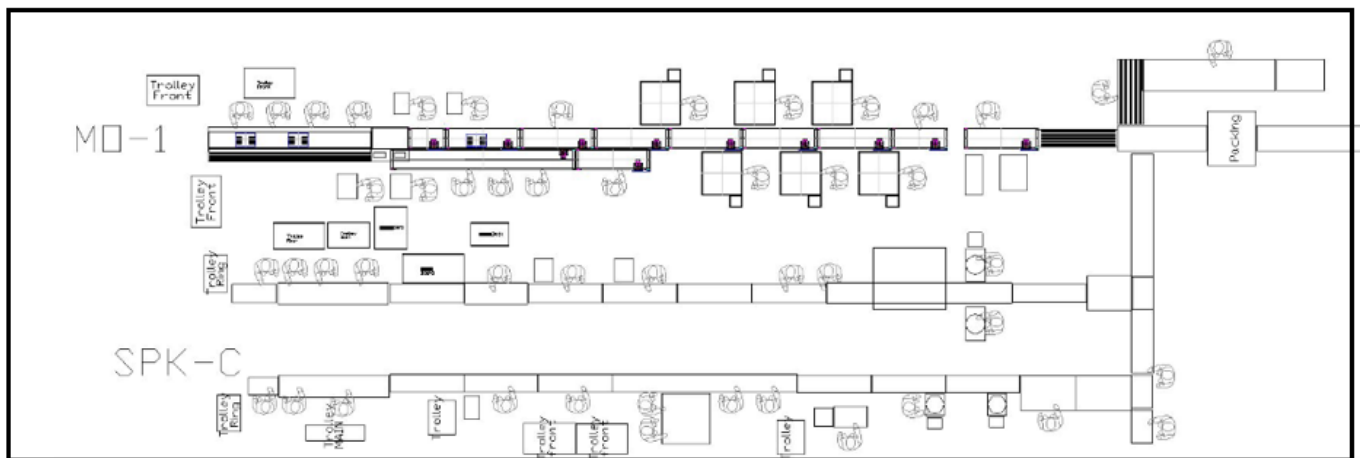


Figure 1: Mini System Production Line Layout (Before)

Source: Own Author

Another problem that was identified in the process was the amount of movement waste, as the devices were taken from the treadmill for assembly and then returned to the same treadmill, causing operators discomfort, quality problems and ergonomic shoulder and arm problems. number of times they loaded the device to assemble and test the assembly cells, as shown in figure 2.



Figure 2: Mini System Mounting and Testing Cell (Before)

Source: Own Author

Given this situation and through the information obtained, a time study was performed to verify all jobs and check which bottlenecks in the process, in order to present a proposal for improvement. The figure below shows a chart with job data, where each bar is equivalent to one job and the time spent at each job, showing more time wasted than necessary, since the rates are quite high.

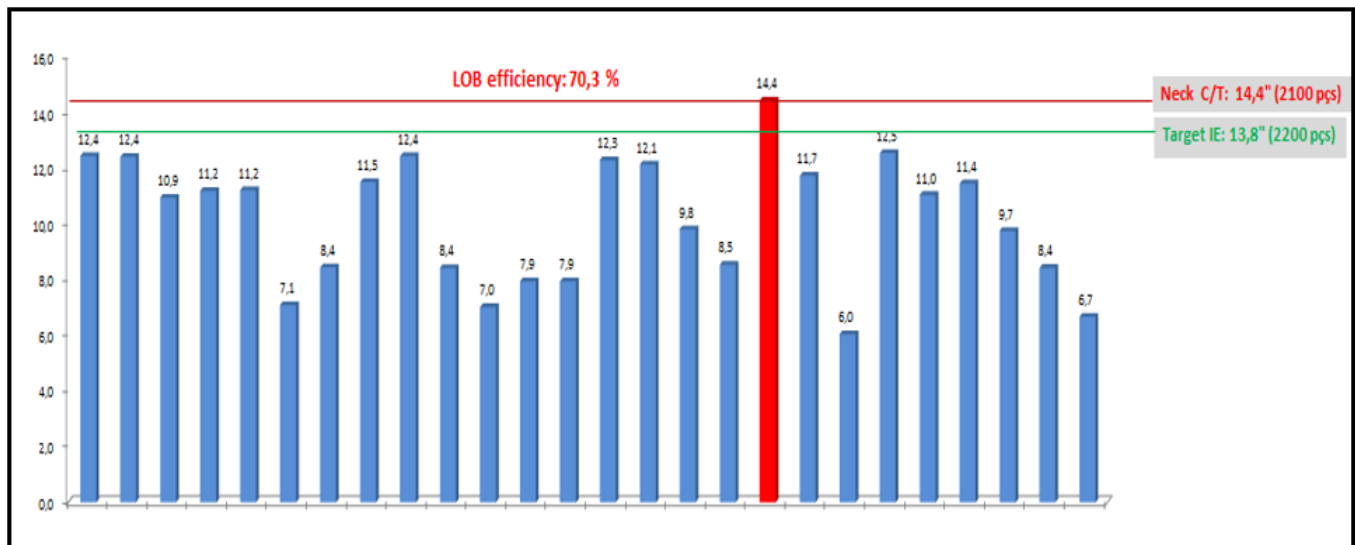


Figure 3: Graph with job data

Source: Own Author

After analyzing the times of each process, it was necessary a meeting with the sectors responsible for each area of activity (Mechanical Engineering, Electrical Engineering, Quality, Production and Innovation). Where built a schedule of activities to be performed after the commencement of the collective holiday of production, so that changes were tested as planned.

5. Results and discussions

After the implementation period, the most important innovation was the new audio testing concept for the Mini System, where the device would be tested on an eight-sided carousel and thus eliminated movement waste (belt grip and placing on same treadmill) and the ergonomic problem (loading the product to test and assemble) that was in the process.

Another important change was the introduction of conveyors to eliminate the quality problems that were in the process. This was because there was also a high rate of damage (beaten and scratched) in the speaker wood, because they used roller mats that transferred the product pushing, which favored the damage to hit each other, because it is a very fragile material that should have less manual process. See the figure below for how the eight-sided carousel test cell works.



Figure 4: Eight-Sided Carousel Test Cell (After)

Source: Own Author

These proposed improvements would bring more operator comfort, product quality, productivity and labor reduction, as the results of the company's indicators sought to produce more using less labor. To do so, innovation would be the main strategy to achieve this company's goal.

To represent the proposal of the new layout, a 3D presentation was built in AutoCAD, in order to provide a better visualization of how the new process and the new audio test concept in Mini System would look, as can be seen in the figure below. .

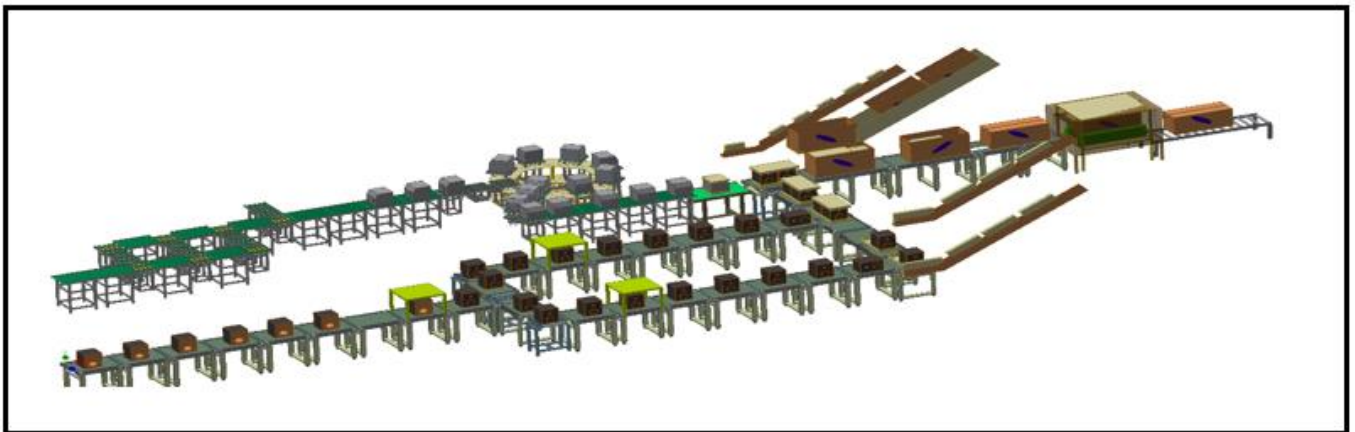


Figure 5: Proposed New Layout 3D Mini System production line

Source: Own Author

As a result, a new time study was carried out to apply the new process, which showed an improvement of 85.4% in efficiency, i.e. an increase of 18% compared to the previous process. It also showed an increase in production of 1000 pieces and a reduction of 28 operated, which equals a saving of 95,617.47 reais per month. Figure 6 shows the job data graph after the changes, where you can see the decrease in time spent on all jobs after the changes are implemented.



Figure 6: Graph with job data (After)

Source: Own Author

6. Conclusion

New work tools emerge from the adoption of technologies, causing changes in the scenario of organizations. In many cases, operators view the acquisition of new tools, or any other kind of change as a negative factor, and companies see it as an expensive process, especially if the objectives are not clear.

By analyzing the current method employed in the Mini System production process, it was possible to realize that it was configured as an unbalanced process, requiring a detailed analysis of the entire production process and the creation of a new proposal. This proposal allowed for changes mainly in the new audio testing concept for the Mini System, which is now done on an eight-sided carousel, eliminating waste and ergonomic problems. Another change was the introduction of automatic conveyors eliminating quality problems and breakdowns.

According to this research, it was observed that the company referenced in the research is able to receive the tools shown in this paper, since the changes implemented generated results that can be qualified as satisfactory, considering that, besides the savings provided by the reduction time and labor required to manufacture the equipment, increasing productivity and consequently the company's production capacity. Due to the positive results offered by the implementation of the new tools, the company showed interest in the implementation of new improvements seeking the reduction of production costs (as a consequence of the reduction of production time) and the increase of quality and productivity. For the current situation of the company, the process improvement will be implemented to study the layout of the other headquarters and to introduce new products in the production line.

Given this, it is possible to state that the objective of the study was achieved through the application of quality concepts and tools such as the Study of Times and Methods, which allowed an analysis of all operators' movements, the creation of a layout change proposal, the implementation and monitoring of results. Following the implementation of the proposal, a new study was performed and an 18% improvement in efficiency was verified; increase in the quantity of parts produced, reduction of labor and cost savings.

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