

Kaizen and 5S as Lean Manufacturing Tools for Discreet Production Systems: A Study of the Feasibility in a Textile Company

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ABSTRACT

At present there is a growing search for entrepreneurs about process optimization tools, where the greatest need and purpose is to keep their organizations active in the competitive market. It is seen that a company needs to ensure the high quality of its products and the continuous improvement of its processes, and this explains the concern to eliminate wastes in the production line. Such wastes can be defined as production elements that absorb resources and increase the cost without adding value to the product. There are numerous tools that help minimize waste during production, and many of them are part of a line of thinking called Lean Manufacturing (LM). In this context, it is hoped to demonstrate together the theme Lean the relevance of the theme Kaizen and 5S's, where in the business scope Kaizen is a tool that allows to reduce costs and to improve productivity, and already the 5S to organize the environment and to generate better. This work presents the study of the applicability of LM in a textile company in its continuous production system. By combining the two tools of the LM, Kaizen and 5S, simulation had an impact in reducing the main losses presented in the production flow. The justification for this work is based on the fact that LM tools in continuous production systems.

Keywords: Continuous manufacturing, Textile, Lean Manufacturing, Kaizen, 5S

INTRODUCTION

In the last two decades, many Brazilian textile companies have faced the effects of globalization. The competition imposed by the emerging countries has become fierce in price. To survive in this scenario, some organizations began implementing programs to improve their competitiveness. Most of these programs were based on Japanese production concepts. The concepts of lean production, lean manufacturing (LM), were based on the Toyota Production System [1]. The word LM is believed by Womack, Jones and Ross [2] in his work called The Machine that Changed the World. The goal of LM is to eliminate wastes in manufacturing processes by removing items that do not add value to the product or service under the customer's vision. Ohno [1] describes seven types of production wastes that may derive from the following: overproduction, waiting,

transportation, over processing, inventory, handling, and defective products. Value to the customer and, at the same time, consume the least amount of resources. Nowadays, the concept of LM is a well-publicized subject in the literature. Hines [3] presented the concept of process improvement with the implementation of LM.

In this way, this work deals with the LM theme with emphasis on the application of Kaizen, as well as notes about 5S, which, when applied accurately, tend to generate better organization, optimization of processes and consequently profitability of the organizations that use these methods.

This paper will present some processes observed as critical in the company studied. Through this, possible and even demonstrative solutions with before and after application of the improvement will be presented.

At the end of the project it is expected that the company studied obtain better gains, both in quality and financial, after all, each day the market becomes more competitive and constantly changing. Therefore, organizations tend to adopt flexible management models, aiming at the implementation of strategic tools to remain competitive and achieve longevity in the current market [4].

There is a great need for an organizational planning in order to promote constant improvements, thus minimizing errors, eliminating waste and reducing costs. For this, organizations must take into account critical factors such as committed team, effective leadership, aligned goals, and culture of continuous improvement, as well as having a full understanding of the internal and external environment of their business [5].

In describing LM, Bahmu [6] in his literary review mentions that Lean's goal is to meet customer demand by minimizing waste, also cites that Lean practices seek to produce low cost and low response time.

LITERATURE REVIEW

In this section, topics related to the LM theme will be presented, where Kaizen and 5S tools will be presented, which are used to optimize processes in various conditions, whether business or private.

Lean

The LM solutions to increase production efficiency with the applicability of one or more tools is needed, such as: Kanban, Kaizen, TPM, 5S, SMED and VSM, the latter is the main tool utilized in this article and will be mentioned in the topic below The Lean Production System is a set of activities aimed at increasing the capacity to respond to changes and minimizing waste in production, establishing a truly innovative management organization. These organizations have the following principles: to have (and maintain) the right items in the right places, at the right time, and in the right quantity; Create and nurture effective relationships within the Value Chain; Work towards Continuous Improvement in search of Optimum Quality in the first unit delivered. The Lean Production system looks for economy and consistency in movement through the study of methods and work times, drawing attention to simple, low-cost solutions [7].

The Lean methodology and its tools have been used in different scenarios and segments, and the more their domain evolves and continues to be dissipated, the more criticisms also arise. The literature on lean management seems to converge to the assumption that efficacy would be limited to contexts of discrete and repetitive manufacturing, where it was initially developed [8]. Discrete manufacturing companies such as the automotive and electronics have great benefits with this practice, however, few studies appear to prove this success in adopting Lean in a universal format for all types of organizations.

According to Werekema [9] one of the important points to be highlighted is that the adoption of Lean Manufacturing represents a process of changing the organization's culture and, therefore, is not easy to achieve. Therefore, using one or more Lean tools does not guarantee that you will succeed in implementing lean production.

It is argued that some articles mention limitations to the implementation of lean manufacturing and suggest that this is due to the differences between the pioneer industry and the one that is trying to apply [3,10]. These differences may include volume or variety [11].

It is known that Toyota Production System is based on the total elimination of waste, and the two fundamental pillars that give support to the system are: Just-in-time and Automation. Therefore, according to Scheunemann [12] Just-in-time is a flow process, whose purpose is the exact control of the items in the production process, where the inputs arrive at the process at the right time and in the necessary quantity. A company that establishes this flow integrally can reach zero stock. We have that automation is defined as the mechanization of the operation, while Automation with human touch, confers human intelligence to the machine. According to Azharul [13] despite the great potential of strategies to achieve lean production, many studies report failures in the expected result of the lean application, so it has what is essential or monitoring each process to enable an application of this tool.

Kaizen

Continuous improvement is a concept that has great relevance in an industrial context. In other words, for a change to improve processes. The most famous concepts associated with continuous improvement also did not arise from

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the Toyota automotive industry already mentioned, the organization is responsible for developing the Kaizen philosophy.

It is possible to say that philosophy is a method of eliminating despair based on good sense, without using cheap solutions to help the motivation and creativity of employees to improve the practice of work processes, in the pursuit of continuous improvement. The word Kaizen of Japanese origin has the meaning - Do Good (Kai = change, Zen = well).

According to Imai (2010) Kaizen represents the practice of improvement, eliminating waste involving all employees. This allows organizations to lower costs and improve quality, as well as product diversification. The benefits generated by companies are immense, such as: productivity increase without relevant financial investments; Reductions in production costs or processes; Adaptability to market changes; And especially the motivation of employees. However, it is possible to affirm that Kaizen requires change in the perception of all those involved in the organization, where they must constantly identify wastes at work in order to highlight them and already propose solutions to eliminate them.

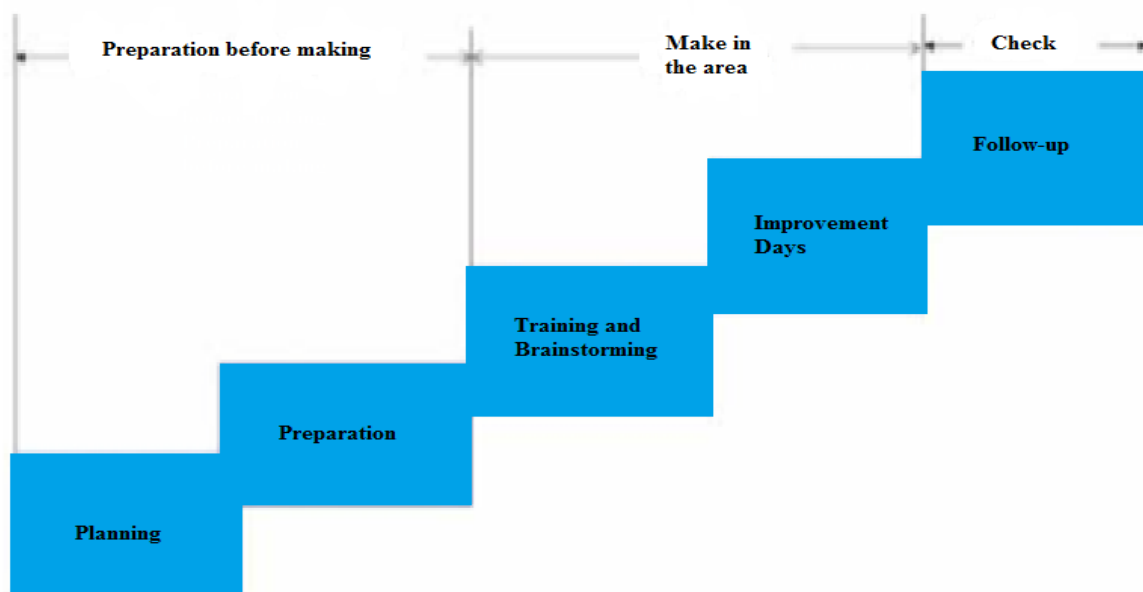
According to Neto [14], the form commonly used in the Kaizen process is the formation of team with multifunction, which meets with the intention of seeking solutions to certain problems in the part of the process being evaluated at that time.

Womack and Jones [15] characterize the term Kaizen as "incremental continuous improvement" in activities normally performed by groups of employees who collaborate to eliminate waste or problems in the production line by using the value stream mapping technique. As Scotelano [16] states, this stems from the philosophy of eliminating waste based on common sense and the use of low cost solutions that support the motivation and creativity of employees to improve their own work processes, with a focus on improvement to be continued.

The great theorist of philosophy Kaizen, Masaaki Imai, enumerates 10 principles that must be followed in the companies: elimination of the wastes; Incremental improvements on an ongoing basis; Involvement of all employees, whether managers, directors or factory floor, without elitism; Low-cost improvements based on inexpensive strategy aimed at productivity increases without significant investments, with technological improvements or with consultants; Possibility of being used anywhere and not only in Japan; Transparent management, making waste and problems visible to all; Focus on the factory floor where gains can be leveraged; Process orientation; Search for training and a new mentality of employees through teamwork, quality circles, self-discipline and the cultivation of wisdom, essential for the support of the program, whose main motto is to learn by doing [17].

Figure 1 shows the phases involved in the application of the Kaizen tool.

Figure 1. Phases of the Kaizen



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Rother and Shook [18], affirm that there are two levels of Kaizen:

- Kaizen of Flow: or Kaizen of system, that has as focus the flow of value, directed to the management;
- Kaizen of process: whose focus is on processes in an individualized way, aimed at work teams and team leaders.

The theoretical framework highlights the importance of the topic addressed and how the Kaizen tool of the Lean Manufacturing System is efficient when applied correctly, helping to coordinate a better production flow, generating value and making processes more efficient and profitable.

Based on this information, it is known that the Kaizen Institute [19] presents the 7 fundamental principles of this philosophy:

- Adopting good processes leads to good results;

- Directly check the source of the problem to understand the situation;
- Talk supported by data and manage based on facts;
- Take action to address the causes of the problems;
- Work as a team;
- To hold all employees of the company responsible for Kaizen;
- Produce great results through small changes accumulated over time;

In addition, the Kaizen philosophy argues that continuous improvement should focus on the elimination of seedlings (Japanese word for 'waste'), ie over-production, excessive stocking, transport, improper Defects and waiting times [20].

In this way, the representation of the 7 seedlings defended by the Kaizen philosophy is presented below in Figure 2.

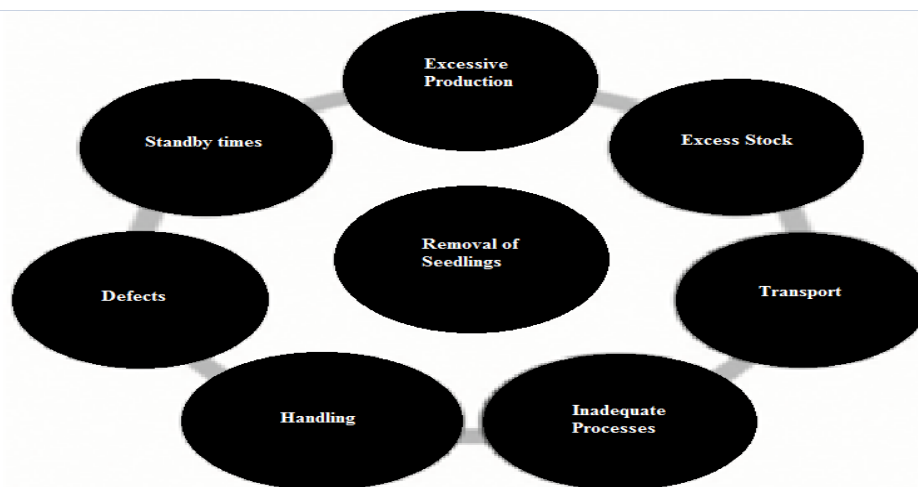


Figure2. The 7 Kaizen Tool Seeds

According to Morse [21] there are many benefits of Kaizen, the same can be seen in all areas, if the leadership is well trained will certainly achieve great results, in addition, Kaizen involves all employees. It is possible to say that Kaizen events help to encourage communication and the involvement of employees in the organization. As a result, new processes are more efficient and less frustrating for employees.

Tool 5S

Based on the Lean theme highlighted, it is still necessary to highlight the relevance of the 5S tool, which has been used by large companies in

order to improve their processes, and especially to improve their informational controls and their organization in general.

According to Jafari [22] and Shaikh [23], the implementation of 5S is the basis for increased efficiency, standardization of practices, improved safety, reduced cycle time, customer satisfaction, and personal flexibility in High spirit and motivation.

It can be stated according to Silva [24] that the five Japanese words that gave meaning to the 5S were: Seiri, Seiton, Seiso, Seiketsu and Shitsuke. In the Figure 3, a summary of the 5S's can be observed.

Sense	Japanese	English	Meaning
1° S	Seiri	Sense of	Use
			Storage
			Organization
			Selection
2° S	Seiton	Sense of	Ordination
			Systematization
			Classification
3° S	Seisou	Sense of	Cleaning
			Zeal
4° S	Seiketsu	Sense of	Asylum
			Hygiene
			Health
			Integrity
5° S	Shitsuke	Sense of	Self-discipline
			Education
			Commitment

Figure3. 5S's Definitions

For Hidalgo [25] concept 5S was originally developed in 1980. It is stated that a picture of the application of 5S within a company was formalized for the first time by Takashi Osada. In this way, the author supports the idea that 5S is a relevant tool to reach the goal of a Total Quality Environment, where it offers a way or even a strategy for organizational development, thus generating learning and change.

According to the author Osada [26], it is important that all the organizations that long for quality improvement seek in principle to meet the basic needs, in this way it is understood that the 5S's are prime points to improve processes, improve environmental conditions and still improve the quality.

Below are presented the tools demonstrating their specific characteristics represented by the 5 letters S, where we have:

Seiri - Sense of Utilization or Selection

We have that, the sense is to create a culture and reduce waste through the conscious use of resources and the conservation of the environment as a whole [27, 28]. On the other hand, Korkut [29] points out that this arrangement is presented in order to name highlighting and thus keeping each material in the place observed, which better organize the environment.

Thus, the contribution to the work place is kept clean and in order, thus improving efficiency in the execution of the processes [30]. It is necessary to follow some observations that are described below [27, 28].

Analyze each resource in the environment:

- Remove all things and documents from drawers, cabinets, and other compartments;
- Keep close to what you use very often;
- Objects with infrequent use, leave in a demarcated place for collective use;
- Avoid keeping resources in excess;
- Avoid discarding what can still be used;
- Keep facilities in good working order.

Seiton - Sense of Organization

All the need of the workplace in order as the tools, equipment and materials should be organized systematically for the easiest and most efficient access [31]. This means preparing the necessary items neatly and systematically so that they can be easily taken and returned to the original site after use [32]. For Haroldo [27] the objective is to create a culture of safety and optimization of time from the physical and rational organization of the environment, such as:

- Define the appropriate location and device to store resources;
- Save resources in a way that makes it easy to locate them visually;
- Avoid mixing features with different characteristics;
- Identify and signal the resources, locations, work station, to avoid wasting time.

Seiso - Sense of Cleanliness

According to Malik [33] the sense represents the cleanliness of the workplace. After sorting out the useful things and putting them in order [32]. For Gavioli [28] a third sense is to eliminate dirt or foreign objects by identifying their origin with the objective of creating a culture of zeal for the facilities and resources from the cleaning done as inspection posture, such as:

- Make the user responsible for cleaning the environment;
- Use places of collective use appropriately, whenever leaving leave them clean and organized;
- Analyze whether garbage dumps and other waste collectors make it easier to maintain cleanliness (quantity, location, signage, frequency of garbage collection, and selective collection practices).

Seiketsu - Sense of Standardization

For Jain [10] work practices must be consistent and standardized. Standardizing procedures and working conditions provides transparency and helps staff quickly implement and complete tasks. This application and consolidation of the first three S, favor the conditions to physical and mental health, from the standardization of environment and behavioral rules and the elimination of contamination and health risks Haroldo, [27]. Such as:

- Identify the facilities and resources according to the standards established by the company;
- Discuss with the teams the rules of coexistence for behaviors that bother some people;
- To rise with the teams of the specialized areas in occupational health, what the problems harm people;
- Empower people to use ergonomic features appropriately and follow health and safety procedures and standards.

Shitsuke - Sustained Order Sense

This sense ends the 5S cycle. Maintain and revise standards. Once the previous 4S has been established, they become the new way of operating [10]. In order to ensure that the company continues to improve continuously using the previous 5S steps [23]. For

Gavioli[28] it is necessary to create the culture of self-discipline, not only for the 5S program, but for several fundamentals such as norms, rules, procedures, such as:

- Maintain the 5S in the day-to-day;
- Strictly comply with all commitments made on the date and at defined times;
- Comply strictly with agreements, rules and rules independent of collections;
- Analyze whether some people's attitudes hurt others directly or indirectly.

METHOD

The research method used in this paper was a case study in the company This work was conducted in a discrete production system in a textile company, located in the Paraíba Valley region, in Sao Paulo state, Brazil. The company considered in this research work is named AC & R TextilLtda (ACR). The company was founded in 1994 and it had never applied any LM method before. In the beginning of this work, several meetings were conducted with the ACR's top management, in order to explain the LM conception and benefits, and to obtain a commitment from them with the work program and its actions' schedule.

The data collected for this research work was collected during a period of four months, which means an output of 120 tons of textile and 12000 sport shirts.

The production line is composed by:

- Cutting
- Hot stamping
- Assembly
- Embroidering
- Yarnexcesscleaning
- Preparation
- Sewing

The layout of the production line follows the inflow and linear conception.

In addition, for the accomplishment of the simulations and analyzes of the data will be used Microsoft Excel 2013, where by means of this one it is expected to be realized all and pointing regarding the presented improvements.

Below, a schematic referring to the method used in this article can be observed in Figure 4.

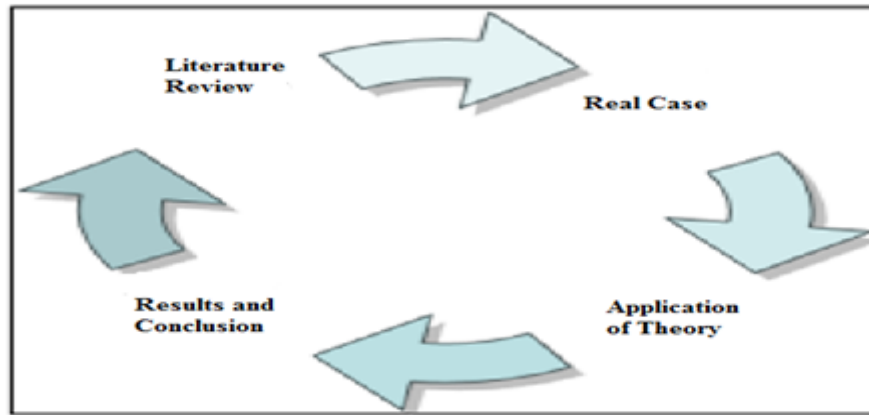


Figure4. Proposed research method

To identify each company process and possible failures, an organization process mapping, or even the most well-known Value Stream Mapping, was developed.

The flow of value is related to the chain of all activities that add value to the product, or that

make up the sequence of activities to transform the raw material into finished product.

Below Figure 5, the elaborated VSM can be observed and from it, it was possible to arrive at some problems that confront the theory of the applicability of Kaizen and 5S.

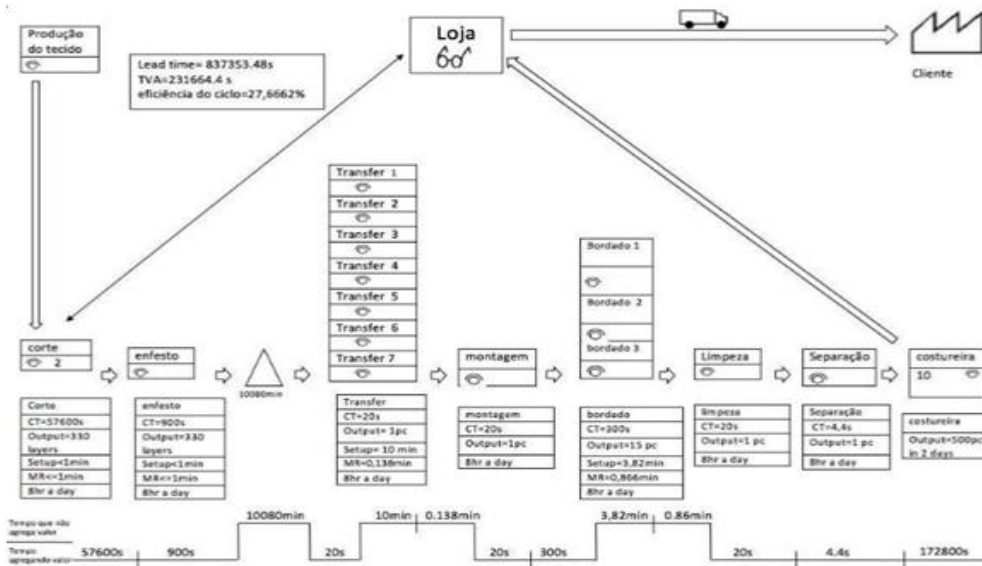


Figure5. ValueStreamMapping Figure 4 - Proposed research method

Based on the field work performed in the ACR, all the company's processes were analyzed, where it obtained some negative points, below

in table 1 are described the points to be improved in the organization studied:

Table1. Notes for improvement of processes

Processeswitherrorsfound	Application Tool	Solution
Marking for embroidery without pattern (without template)	Kaizen	Creating templates to standardize quality
Enfesto for cutting with many sheets of fabric	Kaizen	Decrease of fabric sheets to reduce failure of the shape of parts caused by machine cutting
Rework on the industrialization of parts	Kaizen	QualityControlandScoring
Excessinventory	Kaizen	Evaluate materials that are unnecessary to remain stocked and point data in stock control
Disorganized and bad signposted site	5S	Organizationofthecompany
Bad signs in the company	5S	Signageofdepartments

RESULTS AND DISCUSSION

In this section the results of this case study will be discussed and presented.

Reduced Downtime

In the Table 2 the main problems can be observed that caused the machine stop, among these points two points were chosen and improvement solutions were presented in order to obtain a better future result.

Table2. Processes with Stop Machine

Machine Occurrence	N°	%	Accumulated %
Workers' Holidays	11	289.474	289.474
Machine Regulation	5	131.579	421.053
Engine Fixing	5	131.579	552.632
Chain Break	3	789.474	6.315.794
Needle Break	3	789.474	7.105.268
Pulling Defect	3	789.474	7.894.742
Lack of Worker	2	526.316	8.421.058
Loud Noise	2	526.316	8.947.374
Bushing	2	526.316	947.369
Lack of Electricity	1	263.158	9.736.848
Moving Machines	1	263.158	100
Total	38	100	

As described in the table above, it will be possible to observe in figure 6 below the representation of the machine stops. And through this graph analyze the most problematic

peaks and after that present a proposal of intervention to optimize this time of machines stopped

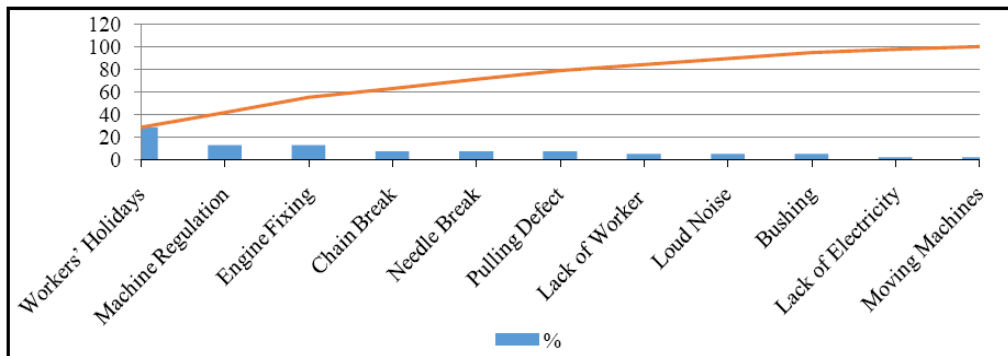


Figure6. Machine Occurrence

Based on Table 2 and Figure 6 available, it was possible to integrate another procedure, that is, a preventive one to be done in the machines and needles in order to obtain better operation of the machines and thus reduce the time of machine

stopped. Below in figure 7, a demonstration of the reduction generated by the preventive implemented can be observed.

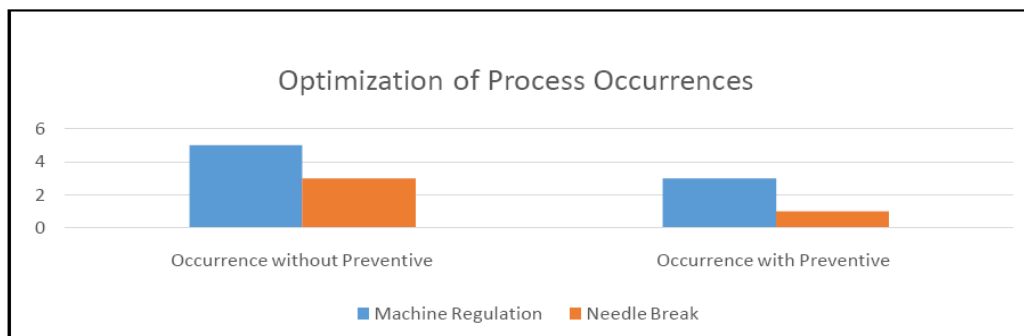


Figure7. Reduction of Processes with Stopped Machines

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After applying the two proposed solutions, a new result was obtained for the presented data and a gain of 10% in the time previously lost. Through this application the importance of the creation of this procedure was identified, making the machines better regulated and also the employees are attentive and interested in predicting possible failures in the process, so the long-term gain is certainly of high quantitative values and qualitative.

Embroidery Process Standardization

Table 3 shows the amount of defective parts that were pointed out by the quality department in

relation to embroideries that were made without a height standard. In this way, it happens that the pieces are produced with the embroidery in different locations and thus are disapproved by the quality department.

In order to correct the problem, a template was elaborated with the purpose of standardizing the height and location of the embroidery, in this way the movement became more repetitive generating gain in the production and also better quality, as well as data presented below.

Table3. Demonstration Results Obtained with Process Standardization

Date	Daily Embroidery Production (Pcs)	Qty of daily defect without template	Percent Daily Defect Without Template	Daily defect quantity with template	Percent Daily Fault with Template
03/out	2000	47	2,35	1	0,05
04/out	1890	40	2,12	3	0,16
05/out	2100	57	2,71	2	0,10
06/out	2300	65	2,83	0	0,00
07/out	1100	33	3,00	0	0,00
10/out	1350	35	2,59	0	0,00
11/out	1350	40	2,96	0	0,00
13/out	1370	22	1,61	1	0,07
14/out	1400	26	1,86	0	0,00
17/out	1790	50	2,79	2	0,11
18/out	1800	17	0,94	0	0,00
19/out	1800	46	2,56	0	0,00
20/out	1800	37	2,06	0	0,00
21/out	1430	48	3,36	2	0,14
24/out	1450	47	3,24	5	0,34
25/out	1450	59	4,07	0	0,00
26/out	1000	46	4,60	0	0,00
27/out	1000	29	2,90	2	0,20
28/out	1550	27	1,74	3	0,19
31/out	1700	54	3,18	1	0,06

In the Figure 8, a demonstration of the reduction generated by the standardization elaborated in relation to the embroidery process can be

observed, where a template for marking the place to be embroidered was placed.

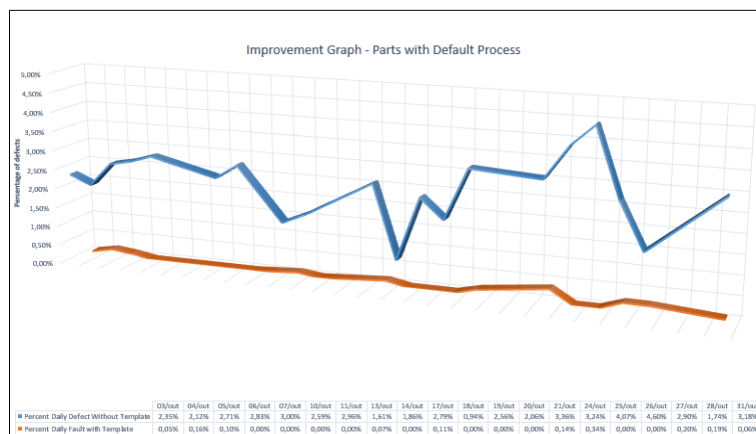


Figure8.Reduction of Defects by Process Standardization

Based on the improvement presented it is possible to emphasize that much more than financial gain for saving time, the greater gain was the quality issue, which is a very important differential in the labor market today.

CONCLUSION

It is known that the constant changes of market have been causing more and more organizations to use continuous improvement techniques to stay in business. Due to increased competition and speed of change, companies are forced to reduce costs, but without neglecting the improvement in the quality of their products and / or services.

In the general context of this study it can be concluded that it is necessary to continue to make continuous improvements in the production process, in this way it is expected to continue to optimize the processes of the organization and thus achieve better working conditions for its employees.

Based on the company studied and the methods applied, the wide range of lean tools was verified, where through these tools it is possible to solve problems, certainly those problems that devalue the company and reduce the profitability of the same.

For the case studied it was possible to make some notes and thus improve the efficiency of the company. Through the theory described in the present article it is realized that the application together with theory brings great results and puts the companies that look for current technologies and tools in high "placements" in the labor market.

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