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# **KAIZEN - ANALYSIS OF THE IMPLEMENTATION OF THE A3 REPORTING TOOL IN A STEEL STRUCTURE COMPANY**

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## **ABSTRACT**

The A3 report is a Kaizen tool that must contain, on one side of an A3 paper sheet, a context, the current situation, the objective, an analysis, countermeasures, an action plan, the monitoring and an upgrade regarding the situation to be improved. This study seeks to analyze the post-implementation effects of the A3 tool, which is part of the Kaizen method. The research method consisted in the collection and evaluation of A3 reports produced in the past seven years in a company of pre-fabricated steel structures. Among the 154 developed A3 reports, it was observed that 76% were drafted by the engineering and manufacturing departments, which converged on the improvement of processes, services and innovative solutions. The manufacturing and assembly sectors had 60% of the improvements implemented by the A3 tool, but the impacts with the greatest economic significance for the company were found in other sectors, such as sales and logistics. The conclusion is drawn that the A3 report was effective in the deployment of Kaizen, resulting in the improvement of services and processes, and consequently in the direct reduction of the cost of the finished product. In addition, it influenced market and business expansion strategies throughout the company.

## **KEYWORDS**

Kaizen, A3 report, Optimization of Services and Processes.

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## **INTRODUCTION**

The impositions of the global market regarding inventory reduction, time and process optimization, product quality and price reduction tend to directly drive the adoption of the lean production model. Lean Production is more than the complex set of tools that make up the system, dealing in a more in-depth manner with practical activities and processes. The core of these Lean Production practices has its origin in the Kaizen philosophy, developed during World War II. This philosophy is based on the elimination of waste based on solutions with a low implementation cost (Singh and Singh, 2009). In 1930, Walter Shewhart defined four steps for the deployment of Kaizen, forming a cycle known as: Plan-Do-Check-Act (PDCA) (Durward et al, 2010).

The PDCA method exceeds the simplified definition of an improvement cycle, but deals mainly with the management method of companies. The management method has become a commercial barrier to companies since the revision of ISO 9000 (Quality management systems by International Organization for Standardization) in 1994, directly implicating the company's management process in the audit processes (Lobodová, 2003). The PDCA is a process and system management method that works by adding quality to the final product. The management method in the PDCA cycle has repercussions not only for process improvements, but also for the evolution of products and business expansion.

The PDCA cycle begins in the Plan stage, in which analyses from the most varied points of view are made regarding a particular product. The goal is to identify possible points of failure and improvement in the implementation process. In the next step, called Do, the actions and metrics established in the Plan phase are carried out in practice. With the practical process in progress, the Check step emerges, where measurements produce performance indicators that are compared to those predicted in the planning phase. Finally, the Act step intervenes in the process in order to propose corrective and/or improvement actions in the cycle, even recommending the creation of a new cycle, if necessary (Womack et al, 1992).

The implementation of the PDCA management method can be incorporated to companies by making use of techniques and methodologies that facilitate its development. The A3 report is one of these tools. It regularizes and systematizes the collected data, presenting the main causes, the actions taken and the proposed solution to eliminate problems and defects in both products and services on one side of an A3 sheet (42x29.7cm). The results presented by this report enable not only the detailed analysis of causes, actions and solutions, but also a record of the occurrences and measures adopted on each A3, forming a history of data for future reference, accelerating decision making (Durward et al, 2010).

The Kaizen philosophy has been adopted across the world for more than 60 years and comes from the Japanese word meaning "good change". Its principle is the quick analysis of the smaller components of a problem, in addition to quick and continuous implementation (Knechtges and Decker, 2014). A variety of A3 reporting structures can be found in the scientific literature (Lenort et al, 2017). Even though the information is summarized, the A3 report should seek to be clear in the presentation of data. As such, the typical sections of an A3 report include: 1-Context, why is this work being done?

How important is it to the company? 2-Current situation, what is the current context? What current aspects are being analyzed? 3-Objective, what are the objectives of the work? What is the expected result? 4-Analysis, what are the causes of the current scenario? What causes this condition and why does it exist? 5-Countermeasures, what is the analyzed basis for defining what must be done to improve the current situation and meet the goal or target? What needs to be done for the A3 document to have positive results? 6-Plan of Action, how will the countermeasures be put into practice? Description of the operationalization of the countermeasures. 7-Follow-up, work status, proof that the expected results have been achieved. In this section, a decision is made based on the developed analysis: if the expected result is obtained, the improvement is progressed to other areas, otherwise the cycle is resumed with improvement of the studies obtained so far. 8-Upgrade, expansion of the work to other areas of the company.

Even though it is a summarized document, the A3 tool mainly promotes the learning of all those involved in the development of each document, making the comprehension and understanding easier for those who did not participate in the construction of the reports. In addition to being an informative report, the A3 tool promotes and develops practices that structure ideas and practices for successful Kaizen implementation (Durward et al, 2010).

The concepts of the A3 report have been deployed in the automotive sector, improving and facilitating the implementation of the Kaizen philosophy, obtaining remarkably successful results in the application of Lean Production, which explains the tool's choice in the approach of this study. The main objective of this article was therefore to analyze the impacts on the implementation of the Kaizen philosophy of the use of the A3 tool in a steel structure prefabrication and assembly company in Brazil.

## **HISTORY OF THE APPLICATION**

A case study was applied to a construction company that implemented the Kaizen philosophy, seeking results through the commitment of all involved in all areas and processes of the company. The Kaizen deployment process used the A3 reporting tool to support improvements, providing for the interaction of several people from a wide range of areas in the company. The improvement of a particular area or process did not depend only on the internal decisions of the sector, but on all those involved, including customers and suppliers. The company's internal productivity gains should be significant as long as the input and output processes were not changed (customers and suppliers), regardless of whether the process is pulled or pushed. The improvement would only be accepted by the managers of the company when all the members of the group were in agreement with the proposal.

Subsequently, costs were gathered and a schedule was developed for a feasibility study of the changes proposed by the A3 reports, which would then either be approved or rejected by the company's senior management. When the group of collaborators didn't have sufficient know-how about some aspect of the process or product, the company would summon at least one representative from each area involved to participate in the discussion. Most of the time, the guests were qualified people, specialists/coordinators in their areas with an up-to-date understanding of a particular product or process.

Continuing with the implementation of the A3 tool, a pilot report was prepared to present the changes to senior management and all coordinators and representatives of the company. The report consisted of a single sheet prepared and printed in the standard ISO 216 format, size A3, printed on only one side. Afterwards, the report was presented to senior management so it could validate and approve the changes as well as the necessary investment, if applicable. With this, the sectors involved were tasked with developing a collective task force for change, with targets set by senior management so that the project could be deployed in the shortest possible time, avoiding any production stops that would result in delays in relation to the schedules already defined with the customers, considering the large portfolio of works (more than 20) performed simultaneously.

The company also devised a procedure in which all improvements presented and implemented by the A3 reports were displayed in an auditorium through printed boards. The objective of this action was to expose to the employees all factors involving the changes, processes, barriers, challenges and, especially, the gains that the company would have based on the development of the documents. In addition to this display, the company held a commemorative meeting with the employees to promote the reports in order to congratulate and recognize the commitment of those involved so as to encourage the continuity of the A3 report practice.

The company records showed that the production sector was the first area to implement the A3 reports, as requested by the presidency. The results were significant even after the first implementations in the productive process, including a reduction of the lead time, which resulted in the creation of a specific sector within the company called Continuous Improvement, which was responsible for managing and implementing Kaizen. The Continuous Improvement sector was therefore in charge of mediating, recruiting, managing schedules and conducting matters that involved improvements for the company, such as the standardization of products and processes. The standardization of products and processes was one of the first approaches implemented in the company by this sector. This is a characteristic process when it comes to continuous improvement, because as the standard is improved, the new standard becomes the foundation for further improvements, creating an infinite cycle (Mlkva, 2016). Kaizen was the focus of the company in the pursuit of the stabilization and improvement of processes and products, making departments train employees, who were always guided by a more specialized leader following the proposal by Hambach, Kümmel and Metternich (2017).

With the consolidation of the A3 tool in the factory line, the practice spread to the other areas, including logistics, engineering, sales, quality and assembly. The A3 report is created with the information laid out in a compact and clear manner. It works with such tools as Pareto charts, Cause-effect diagrams, Five whys method, graphs to express the obtained data or results and statistical analyses to get an accurate overview of all the information. As such, a standard was created for the report, which can be seen in Fig. 1.

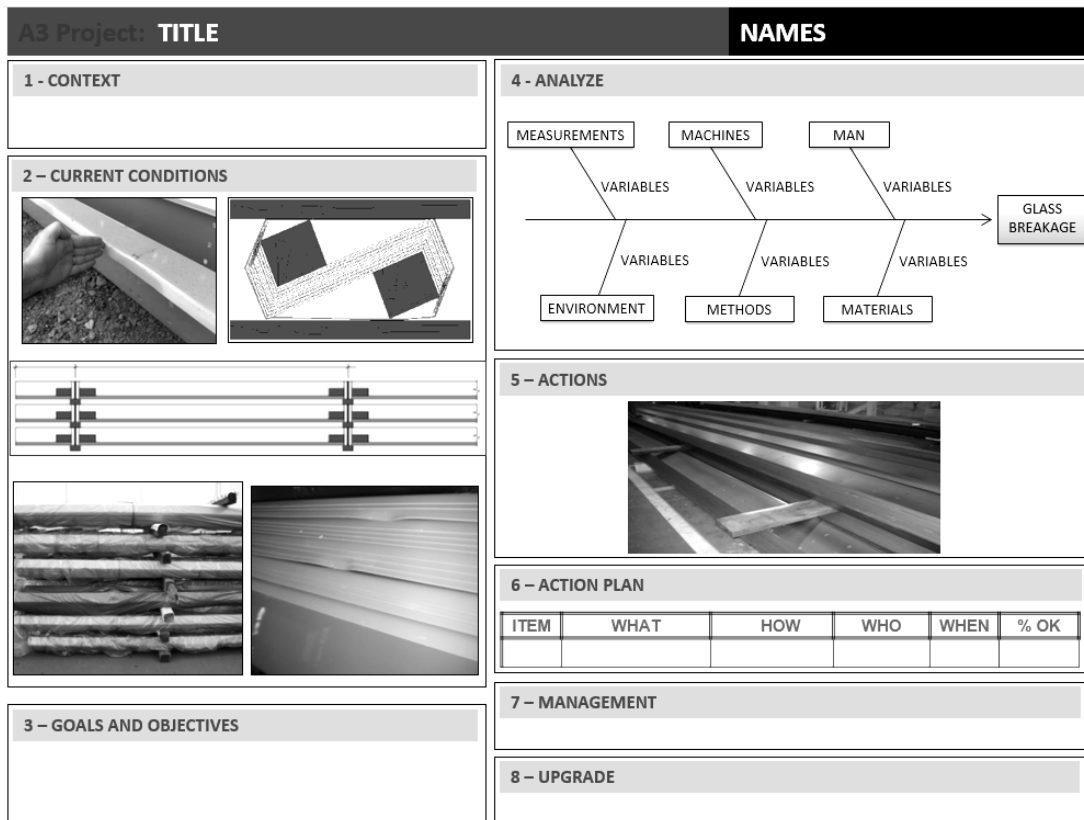


Figure 1: A3 standard developed by the company

## RESEARCH METHOD

This study was developed in a Brazilian prefabricated steel structure company that has been operating in the market for forty years. Its specialty is constructive systems made of steel structures and it is active in both the national and international civil construction sector. The company has sales, engineering, factory, logistics and assembly sectors for the development of its products, including: industrial warehouses, multi-story warehouses, factories, malls and distribution centers. Designs are developed and parts are manufactured simultaneously, which means the adopted solutions must be compatible with the factory's limitations. The company has an average portfolio of 20 works being designed and manufactured simultaneously, which tends to increase the complexity of the management, taking into account the variability of the product and the volume of demand. Because of these aspects, the company sought to implement techniques and tools that could promote the development of an adequate management of all its sectors, adding value to the final product and improving the company's market competitiveness.

As such, the A3 reports developments by the company over the course of seven years, during which the Kaizen approach was used, was studied. The plan and sequence of the employed research can be observed in Figure 2.

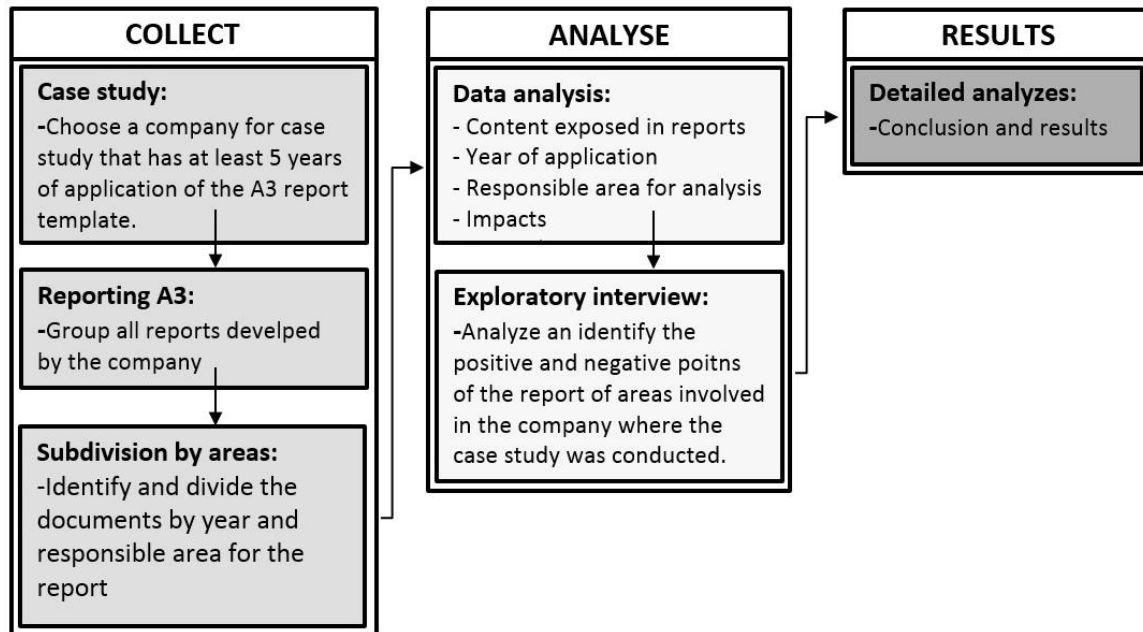


Figure 2: Research steps

The first step of the case study consisted in collecting all the files and reports developed by the company over the seven years. The company's IT manager made the files available, which were archived throughout the development as part of the company's process. The next step was to subdivide these reports according to the year and sector responsible for implementing the measures proposed in each report. The gathering of A3 reports resulted in a detailed analysis of the content of each document found, which sought to identify those that were most significant for each segment of the company using criteria such as time reduction, cost reduction, safety improvements and product innovation. The reports were classified as product, process and market strategy improvements, with each document receiving a score (from 0 to 10, with 0 being low impact and 10 high impact) regarding the results obtained with its implementation.

The third step of the study consisted of an exploratory interview with the coordinators of each sector of the company with questions focused on the characterization of the positive and negative points in the application of the A3 reporting method. The questions were of a discursive nature, giving total freedom to the respondents in their answers and comments on the subject. Finally, with the information collected, the five reports with the greatest impact on the company were selected based on the classification described above, which were developed with the intent of addressing the biggest problem pointed out by the industrial direction, high time to prepare the machine configuration to start production.

## RESULTS

From 2010, when Kaizen was first implemented, until the end of 2017, a total of 154 A3 reports were compiled by the manufacturing, engineering, sales, logistics and assembly sectors. Figure 3 shows the progress and formulation of the A3 reports, dividing them by area and year of development.

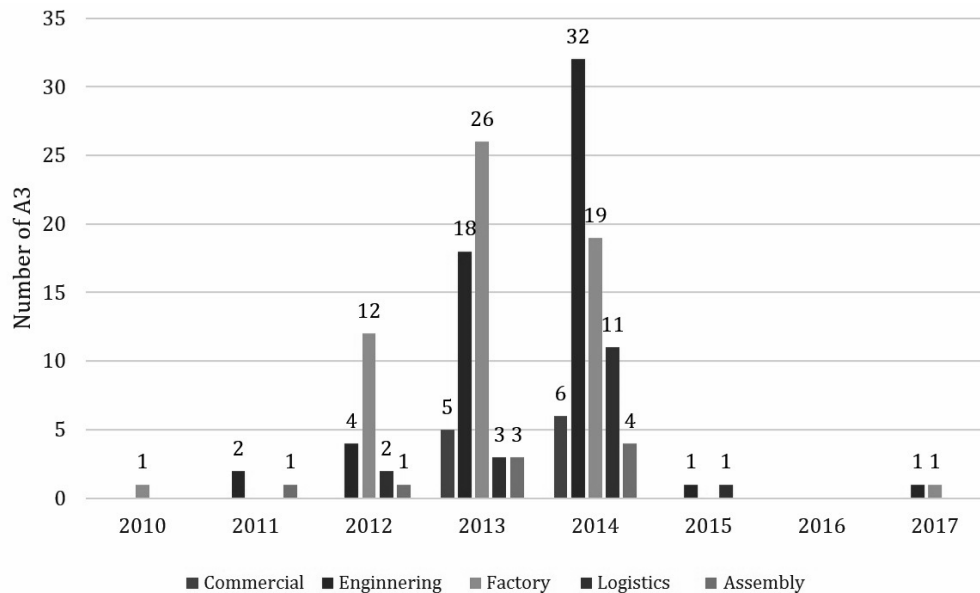


Figure 3: Number of A3 copies developed in each sector of the company

In 2010, only one A3 report was developed, considering that this was the pilot project for the implementation of the Kaizen philosophy in the company. Between 2012 and 2014, the largest volume of A3 reports was produced, which was also when the project underwent its greatest development in the company. After 2015, a significant drop in the creation of reports can be observed, which can be explained by the reduction of investments made by the company in the areas of innovation, standardization and continuous improvement (Kaizen) because of the recession in the construction sector.

With regard to the sectors, the engineering and manufacturing sectors were identified as being responsible for 76% of the generated A3 reports as shown in Figure 4, which could be explained by the fact that the engineering director was the greatest promoter of the improvements, creating A3 reports with more complex criteria related to the standardization of engineering processes and manufacturing projects. As for the factory, the reports had less complex criteria, linked directly to the actual problems faced by workers in their day-to-day work.

The A3 reports were also classified according to the type of solution, observing the criteria used by the company to divide the main areas of focus: services, innovation and processes, as can be seen in Figure 5. Services refer specifically to improvements in the quality of services provided by the company. The A3 service reports are mainly focused on the assembly area, on flow and cost management. Innovation, on the other hand, was a

fundamental pillar in the sales area, especially regarding customer retention, market prospecting, competitiveness and portfolio management. The reports were also developed by the Engineering and Production sectors, with engineering creating new constructive solutions and improving product designs, while in the factory innovative tools were created based on the lean production concepts. The processes were the ones that stood out most in the engineering, production and logistics sectors, staying considerably above the average line due to the adjustment of production processes according to, once again, the Lean Production concept. The average line is composed of the total of A3, divided by the number of sectors of the company analyzed, showing the focus of the actions developed, through a medium line.

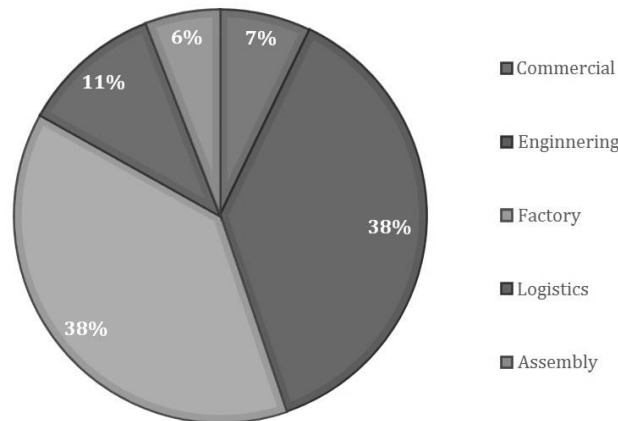


Figure 4: Participation of the areas in the development of Kaizen management

The increasing use of A3 reports between 2012 and 2014 can be associated with the acceptance and incorporation of this practice by all employees in the different areas of the company.

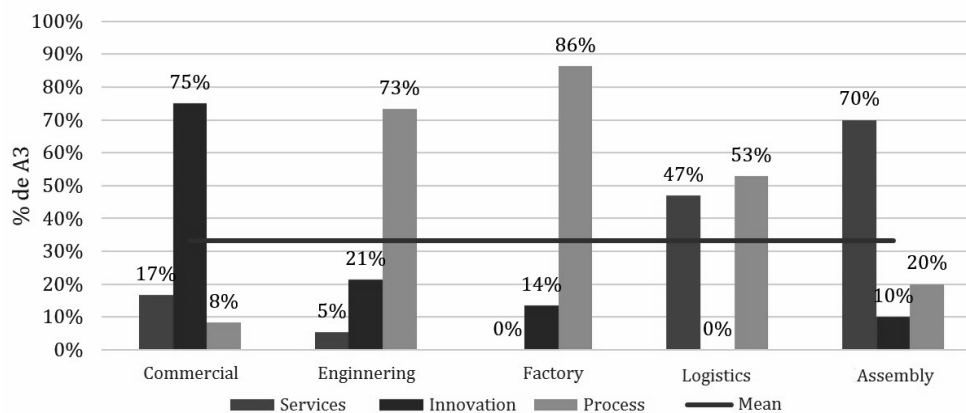


Figure 5: Percentage of A3 reports per solution type

Regarding the degree of impact of the improvements for each sector of the company, Figure 6 divides these impacts into low, medium and high impacts. The scores were



ranked from 1 to 10, classifying 0 to 4 points as a low, 4.1 to 6 as average, and 6.1 and over as a high grade. The score was defined by a group of the company's continuous improvement sector in conjunction with the development of this study, based on such factors as the added value of the improvement, deployment cost, improvement benefits, and popular vote (among company employees).

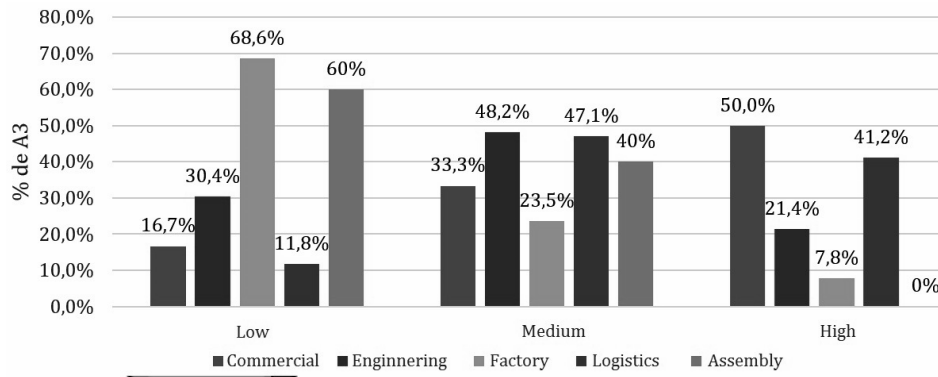


Figure 6: Percentage of A3 reports by sector and degree of impact

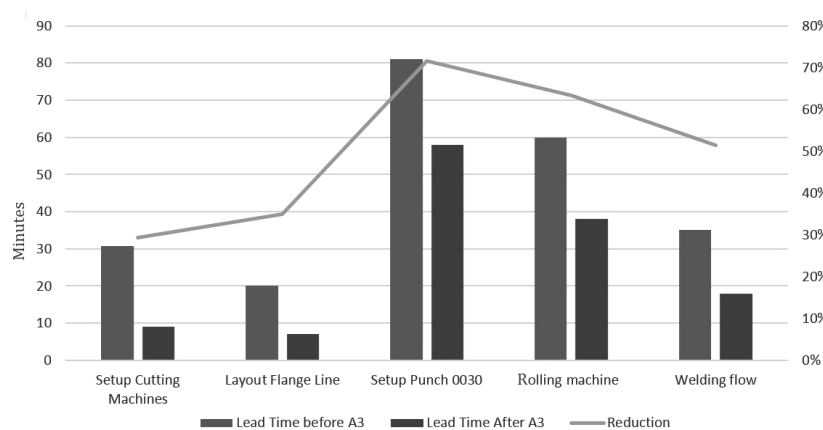


Figure 7: Result of the A3 tool in processes

Five A3 reports of the factory processes were selected in which the obtained results revealed a reduction in lead time in the production of parts in all the sectors where Kaizen was applied with the A3 tool. After applying the A3 report in the machine setup and layout processes, according to Figure 7, satisfactory lead time gains for the company were identified when compared to the previous scenario, in some cases cutting these times by a third of the previous time. The reduction in lead time resulted in such gains as the synchronization of the production process, with a capacity to calculate the productive capacity of the work center and consequently schedule production, reducing buffers or inventories of raw material.

## **CONCLUSIONS**

The implementation of the Kaizen philosophy adopting the A3 reporting tool was effective in making those involved in this study absorb the concepts. The record of the situations addressed and treated by the A3 tool tends to result in an acceleration of decision making in future recurrences, since a database is created with the scenarios of the application of each improvement. Although the development of the A3 tool is feasible for any employee, the involvement of the managers and the commitment of the workers are fundamental for the success of the tool. That is why the recommendations on how to produce effective A3 reports are related to the implementation instead to the A3 tool itself.

The company's recognition of the developed A3 documents motivated employees in the routine identification of improvements in processes and services during their daily work. To the extent that problems were found and resolved and processes organized, the time that was previously spent on unnecessary activities (waste) was now used to solve new problems that emerged, forming a continuous improvement cycle.

The implementation of Kaizen brought gains to the company as a whole, optimizing processes, reducing production lead time, organizing services, standardizing products and contributing to product innovation, leading to the continuous pursuit for quality, error minimization and waste reduction.

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