REGMPE

Revista de Empreendedorismo e Gestão de Micro e Pequenas Empresas

IMPLEMENTATION OF LEAN MANUFACTURING IN THE SIDE PLATE PROFILER LINE OF THE KEPLER WEBER SILOS FACTORY

[1]Gilberto Martins Santos
[2]Fabiana Quadros De Moura
[3]Tomas Laion Malheiros

ABSTRACT

The global market is increasingly competitive and fierce, many companies are looking for alternatives to support themselves by eliminating waste. These wastes are constantly caused by internal factors, such as overproduction, high inventory levels, unnecessary movements and high waiting rates for the next process. In this sense, lean manufacturing has become a way for companies to remain in the market with competitive potential, as it enables the improvement of production processes. In view of this, Kepler Weber began its "lean journey" using the tools to achieve its strategic objectives. Initially, the necessary steps were established for the implementation of some of the tools that make up lean. After they were implemented in all of its stages. The analysis of the monitoring indicators and proposals for improvements was added to the implementation process. The application of lean tools enabled the identification of several improvements in the side plate profiling line, among the most relevant: the reduction of lead time, increased inventory turnover, increased availability and increased line productivity. On the other hand, it was found that the quality indexes were unsatisfactory, however it is worth noting that before the project there was no specific indicator on the quality of the line. increased inventory turnover, increased availability and increased line productivity. On the other hand, it was found that the quality indexes were unsatisfactory, however it is worth noting that before the project there was no specific indicator on the quality of the line. increased inventory turnover, increased availability and increased line productivity. On the other hand, it was found that the quality indexes were unsatisfactory, however it is worth noting that before the project there was no specific indicator on the quality of the line.

Key words: Toyota Production System, Lean Production, Lean Tools.

1 INTRODUCTION

Production systems have always existed, the pyramids of Egypt, the wall of China and the roads of the Roman Empire confirm the existence of the industry of the peoples of antiquity, however the form of production was quite different from the form of current production. The production was done in a homemade way, the artisans performed the work manually, this form of production had a low yield and a high added cost.

[1]. Federal University of Santa Maria - UFSM - professorgilberto@ufsm.com.br
[2]Federal University of Santa Maria - UFSM - fabianaquadrosm@gmail.com
[3]Federal University of Santa Maria - UFSM - tomas.malheiros@kepler.com.br
Santos, GM, Moura, FQ, Malheiros. TL; Implementation of Lean Manufacturing in the Kepler Weber Silos Factory Side Plate Profiling Line.Magazine of Entrepreneurship and Management of Micro and Small Enterprises V.4, Nº2, p.43-58, May / Aug. 2019. Article received on 05/06/2019. Last version received on 07/25/2019. Approved on 05/08/2019.

Due to the need to increase production, the movement called the industrial revolution began in England in the 17th century, the main elements of which were the replacement of human strength and water by mechanized force, thus establishing the manufacturing system.

The beginning of the 20th century is marked as a major milestone in scientific management, Henry Ford, an important American engineer, revolutionized the auto industry, starting the production of standardized, mass-produced, low-cost, in-line cars.

Awakened by the need for Japanese companies to develop innovative methods to manufacture vehicles that could compete with vehicles from American industries, Ford Company and General Motors, which were market leaders and stood out for mass production, Taichi Ohno, initiated the Toyota System Production.

The Toyota production system was developed by Toyota after the Second World War. Soon after Eiji Toyota visited the plants in the United States, he returned with a new task for Taiichi Ohno, which consists of perfecting Toyota's production process to match Ford's productivity. Taiichi Ohno implements the system to increase productivity, reduce lead time and reduce waste using management techniques and tools such as kaizen, standardized work, kanban and just in time.

Thus, lean manufacturing developed by Toyota in Japan, was the main factor that contributed to the company becoming a global example of a lean company and one of the main industries in the automotive segment. Companies that seek to implement lean thinking aim to increase their competitive potential, and in that sense Kepler Weber started its “lean journey” in June 2015 in the production of cleaning machines, since then it has been developing new projects and disseminating the philosophy for the other areas of the company.

At Kepler's silos factory, several production systems are used, with the lateral plate profiling line being the most important line, taking into account that the side plates represent approximately 70% of the silos equipment. The largest production volumes go through the profiler, therefore, efforts will be concentrated on the implementation of lean tools, aiming at reducing lead time, increasing productivity and reducing non-quality. To carry out this study it is necessary to present the philosophy of lean manufacturing, its tools and how it is implemented in the industry.

1.1 Goals

Thus, the general objective of this study aims to understand the activities and processes of the side plate profiling line, aiming at reducing activities that do not add value, reducing non-quality and increasing productivity. The other objectives are intended to: Map the current flow of the side plate line; Identify waste; Map the future flow of the side plate line; Prepare the A3 report; Implement lean manufacturing methodology in the side plate line; Monitor the results.

2 THEORETICAL FRAMEWORK

2.1 Evolution of Productive Systems

In the past, production systems were quite different than they are today. According to Moreira (2008, p. 04) "the administration of production has come a long way until it reaches what it is today". Moreira (2008, p. 07) defines production systems as "the set of activities and interrelated operations involved in the production of goods (industry case) or services".

According to Gaither and Frazier (2007), the industrial revolution solved two main elements: the widespread replacement of human and water by mechanized force and the establishment of the manufacturing system.

At the beginning of the last century, engineer Frederick Taylor led the application of rationality and scientific methods to the management of works in factories. Right after the end of the first world war, Afred Sloan, from General Motors, and Henry Ford put an end to artisanal production led by European firms for the beginning of the new era of mass production (WOMACK, 2004). The simple mastery and application of the set of techniques, such as division of labor, rationalization of methods, timing, standardization, mechanization, automation and balance of lines, bequeathed by Taylor, Ford and their disciples, became obsolete and insufficient for the companies to remain competitive in manufacturing.

A new set of principles and techniques that characterize the so-called lean production system, or, literally, "lean" in Portuguese, has the ideal to produce more and more with less resources.

The end of World War II marked a new beginning for Toyota, Japanese companies aimed to manufacture vehicles that could compete with vehicles from

American industries, the Ford Company and General Motors, which were market leaders and stood out for mass production, Taichi Ohno started TPS. According to Womack (2004, p. 01). "Eiji Toyota and Taiichi Ohno, from Japanese Toyota, were pioneers in the concept of lean production". The biggest difference between mass production and lean production is found in its final objectives (WOMACK, 2004). Mass production producers set themselves a limited target as “good enough” that determines an acceptable level of defects, an amount of stock and a limited variety of standardized products (WOMACK, 2004). Lean producers “openly aim for perfection:

2.2 Lean production

According to the Lean Institute Brasil (2018) lean is a management philosophy inspired by the practices and results of the Toyota system. It had its appearance in the post-World War II period, where Taiichi Ohno, Toyota's head of production, coordinated the development of the Toyota production system (TPS). It was put into practice initially in the machining sector and later spread, as a model production system through its publication in the book “The Machine that Changed the World”.

Shingo (1996) describes that the Toyota production system (STP) was developed through the use of a general theory of production and implemented through practical tests using logic of trial and error. Still in this context, Shingo (1996) defines that the main objective of the Toyota production system is to enable organizations to have stability in their processes and be able to adapt to variations in market demand, through the effective reach of the main factors of competitiveness: flexibility , cost, quality, service and innovation.

2.3 Cost Reductions in Manufacturing Processes

According to the lean Institute Brasil (2018) lean thinking is the continuous reduction of waste, activities that do not add value and that are found in virtually all production and administrative processes.

For Shingo (1996), in the Toyota system, the search for waste is persisted, which is generally not noticed because it has become a normal part of routine work, thus reducing waste, process costs tend to decrease.

For Byrne (2014), the lean system with its focus based on the removal of waste creates a constant learning environment for employees, thereby leading to teamwork,

contributing to the organizational climate and dissemination of identification and reduction of waste in company.

3 METHODOLOGICAL PROCEDURES

The research in this study is classified as applied, as it aims to generate knowledge for application in practice. According to Oliveira (2004, p. 123) the classification is considered applied when “It requires certain theories or broader laws as a starting point, and aims to research, prove or reject hypotheses suggested by the theoretical models and make their application”.

As for the approach to the research, it is classified as qualitative, according to Gil (1999, apud ZAMBERLAN et. Al. 2014, p. 94) “The natural environment is the direct source for data collection and the researcher is the key instrument” . In this sense, the company's data for the study were collected from the company, thus not needing to use the statistical method.

Regarding the objectives, the research is classified as descriptive, according to Gil (1999, apud ZAMBERLAN et. Al. 2014, p. 95) explains that this is determined “when one wishes to describe characteristics of a given population, phenomenon or relationships between variables” . As for the bibliographic procedure Vergara (2007, p. 48) describes that it is when the study is “developed based on material published in books, magazines, newspapers, electronic networks, that is, material accessible to the general public”.

Regarding technical procedures, the research is classified in bibliographic, documentary, survey and participant observation, since the researcher participated in all stages of the implementation of Lean tools. According to Zamberlan et. al. (2014, p. 119) "Observation involves the systematic recording of behavior patterns of people, objects and events, in order to obtain information about the phenomenon of interest".

4 ANALYSIS OF RESULTS

4.1 Characterization of the company

Located in Panambi / RS, Kepler Weber is 93 years old and was founded in 1925, focusing on agribusiness since its creation, Kepler Weber is specialized in the development of complete solutions for storage. With an agile and integrated structure, it serves from small producers to large companies such as cooperatives and industries.

Plays a prominent role in the development of agribusiness in Brazil since 1973, the company is the current leader in the segment in Latin America with exports to countries like Cape Verde, Cuba, Venezuela, Ukraine, China, Egypt, Angola and Syria.

Currently the company has more than 1300 employees, is a publicly traded company, registered on the Stock Exchange, Merchandise and Futures (BM & Bovespa), and has been in the market for more than 90 years, being an exporter for over 40 years. Currently, the Kepler Weber group has two manufacturing plants located in the cities of Panambi, in Rio Grande do Sul and Campo Grande, in Mato Grosso do Sul. It operates in the market providing solutions for the processing and storage of bulk products in two main segments: agricultural facilities industrial facilities.

4.2 Phases of implementing the Lean philosophy

To implement the lean philosophy in Kepler Weber's side plate profiling line, it was necessary to initially assemble a multidisciplinary group composed of a sponsor, a flow manager, a flow leader, a lean coordinator and three other components that formed the work team. and has the following responsibilities.

The sponsor must provide the team with the guidelines for the improvement project, interfere when the team encounters obstacles within the organization.

The value flow manager focuses the organization on aligning activities and resources towards creating value, although none of the resources (financial, human, assets, etc.) really "belong" to him.

The value stream leader is an offshoot of a main value stream, for which the project / value stream manager is responsible. At Kepler, this function will be more common in manufacturing and logistics.

The lean coordinator supports the project manager / value stream in project management, holds workshops / trainings on lean concepts and the use of tools during the project for the entire team, in addition to forming multipliers for continuous improvement in the areas.

4.3 Training

To implement the lean philosophy in the lateral plate profiling line, a meeting was initially held with the project participants and other employees of the line, in order to

share and level the knowledge of the philosophy and define the training schedule in the lean tools, as well meetings for the performance of project activities.

4.4 Preparation of value flow maps - MFV

The value flow mapping is a simple tool, but of great importance in identifying waste from all stages of the chain, be it information flow or material.

According to the Lean Institute Brasil (2018) the value flow manager is the key person, responsible for the smooth running of activities, identifying what is value for the client and managing efforts to achieve an increasingly better and leaner flow .

After understanding in theory and practice, the principles of lean thinking and with the entire team committed, we arrived at the training of value flow mapping, which include the mapping of all actions, whether or not they create value.

Later in the mapping of activities, using lean tools it was possible to identify some inefficiencies, including:

- The production system is pushed, that is, production is done through manufacturing orders, based on sales forecasts;
- Large stock of raw material and finished product;
- Low inventory turnover of 2.3 times a year;
- Very high lead time, totaling 156.7 days;
- Low availability, which according to the Lean Institute Brasil (2018) is the fraction of the time a machine works properly, when necessary.

4.5 Preparation of the A3 report

The A3 report is an innovation, a widespread practice in the Toyota culture used to solve problems, where problems are defined, soon after the problem analysis, the definition of containment actions and the action plan (LEAN INSTITUTE BRASIL, 2018).

After the future value stream mapping was completed, the A3 was prepared as follows. In the context part, the problems were identified as already identified in the current value stream mapping and objectives, action plans, monitoring forms were defined and A3 signing by the participants committing to the results.

4.6 Objectives / Goals defined

The objectives and goals were defined based on the purposes of the lean philosophy and the inefficiencies found during the value flow mapping, with the following being defined:

- Reduce lead time by 55%;
- Increase inventory turnover from 2.3 to 5.2 times in the year;
- Increase availability by 10%;
- Improve productivity by 16%;
- Improve quality by 33%.

4.7 Action plan

Several actions have been defined, here the most relevant ones are mapped to achieve the objectives set, namely:

- Create a balanced monthly programming agreement to level production;
- Organize stocks of raw materials;
- Implement control in the intermediate stock;
- Develop external setup on the line;
- Reuse leftover coils to reduce the cost of non-quality;
- Implement standardized work on the line;
- Develop preventive maintenance schedule on the line;
- Increase raw material deliveries every 30 days;
- Eliminate coil stock at the port;
- Synchronize coil consumption with orders;
- Implement andon system on the line;
- Deploy help chain.

4.8 Control Tools

4.8.1 Daily Management

Daily management ensures that the right job is being done, in the right way, at the right time to achieve business success, at all levels of the organization. This management consists of daily meetings that last about 15 minutes and are used to analyze the production progress, indicators, deviations, analysis and problem solving. In this way, GD is the key to avoid surprises or start solving problems, generating organizational learning and achieving high competitiveness.

The area supervisor, leaders and employees in the areas of PCP, planning, supplies, quality, maintenance and logistics participate in the daily management.

4.8.2 Andon

Andon is the visual management tool that shows the status of operations in a single location, showing when something abnormal happens. The andon of the tillers line was developed internally to reduce costs.

This system works directly related to the activation of the help chain, and the green color is activated and the process is flowing normally. With the yellow color activated, it is a sign that the line may stop, possibly due to some mechanical damage or even due to the lack of grids where the pieces are stored. When the red color is activated, it is a sign that the line has stopped due to process reasons, such as mechanical or electrical damage or due to quality, as an example of the wrong dimensional parts.

4.8.3 Help Chain

The help chain is a routine with the interaction and involvement between people to solve a certain problem when it arises, starting at the first level affected. This chain involves the immediate leadership and those responsible for all support areas, with standardized tools and methods, to eliminate the instabilities of the process.

4.8.4 Kamishibai

The kamishibai is a simple, flexible and visual tool that serves to ensure that the necessary controls are being carried out. The kamishibai formalizes, prioritizes and schedules the checks or actions to be done on the gemba.

4.8.5 Kanriban

IS a framework that is used by the area leader and supervisor to manage the workforce. In this table are the jobs in the area and a badge with information from employees. These badges are placed at the post where the employee is working.

Through it, it is possible for anyone to identify whether the employee was absent, is on vacation or is working on another process.

4.8.6 Heijunka

Heijunka it is a tool used to level production and a framework where the PCP makes the programming according to the process times of each product.

4.8.7 QAP - Production Monitoring Framework

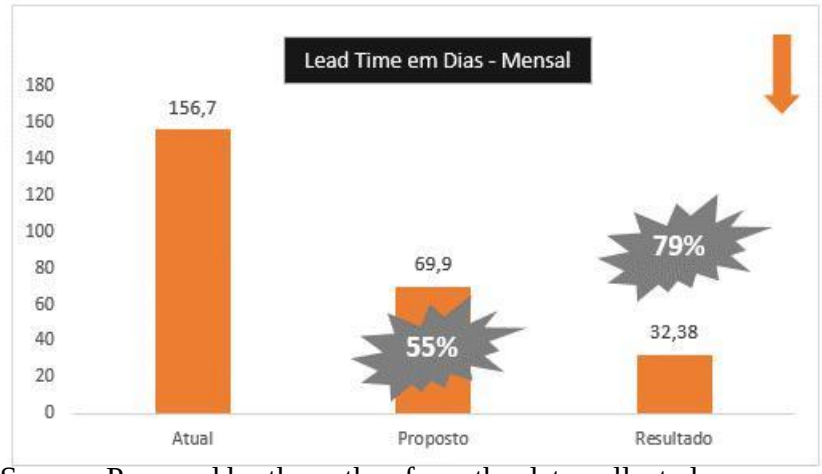
The QAP is a board that is located next to the side plate profiling line to show actual performance compared to the planned line performance.

4.9 Implementation result based on indicators

In this item we present the results and analysis of the indicators defined as a goal in the action plan of the A3 report of the side plate profiler line, being in the following order: lead time, inventory turnover, availability, productivity and quality.

The analysis of the indicators allows to evaluate the results achieved at the end of the project, that is, if the actions put into practice through the lean philosophy have yielded positive results for the company.

Figure 1 - Comparative lead time indicator



Source: Prepared by the author from the data collected

Figure one shows the total time it takes the side plate of the line to be ready, from the customer's order, through the acquisition of the raw material to the final product at the customer. The target proposed in the A3 report was a reduction of 55% and the result obtained was 79%, with an extremely significant reduction. One of the actions with the

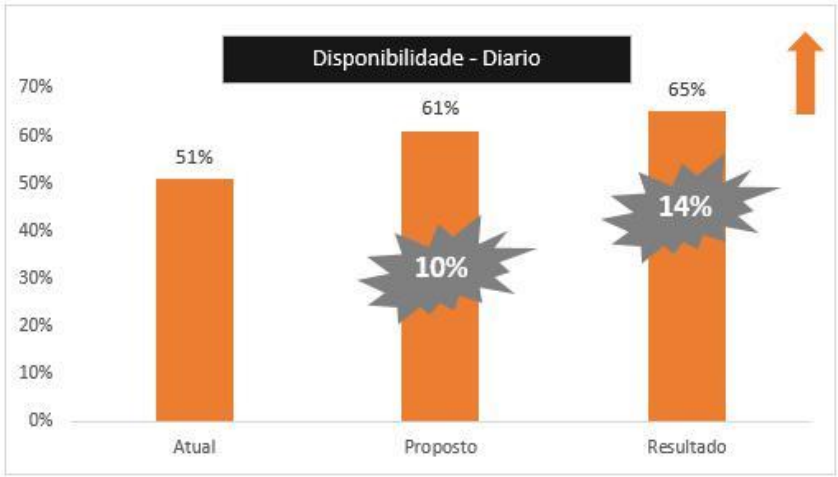
greatest impact was the purchase of fractioned raw materials at the port, with the receipt reduced from 120 to 30 days.

Figure 2 - Comparative stock turnover indicator

Source: Prepared by the author from the data collected

Figure two shows the percentage of increase in inventory turnover, with the expected target of 126% and at the end of the project, there was a 383% increase in the amount of turnover at the beginning of the project. This number was made possible with the implementation of some actions such as a pulled system, reduction of stock and controlled purchase of raw materials.

Figure 3 - Comparative availability indicator

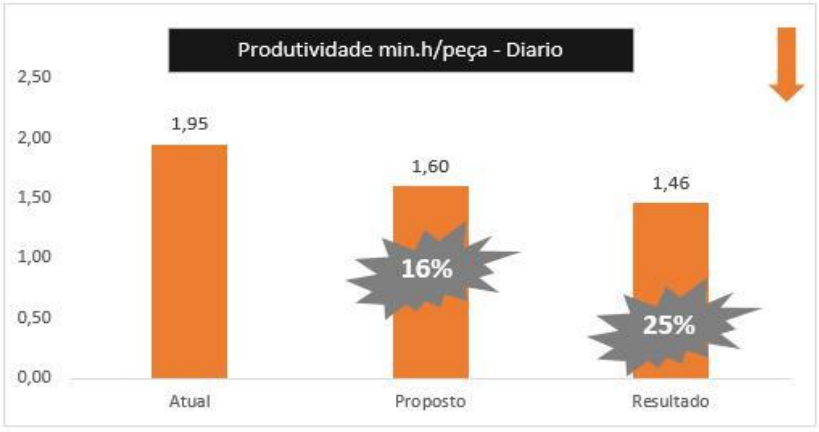


Source: Prepared by the author from the data collected

Figure three indicates the percentage that the machine is available for use as scheduled, with a target of 10% increase in availability, resulting in a 14% surpassing what was proposed. The main actions that impacted the result were the implementation

of tools such as daily management, help chain and preventive maintenance on the machine.

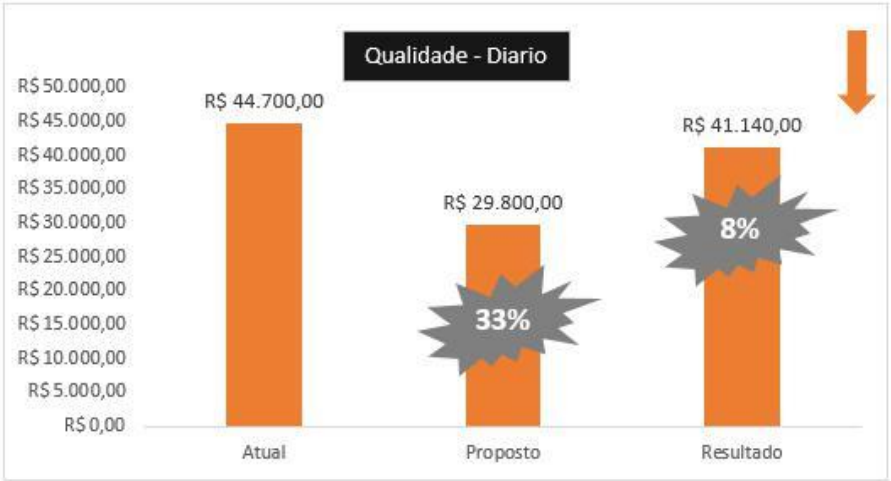
Figure 4 - Comparative productivity indicator



Source: Prepared by the author from the data collected

Figure four indicates the percentage of productivity, with the goal of increasing 16% and the result obtained was 25%, exceeding the established goal. The main actions that provided the positive result were the implementation of tools with quick setup and preventive maintenance, which together increased the availability of the machine.

Figure 5 - Comparative quality indicator



Source: Prepared by the author from the data collected

As shown in figure five, the quality indexes were unsatisfactory, serving only 8% of the target, but it is worth noting that before the project there was no specific indicator on the quality of the line.

5 CONCLUSIONS AND CONSIDERATIONS

From the data collected it was possible to verify that the implementation of the lean philosophy was extremely important for the company's sustainability and competitiveness in the current scenario. Through its tools it was possible to obtain expressive results, both in the performance of the indicators of the side plate profiler line and in the specialization of the workforce, contributing to the formation of the lean culture in the company.

By mapping the value stream, it was possible to see the side plate profiling line systemically, identifying the waste in the entire chain and suggesting improvements to reduce this waste and in some cases its elimination.

In the vast majority, the main indicators defined in the value flow mapping had a satisfactory result, however the quality indicator was the only indicator that did not reach the established goal. It must be taken into account that before the project, there was no specific indicator to monitor the line waste, thus making it difficult to map the history and define such goals.

Through the implementation of lean tools, the company obtained many gains that are not measurable and were not plotted in the value flow mapping of the side plate profiler line:

- Team engagement through the creation of the kaizen circle program, which is made up of teams of 4 to 5 people and aims to encourage the use of employees' creativity through voluntary participation to strengthen the filling of gaps in lean deployments in the flows of value and review processes and products by developing new ways of executing them;
- Team training in all lean tools, totaling 200 hours per employee;
- Reduction of accidents and greater safety in the performance of activities obtained by the organization and standardization of areas;
- Gain in m² area obtained through inventory reductions and layout changes;
- Increased manufacturing capacity;
- Reduced delivery time for the customer.

Thus, it can be concluded that the implementation of lean manufacturing and its tools, enabled an expressive gain in the performance of the entire chain of the side plate line, both in the formation of culture, in the specialization of labor, in the growth of employees and mainly in the financial gains for the company.

REFERENCES

BYRNE, A. Lean turnaround: the great turning point. São Paulo: Lean Institute Brasil, 2014. 240 p.

GAITHER, N; FRAZIER, G. Production and operations management. 8th ed. Thomson Learning, 2007.

GIL, AC How to prepare research projects. 5th ed. São Paulo: Atlas, 2010, 184 p.

WAR E. Qualitative Research Manual. Belo Horizonte. Ãnima Education Group: 2014.

KAMADA, S. Lean Institute Brasil. The aid chain to maintain productive stability. Available at: https://www.lean.org.br/artigos/35/a-cadeia-de-ajuda-para-manter-a-estabilidade-proditiva.aspx. Accessed on 06/04/2018.

FERRO, RJ, GOUVEIA, R. Lean Institute Brasil. Daily management to execute the strategy. Available at: https://www.lean.org.br/artigos/304/gerenciamento-diario-para-executar-a-estrategia.aspx. Accessed on 06/04/2018.

LEAN INSTITUTE BRASIL. Common questions. Available at: https://www.lean.org.br/perguntas_frequentes.aspx. Accessed on 01/06/2018.

LEAN INSTITUTE BRASIL. Common questions. Available in:https://www.lean.org.br/conceitos/72/mapeamento-do-fluxo-de-valor-(vsm)---estado-atual-e-futuro.aspx.THEon 05/21/2018.

LIKER, JK Toyota model: 14 management principles from the world's largest manufacturer. Porto Alegre: Bookman, 2005. 320 p.

MOREIRA, DA Production and operations management. 2nd ed. São Paulo: Cengage Learning, 2008.

NARUSAWA, T; SHOOK, J. Kaisen express: fundamentals for your lean journey. São Paulo: Lean Institute Brasil, 2009. 154 p.

OHNO, T. The toyota production system: beyond large-scale production. Porto Alegre: Bookman, 1997. 131 p.

OLIVEIRA, SL Treatise on scientific methodology: research projects, TGI, TCC, monographs, dissertations and theses. São Paulo: Pioneira, 2004, 324 p.

ROTHER, M .; SHOOK, J. Learning to see - Value Stream Mapping to Add Value and Eliminate Muda. The Lean Enterprise Institute, MA, USA, 1998.

SHINGO, S. The toyota production system from the point of view of production engineering. 2. ed. Porto Alegre: Bookman, 1996. 282 p.

FEDERAL UNIVERSITY OF SANTA MARIA. Structure and presentation of monographs, dissertations and theses: MDT. 8. Ed. Santa Maria: Ed da UFSM, 2015.

VERGARA, SC Management research projects and reports. 8th ed. São Paulo: Atlas, 2007, 96 p.

WOMACK, JP; JOKES, DT; ROOS, D. The machine that changed the world. Rio de Janeiro: Elsevier, 2004.

ZAMBERLAN, L. et al. Research in applied social sciences. Ijuí: Unijuí, 2014, 208 p.