

LEAN MANUFACTURING IN A HOSPITAL PRODUCT MANUFACTURER: IMPLEMENTATION AND EVALUATION IN THE PERCEPTION OF MANAGERS

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ABSTRACT

The use of lean production in organizations, which aims to broaden your results using fewer resources, that is, to increase productivity producing essentially necessary and eliminating what does not add value to clients, requires actions that include mapping of success environments and organization's readiness for change management. Hence we have the current case study, descriptive, which presents the implementation of lean manufacturing in the textile plant in Blumenau (Santa Catarina) that manufactures medical products from a company with three manufacturing units. Next, there were interviews with thirteen managers and staff who participated in the lean manufacturing implementation process in the unit in focus. As a result, we identified that the requirements and preparations for the deployment mentioned are directed to a behavioral change that includes preparation of leadership, aligned with the organization's strategy, which needs to be deployed to all areas. Also featured are the stages of implementation and attempts to institutionalize the environment provided by the principles of lean manufacturing. It concludes with the identification of categories of analysis for the changes arising from the aforementioned deployment.

Keywords: Assessment. Lean Manufacturing. Deployment Strategy.

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1. INTRODUCTION

Lean manufacturing emerged in the 1950s when a delegation of Japanese businesspeople visited a North American auto factory and returned to Japan with new ideas and conceptions of manufacturing organization. Adaptations of concepts, coupled with their own contributions and elaborations, led to the emergence of what was conventionally called the Toyota Production System. In this context, in a post-war crisis scenario plaguing Japan, lean manufacturing emerged as a form of manufacturing of mass goods and services, creating a new manufacturing management environment. The context was thus described by Toyota (DENNIS, 2008):

- a. Small Japanese market and demanding variety of vehicles;
- b. Economy devastated by war and without the possibility of using advanced technologies;
- c. Consolidated market in the world of automobiles, with many competitors.

The term lean manufacturing, lean manufacturing, was used by Womack et al. (2004) to describe the transformation and conception of manufacturing organization, standing out as a program applicable to manufacturing operations in general, as well as banks, hospitals and government.

For Womack and Jones (2004), lean manufacturing provides greater efficiency and productivity, with a greater focus on the organization's business as a whole and a cultural transformation in management by prioritizing customer value creation, expanding that logic to the other links of the production chain.

Thus, a deployment implies cultural change and the need to conduct it safely in the face of difficulties. The techniques and tools used in the Toyota initially often used as a guideline in the effort to produce just enough essentially eliminating processes that do not add value to customers (LIKER, 2005).

It is also necessary to evaluate the results of the implantation, because partial results usually contribute to accommodation, when favorable, or withdrawal, when unfavorable. Liker (2005) highlights the need for discipline, standardization, and rigor in deployment with changes in the shop floor and attitudes that reinforce the notion that cultural changes do not occur immediately.

For the implementation of lean manufacturing, several techniques are used, such as Value Stream Mapping (VSM), 5S, Quick Change Over (QCO), *Jidoka*, *Kanban*, Cellular Manufacturing and Total Productive Maintenance (TPM). The starting point is Value Stream Mapping, which allows identifying opportunities for improvement, the main flows and bottlenecks of production in its main production processes. After identifying the main flows and opportunities for improvement, there are the movements that lead to the reduction of waste (DENNIS, 2008).

Thus, the paper refers to a case study that describes the implantation of lean manufacturing in the unit of hospital adhesives of a company with three manufacturing units, occurred after a moment of crisis, and aims to (i) describe the changes in the organization and (ii) to evaluate the results, generating categories of analysis of modifications resulting from this implementation, based on the perception of those involved. As results the work presents a contribution in relation to categories of evaluation and descriptors, constructed from the responses of the participants of the implementation of lean manufacturing in the case under study.

2 METHODOLOGICAL ASPECTS

This is a qualitative research carried out by means of a descriptive case study in one of the three manufacturing units of an industry (all located in the State of Santa Catarina, Brazil), which underwent the pilot implementation of lean manufacturing. Already, the method of reasoning adopted was the deductive, since, based on the concept of Bêrni and Fernandez (2012, p.46), it is understood that the development of the present work follows a “logical construction according to which , from two propositions called premises, one extracts a third, logically necessary, called conclusion”. Under these conditions, the research flow begins with the description of the phenomenon under discussion and ends with the definition of categories of analysis, obtained from interviews with key informants of the organization and that can be applied in similar future studies.

Therefore, in a first moment, the transformations occurred with the aforementioned implantation in the unit of hospital adhesives of the company are presented. Next, the managers were interviewed, in order to seek their perceptions and evaluation regarding the implementation of lean manufacturing in the organization. These interviews took place on the basis of a pre-elaborated, semi-structured script, and sought the construction of categories of analysis of the implantation. Some were in the semi-structured script designed as an interview script, as in the case of, for example, the so-called preparation of people and alignment with organizational goals, others emerged, allowing a broader understanding of the interviewees’ company.

Managers and employees involved in the implementation of lean manufacturing were identified in an intentional way, which are the key informants of the research. After analyzing the involvement of the managers with the implementation, the following were selected to participate in the research:

- a. Sensei responsible for the implementation of lean management;
- b. Manager of the company’s three plants;
- c. Coordinators of the three plants of the company;
- d. Supervisors of the three plants of the company;
- e. Four members of the company’s lean office.

The data collection instrument of the research was thus applied to such informants, and the answers provided by them were now confronted with the existing literature and with available documents. Thus, interviews conducted in the second half of 2014 with thirteen managers from different hierarchical levels of the organization allowed highlighting points that served as element of construction of the categories of analysis of the implementation of lean manufacturing design.

It is worth noting also that, as this is an empirical research, there are limitations that need to be clarified. First, since the data were obtained from the perception of a selected set of managers, it is possible that others, from the same organization, may have different opinions. Finally, the organizational diagnosis and the categories resulting from the current study, in theory, can not be extrapolated to other organizations, either in this field or in another, although they have been generated through the inductive method of reasoning and, therefore, constitute general recommendations. Since each organization has its peculiarities, both relating to their internal and external environment.

3 THEORETICAL ASPECTS

The origin of lean manufacturing is usually located in 1950, when Eiji Toyoda and Taiichi Ohno visited one of Ford's plants in Detroit, United States of America. After returning to Japan, they analyzed the mass production system, their viability in Japan and proposed a new production system known as the Toyota Production System (TPS). (GODINHO FILHO, FERNANDES, 2004, 2005; LIKER, 2005)

According to Dennis (2008), the Japanese economy was devastated by war and lacking capital. Toyota developed activities to engage team members in total improvements which was an absolutely innovative idea. (FUJIMOTO, 1999)

The world oil crisis in 1973 reconfigured consumer preferences for automobiles, saving fuel became a fundamental requirement and the Japanese advanced the world market. Toyota drew attention in 1980, making it clear that there was something special about Japanese efficiency, with automobiles that lasted longer and required less maintenance than the Americans (LIKER, 2005; DENNIS, 2008).

Liker (2005) states that Toyota has transformed operational excellence into strategy, based on quality improvement methods, which the company has made famous in the industry world, such as just in time, *kaizen*, unit flow parts, *jidoka*, and production leveling (*heijunka*). These techniques helped to trigger the spread of lean production. In addition, continued deployment success stems from a business positioning based on people's understanding and human motivation. Thus, it seeks to cultivate leadership, work in teams and culture to create strategies, build relationships with suppliers and maintain a learning organization.

The Toyota Production System has come to be defined as a five-step process: defining customer value, defining value flow, making it "flow", "pulling" from the customer and striving for excellence. In order to be lean manufacturing, it is necessary to concentrate on making the product flow through uninterrupted processes of value aggregation (unit part lots), a system drawn from customer demand, replenishing only what the next operation consumes in short intervals, and a continuous effort for improvements.

3.1 Principles of Lean Manufacturing

Womack and Jones (2004) present the following principles:

- a. **Specify value** – value must be defined by the final customer, expressed in a good and/or service that meets their needs at a price and at a specific time;
- b. **Identify value flow** – a set of specific actions necessary for a product and/or service to go through the three critical management tasks in any business: problem solving (from conception to product launching, to detailed design), information management (receipt of order to delivery, on a schedule) and physical transformation (from raw material to product in the customer's hands);
- c. **Continuous flow** – flow of value of a given product and/or mapped service and elimination of wasteful steps. A continuous flow is important to move material quickly, with steps and information chaining processes and people together so that problems become visible. For Fujimoto (1999), it is the key to the process of continuous improvement and development of people;
- d. **Pull System** – means that no one from the previous flow should produce goods or

services without the next step being requested. In the most common design, the customer withdraws the product and fills the gap created with such withdrawal. Womack and Jones (2004) and Dennis (2008) state that *Kanban* is a visual tool used, usually with an authorization card to produce, which may contain other related information;

- e. **Perfection** – when you specify the value accurately, steps flow continuously and customers pull the value. Then, the involvements with the processes of reducing effort, time, space, cost and errors grow, and at the same time, a product comes closer that even more than the customer really wants (LIKER, 2005).

The four principles interact with each other in a powerful circle (FUJIMOTO, 1999). Making value flow faster exposes hidden wastes, and the further pulling, the more obstacles will be revealed, allowing them to be eliminated (DENNIS, 2004).

3.2 Lean Manufacturing Tools

Lean manufacturing seeks stability, reliability or robustness of processes. Machine stability requires 5S and Total Productive Maintenance (TPM), which increase standardization and safety; and quality is enhanced with fault prevention (*jidoka*). The beginning occurs with Value Stream Mapping (VSM), which allows understanding the current situation and identifying opportunities for improvement that guide future configuration.

For Liker (2005), VSMS are material and information flow diagrams, capturing processes, material and information flow of a product family, and identifying losses in the system. Dennis (2008) states that 5S was designed to create a seemingly simple visual work space consisting of: separating; to rank; clean (and inspect); standardize and maintain. For Liker (2005), visual management is any communication device used to promptly warn how and when a job should be run and whether there is any deviation. Womack and Jones (2004) state that standardization is the foundation of production and use of a standard is the basis of excellence.

According to Dennis (2008), standardized work presents benefits such as:

- a. Stability of processes, which means possibility of repetition;
- b. Clear start and stop points for each process;
- c. Organizational learning;
- d. Base for the training of employees.
- e. For Rother and Shook (2009), standardized work tools help identify value and waste in a process that consists of three elements, which are:
- f. Takt time, which provides frequency that a product must occur;
- g. Sequence of work, defines the order in which the work is done in a given process;
- h. Stock in process, the minimum quantity of parts necessary for the operator to complete the process without being stopped in front of a machine.

The basic objective of developing, maintaining and maintaining a physical arrangement is to increase or maintain profitability, and the way it is designed can also increase quality, customer service and employee satisfaction (LIKER, 2005). For Harmon and Peterson (1991), changes in physical arrangements are characterized by large scale construction processes and, as new and revised processes are placed in the available spaces, the plant becomes less productive because the original facilities have varied and irregular formats for incorporation of new processes.

The size and shape of the process blocks must also be determined by the dimensions of the equipment. There are cases where you can modify the design of the equipment used, with long, straight processes for relatively short process (HARRIS, HARRIS, WILSON, 2008). In these cases, U-shaped processes simplify the overall physical arrangement of the plant and can reduce the total cost of equipment. Harmon and Peterson (1991) present the advantages of such a physical arrangement, namely:

- a. The inlet and outlet ends of each process are as close as possible to the factory aisle;
- b. Each corridor attends processes on both sides; thus, the ratio of corridor and process space is greater than that of a corridor adjacent to a wall or a non-productive installation;
- c. U-shape is relatively easy to compress and expand, like an accordion, to fit.

Regarding Total Productive Maintenance (TPM), Paranhos F^o (2007) states that the operator's involvement is part of the technique by participating in the maintenance of his machine with lubrication activities, adjustments and training to identify noise, vibration and temperature, which may serve as a malfunction alert.

Dennis (2008) considers that 5S naturally leads to Total Productive Maintenance, which is essential to stability through training the team to take care of their own equipment. This represents a change of mentality, aiming at no interruption in machine operations by involving the team in eliminating the following losses: equipment failure, assembly and adjustment delays, idle time, small downtime, reduced speed, processing defects and reduced yield.

There is also a need to reduce machine preparation times. To enable flexibility in manufacturing, Quick Change Over (QCO) is critical. For Rother and Shook (2009), the reduction of setup is important for three reasons:

- a. With high preparation time, manufacturing batches and inventories increase;
- b. With quick change techniques, tool adjustment errors decrease;
- c. Rapid conversion techniques provide additional capacity for the machines.

The concept of lead time together with the reduction of the setup times allows scheduling the production in a level way, managing to operate with ideal lots (SMALLEY, 2004; CONCEIÇÃO, 2009).

The Japanese gave the name of *Heijunka* to the overall leveling of programming (in terms of variety and volume of demanded items) directly linked to sales performance. Leveling production means avoiding the impact of oscillating demand, bringing stability to operations. Harmon and Peterson (1991) reinforce that, by reducing the setups, it becomes possible the daily production of all items. The ultimate goal of manufacturers should be to meet customer requests through production, without inventory, feasible when production lead time is reduced, machine setup minimized and capacity adapted to meet peak demand.

The moments of improvement, called *Kaizens*, mean, for Imai (1988), the continuous improvement involving all. Improvements in quality, cost and scheduling are important, but their emphasis is on process improvement (DENNIS, 2008).

Flexibility has become one of the virtues and one of the most obvious requirements of manufacturing. With turbulent markets, agile competitors, and technological change, manufacturing management has to reevaluate its ability to modify what it does and how it does (WOMACK; JONES, 2004). The main reasons for flexibility in manufacturing are delivery times, product assortment expansion,

variety of output levels and variety of delivery lead time. Flexibility affects three other performance goals: making manufacturing more reliable; accelerate the flow and reduce direct costs.

3.3 Difficulties in the implementation of lean manufacturing

Lean manufacturing often presents some difficulties in its implementation. The first is when there is no alignment of areas and focus on organizational goals. (NISHIDA, 2014). The constant exchange of command and the multiplicity of strategic initiatives, some of which are in conflict with one another, are important factors in the deployment. Delegation of deployment to coordinators, or production management, reinforces the notion of a tool and not a system. (SMALLEY, 2004; NISHIDA, 2014)

Saurin, Ribeiro and Marodin (2010) point out as main difficulties for the implementation of lean manufacturing:

- a. Difficulty in adapting concepts and practices;
- b. Resistance of people to change;
- c. Lack of focus;
- d. Difficulty in quantifying financial gains;
- e. Lack of human resources;
- f. Lack of commitment of the top management;
- g. Failure of past initiatives;
- h. Lack of financial resources.

Sales management is also vital for a pulled system, artificial oscillations in volumes and assortment should be avoided in order to maximize results from the area itself to the detriment of organizational goals; and there is a need to work with sales or forecasts that use a consistent analysis methodology (SMALLEY, 2004).

It also occurs when Planning, Programming and Production Control (PPCP) perceives the system change, with each process communicating directly with another without going through the PPCP (DENNIS, 2008). The pull system can lose agility, involvement and engagement of people on the factory floor in case of interference and can continue with elements of the system pushed, even with kanban replacing the old production orders (SMALLEY, 2004)

For Nishida (2014), there is also lack of monitoring of supermarket levels and not review of replacement policies. Sizing once and not reviewing the calculation will face many difficulties in case of significant variations in demand (SMALLEY, 2004).

Finally, the training of people, without close supervision of supervisors, with unclear responsibilities, restricted autonomy and difficulties generated by Information Technology systems, making management more complex and less visible. Prior to implementation, the basic conditions required must be verified: material, method, labor and machine stability, schedule stability and staffing involved, senior management commitments, available capacity and clear production flow, well-defined, streamlined, standardized and with the rhythm defined by the customer (NISHIDA, 2014; LIKER, 2005).

3.4 The transition to lean manufacturing

Each company can use specific strategies in the implantation, due to its peculiarities. For Jones and Womack (2004), many deployments occur through point improvements (kaizens). Good initial results motivate, excite and stimulate companies, but do not guarantee sustainable effects in the medium or long term.

For Womack and Jones (2004), initial activities need to focus on essential, strategic value streams, no longer focus on single tools and move to a systemic view. They suggest starting with the need, identifying the problem and then the appropriate tool. The more relevant the problem, the greater the momentum of the deployment. Liker (2005) states that in analyzing the most relevant value stream, it will be noted that manufacturing is an important stage. The tools are already known and tested, favoring the start of the factory floor, but a prior diagnosis of stability (materials, machines, labor and methods) is necessary. The resolution of these issues precedes and may be more relevant to ensuring the necessary continuous flow (NISHIDA, 2014).

The same holds for managing the workforce with unclear instructions, or lack of skilled labor, or inadequate methods that affect productivity and quality indicators (DENNIS, 2008). For Nishida (2014), the development of people is essential to gain new skills, behaviors, qualifications and experiences. Leadership is essential and directors must be directly involved, accompanying and supporting implementation; managers should have a greater focus on the shop floor, understanding how to develop their activities.

3.5 Evaluation of Lean Manufacturing Deployments

Regarding the evaluation of lean manufacturing deployments, Walter and Tubino (2012) affirm that much has been published on ways to implant, but there is still concern about implementation failures. There are authors who recommend an investigation that statistically positions how many companies have succeeded in lean manufacturing deployments (BHASIN, 2008; BHASIN and BURCHER, 2006; PAY, 2008).

For Sellitto, Borchardt and Pereira (2010), around 10% of the deployments are successful; Pay (2008) states that 2% of deployments reach their goals fully; and for Taj (2005), 70% to 90% of companies waste resources in deployments.

Bhasin (2011) states that there are few reliable parameters to judge the success of deployments. Walter and Tubino (2012) carried out a survey about the different evaluation methodologies of lean manufacturing deployments, among which is the proposal by Nogueira and Saurin (2008), focused on company strategy, cultural and organizational aspects. After the application of the checklist, a seminar is held with managers from the areas of maintenance, production, sales, purchasing, Production Planning, Scheduling and Control, Product Engineering and administrative for validation and consensus on the results collected (WALTER; TUBINO, 2012). There is also the work of Giesta and Maçada (2002) that proposes a method that aims to measure employee satisfaction with the implementation.

Paoli, Cezar and Santos (2016) present the evaluation model of the implantation developed by Ferreira et al. (2002), known as the Brazilian Instrument for Assessment of Organizational Culture (IBACO), where there is an emphasis on evaluating organizational culture through its values and practices. Constructed from a questionnaire with 126 questions, where 68 were associated with values and 58 with organizational practices, Ferreira et al. (2002) used the method of oblique rotation and factorial analysis to obtain a questionnaire with 55 questions applied to organizational value and 50 of organizational practice, which became known as IBACO.

The concern in evaluating the implementation of lean manufacturing in companies is growing among the authors. The work of Walter and Tubino (2012), in annals of the National Meeting of Production Engineering (ENEGEP), identified 28 articles in the period 2001 to 2010 that dealt with the subject, without there being a methodology of evaluation common to all publications.

4 THE IMPLANTATION IN THE UNIT OF HOSPITAL ADHESIVES

The implementation of lean manufacturing in the organizational unit under study began with training with people from leading production, automation engineering, production planning, quality, process engineering and machine operators with the intention of leveling knowledge before beginning the deployment.

Next, the product family was defined for the realization of the first Value Stream Mapping (VSM): family of small plasters. A map was drawn from the entry of the raw material to the finished product, passing through the processes of value aggregation, identifying improvements. The current state VSM is in Figure 1.

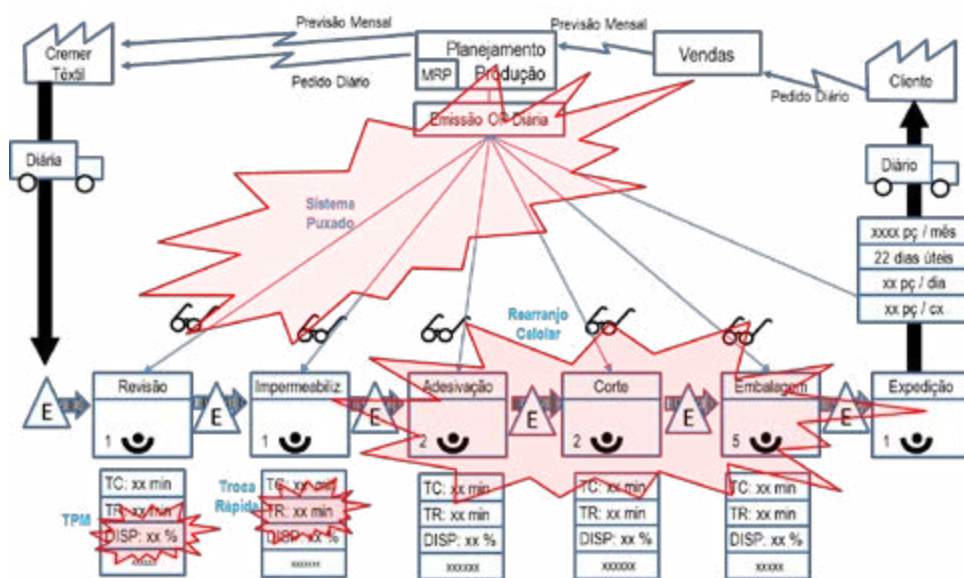


Figure 1 - Current value flow map – small plasters

Source: Company data

Figure 2 shows the future state of the flow, from the identification of *kaizens*.



Figure 2 - Future value stream map – small plasters

Source: Company data

From the definition, the transformations in the family of small plasters were: 5S, cleaning and organization of the workplace; TPM, increased reliability and productivity of cutting equipment; two events of cellular arrangement, providing the physical arrangement in a continuous stream; a quick exchange event to reduce the setup; and a kaizen standard work and visual management, where activities were standardized and indicators and production meters established. Work in the pilot area occurred in approximately four months.

The replication started from the familiarization of the team with the tools and processes similar to those of the pilot area underwent the same modifications. Thus, the master plan arose, which conceived the expansion of the program with a planning for the whole factory park and resizing of the capacities of the machinery.

The master plan projected an increase in production for the next three years. One of the main difficulties was the layout, there was no flow of clear and coherent material. Thus, the proposal of alteration of the physical arrangement, acquisition of machines and preparation for an increase of the volume of production took place. Figure 3 presents the comparison between existing and proposed physical arrangements:

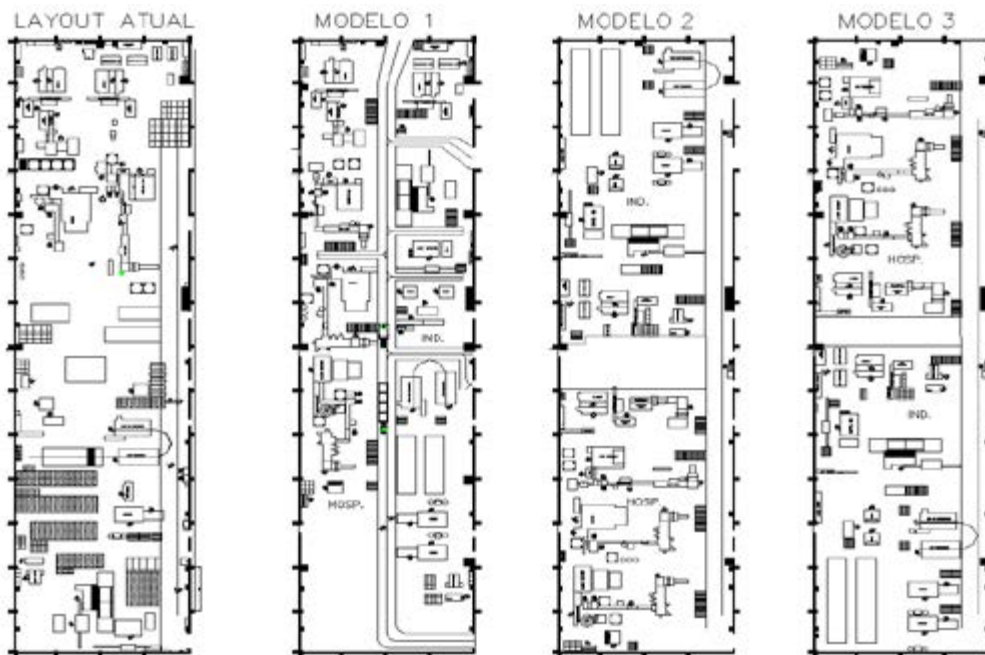


Figure 3 - Layout proposals
Source: Company data

The proposals were compared in order to determine which would be implemented. The synthesis of this evaluation is shown in Table 1:

	Current	Model 1	Model 2	Model 3
Concept	Partially divided H/I. Reflux of material. Transverse separation.	H/I with longitudinal division Layout in "U" Direct flow of material.	H/I with transverse division industrial in the entrance. Hospital in back. Direct flow of material.	H/I with transverse division. Industrial in back. Hospital at the entrance. Direct flow of material.
Positive		Defined flow and clear. Free area of 217 m ² . Optimized flow of inputs Management of the U-cell Ease for "milk-run"	Industrial in the entrance (greater volume) Free area of 116m ²	Lower machine movement. Free area of 65 m ²
Negative		Narrow aisle (sorted out)	Access to pallets in the industrial area. Difficulty accessing maintenance.	Difficulty accessing the pallets in the industrial area. Difficulty accessing maintenance.

Table 1 - Pros and Cons of Physical Arrays
Source: Company data

Based on the analysis, the team opted for model 1, understanding that it presented the necessary conditions to attend to the creation of new flow of materials. In Figure 4 are the different stages of the changes.

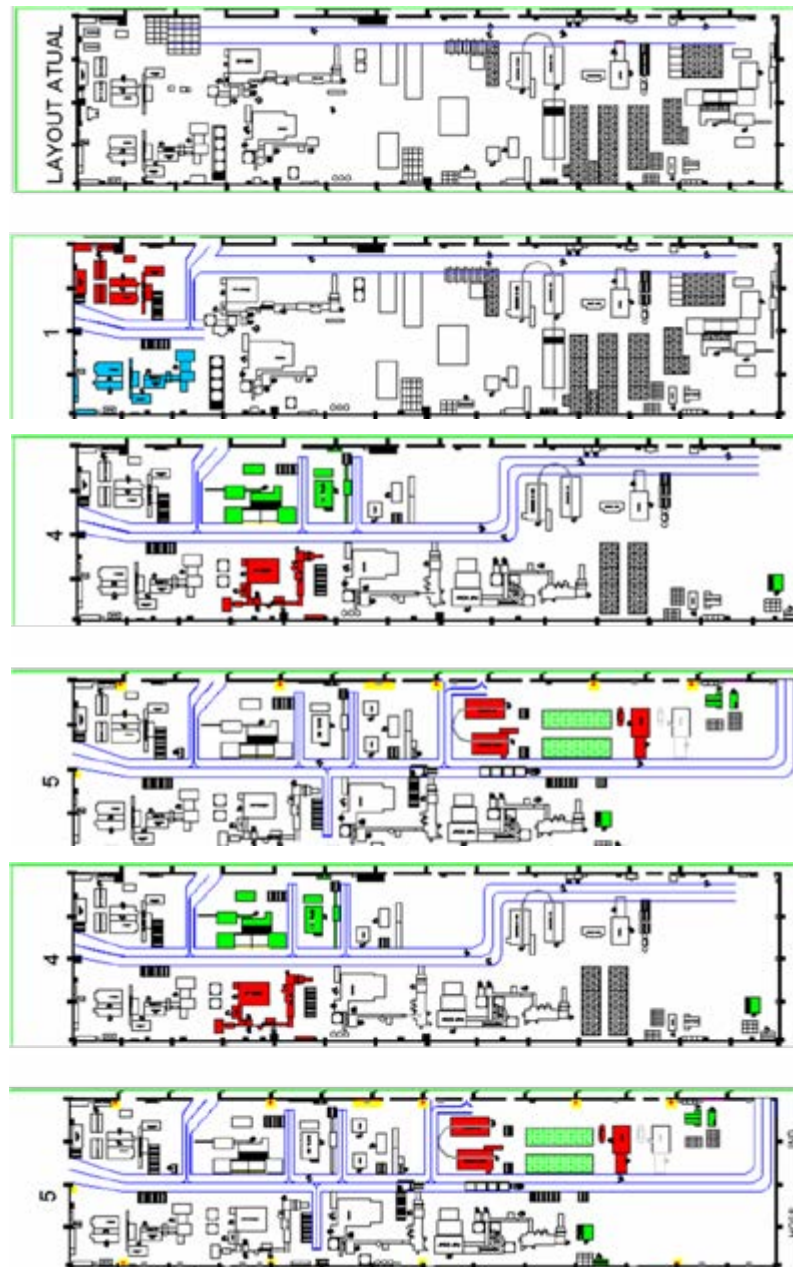


Figure 4 - Layout Change Steps

Source: Company data

The change of the physical arrangement occurred in steps: (1) moving the access door to the building from the side to the front, (2) moving the machines gradually, (3) establishing a continuous flow between the cut and the packaging, and (4) U-shaped cells. Thus, a central corridor emerged, where the product was processed and exited more efficiently.

After the alterations, there was the expansion to two other stages, namely: preparation of back and adhesive. Finally, the acquisition of a material tug to implement the “milk run” or route of supply of inputs, which allows to supply the productive cells more frequently, reducing the inventory in process.

5 IMPLEMENTATION ASSESSMENT

According to the interviews, categories of analysis were highlighted for each participant. First, the approach with the program leader in the organization (Sensei) was carried out. Table 2 gives the description of his observations.

Actor	Category	Description
Sensei e Industrial Director of the Analyzed Plants	Behavioral	We should act with reason and not with our hearts. Several managers did not understand that it was a management philosophy and not a template to follow because the director is ahead of deployment.

Table 2 - Sensei Content Analysis

Source: Prepared by the authors

The interview with Sensei showed that he is disappointed with the performance of the other managers of the organization in the implementation of the program in the company. For the interviewee, in the background of an effective implementation should be considered a behavioral category of the participants in the process. Thus, it goes through an understanding of the lean manufacturing and the training of the people for the application and change of the form of management.

With respect to the manager of the three manufacturing plants, Table 3 presents the categories and descriptions that emerged from the interview.

Actor	Category	Description
Industrial Manager of Analyzed Plants	Forms of Deployment	The beginning I would do exactly as it was. Good staff and Strong base. He would be more careful in extending it to the other areas of the company, forming with more emphasis the substitute components of the lean team
	Culture not Implanted	The lean culture does not yet exist, the formation of people is still not good.
	Shock with other tools	We implemented tools that gave results and many did not. This also a function of not formalizing them for standard use. We formalize working procedures and instructions, however the guideline is not fully formalized. The quality manual is the company's already official tool.
	Maintaining the Lean Walking Program	Lean walking should be done in a way that causes people to be questioned, answering the questions will make it happen in the right way, because they will take responsibility in their minds

Table 3 - Content Analysis of the Industrial Manager

Source: Prepared by authors

Table 4 presents additional categories, with concern regarding the form of implantation, culture of the organization, tools of management and maintenance of the program. It also showed concern about the expansion of the implantation to other areas, being necessary preparation of the managers, with emphasis of the initial phase. This concern comes from Jones and Womack (2004) who say that the initial results are motivating, encouraging and stimulating companies, but they do not guarantee medium- and long-term effects. Thus, initial activities need to focus on the essential flows, moving from a focus on stand-alone tools to a systemic and comprehensive view.

Emerged the culture category not implanted, where the interviewee stressed the need for a good training of people for a real change of management culture. In this sense, Dennis (2008) corroborates, noting that the organization can better manage the workforce with clear instructions, reducing the effect of lack of skilled labor or inadequate methods that can disrupt deployment.

Another category was shock with other tools, in which the interviewee pointed out that there had been no concern with existing information technology, causing the shock. This observation points out that the Information Technology systems, existing in the organization, need to be analyzed in order to avoid conflict (SMALLEY, 2004).

Finally, the category maintenance of the program through the lean walking tool, which refers to the systematic monitoring of managers on the factory floor in a formal way and focused on the deviations that may occur and the immediate correction of errors. The coordinators of the textile, adhesive and plastics plants were interviewed and the categories of analysis and descriptions of the observations are shown in Table 4.

Actor	Category	Description
Textile Plant Coordinator	Forms of deployment	Do not deploy the tools at once. Study the tools better before putting them into practice
	Preparing people	Prepare teams differently. There was no charge for what they should do.
	Maintaining knowledge	Keep the office staff lean
Coordinator of Adhesives Plant	Preparing leaders	Preparation of the leader first in the tools. The program hit manufacturing cells first, without the leaders knowing what was changing. Leadership training from top to bottom
	Preparation of the areas	Prepare in advance the areas to receive lean. Placement of a facilitator in each sector.
	Deploy and maintain organizational impact tools	Ensure the implementation of Total Productive Maintenance (TPM) , Quick Change Over (QCO) and Jidoka tools (failure prevention mode)
	Lean Culture	Culture of the Lean to be incorporated by leading leaders
Coordinator of the Plastics Plant	Preparing leaders	Involve the leadership in Kaizens based as 5S and Standard Work
	Goal Alignment	Alignment of objectives and goals of each area with lean goals and goals.
	Sustainability	Ensure the sustainability of the implemented tools
	Deploy and maintain organizational impact tools	Ensure the deployment of Reliability (TPM) and flexibility (QCO) tools.
	Ensure de the basis of the program	Start with the basic 5S (organization and cleaning)

Table 4 - Analysis of the Coordinators of the Industrial Plants

Source: Prepared by the authors

In the textile plant, the coordinator emphasized three categories: forms of implantation, preparation of the people and maintenance of knowledge. In terms of implementation, the concern corroborates that described in Womack and Jones (2004), which suggest starting with the need, identifying what is the crisis or the priority of the business. The more relevant the initial problem addressed, the more momentum the deployment has. People's preparation, which emerged category, refers to deployment delegation to coordinators or production management and reinforces the vision of tools and not as a system. The maintenance of knowledge is due to the fact that there were rapid modifications of the initial deployment team. This observation reinforces that constant command change and multiplicity of strategic initiatives, sometimes conflicting with each other, are relevant to the deployment (SMALLEY, 2004; NISHIDA, 2014).

The categories identified in the responses of the adhesives unit coordinator were: preparation of leaders, preparation of areas, implementation and maintenance of impact tools and lean culture. Preparations of leaders and areas were highlighted similarly to the one indicat-

ed by the textile coordinator. Implementing and maintaining the impact tools in the organization was highlighted for the implementation of lean management through tools. This understanding, that of obtaining small successes that will not be sustained over time, is not an adequate method of implantation (JONES, WOMACK, 2004).

The adhesive unit manager, stressing the use of impact tools in the organization, indicates that she is facing situations that need to be corrected before implantation. There is then a need to solve previously problems in the flow of materials, information, equipment reliability and continuous flow from the demand. (NISHIDA, 2014). With regard to the lean culture to be incorporated by the leaders, the change of values, culture and management system are fundamental for the transformations of the business and there is a need to unfold the strategies of the organization, aligning plans of the top management with actions of the other hierarchical levels (JONES, WOMACK, 2004).

In the interview with the coordinator of the plastics unit, the following categories emerged: preparation of leaders, alignment of goals, sustainability, implementation and maintenance of impact tools in the organization and guaranteeing the basis of the program already mentioned by the managers mentioned above. should occur prior to implementation: 5S (organization and cleaning program), maintenance of 4M (Material, Method, Labor and Machine), scheduling and personnel stability, as well as senior management commitments (NISHIDA, 2014).

In the same way that the interview with the plant coordinators was done, the interviews of the area coordinators, presented in Table 5, were analyzed:

Actor	Category	Description
Maintenance Co-ordinator	Lean Team Members Profile	Implement a more operational and less strategic vision of lean team members. This fact would provide a greater acceptance on the part of other collaborators
Coordinator of Weaving	Use of the Realities of each group	Develop strategies to work on the proposed improvements with those actually perform each task
	Ensure the basis of the program	Start with the basic 5S (organization and cleaning)
Coordinator of Warehouse and Receiving Materials	Deployment Time	Delays in reaching the entire company
	Benchmarking	Visit others companies to analyze the best deployments for each tool.
	Sustainability	Ensure sustainability through audits.
	Participation	Greater involvement of all sectors of the company
	Ensure the basis of the program	Start with the basic 5S
Manufacturing Coordinator	Coordination Division	Split sectors, lean office members must be a representative in each sector.
	Daily Routines	Application of lean routines in the day to day, do not wait for the moment of improvement (kaizen).

Table 5 - Analysis of Sector Coordinators

Source: Prepared by the authors

For the maintenance coordinator, there is a need for greater operational engagement with the implementation by the team that has the knowledge of the tools (lean team), with an emphasis on the knowledge of the operations. For Womack and Jones (2004), promotion occurs when there is a lever or crisis that provides value-mapping, organization by family of products, and promotion through a management office, which must be temporary until implementation of the training of all in the organization by a sensei, being absorbed these people by the other

areas. Thus, the profile category of the members must be operational, to be absorbed later in the positions of strategy and support of the organizations.

The coordinator of weaving presented a different category of the previous ones, the use of the realities of each group, in which the people who lack in a certain sector harms the performance of that sector. Thus, *kaizens* improvement moments are performed with people who do not perform the function or area analyzed, so that the improvements do not occur in a sustainable way. For Nishida (2014), the development of people is essential for new skills, behaviors, qualifications and experiences.

With the coordinator of warehousing and receiving of materials, the categories of implementation and benchmarking emerged. Regarding the time of implantation, Nishida (2014) emphasizes that the time will be long if the chronic problems are not solved before the implantation. It is more relevant to deal with the internal movement of materials and logistics in the event of a chronic lack of materials or to start a maintenance program for machines and equipment that break frequently and hinder the flow. As for benchmarking, best practices should be discussed and analyzed through specific forums and technical visits such as those observed by the respondent.

The manufacturing coordinator had less than six months in the company and was still becoming familiar with the deployment. The categories express the need for support of the understanding, suggesting the decentralization of the implementation and daily execution routines with punctual corrections. The same questions were asked to members of the lean office. The categories surveyed are presented in Table 6.

Actor	Category	Description
Member 1	Forms of deployment	Do not deploy the tools at once. Study the tools better before putting them into practice.
	Preparing people	Prepare teams differently. There needs to be higher charges from top management.
Member 2	Preparing leaders	Preparation of the leader first in the tools. Leadership traing from top to bottom
	Deploy and maintain organizational impact tools	Ensure the implementation of Total Productive Maintenance (TPM), Quick Change Over (QCO) tools..
	Sustainability	Ensure the sustainability of the implemented tools
Member 3	Lean Culture	Culture of the lean to be incorporated by leading leaders.
	Goal Alignment	Alignment of objectives and goals of each área with lean goals and goals
Member 4	Maintaining Knowlwdge	Keep the office staff lean
	Sustainability	Ensure the sustainability of the implemented tools

Table 6 - Analysis of Lean Team Members

Source: Prepared by the authors

Table 6 ratifies the previous analyzes, repeating the categories and allowing to infer the same concerns of the other leaders occur and a concern with the progress and the learning verified throughout the implantation. Lean team members demonstrated that they were trained in the different tools and came to understand the form and the concepts. They believe that many of these concepts conflicted with the ideas of the company as a whole and made it difficult to implement because there was no alignment of the areas focused on the same objectives, which is explained in Nishida (2014). They reported that there were *kaizens* quantity targets to be realized, which impaired the analysis of the real needs identified in the value stream mappings.

The documentary research showed that there was greater progress in adhesives and plastics units in relation to the results of the textile unit. According to the members of the lean

team, this difference occurred due to a greater engagement of the leadership of these units in training. All of their coordinators and supervisors did a lean graduate offered in company to the members of the company.

5.1 Analysis of categories

The categories that emerged during the interviews through the descriptions according to Tables 2, 3, 4, 5 and 6 are presented in Table 7.

Categories	
Preparing people	Ensure the basis of the program
Maintaining knowledge	Lean team members profile
Preparing leaders	Use of the realities of each group
Preparation of the areas	Deployment time
Deploy and maintain organizational impact tools	Benchmarking
Lean Culture	Participation
Goal alignment	Coordination Division
Sustainability	Dayli routines
Behavioral	Forms of deployment

Table 7 - Categories of Analysis that Emerged from Interviews

Source: Prepared by the authors

It can be observed that the categories refer to the preparations that precede the implantation. The main base is in preparing the people who need to be trained in all areas of the company's application. Lean manufacturing is behavioral and needs to be aligned with other company strategies. It can also be observed that there is variation regarding the importance assigned to each category by the interviewees.

6 FINAL CONSIDERATIONS

This paper, after describing the implementation of lean manufacturing in a manufacturing unit of hospital adhesives in Blumenau (SC), identifies the changes that have occurred in the organization, made possible with the support of the answers obtained from interviews with 13 informants involved with the process, produce a set of analysis categories of modifications resulting from this deployment.

In view of this situation, it was verified that the main preparations for the application of the lean manufacturing were the formation of a deployment team, with people trained and who had knowledge about the tools involved in the process. Operational leaders did not have the same level of knowledge of the tools, stating that the training was insufficient, causing a lack of understanding of the concepts among those involved with the implementation.

In addition, it was verified that the motivation for implantation was the change in the board, with the necessity diagnosed by the new composition to review processes and to increase results. Preparations focused on preparing for the behavioral change of those involved, although differences were identified between preparations between one plant and another.

Similarities and differences in the implantation were perceived in the categories that emerged during the interviews. Accommodation, expectations regarding the team's implementation and differences regarding the knowledge and motivation to participate in the implementation were perceived.

The difficulties in the implementation, identified by the authors, were highlighted by the interviewees, especially the preparation of the leadership, alignment of goals and sustainability of the results achieved, serving as an aid to the expansion of deployment, as well as to other companies that face the challenge of implementing changes in its operations management.

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