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IMPLEMENTATION OF A LEAN PRODUCTION COMPONENTS SUPERMARKET IN AN AUTOPARTS INDUSTRY – CASE STUDY

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ABSTRACT

M*arkets competition is fierce and has been intensified in the last two decades. Several factors contribute to this fact, such as: intensive use of information technology, scarcity and difficulty of capital access, market maturity, and globalization. In this scenario, the manufacturing becomes powerful weapon, and source of competitive valuable advantage. Therefore, companies must maximize their productive resources, the acquisition of inputs, integrate logistics, and enhance the acceptability of products and value-added services, which are becoming less differentiated. The principles and techniques of lean production are important strategic tools for this purpose, since it focuses on inefficiencies elimination. This paper presents a case study of the implementation of a supermaket of semi-finished components, in a production of auto parts industry. This deployment has yielded significant gains in agility, waste reduction, inventory decrease, and final product quality improvement. Due to this project success, the concept will be expanded to other plant production areas.*

Keywords:
Components Supermarket, Lean Production, Manufacturing Process, .

1. Introduction

Markets globalization, in the late 1990s, has increased the competition. The maturity and saturation of the main world markets attracted attention to the factories, in order to achieve greater efficiency of the installed features, and more effective production processes for firms, in higher competitive level.

According to Hill (1998), globalization can be understood as a series of interconnected changes towards a more integrated and interdependent world where trade, finance, markets and production have not a purely local scope. It has been driven by several factors such as the increasing deregulation of markets, falling trade barriers, the development of new modes of transportation, and the consumer behavior change, requiring higher added value. In the automotive sector, for example, it is driven by the saturation of European, North American and Asian markets, and the potential growth of emerging contries markets (HUMPHREY *et al.*, 2000; LUNG, 2000; SCAVARDA *et al.*, 2001).

Globalization in manufacturing is characterized by the integration of the plant production processes, with logistics and operations, based on support work methodologies and management techniques, and also on applied technologies, such as ICT (Information and Communication Technologies), as a way of adding value and getting added competitive advantage.

Yip (1989) and Douglas and Craig (1989) address the globalization in business management context, conceptualize it as "*the development of internationalization strategies of companies*."

Hilletofth *et al.* (2009), on the other hand, indicate that due to competition increase, companies are forced to offer greater number and variety of personalized products, with increasingly smaller life cycles, thus obtaining greater value for the use of enterprise resources.

According to Abdulmalek *et al.* (2007), value is equivalent to something that the consumer is willing to pay for a product or service. Hansen and Mowen (2001) define competitive advantage as "*the creation of a better value to the customer by an equal or lower cost, than that offered by competitors*".

To Rother and Shook (2003), a value stream includes all essential activities of a stream by which a product passes, that may or may not create value during these processes. The authors also state that, whenever considering the perspective of the value stream, it can be expanded to a broader framework, in which there is not only individual processes improvements, but also in a systemic scenario, more global.

In response to the need for greater competitiveness, Organisations have looked for effective management of production resources approaches, application of continuous improvement concepts and techniques, not only on products, but also on processes.

According to Lima *et al.* (2009), continuous improvement expression has often been associated with the movement of Total Quality, present in Six Sigma methodologies. However, the concept can be applied to other approaches. In this sense, Caffyn (1999) considers continuous improvement as the incremental innovation process, which involves the entire organization. For Bessant *et al.* (1994), continuous improvement is easy understood and requires low investment, reason why it has been widely used as an efficient way to increase the company's competitiveness.

An important continuous improvement approach is the lean production, not only by the set of principles and techniques involved, but also by the feasible, comprehensive and prompt implementation.

According Rebelato *et al.* (2009), lean production has become an important concept in improving the quality of tasks, initially applied by the Engineer Taiichi Ohno at Toyota Corporation of Japan, in the 1950s. The Toyota Production System (TPS), how became known the set of principles used by the Japanese automaker, has been the basis of Lean system, and a response to traditional mass production, dominant system for more than a century, and that showed serious weaknesses in the face of frequent and profound market changes, that has been happen since the 1990s.

Womack and Jones (2004) state that the purpose of Lean production is the elimination of any waste, that is, all that does not add value to the product, and/or prevents the process of receiving incremental improvements. In this sense, with the waste elimination, there is an improvement in the flow of the processes and employees work, decreasing the production lead time, making the company more flexible to meet its Market demands.

Souza and Carpinetti (2014) state that in recent decades, pressures for competitiveness has led companies to implement initiatives of costs reduction and improvements in its operations, in order to provide higher quality products to meet most dynamic markets and with more requirements specific.

Thus, the application of principles of lean production lead to waste reductions and performance improvements, gaining importance as strategic weapon (TAJ and MOROSAN, 2011).

For Souza and Carpinetti (2014), the implementation of lean production is a process that requires the mapping of the current situation, the development of a production system based on lean concepts, and the application of techniques to reduce waste.

According to the autors, the evolution of the current state to the future comprises a continuous improvement process, which considers the existence of many Kaizen projects for elimination and / or reduction of all types of waste that becomes a barrier to obtaining lean processes. So, a key aspect of planning the implementation of lean production is to decide what types of waste should be prioritized.

Imai (1986) defines Kaizen as "*occasional or continuous improvement in social, family, and professional. In the workplace, Kaizen means continuous improvement in the participation of all, managers and other employees"*. Newitt (1996) explains that Kaizen word is derived from two Japanese kanji, KAI = change, and ZEN = good (for the better).

Suárez-Barraza and Miguel-Dávila (2011) complement the concept, indicating that the Kaizen is "*a set of personal principles that make you grow as a person, and that assumes that your way of life - whether at work, social, or family - deserve to be constantly improved* ".

This article aims to analyze the implementation of a supermarket of semi-finished components in the production of auto parts industry process, based on Lean principles. The article is divided into two sessions: a literature review to substantiate the concepts, principles and applications of Lean production; and an analysis of the implementation of the supermarket on autoparts plant components, correlating the various elements of structure and process followed with lean principles. The development and structure of the arguments are based on the methodology discussed below.

2. Methodology

According to Peters (2010), due the fact that lean production have its focus both on increasing the value of processes, and in the waste elimination, it has become one of the most important approaches to improving business performance in recent decades.

Also, Ballard and Tommelein (2012) state that lean production is a management approach that had its origin in the automotive industry, initially spread in other forms of repetitive manufacturing, and more recently used in service companies.

According to Marconi and Lakatos (2002), a problem must be formulated clearly and objectively. Thus, the problem addressed in this article is summarized in the following question:

> ***What principles of Lean Production are addressed in the implementation of a supermarket of semi-finished components in a production process of an auto parts industry; and the benefits expected to be achieved with this operation?***

Within the context of this work, the basic assumptions of this article are:

- A supermarket of components favors the logistic flow and reduces waste;
- The implementation of automation tools, such as the use of bar code, increases productivity and reduces operational errors;
- By implementing a supermarket components, there is a reduction in use of processing resources, such as towing vehicles, as well as physical space for storing these components.

According to Silva and Menezes (2000), a survey can be classified in four ways: on the nature, how to approach, on the objectives and on the technical procedures.

The nature of the research can be classified as basic or applied (SILVA and MENEZES, 2000).

This work is an applied research which objective is theoretically discuss the concepts and applications of Lean Production, and starting from this point, evaluate a case study in implementation of a supermarket components in an auto parts industry.

Related to the problem approach, a research can be classified into quantitative or qualitative (SILVA and MENEZES, 2000). This article, because of the characteristics and techniques used, falls into a qualitative research. This is due to the data interpretation inductive method, and main focus being the process and its meaning, beyond the researcher's role as a key element.

As for the research objectives, it can be classified, according to Silva and Menezes (2000), as exploratory, descriptive or explanatory. This research has characteristics of a predominantly descriptive research because it involves literature search and a case analysis of the application of these concepts identified in the theoretical foundation.

Regarding technical procedures, the research can be bibliographical, documentary, experimental, survey, case study, research ex-post-facto, action research or participatory research (SILVA and MENEZES, 2000). This paper consists of a case study because it considers the application of the concepts of Lean Production in an implementation of components supermarket in the auto parts industry.

The choice of case study is contingent and convergent with the nature of the problem, and the current state of knowledge. The following considerations justify the mehtod choice:

- This study focus in the use of lean production principles into an autoparts manufacturing process, specifically on the application of componentes supermarket concept, being the available literature scarce on this topic;
- Based on this study characteristics, case study proves to be the most appropriate approach for the proposed research. As suggested by McCutcheon and Meredith (1993), Yin (1989) and Eisenhardt (1989), this approach is typical for scenarios where an empirical approach will be applied;
- Research these lean production principles application on a specific manufacturing process requires the researcher to place the events in a chronology, to determine causal connections. By doing this, the case study becomes the initial basis for such causal references (YIN, 1989).

This work intends to support the relevance of the concepts presented in the literature on Lean Production with the practical application of these concepts in productive environment. The contribution is the analysis of the results, the method employed, and the direct relationship of the benefits achieved compared with that described in the literature. By the characteristics of research and appropriateness to theme, it is justified to study the theme.

3. Lean Production

Rebelato *et al.* (2009) state that the value is generated within the activities of the supply chain flow of product to the end customer. In this process of identifying activities with the greatest potential to create value, the company focuses on eliminating losses that avoid this Company to achieve greater productivity and better quality. It is importante, however, to seek in the identification of activities that do not generate value, from the end user perspective, which is not always trivial, but if properly identified and mitigated, allow the company to establish leaner operations.

Panizzolo *et al*. (2012) and Jadhav *et al*. (2014) state that in the last ten years, even industrial companies located in emerging countries such as China and India, are working to transform their processes of production, from based on low cost and intensive labor, to production of high value added, more flexible and productive, based on lean production systems.

Stone (2012), on the other hand, explains that over the last decades lean principles are used beyond the boundaries of manufacturing, acting also as performances enhancing mechanisms.

Bhasin *et al.* (2012) complement, pointing lean as a business model that delivers superior performance for customers, employees, and stakeholders in general.

Malmbrandt and Ahlstrom (2013) state that although the interest of service companies to adopt lean practices is large, research involving lean applications in services is still at an early stage.

Preliminary studies of Bowen and Youngdahl (1998) argue about the applicability of lean practices in service companies. Later were conceived conceptual studies with contributions to lean practices adaptations, originally designed for manufacturing, to services (AHLSTROM, 2004). Balle and Regnier (2007), and

Proudlove *et al*. (2008) also reported several cases of lean practices successfully adopted by service companies, especially in the healthcare industry. However, rigorous and systematic empirical research is scarce (MALMBRANDT and AHLSTROM, 2013).

Pilkington and Fitzgerald (2006) indicate that the reasons for this include: lack of conceptual clarity, and definition of operational measures of attendance.

For Chual *et al.* (2010), lean operations enable the company to reduce waste and optimize, in general, the activities of its value chain. Oduoza (2008), on the other hand, adds that lean systems that enable best practices are incorporated into business processes, such as JIT (Just in Time), TQM (Total Quality Management), continuous improvement, and Supply Chain Management (SCM).

According to Womack and Jones (1998), main losses sources are in:

- Super processing: it implies apply more effort to a service / process / information, which customers are not willing to pay;
- Transportation: moving unnecessary materials throughout the process flow;
- Handling: handling unnecessary resource processing, in particular employees, during the production process;
- Inventories: according to Martins (2009), stock is any accumulation of resources. The purpose of keeping stocks, according to Slack *et al*. (2002) is to regulate the flow / rate between supply and consumption. Traditionally, within the production, stock is considered a protective mechanism against process variability. Within the principles of Lean, however, any stock beyond what is necessary for customer service should be avoided, due to cost and processing additions;
- Wait times: are considered here any delay or time that a material spend whenever waits to be processed. It can also be categorized as expected delays for the slow processing pattern;
- Defects: defects include all aspects of the product or service that is not in accordance with the needs and or requirement of the internal / external customer or process. Are considered in this category: missing information, failure to comply with terms and conditions that result in additional work (such as the re-process of semi-finished materials);
- Overproduction: production in excess, which mean, that needed for immediate use. Overproduction can result from a lack of production prioritization, or failures on customer demand visibility. Overproduction has another negative aspect, which is the use of resources for processing of non-priority items, and consequent unavailability for use in production flexibility.

Rebelato *et al*. (2009) state that the company must set goals in order to reduce waste. Hines and Taylor (2000) define five essential principles to eliminate waste, which serve as a guide for lean transformation:

- Specify which tasks creates value for customers and the company;
- Identify all required steps for product design as well as for productive operation, in order to identify the flow losses, or non-value added activities;
- Take actions to create value stream without interruption, detours, delays or waste;
- Carry only tasks that the customer expects, ie, without the application of additional effort or overproduction;
- Evaluate constantly the flow and remove new sources of waste, as far as they are discovered.

For Spear and Bowen (1999), apud Lima *et al.* (2009), there are four basic rules which guide the development, operation, and improved activity, or interconnections flows associated with any product or service, in accordance with Figure 1.

- 1st Rule: The tasks should be fully defined in terms of content, sequence, timing, and results. Thus, the details assist in creating a basis for these activities improvement;
- 2nd Rule: Every customer-supplier relationship must be direct. They must specify precisely the employees and customers involved, the form and quantity of goods and services provided, how requests are made, and the estimated time of service;
- 3rd Rule: The flow followed by each product or service should be simple and straightforward. This rule states that goods and services flow to a predefined operator or machine. Thus it is possible to identify whether there are capacity problems with particular work center, and to work on solving it;
- 4th rule: Any improvement must be made using a scientific method, at the lowest organizational level possible. This method comprises the clear formulation of hypotheses such as "what-if", which mean that “if these modifications are done, the following results will be obtained”.

Figure 1: Four Task Improvement Basic Rules. Source: Spear e Bowen (1999) apud Lima et al. (2009)

	Creation and Operation	*Modification*
Tasks that Add Value	Rule 1	Rule 4
Interfaces among Operations	Rule 2	
Flow of Activities	Rule 3	

Likewise, Liker and Meier (2007) show the four (4) "P" underpinning the principles of lean production:

- Philosophy: Philosophy is the basis for the long-term vision. Leaders should see the company as a conduit or vehicle that adds value to stakeholders (customers, society, community, employees);
- Process: certain processes lead to certain results;
- People and Partners: Continuous development of employees and partners, in long-term, as a way of adding value;
- Problem Solving (Troubleshooting): Continuous root cause analysis for problems solution leads to organizational learning and strengthens the company.

Based on the four (4) "P" of the Toyota, Liker (2006) proposes the following principles:

- 1st. Principle: Administrative decisions should be based on long-term philosophy, even if sometimes the financial goals have to be despised;
- 2nd. Principle should be established a continuous process flow so that problems can be identified;
- 3. Principle should be used "pulled" systems to avoid overproduction and overprocessing. The JIT and Kanban allow the reduction of inventories. In addition, the problems are visible and there are conditions to eliminate them at their source;
- 4th. Principle: heijunka - The workload must be leveled;
- 5. Principle: The company culture must be molded / built / adapted to stop and solve problems as

they arise, to obtain the desired quality the first time - jidoka;

- 6. Principle: Standardization is the basis of continuous improvement, and training employees;
- 7. Principle: Visual control must be applied, so that problems are apparent (not hidden);
- 8. Principle: Reliable and fully tested technology that meets employees and processes must be used;
- 9. Principle: Search developing leaders who understand the work and its subsystems, living the lean philosophy, and feel good in teaching others;
- 10. Principle: Pursue the development of people and high-performance teams, and that follow the company philosophy and culture;
- 11. Principle: See and understand fully the situation and its implications (Gemba);
- 12. Principle: Take decisions slowly, by consensus, and consider all options. However, implements them quickly.

Other authors, however, believe that the principles above are part of a structure enablers elements, that is, if correctly applied contribute significantly to the company create lean operational flows, maximizing value for the customer and the company. These enablers are practices, techniques and methodologies that support the Lean Production (SODERQUIST and MOTWANI, 1999; RIBEIRO and MEGUELATI, 2002; SLACK *et al.*, 2002; SIMON, 2003; ROBERTS and SANTOS, 2004; MARRAS, 2005; LEAN ENTERPRISE INSTITUTE, 2007), and are formed by:

a) Just in Time (JIT): JIT comprises the supply of materials required for a process step at the time, quantity, and quality required. It assumes processes with low disturbance and high internal reliability, so it can avoid the usage of stocks, as protection mechanism. In addition, due to agility and less material handling, and also the use of smaller lots, JIT provides flexibility and shorter lead times;

b) Kanban: This is a mechanism that authorizes and directs the production or output items in a pull production system, ie, in which the work center "consumer" pull the job specification for the work center "supplier ". Thus, the consumer is the one who starts the production cycle, and the work is pulled to the extent necessary;

c) Program leveling (heijunka): It applies in cases where there is a definite cycle, since it uses a balanced mix of the daily production schedules that are set for the production of each product. Thus, it is easier to monitor compliance with production orders avoiding, at the same time, excess inventory and increased costs / lead times;

d) Setup Time Reduction: The time of set up is conceptually a waste because there is a temporary interruption in production. The smaller the setup time, greater is the flexibility and productivity of the system. One can reduce waste in activities like searching tools, and pre-preparation tasks;

e) Involvement: the commitment of employees to enable them to feel part of the process to take on more responsibilities and more fully use their skills. They are trained and motivated to take on new responsibilities in carrying out their work;

f) Visual management: mechanisms are used to facilitate understanding of the operations statuses. The content and form vary, but the most common are the performance measures, indicator lights charts, control charts, checklists and visible improvement techniques, among others;

g) Streaming: The purpose is to produce and move one item at a time throughout the process, that is, each step carries out only what is demanded by their "client", the next phase of the process. Assembly lines or work cells may be used;

h) Poka-yoke: These are devices or systems foolproof, ie implemented methods that prevent that employees make mistakes in the execution of their activities, such as choice of part, assembly, activity sequencing, etc;

i) 5S: Which consist of organizational practices, housekeeping and discipline in the workplace. Are useful for the visual management and lean production (sense of use, organization, cleanliness, standardization, and self-discipline);

j) Workforce multi skilled: is the working practice that considers the constant development of employees, that is, they can acquire skills and abilities to work in more than one process;

k) Total Productive Maintenance (TPM): Includes the constant and effective maintenance of production facilities to ensure that the production process are available and with maximum effectiveness to accomplish their tasks;

l) Value stream mapping (VSM): Process mapping that considers all stages of the flow, containing the information needed to serve customers in the delivered period. They can be drawn at different times in order to reveal improvements opportunities;

m) Empowerment: aims to give greater autonomy to employees to make decisions in times and places where they occur and are needed, which can prevent time losses on decisions process escalation to higher hierarchical levels. Empowerment also increases employees commitment.

Thus, there is an agreement among studied authors about the fundamentals of Lean Production, indicating that its correct and disciplined application creates value, and generates lean operations.

These principles will be analyzed in a case study, applied in a production process of an autoparts industry.

5. Case Study

5.1 The Company

The Autoparts Ltd is a transnational autoparts enterprise, headquarted in US. It has thirty plants wroldwide, ten in the country of origin, being present on all continents. The company employs about 60,000 direct collaborators. The annual demand for your main product is 180 million units.

In Latin America, there are eight strategic business units (SBUs), including plants and sales offices, located in Argentina, Uruguay, Chile, Brazil, Colombia, Venezuela, Peru and Mexico.

In Brazil, the Autoparts Ltd is present since late 1930s, and currently owns two plants, four sales subsidiaries, five automotive centers, and roughly 4.000 direct employees. It has a distribution network comprising of 150 distributors and about 560 sales points.

The case study of this paper is focused on the componentes production process automation, inside a manufacturing unit which produces 40,000 daily units of the main product.

5.2 The Production Process

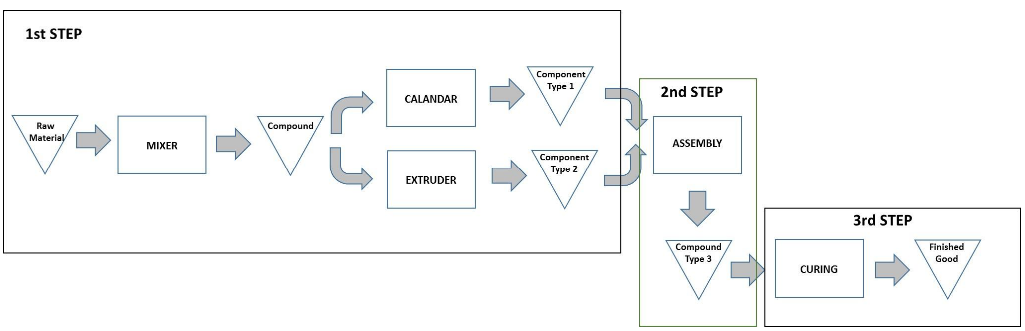
The production process consists of three main steps, as shown in Figure 2:

a) Components Preparation (1st stage): This stage involves the homogenization of raw materials to generate the compound, basic material to be used into calendering and extrusion processes, to generate the remaining components of the main product. As a result of the calendering, are generated about 15 different components (Components Type1). As a result of the extrusion, 5 different components are generated (Components Type 2);

b) Building (2nd Stage): comprises product assembling, that is, in this step the various components are added to the main product for subsequent curing process;

c) Curing (3rd Stage): Final step of the manufacturing, in which the product receives its final conformation and properties, thus being concluded.

Figure 2: Autoparts Ltd Productive Process



4.3 Components Supermarket

The project consisted of implementing a supermarket to optimize the flow and inventory reduction of two types of components (COMPA and CompB) in the assembly área (Step 2). These components are used directly as inputs for product assembly.

Prior to the implementation of the project, there was an excessive amount of Compa and CompB in assembly machines, causing time losses on scheduling changes to find the desired componente, at the time of use. The machine working condition (eg.: capacity, amount of routing tasks, layout) did not favor the organization, making the 5s efforts not being translated and potentiated in results. The analysis of the previous situation indicated the following problems:

- Excessive stocks of Compa and CompB around assembly machines;
- Inappropriate layout for effective material flow;
- Time losses due to lack of inputed components;
- FIFO (First In First Out) system not used;
- Inappropriate use of the remaining component batches;
- Operations with unnecessary tasks;
- Manual controls;
- Components Scrap out of date and unbalanced.

During the project planning phase, were held meetings with the participatory of employees who were directly and indirectly linked to the process. The objective was to collect, classify and prioritize ideas for later implementation. This involvement was crucial and brought better results because employees felt accountable for gains that the project would bring.

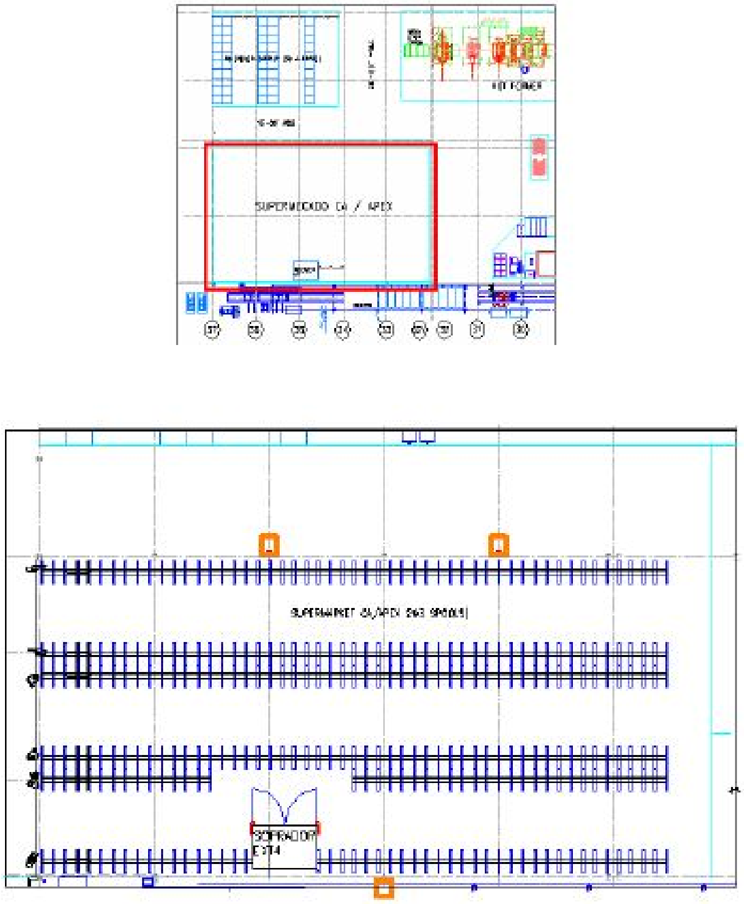
In the project definition were raised various items such as: identification of opportunities with operators; creation of a process called "Plan For Every Part" area (PFEP), which implies that all the component used in the process must be planned in terms of flow and level, batch and inventory level; study and adaptation of the layout; creation of visual supermarket; determination of rules to be applied into supply logistics; designing and installing operating devices; train operators; testing and Startup.

The method used in the project was based on the procedures described by Hines and Taylor (2000) *apud* Rebelato *et al.* (2009), above.

As support for the componentes supermarket operation was installed a computerized system, with barcode readers, and all materials wiht their batches, existing quantities were identified. This scanner system works via radio communication, and it has all data stored in a single database into a shop floor information technology solution, designed to address the following requirements: instantaneous location of all components in the area; elimination of lost time on the machine due to lack of components; reduced time for inventory counts; elimination lost time during material balancing; immediate visualization of components batch quantities remaining on assembly machines and also on the supermarket; reduced lost time in the extruder production (Stage 1) due to equipment lack (eg.: cars); immediate disposal of waste for overdue materials; information of the last car (kanban) used in the assembly machine; elimination of erros due to manual input (causing batch duplication); operador not required to leave its work position (into cars) to input data; generation of consumer Reports, like components by machine; functions as Poka-yoke when data are included incorrectly; improvement of information reliability / agility; inventory reduction of 10% to 20%; possibility of extending the project for use in the other processes and áreas of the plant.

The flow was also changed. Was created a location for storing the remaining quantities of a particular batch (Figure 3). Such components have a shelf life of a few hours before losing its physical and chemical properties, so their prompt use is a critical factor in the process. Thus, there is a decrease in the number of scraped components because assembly machines will use the remainder of componentes batches, and which eventually left over, returns to the Supermarket.

Figure 3: Layout of Components Supermarket



Another modification is the route that suppliers do. For components delivering are used tow trucks and cars. Due to routes reduction, the fuel rquired to be used in these vehicles decreased, and there is less time lost in moving cars, as the level of use of these cars has increased, and minimized the absence of such equipment, which was identified before implementation of the Supermarket.

This project scope, named Project A, consists in developing a solution of ICT (Information and Communication) to:

- Perform raw materials transfer from raw materials warehouse (A) to consumption warehouse (B), this latter located at the production starting point. This transfer occurs by means of bar codes reading, and consequent inclusion on the corporate ERP – Enterprise Resource Planning (SAP). For this process, the concept of FIFO (First In First Out) was observed;
- Automatic raw material stock consumption, in mixing, calendering and extrusion processes, by reading barcode label material, and consequent registration in MES (Manufacturing Execution System), ando n SAP.

For this project implementation, was selected a multifunctional team, with participants from logistics (5), Manufacturing (8), Engineering (3), Finance (3), and IT (5), besides three partners companies, being one for developments in SAP ERP, other to do adjustments to the MES system, and the last to make integration of plant floor systems with global manufacturing systems.

4.4 Results Analysis

There were gains in several areas of the process because performance measures improved in one dimension affect other positively. The results corroborate the fact explained by Hill (1998), that traditional trade-offs among competitive priorities can be eliminated if a set of activities that strengthen and create value are selected.

As a result of the componentes supermarket implementation were an average reduction of the use of car components, from 41 to 18 units.

Regarding the overdue materials, daily the amount stated 19% of the total, corresponding to 8 loaded cars. This fact occurred mainly due the difficult to locate the material, and due to componentes overproduction. This number dropped to less than 1%.

There was also a reduction in the need of line products balancing, by about 50%. This result was not higher because of existing opportunity in the production process, and which requires financial investment in automation of the extruders (production process stage 2).

The movement of the car trailers also decreased due to the pre-determined routes. Before, the moving average of these cars was 160 km / day each, now the most efficient route decreased to 112 km / day, a reduction of 30%.

The reduction of inventories was a key to the success of the project, because it made possible the reduction of 284 cars to 200, representing 30% of stocks reduction.

In economic terms, the reduction is about US$ 340,000 in scrap components, US$ 40,000 in fuel consumption, and US$ 55,000 in vehicles maintenance. The total investment in the project, including equipments purchase, information system deployment, and services implementation was US$ 120,000, which presented financial return in 3.6 months, after implementation.

6. Conclusions

The article related the concepts, principles and tools of Lean Production techniques with the process and results of the implementation of a componentes supermarket, in the production of autoparts industry.
Lean establishes guiding principles of work. According to Womack and James (1998), among these principles are: creating and analyzing a process flow to identify the activities that add value to the products or not, the use of production systems "pulled", the search for the disposal of waste of any kind (overproduction, waiting, inventory, super processing defects, handling and transport). For the operations may be changed and be lean, it is necessary to use enablers described in Soderquist and Motwani (1999), Ribeiro and Meguelati (2002), Slack *et al.* (2002), Simon (2003), Roberts and Santos (2004), Marras (2005) and Lean Enterprise Institute (2007), which are: Just in Time, Kanban, Heijunka, Poka-yoke, continuous flow, time reduction set up, Total Productive Maintenance (TPM), 5S, multi-skilled Works, people involvement, visual management, Empowerment, and Value Stream Mapping. These enablers, however, should be applied to each production reality in a unique way, according to the characteristics of each company, in structural terms, aligned to cultural, functional, or technology maturity of the enterprise. The article demonstrated the case study of the implementation of a componente supermarket, comparing the results of the process of components assembly before and after, identifying the obtained results. These results show that principles and techniques that guide the Lean Production are important tools in the arsenal of any competitive industry.

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