Lean Management in Brazilian Small and Medium Enterprises: a Case Study in the Technology Sector

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Abstract

The present study aims to assess the lean practices and principles in a small business from the Lean Management System. It follows a qualitative methodology, featured as a case study, which crosses the analysis of information obtained through observation visits in a company and interviews with the CEO and the Chief of Production. The key findings show the main difficulties in establishing lean practices in small and medium enterprises (SMEs), related to the Brazilian context of technology. Among the highlights of the study there is the emphasis in design of strategic networks with customers, suppliers and internal leadership training. This is a preliminary research that has prospects of extending out about future comparative studies, advancing on a field of study which is still open and necessary in the country.

Keywords: Lean Management System; Qualitative Assessment; Small and Medium Enterprises; Technology; Telephone Stations.

1 Introduction

Contemporarily recognized, the Lean Production Management is associated with an increased global competitiveness and has gained ground among executives, researchers and corporations (Womack, Jones & Roos, 1992; Furini & Saurin, 2008; Veiga *et al.*, 2008). Guided by the purpose of creating value for customers with lower costs by identifying process improvement through the involvement of qualified, motivated and with initiative workers (Ohno, 1997; Lean Institute Brasil, 2011), the Lean Production Management is also identified generically as Lean Management System (Emiliani & Stec, 2005).

The support of Lean Management System excels in simplicity and clarity of procedures and tools to all involved, especially "(...) the effective use of technological innovations in products, processes and organization of companies" (Silva Neto, 2000, p. 12). It performs deliveries just-in-time, where time and quality are the guiding performance of machines and teams with the fewest losses (Shingo, 1996; Lima & Zawislak, 2003). Its principles include the continuous improvement related to leadership development (Emiliani, Stec, 2005), while the practice "involves creating streams and pull systems, based on actual customer demand, analyzing and improving the value stream plants and the whole chain, from raw materials to finished products" (Lean Institute Brasil, 2011).

The lean proposal supports the accessible production development to companies of different sizes, operating in various business segments (Lean Institute Brasil, 2011). Considering the Brazilian reality, an opportunity of study is available considering lean management in Brazilian small and medium enterprises (SMEs). Companies of this size in the country may be highlighted because they are most noteworthy and also for being linked to multiple business segments involved in the development of the country.

According to the Inter-Union Department of Statistics and Socioeconomic Studies (Dieese) and Service to Support Micro and Small Enterprises – Sebrae (2009), the number of industrial SMEs in Brazil reached 55,938 in 2008; 14,248 of these firms (25% approximately of the total) are found in South and 4,947 in the Rio Grande do Sul state. Even in the South, industrial SMEs accounted for 52% of the 1,896,199 formal jobs. Another survey, elaborated by Sebrae (2009), shows that small businesses in the country tend to

maintain a continuous monitoring of cash flow (86%) and 82% continually assess market trends, which indicates they are trying to get close to Brazil's industrial performance.

As pointed by Amato Neto and Olave (2001), SMEs began to incorporate technology in their production processes to change their internal organizational processes in order to restructure and compete in a scenario dominated by large companies. In turn, Balestrin and Vargas (2004) commented the importance of strategic networking to the SMEs on way that they can optimize and streamline their business partnerships with suppliers.

Cândido and Abreu (2000) reinforced the need for strategic networks in order to compete in an industrial environment of changes and increased complexity. The authors emphasize the main changes between technical obsolescence, the increased supply, entry of competitors, the government participation in the macroeconomic level, the demands of customers by lower price and higher quality, market fluctuations with increased uncertainty in decision-making processes.

Thus, according to the authors, it is necessary to stimulate the entrepreneurial spirit for survival and development of SMEs because they generate jobs and incomes and also for its innovative character without lots of bureaucracy. These are companies that can support the market arbitrariness and find opportunities to develop consumption demands.

However, there are few cases of SMEs in the technology sector that have implemented lean production as a corporate philosophy. Several companies just focus on the application of lean tools, with no more concern about the holistic view of processes and training of leaders and teams (Scaffede, 2002). Furthermore, these companies often face systemic problems as their low competitive ability, training policies ineffective, delays, technological obsolescence, lack of resources for investment in research and development, difficulty of entry into international markets. In relation to new management technologies, it is necessary for SMEs to invest in new models and techniques, able to impact the company as a whole (Cândido & Abreu, 2000; Achanga *et al.,* 2006). Therefore, the Lean Management System may represent a key factor for survival.

Considering the present scenario of frequent changes and the identified gap, this paper aims to study the case of SMEs in the technology business that seeks to differentiate themselves by quality processes. The main objective is to evaluate the production process of a small business from the Lean Management System perspective, checking the existing level of lean production inside companies.

It should be noted that this work is part of an exploratory study conducted within an average company in the technology sector of telephone systems. This is an initial assessment, with results taken from the evaluation of lean principles related to strategic partnerships with customers, suppliers, competitors. Through comparisons between the referenced lean models and the production model of the company, it is possible to understand the degree of lean development inside the firm. It is part of the work the understanding of how strategic networks with competitors, clients and suppliers are formed and how the company is leading with the dynamics of teamwork and diffusion of knowledge internally.

Further studies are still being conducted in the company so that, from the data presented, will be possible to analyze the losses of the production process adopted in the company and its conversion to lean management model, with adjustments compatible to the company's reality. Future studies are encouraged in order to increase the range the companies researched in the field of technology, primarily related to the growing segment of telecommunication in Brazil.

2 Methodological Procedures

Based on the appropriation of concepts taken from reference studies about Lean Management System, this research follows a qualitative methodology (Malhotra, 2001), which was held in a case study (Yin, 2009) in a small to medium size company (Sebrae, 2009). This company is located in a technological pole of the Metropolitan Region of Porto Alegre city, with emphasis on their approach to the reality of SME

technology in Brazil. The study was conducted in two distinct and complementary activities of gathering information: first with managers, and second by an observation oriented process.

2.1 In-depth interviews

Two in-depth interviews were conducted with a semi-structured script and average duration of one hour and thirty minutes. The first interview was conducted with the CEO of the company, making possible to understand the company's business. The second interview was done with the Chief of Production, responsible for coordinating and supervising all production processes, including the times of work, quality testing, inventory management, scheduling and closure of production orders (POs).

Both interview's content were different and based on the fourteen Liker and Meier (2006). On this way, an adjustment was made on the script so that the interview with the CEO prioritized assessment of the company's strategic profile, their formation of networks, a leadership training and employee development, and how the objectives in the medium to long term. The interview with the Chief of Production prioritized understanding of the actual production, as well as visualization of deployment of lean practices, monitoring of production times, flows and work routines, as shown in Table 1.

Table 1: Lean principles in interviews

N.	Principle	Interview with CEO	Interview with Chief of Production
1	Base your management decisions and a long-term philosophy, even at the expense of short-term financial goals.	x	
2	Create a continuous process flow to bring problems to surface.		X
3	Use pull systems to avoid overproduction.		X
4	Level out the workload.		X
5	Build a culture of stopping to fix problems, to get quality right the first time.	x	X
6	Standardized tasks and processes are the foundations for continuous improvement and employee empowerment.	x	X
7	Use visual control so no problems are hidden.		X
8	Use only reliable, thoroughly tested technology that servers your people and processes.		X
9	Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.	x	
10	Develop exceptional people and teams who follow the company's philosophy.	x	X
11	Respect your network of partners and suppliers by challenging them and helping them to improve.	x	X
12	Go and see for yourself to thoroughly understand the situation.	x	
13	Make decisions slowly by consensus thoroughly considering all options, implement them quickly.	x	
14	Become a learning organization through relentless reflection and continuous improvement.	x	

Source: adapted from Liker and Meier (2006).

2.2 Observation oriented process

After interviews, observations were made directly on the targeted production area, which had three visits, lasting about two hours each. From the observations and photographic records the following practices were assessed: continuous flow and pull production, supply chain integration, production leveling, balancing production, standardized operations, flexibility of workers; zero defect quality control (ZDQC), total productive maintenance (TPM), rapid exchange of tools, visual management, continuous improvement, value stream mapping (VSM) (Ferreira & Saurin, 2008).

Documents of production flows and production times were evaluated and contrasted with the information collected in the interview. The previous results were presented and reviewed with the Chief of Production,

which was asked an opinion on the interpretations made by the researchers. In addition, outstanding questions were solved.

All data collected were organized through a table adapted from Rother and Shook (1998) and Lima and Zawislak (2003). In the application made to it all, the table has four main blocks with relevant information about the production model of the analyzed company. In the first block were raised general aspects of the company's profile. The second section presented topics of client relationships. The third block, production processes appear briefly. At last, in the fourth block, the relationships with suppliers were highlighted. The proposed information table is a short form of reporting to facilitate the understanding of the formation of strategic relationships in the company, and to facilitate future comparative studies.

3 Findings

The key findings presented are discussed based on the understanding of the company, its business and its production practices, followed by evaluation of leadership training, as explained in subsequent sections.

3.1 Company's Profile

The company studied is small to medium size, headquartered in the technology hub in the metropolitan area of Porto Alegre city – RS. For more than a decade, the company has been working with telecommunications access products, targeted to produce telephone stations with digital technology. About one hundred employees work at the company, distributed in the parent firm, in a commercial office in São Paulo – SP, and in commercial representations in various capitals of the country. Altogether, this firm manufactures eight product families that have between two and eight products each. Initially, its scope was just selling call centers with fully outsourced production. With the business growth, however, the company felt the need to set up its own production processes, and redesigned it for all products.

In addition to its production, the company's business also covers support services, and software support to provide outsourced services to the information Technology Department of its corporate customers. The company defines its market as fast and dynamic, which requires continuous improvement by the players. The main concentration of clients is located in the Brazilian market, although this is a business with a global profile.

Its indirect competitors are big players in the telecommunications access products, which serve as reference for their work. To follow the strategies of competitors and to improve strategic networks, sales representatives frequently visit international technology fairs. On its turn, the direct competitors are midsize companies in the industry, which seek to expand its market share by adding services to products offered. An important point that should be noted is the fact that the industry as a whole has struggled with the entry of Chinese production, making it cheaper to buy Chinese parts and assembly them in Brazil than design and produce every component or product.

3.2 Production Processes

In the analyzed company, production is characterized by being pushed, not pulled – which would be indicated in a Lean Management System – basically being driven from the time machine. This contributes to an imbalance in production, responsible for transform the testing area in the bottleneck, compromising the continuity of the flow.

The production process is organized in a layout in a "U" format, where the entry of materials is also the exit for finished products. It is possible to identify an attempt to build unit cell due to the proximity of space between jobs and information flow, current and available to everyone through the system.

The forecast demand is made entirely based on sales forecast for the Sales Area pointed to the most requested products and assembly-to-order products for fewer orders. The prediction is made monthly, also considering the following two months (30 + 60 + 90 days). Based on the current month, the production emphasizes the weekly demand and daily demand. The production order (PO) is released into

the system, but in more than one operation, not necessarily in sequential order. The sales orders are closed in the afternoon the day before and start the next day.

The formula of scaling is automated so that each PO is evaluated considering the existence of raw material in stock and the existence of finished products or not. Software programs are used to promote a better and controlled schedule of production. These programs offer a sequence to be produced based on the optimization of machine setup times. This sequence is reviewed and approved and/ or changed by the operator.

It is important to point out that the company constantly has to deal with urgent, business closings coming from outside what may influence and change the production order. In these situations, all the demand forecast is revised weekly and monthly, with rearrangements of POs, fractionation of batch production and negotiation between the Production Department and Sales Area in order to reallocate priorities.

Furthermore, definitions are not clear in relation to measurements of lead time, takt time and cycle times. Currently, the calculations of cycle time of machines and manpower are reviewed monthly by product. The lead time is calculated and funded within the product structure as a function of demand issued by the Sales Area. Such times (lead time and cycle times) are applied to software, especially for controls setups and organization of POs. The takt time is not part of the daily production and is only available in spreadsheets in the system, without viewing and daily control of the operators. Tables 2 and 3 exemplified the distribution of production time between work positions and workers, and the capacity per week and per month.

Table 2: Production time per workstation (minutes) – product family 001

	1 worker			**2 workers**		**2 workers**		**1 worker**	**1 worker**	**3 workers**	**1 worker**
Family 001	**Setup SMD**	**Assembly SMD**	**Inspection SMD**	**Setup PTH**	**Assembly PTH**	**Setup solder**	**Solder**	**Final inspection**	**Pre-test**	**Test**	**Package**
Base XT 130	100	13	5	15	18	20	5	10	13	60	8
Total Prod. Time						269,00					
Base XT 88	100	13	5	15	18	20	5	10	13	57	8
Total Prod. Time						266,00					

Source: analyzed company (2011)

Table 3: Production time per week (minutes) in each workstation – product family 001

Total Production Time	**Bottleneck**	**Factory (Mon-Thus)**	**Factory (Fri)**	**Capacity (Mon-Thus)**	**Capacity (Fri)**	**Total (week)**	**Total (month)**
269,00	30	525	465	9,53	7,53	45,67	182,67
266,00	27	525	465	10,59	8,37	50,74	202,96

Source: analyzed company (2011)

As a result of imperfect adjustment between demand and time measurements, the production line is often overloaded, which can generate higher production than the demand. This is a serious problem that features a push production, out the logic of lean production in small batches, perfect times, according to

demand. The weakness of the organization in production times shows a lack of appropriate involvement among processes and people.

3.3 Quality procedures and decision-making process

Since it is a small to medium-sized company, it frequently deals with problems typical of this kind of business model in the Brazilian context. Overall, the company cares for its quality certifications, although there are points to be improved about testing and quality indicators. In relation to the machines, the company chooses, whenever possible, preventive maintenance, in which every 3.000 hours the machine should be reviewed. The corrective maintenance is only done in extreme cases, when the machine really has problems that require it to stop for repairs. Already operational effectiveness of equipment does not have measurements, which undertakes a better assessment in this regard.

At the beginning of the production line, there is an initial inspection before the initialization process in the machine. This is done either through software or through the inspection of the operator. However, beyond the capabilities of the software itself, there are not 'poka-yokes' (failsafe devices) to strengthen this inspection. In addition, many processes that would require the inspection are made after assembly of the product/component. As mentioned by the Chief of Production, the ideal would be more automated processes with bar codes, preventing human error and even error in the production of boards a whole lot.

In case of any problems during board assembly, the machines have autonomation or 'jidoka' (Liker & Meier, 2006) to stop the process, the same way that operators can stop the line in case of non-compliance. This is constantly monitored through monitors and 'andons' (visual warning devices), which signal problems or downtime. Any problem is immediately solved, without continuity until the process is entirely restored. There is also an expert within the company in order to expedite resolution of problems and nonconformities.

The machines are near each other, which facilitates the process. Supermarkets and tools are also nearby, which prevents large losses with transportation (materials) and movement (people). Flows between supermarkets and storage have an operator to replace the parts. This is not done with kanbans, but by visual evaluation and also according with the PO available in the system, suggesting the required number of pieces per day. There is no visual indicator that could signal with different colors or markings the need of replacement.

Since the first plate is produced, it is hundred per cent conferred, which means all the components are thoroughly inspected by an operator at the end of the line of machines, as available in the model available in the system. This piece serves as a template and poka-yoke control for the subsequent pieces. These subsequent pieces have an informative inspection that is done by visual assessment, checking if the components are in the right places. After that, the pieces are placed on the shelf for assembly.

The plates with problems are sent to a supermarket of non-conforming parts. Monthly, non-conforming parts are registered for control. Having identified a non-compliance at the end of the line, the process is also stopped and corrected, so that the other parts will not have with the same defect. Conforming parts are sent to the packaging sector, and then to the expedition or to the stock (Figure 1).

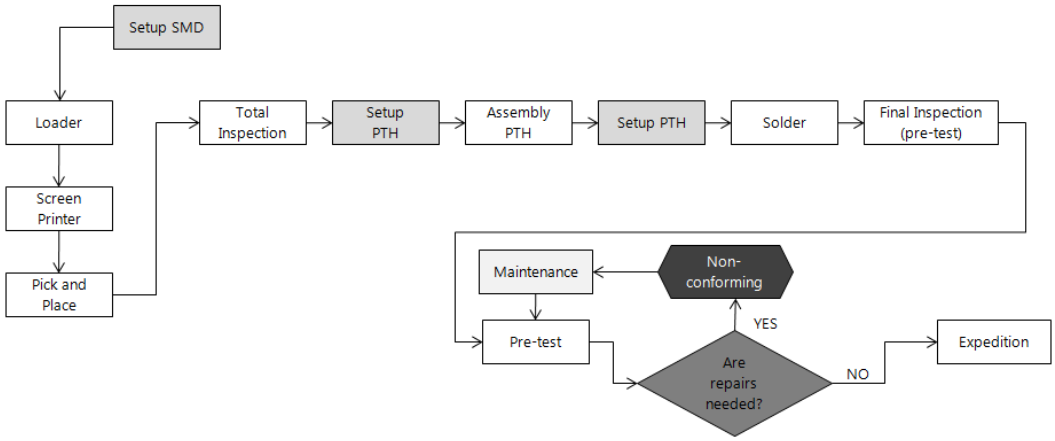

Figure 1: Flow of conforming and non-conforming parts. Source: analyzed company (2011)

3.4 Standardization of word and strategic networks

It is understood that the practices reflect corporate principles. Among the most interesting points, it is important to notice the way and the competence of the company to know how to indoctrinate and retain its leaders, aligned with the organization's strategic goals. In relation to the task, it was observed that the company has multifunctional operators, trained to perform more than one activity and to support colleagues in different parts of the plant.

In relation to training and knowledge management in the company, there is a search for costs optimization tied to the passage of knowledge between employees. Thus, new employees receive training and activities are taught by a colleague with more experience. Eventually, there are workshops to update groups of employees. It is restricted, therefore, participation in outside activities of operators, and also restricted the collective training which reduces the possibilities of exchanges ideas.

The leadership training ends up being very technical and operational, with little vision of the business model as a whole and comprehensive understanding of the company's strategic objectives. The goals pursued by the Sales Area are searched daily, but with a planning that is not always followed, as seen in the input demand and eventually destabilized the technical formulations. The emergency demands require greater strategic and tactical skills so that processes could be optimized.

About continuous improvement it is possible to say there is an attempt to encourage participation of operators in the improvement of activities. The improvements can be suggested by employees, and documented, and if approved by the Coordination of Production and Management, they can be implemented. However, the formation of strong leaders capable of promoting business innovation is still weak, with little emphasis on lean management, and dissemination of principles and practices. This is reflected as one of the key points of changing necessary in the company to promote the continuity of an growth curve.

In general, the Chief of Production is the person with greater knowledge and greater contacts with the administrative sectors of the company, responsible for disseminate knowledge in the manufacturing area. Her role is also to manage software and flows. Lack of lean concepts like lead time and takt time makes it difficult for operators to have greater autonomy. The available data are not updated as often as necessary, which also causes difficulties in autonomy by employees.

Table 3: Company's profile and strategic networks

General Information	
Foundation year: 1999 **Size:** small to medium **Sector:** technology	**Market:** telecommunications access products **Main products:** telephone stations and support services
Internal networks – production processes	
Production stages related to the product: setup, loader, screen printer, pick and place machine, total inspection and pre-test, assembly area, solder, test, expedition **How occurs the production shooting:** Sales Area sends the planning of the demand forecast to Production Area; setups and time of machines are arranged according to this **Principles related:** 1, 2, 3, 4, 6, 7, 8, 13, 14	**Production layout:** "U" format. The production is pushed **Use of tools for planning and production control:** softwares, machines and some tables help to plan and control production. Takt time and lead time are not visible for all the operators all the time **Work shifts:** morning shift – lunch time – noon shift
Networks with clients	
Main clients: Brazilian corporate clients; some clients in Latin America, Africa, Australia and Iran **Frequency of delivery:** variable according to demand forecast **Frequency of forecast:** planned for three months (30+60+90); unusual products are produce as *assembly-to-order* **Principles evaluated:** 3, 11, 14	**Transport of finished products:** big batches are preferred **Packing of finished products:** products are assembled and packed to order, according to demand forecast; for common products, the company uses large batches packed
Networks with supplier	
Main raw material: plates, chips and electronic pieces, steel and copper **Transportation of raw materials:** most of the raw materials come in big marine containers **Raw package:** large batches **Main suppliers:** Chinese suppliers are the most important suppliers but there are small Brazilian suppliers spread in the country **Principles evaluated:** 3, 8,11, 14	**Average amount acquired:** the company prefers to buy raw materials due to overly tight market, the import costs and shipping delays **Frequency of delivery:** low frequency of delivery; sometimes it can take more than a entire month **Frequency of shopping forecast:** it is not frequent, considering the shipping costs
Networks with workers	
Knowledge management: knowledge focused in people only, not in processes **Leadership education:** most of the workers are not prepared to become leaders **Acquisition of knowledge:** empirical, based on experience **Company's structure:** vertical, the processes are not horizontal and knowledge is barely spread **Principles evaluated:** 5, 6, 9, 10, 11, 12, 13, 14	**Frequency of training:** low frequency of training **Lean principles and practices:** not diffused between workers and coworkers **Diffusion of strategic objectives:** the workers do not have in mind the most important objectives and work in a operational mode most of the time

Source: analyzed company; adapted from Rother and Shook (1998); Lima and Zawislak (2003)

4 Conclusion

The present study sought to evaluate the implementation of lean practices in a small business from the Lean Management System concepts, through a case study. Overall, the key findings obtained by observation and in-depth interviews have shown that the company has some lean production practices inserted in a productive composition that is pushed and traditional (Lima & Zawislak, 2003). In such

context, the reality of business is not far from their peers and reflects weakness in the integration with the supply chain, the balancing of production and continued production. The weakness in these three practices also leads to weakness in the value stream mapping and continuous improvement. Practices such as rapid exchange of tools, visual management and leveling of production are still dubious and not strong enough to propel the company.

On the other hand, there are practices that the company has implemented to improve and reduce its losses, such as the standardization of operations, quality control, zero defects, total productive maintenance and flexibility of manpower. These practices are a competitive factor for companies that are competing among market giants. This practices already applied can serve as a differential because there is the possibility of companies of this size to optimize their workforce, enabling it to multi-functionality linked to optimal control of processes and final product quality.

Thus, it is important to emphasize in the case studied the contrast of resource constraints, space and time to analyze and implement changes. The analyzed company often chooses to learn from the experience and empiricism in managing its processes with strategy based on differentiation through the constant search for an efficient quality control and customer satisfaction – though such a strategy could mean, sometimes, increased production time. This represents part of the company's survival, considering the volatile market segment where the company is placed.

One of the most critical points that affect a healthy process of inspection, promotes a lot of rework and generates various losses is the puller relationship with the Chinese suppliers chain, which are conspicuous by low costs but offer no guarantees of quality needed in the standard deliveries of the company. In a vision macro-environmental, this point affects not only the company in question, but the entire industry of technology in which the company is linked. In the case of SMEs, it becomes even more critical because it implies in some strategic crucial decisions about their inventory and their production times and delivery. Understanding these critical points is necessary, considering the Brazilian economic development and the investments of the country in technology in the last years, strengthening the capitalization of the technology sector as a whole – including suppliers, strategic business partners, customers and governments.

In a wide view towards the subject, this work contributes to add a qualitative analysis not only in relation to a specific company, but also related to the difficulties and uncertainties of Brazilian small technology industry. Initially it was evident the lack of scientific studies in the area, as well as there are few lean assessment tools to SMEs. More research must still be performed to propose and consolidate lean models for small and medium businesses. As commented in the beginning, this is a preliminary study and it is planned to be continued with the assessment of losses inside small companies, belonging to the technology sector in Brazil.

Besides that, other methods must be worked in this line of research, in order to eliminate subjective and particular aspects inherent to case studies with qualitative profile. The first steps toward the Lean Management System have already been taken. However, it is still needed to assume the lean system in a strategic way, encompassing the organization at the corporate level. Therefore, it is suggest further research in the area in order to make up a more complete picture of the Lean Management System in SMEs.

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