



Six Sigma Project in a Vendor Company of Transmission Systems for Automotive Industry: A Brazilian Experience

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Abstract: Six Sigma has been gaining more and more space in business as a very effective tool to solve structural problems by reducing the process variation and supply of products and services within the needs of customers. The main way that seeks to achieve this goal is through the development of projects for improvement. In this paper an analysis of a project cost reduction tool in an industry supply systems for the automotive industry is presented. The research methodology used in the study is based on case study accompanied by exploratory research. Data analysis provided positive evidence that the factors mentioned influence effectively the success and consolidation of Six Sigma and its tools in the company studied.

Keywords: Six Sigma, Lean, 5 Why, GUT, cost reduction

Paper received: 30/09/2014

Paper accepted for Publication: 30/03/2015

INTRODUCTION

Administrative theories used in modern times invariably cite the need to implement improvements in business. Are motivated by customers, or by competitors, they are considered fundamental to the company's survival in an environment of continuous change as it currently presents. An alternative improvement can arise from programs that support competitiveness and organizational performance as the Six Sigma program. According to Santos and Martins (2005), the Six Sigma program has been gaining momentum in organizations as a quality program that promotes the increase organizational performance and, therefore, is becoming increasingly inserted at strategic level of organizations.

According Gerolamo (2003), that improvement actions are consistent with the strategy it takes to unfold it and prioritize investment in areas that foster the desired strategy. In Six Sigma, the prioritization can be achieved through the selection of Six Sigma projects, as this process directs the force enhancement (WERKEMA, 2004). In Brazil, Six Sigma has been disseminated since 1997, when the Brasmotor Group introduced the program in its activities and was found in 1999 earnings of 20 million reais (WERKEMA, 2002a). However, there are few data regarding the results obtained with a more extensive application of Six Sigma program in the country.

The description of several successful cases of the results of investment in Six Sigma (Coronado, Antony, 2002) sparked interest organizations on the subject of various industrial sectors because of enabling not only improve the quality of products, services and processes, but also by allowing a significant increase in organizational performance, culture change and increasing human capital. Because of the growing need to seek the reduction of production costs, eliminating waste and reducing variability in business critical processes, statistical thinking and statistical methods came to be valued as a vital means to achieve the strategic goals of some organizations, having strategic alignment as a catalyst.

Over the last decade, Six Sigma has been consolidated as a comprehensive approach that is aligned with the implementation of strategies that promote the improvement of business performance, increasing the competitive potential and driving the strategic and managerial actions that: (a) prioritize continuous improvement of quality products and / or services; (b) boost the capacity for innovation, despite the difficulty of establishing competitive advantages; and (c) reduce costs and waste. In light of their implications, these organizational actions are gaining more prominence and attention, not only in the academic community but also in business (SANTOS, 2005). These aspects suggest that the implementation of Six Sigma program is treated as a broad topic, set strategic actions to those mentioned above, and with coverage that goes beyond the application of a systematic methodology for project implementation.

THEORETICAL ON THE LEAN - SIX SIGMA

Lean Production

The Lean Production or Lean Manufacturing, also known simply as Lean is a management methodology popularized in the early 90s. This production system is based principally improving quality and reducing production times and costs by removing whatever is considered wasteful in the eyes of the customer.

Many of the basic principles of Lean arise naturally from common sense, since there

are many examples of its application throughout history. However, only in the early twentieth century the importance of waste reduction as a way to increase profits began to be properly acknowledged and documented. Publications by Frederick Taylor (1911) and Henry Ford (1922) introduce concepts such as standardization and different sources of waste. Despite the success of large-scale production system of Ford due to its efficiency, this presented some problems like lack of flexibility on the production and weak capacity for innovation. It is in this sense that Toyota began to develop almost from the outset a set of ideas that would give the Toyota Production System (TPS).

The TPS is the major precursor of Lean methodology. Was initially based on the methods of Ford and inventory reduction Just-In-Time (JIT), the great evolution of the TPS strategy took place between 1948 and 1975 by the hand of engineers as Taiichi Ohno and Shigeo Shingo. Like Ford, TPS focuses on maximizing the efficiency of a process, there are however a greater concern with the ability to process response to market fluctuations and increased attention to the real needs of the customer. Put simply, as expressed in *The Toyota Way*, is intended to develop “fast processes, flexible to provide customers what they want, when they want, the highest quality and at affordable costs” (LIKER 2005).

To achieve this goal, the TPS strategy focuses on eliminating overhead (Muri), inconsistency (Mura) and waste (Muda) process. The removal of these elements of the process is done through the use together of various concepts and techniques, including: JIT, Kanban (signage), 5S (organization of the workspace), Kaizen (continuous improvement) and the Poka-yoke (error-proofing) (LIKER, COSTA & HOSEUS 2009).

Despite being a mistake to consider the Lean just a generalization of the TPS to other industries and concepts, there are some differences, especially at the level of implementation of the two systems, the two terms are often seen as synonymous. As in the case of TPS, one of the pillars of the Lean is the removal of all actions or elements that do not add value to the product in the eyes of the customer, ie removing all sources of process waste. Compared to TPS, Lean is more focused on the elimination of Muda, sources of waste that arise when a process is already deployed, as opposed to Muri and Mura that arise in the stages of planning and design. The seven types of changes considered by the original TPS is defective; on production; transport; excess inventory; movement; waiting time; inadequate processes. Have recently been considered other sources of waste as the human untapped potential and information poor.

With regard to the implementation of a pull mindset, Lean mainly uses the JIT and tools like the Kanban. In the case of continuous improvement, the mechanism used by Lean is the Kaizen. Kaizen is a cyclical process where participating members from all sectors of an organization to solve a problem or optimize a section of a process. The Kaizen usually consists of small spontaneous meetings between workers to resolve a fault, also existing Kaizen events lasting a week where an issue is thoroughly discussed, looking this way, seek solutions themselves. (IMAI, 1996)

Finally, with regard to the impact of Lean in an organization’s mindset, deserve mention two principles: the importance of people in the organization and the development of good relations with customers and suppliers. In a Lean organization is given a prominent role to each element of the company structure, ie, believes that the intellectual capacity of all employees is a precious resource must therefore educate every person in the Lean philosophy and opportunities should be given for people to evolve, participate in Lean initiatives and contribute ideas for improving

the company. With regard to the relations of the organization with its partners, it is important that the customer relationships are very close in order to meet their real needs. Also the vendor relationships should not be overlooked, it is essential to educate them on Lean practices so that they can respond appropriately to the needs of the organization (WOMACK & JONES, 2004).

The Lean philosophy is “successful initiatives that drive increased efficiency and low cost of inventory, increased productivity and flexibility and fast response time for the customer” Subramaniam (2007), and this is due to connection given in full flow value chain. For the same bias Todorut et. Al. (2012) argues for the importance of management for this feature is a lean and agile management system, able to adapt quickly to “all the changes in the environment” and also by the aforementioned advantage in the above paragraphs. The same authors conceptualize this management philosophy supported by Badea (2009) as an evolution of guidelines perfectly correlated with production conditions in which companies of the century, that is, understand the process of evolution and adaptation to changes as the main concept for organization. Therefore, the manufacturing Lean brings the customer value and eradicate unnecessary activities, accordingly suppresses undue costs of the process and is aimed at all higher gain, not restricted to a part but all sectors and their activities and integrates a single thread management, allows possible changes more easily and from this perspective makes the company competitive.

The five principles of Lean Thinking

As Roger, Martha (2010), there are five principles of Lean Mindset for implementation of this philosophy, as shown in chart 1.

Value	Identify what the needs and expectations of its customers, so that thus can satisfy them and charge them at a specific price in order to increase their profits through continuous process improvement, cost reduction and satisfaction customer.
Flow Value	Identify and analyze to dismember the production chain the sequence of activities in three items: those that add value; those that do not add value, but necessary for the proceedings; and that do not add any value (waste) and should be eliminated.
Streaming	Is characterized by competence produce only what is needed and, accordingly, reduce the time in product development, order processing and inventory. So after identified the value chain and waste inherent to it, should provide better flow for the other activities and processes.
Pull Production	Allows reverse the production flow, in which the products in stock are no longer pushed to customers through discounts and promotions, but who controls the production is the consumer. For this system, companies can reduce the need for stock and enhance the product to the consumer.
Perfection	after setting the value according to the client's needs, identify and analyze the value stream, create a continuous flow between processes and implement a system in which the consumer is the one who drives the production for the organization achieve perfection, it must seek continuous improvement in waste disposal processes and create activities that add value to the product or service.

Chart 1- The five stages of DMAIC
Source: Authors

Therefore, the results obtained by applying the Lean cause increased ability to respond to what the consumer demand at lower costs, shorter lead team and increased profitability for the company.

Six Sigma

To Senapati (2004), Six Sigma is a management methodology process, originally developed by Motorola, which is currently disseminated globally in different sectors of the global industry. Six Sigma seeks constant improvement of process quality by identifying and removing the causes of defects and variability points of the process.

Six Sigma is aimed at improving the ability of the processes by cutting time and unnecessary costs, but simultaneously want to increase the value of the product to the customer's eyes. It is defined as a unit of measurement that describes the statistical distribution around the mean (or variability) of any process or procedure. Another important concept is the defect or error: in a case where the property of interest is a variable, the default is set to a value that falls outside the specification limits. Assuming and using a normal distribution of this variable, the proportion can be found, and parts per million (ppm) of defects. Thus, a process that aims to achieve a six sigma capability must have a defect rate of some units per million (HAHN et al. 2000). More specifically, six sigma process results in the occurrence of defects in less than 3.4 million opportunities (or an efficiency of 99.9997%).

The fundamental principle of Six Sigma program is to continuously reduce variation in processes, and thus eliminate the defects or failures in products and services. Today, Six Sigma is understood as a management practice that seeks to improve the profitability of any business sector companies, whether products or services or any size (Hahn et al, 2000.) - Small, medium or large company (WESSEL, Burcher, 2004), in order to increase market share, reduce costs and streamline operations (Breyfogle III et al, 2001)..

The approach of Six Sigma requires a structured approach in its implementation so that it can be successful. After implantation, the total employee engagement becomes critical, which brings positive results and employee satisfaction. The more the Six Sigma are ingrained in the culture of the organization, the better those results. (SUNDER, 2013)

The statistical approach, as emphasized in the publications of the early 90s, continues to be a priority, however, more narrowly, the systematic application of the methodology DMAIC cycle (define, measure, analyze, improve, and control) and the DFSS (design for Six Sigma). DMAIC is more characterized by its potential for troubleshooting to ensure the reduction in the rate of faults and defects in products, services and processes. Have DFSS by its more preventive approach is more directed towards innovation and optimization and has been a powerful solution in minimizing potential risks and inconveniences associated with the launch and development of new products as well as the redesign of new processes. The implementation of Six Sigma includes the use of these two methodological approaches (ANTONY; BANUELAS 2002).

Tools of Lean Six Sigma

In Lean Six Sigma a number of tools are used together in Lean and Six Sigma, there may be unique methods of Lean Six Sigma. These tools act complementarily, offsetting some of the

other shortcomings. Generally, when a Lean Six Sigma project is applied to improve a process or a specific sector is used the Six Sigma DMAIC method based strategy, and then used the remaining tools in different phases of this system.

DMAIC

DMAIC is the basic method of solving problems of a process of Six Sigma, which is also used in conjunction with Lean tools from the Lean Six Sigma. There are five key stages in the implementation of such a project: Define, Measure, Analyze, Implement and Control - DMAIC. These stages operate cyclically, after an improvement being implemented and the results meet-controlled, new goals which in turn lead to the deployment of new improvements in the process are defined. The meanings and description of the different stages are outlined in the table below.

Define	The goals of the project in accordance with the requirements of the process (suppliers, customers, inputs, outputs) are defined. It is compiled and reviewed all the information that already exists about the process or problem at hand. A plan and guidelines for the project is developed.
Measure	The current performance of the process is measured. The process is carefully observed and information is collected from all genres. If there is already a system for measuring the parameters to be measured, it must be improved if necessary, if not, a new measuring system to be developed.
Analyze	The gap between the current process performance and the performance to be achieved is analyzed. Priority problems and the root causes of these problems are identified. Process parameters to control are identified. If possible, the inputs and outputs of the process should be compared with established standards.
Implement	Solutions to these problems are outlined. These solutions must be in accordance with the previously defined objectives and should solve the problems permanently. The solutions are tested and its large-scale deployment prepared.
Control	The improved process is implemented to ensure that the gains are sustainable. The new and improved process is documented. It is given to those responsible for training new process. The maintenance of process performance is ensured through the implementation of an adequate control system.

Chart 2- The five stages of DMAIC

Source: Kwak; Anbari (2006)

Thus, according to the Lean Six Sigma, the DMAIC is a strategy that is based on gathering information and statistical analysis to identify this the real causes of the problems and find solutions to eliminate these problems permanently.

Integrating Six Sigma with Lean Production

Although many organizations opt for Lean or Six Sigma initiatives to restructure, begins to be increasingly frequent adoption of programs that include components of both methodologies, ie Lean Six Sigma programs. This combination was inevitable: Lean and Six Sigma principles and share important goals and, despite differences in both strategies, complement it with great

benefits for those who opt for the fusion of the two. Table 1 shows a brief comparison of the two systems.

	Lean Production	Six Sigma
Goal	Increase profits and build a dynamic competitive advantage	Increase customer satisfaction and increase profits
Estrategy	Eliminate waste with the goal of creating value	Reduce variability in the organization's operations
Focus	Chain of value of the organization (all processes, functions and people)	All the processes of the organization
Method of Implantation (examples)	Mapping of the value chain Kaizen	DMAIC Statistical tools
History	Since the end of 1940 (with history from the beginning of the century. XX)	Since 1986

Chart 1- Comparative analysis of the Len Production e Seis Sigma
Source: Bozdogan (2006)

Beginning by examining the differences between the two methodologies, one can see immediately that the objectives of both, although similar, are not exactly identical. In the case of Lean, the focus is mainly on increasing the profit margin and improving the efficiency of the process, while the Six Sigma the economic factor is not so relevant, their main concern being to maximize the quality of their products and ensure total customer satisfaction. Also how these goals are achieved differs considerably: Lean is dedicated to the identification and removal of different types of waste, the only concern of the Six Sigma the removal of all sources of variability using statistical methods. Finally, also the management plan of an organization level there are differences: Lean have a broader view, extending its philosophy to all sectors of an organization in order to obtain a solid structure for later release of specific improvement projects; Six Sigma develops a strategy based on more localized projects, initiatives being undertaken by independent improvement which originate several “islands of success” in the company structure.

Regarding the characteristics common to both systems, these include customer focus, continuous improvement, cooperative relations, management based on reliable information and the importance of the role of people in the organization. However, even more important that the principles common to both methodologies is their great synergy. While the removal of sources of waste in Lean makes the flow of information and materials faster and more efficient, Six Sigma allows a reduced rate of defects and ensures statistical process control. Using both methods and tools for their assembly amplifies the benefits of both. Thus, the combination of the two into a unified system is inevitable, only through Lean Six Sigma organization has at its disposal all the necessary tools to ensure the fastest rate of improvement in areas such as: customer satisfaction, reduced costs, increased speed of the process and increase the quality (PFEIFER et al., 2004).

Implementation of Six Sigma

The application of Six Sigma occurs with the support of a number of tools to identify, analyze and solve problems, with strong foundation in the collection and processing of data, and statistical support (HONG; GOH, 2003). Thus, the differential of the Six Sigma program is structured in the form of application of these tools and procedures and its integration with the goals and objectives of the organization as a whole. Thus, the participation and commitment of all levels and functions of the organization is the key factor for the successful implementation of the program, and other factors of utmost importance, such as the commitment of top management, an attitude pro-actively involved in the program, and systematization in pursuit of satisfying the needs and objectives of clients and the organization itself (ANTONY; BANUELAS, 2002).

Six Sigma also prioritizes the judicious choice of the people who will be involved in the implementation and application of the program, as well as the training and the formation of teams for the selection, implementation, conduction and evaluation of the results obtained with the implemented projects, which are the foundations of the program (INGLE; ROE 2001).

It is also considered as a decisive factor in the implementation of Six Sigma, the need of an appropriate organizational infrastructure in the companies to ensure the introduction, development and continuity of the program (WIPER; HARRISON, 2000). One of the requirements of the infrastructure needed to sustain Six Sigma in business is the training of staff involved with the program. The training of employees who are involved with Six Sigma uses a distinct practice, by which names are assigned according to the workload of training projects in the hierarchy of time and dedication to the program (Behara et al., 1995).

It is important we deploy the importance that leaders have for the effective implementation of Six Sigma, because it covers issues of organizational change - a process that we know to be of great difficulty in the organizations.

In this context, the professionals involved in Six Sigma receive specific terminology such as: sponsor which is the “number one” on the program of the organization and has the responsibility to promote and define the guidelines for the implementation of Six Sigma; sponsor facilitator who plays the main roles in the development of projects of the program; champions, who are the project managers and support actions or remove possible barriers in conducting projects. Then follow the other members of Six Sigma, which are differentiated according to levels of knowledge and training, receiving the following names: Black Belts (black bars), green belts (green bands), yellows and white belts (white and yellow bands), though that comprise the so-called “factory-floor”, are trained in the fundamentals of Six Sigma in particular on the use of basic tools that apply to the various phases of the project (Han and Lee, 2002).

METHODOLOGY OF RESEARCH

The research methodology is employed in the case study followed by an exploratory research strategy. The authors have access to data relating to the implementation of the project applying the concepts of Six Sigma in optimizing Kapp machines and reduces the amount of tools on the production line in a supplier of transmission systems for the automotive industry manufacturer of clutches and transmissions. Thus, the aim of this article is to present the methods and techniques applied in the preparation and development of the survey, analyze the results obtained in the case study and compare with the theoretical part.

CASE STUDY

Presentation of the Case

This case study deals with the application of Lean Six Sigma in reducing the consumption of tools and rework in recoating diamond, targeting a reduction of 30%. The case study was prepared in ZF Systems of Brazil, located in the city of Sorocaba-SP. ZF Brazil is a supplier of transmission parts and gearboxes for automakers, being the focus of the case study of a group of machines, called Kapp machines.

As a starting point, the tool costs (R \$ 3.38 per linear foot) were collected and observed poor performance of CBN grinding wheels and high machining times. As it is a wheel with an approximate cost of recoating 2,300.00 reais each, hence the importance of treating not only the reduction of tools as well as the reduction of machining times. The wheels are used for machining various types of gears groups each with their respective costs per linear meter.

TMA (Theoretical Model Analysis)									
Project: Optimization of Kapp machines									
Priority by TMA	What justifies the problem	% Prioridade	1ª why?	2ª why?	3ª why?	4ª why?	5ª why?	Proposed solutions	GUT
4	Excess of material to be removed (waste)	50	Milling cutter operation with excess supplement	Systematic failure to experience rectified parts	The Focus of the experiments in parts of Shaving			Deploying system for experimenting with parts for grinding of teeth	U
		50	Ensure there is no failure in the grinding operation teeth	To avoid waste / rework				Monitoring post deployment system for living experience	
4	Milling teeth without correction (tool taper)	100	To increase the yield of the grinding wheel	To reduce the cost of the product				Having experience and creating correction sheet	U
3	Low life of the grinding wheel	50	Monitoring the life of the grinding wheel	To identify anomalies in the process	To correct the process	To reduce tool costs		Implementing and monitor life of grinding wheels of Kapps	U
		50	Tool number in the "CURRENT"	Stops for lack of tools				Performing physical inventory, implement control via SAP system and set the current need for systematic calculation	
5	Damage by collision	100	Increases the cost of rework tool	Damages the wheel, requiring reprofiling	To decrease stock of current tools	Long-term reshaping	Rework lengthy process	Deploying anti-collision sensors and train personnel involved	U
2	High tooling cost and CBN coverage	30	To reduce cost of wheels cover	Due to the increased volume of wheels	Increased production and new products			Testing another coverage option	U
		70	To renegotiate contract	Due to the increased volume of wheels	Increased production and new products			Shopping: negotiate on account of the increase in consumption of tools (productivity gain in the supplier)	
1	Better use of assets and tooling of KAPP-300P	20	Cost reduction with tools	Increases tool life	For a more stable process			Reducing initial cost with new developments	U
		30	Reduction of product cost	Shorter cycle times				Shorter cycle times	

Chart 2 – Modelo Teórico de Análise (MTA)
 Source: from the company studied- from the authors

In the current situation the value of average monthly cost to rework this material is R \$ 109,081.48 / month, and the annual cost reaches R \$ 1,308,979.47. Tool Ishikawa (6M), in order to identify the causes of the problem was also used. The main causes were: (a) “pushed” the system supplier sends everything is covered; (b) lack of programming for items with closed requisition; (c) high hardness and low parts of the life of the coverage.

Subsequently, we used the Theoretical Model Analysis (MTA) with the tool of 5Why and Prioritization Matrix Improvements to the technique GUT to map more clearly the actions to achieve the goal of reduction.

The MTA, with 5 Why is an approach in the form of an array of questions that guides the group in getting answers to certain problems or plans of action. It is a system to better understand a situation, exploring its different aspects. The priorities set out above in 100% and 70% relate

to the priority of each topic, established by the team and focusing on improvements to solve the problem set, and in the penultimate column offers solutions to problems.

Then the prioritization matrix was performed aiming to reduce and order, rationally, the number of items to be deployed, and later to be ordained in the matrix. It is a specially built to sort a list of items, a tool for decision making, as it sets a prioritization, which may or may not be based on defined criteria with weights matrix.

Weights were defined together with shop floor personnel (user machines) and personnel involved in the Project for Improvement of the factory. Headquartered use the Gut technique. The procedure used for making the Matrix, was to list all related to what was treated in condition to be explored problems (or risks).

Then we assign a score (1-5) for each problem in 3 aspects: Gravity, Urgency and Trend (hence the name GUT). Gravity is the size of the impact of that problem, should it happen. Urgency is related to the time that this issue should take place, the higher the less urgent the time available to solve this problem. Trend is the potential of the problem, ie, "If I do not solve this problem now, it will get worse gradually or abruptly will get worse?". Adding up the values of each of these aspects (Gravity, Urgency and Trend), we have a priority. Problems with higher priority are the ones you should tackle first, precisely because they are the most Gravity, Urgency and Trend. The rest you can leave for later, or even ignore, if necessary.

The highest priorities in the matrix (125 points) are due to: the criticality of each item defined by the team responsible for the project, based on the amount set for the resolution of problems and so on based on the importance. So after several brainstorming sessions, the matrix was completed.

For each Kapp machine, they produce various groups of materials (gears, wheels and planetary). In 2008, early in the project to reduce the consumption of tools and machining times, the figure 1 below provides monitoring the situation in 2008. The cost of January was spent on tools worth \$ 153,426.00. How does this group spent the month in linear meter (53469 m), the monthly cost per linear meter of the groups was calculated (R \$ 153,426.00 / 53469 meter) R \$ 2.83 per linear foot.

MATRIX OF PRIORITIZATION IMPROVEMENTS						
Project: Optimization of Kapp machines						
PROCESS VARIABLES	SUBJECT	G	U	T	Priority	Priority by TNA
	Deploying system for experience with pieces To rectify teeth	5	5	5	125	
	Monitoring post deployment system for living experience	5	5	5	125	
	Having experience and creating correction sheet	5	5	5	125	
	Implementing and monitoring life of grinding wheels of Kapps	3	3	3	27	
	Performing physical inventory, implementing control via SAP system and setting system for calculation of need for current	5	5	3	75	
	Implementing anti-collision sensors and training personnel involved	5	5	5	125	
	Testing another coverage option	3	3	3	27	
	Shoppings: negotiate on account of the increase in consumption tools (productivity gain in supplier)	3	3	3	27	
	Reducing initial cost with new developments	5	3	1	15	
	Implementing and evaluate improvements in cycle time	5	5	3	75	
	Evaluate existing products that enable the use of the same tooling	5	5	5	125	
G	The project that may occur will be 5 very important 3 +/- important 1 immaterial	U	I feel that it should take action 5 Right away 3 Can wait 1 No rush	T	No action will cause 5 worsen 3 stabilize 1 Improve	

Chart 3 – Matriz de Priorização de Melhorias (MPM)

Source: from the authors

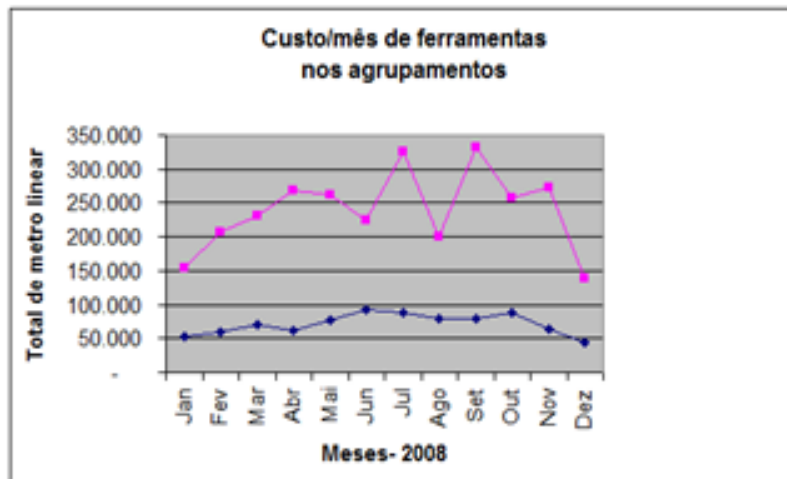


Chart 1 – Tool consumption
Source: from the authors

Therefore an improvement to this design, was placed as a parameter a cost per linear meter of 3.38 in 2008 and the monitoring and troubleshooting with the tools described earlier in the matrices, and the results obtained in 2009 (Picture 2).

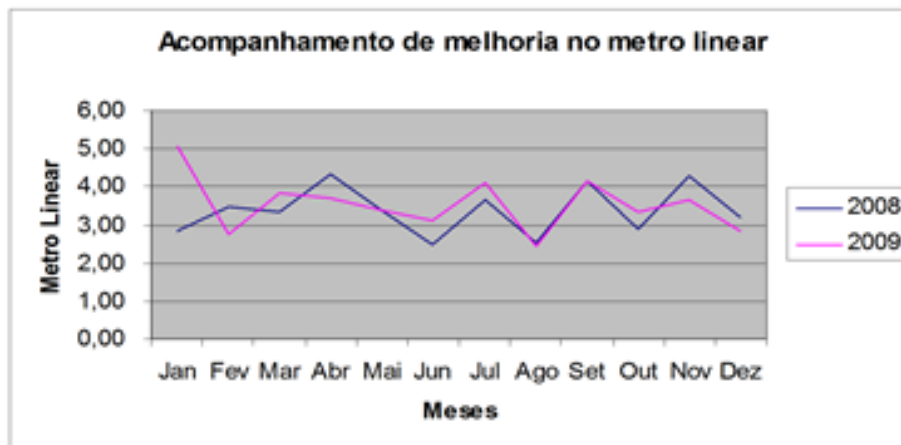


Chart 2 – Monitoring the linear meter (R\$)
Source: from the authors

According to the graph below, this shows what was spent in 2009. Established in saving The project was R \$ 250,000.00. The actual saving itself is the ratio of total production in the month multiplied by the rate held in 2008 less spending in 2009.

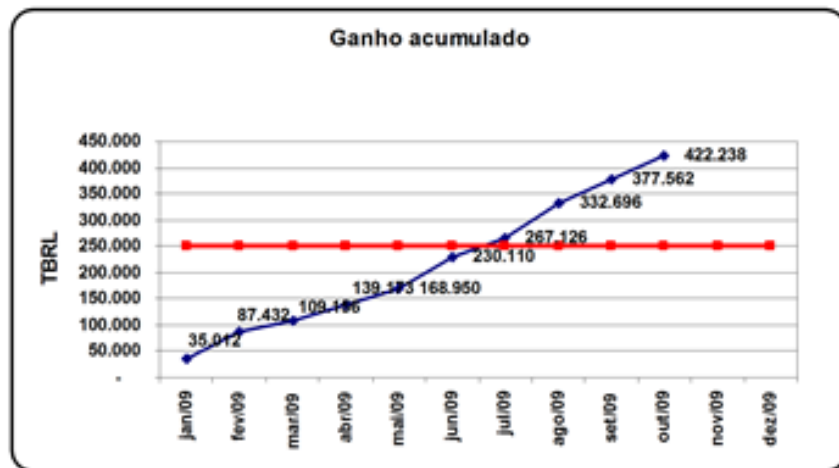


Chart 3- Gain after applied improvements
Source: from the authors

After using the techniques applied and described in the study, the following results were achieved:

- Working with the parts within the specified surface hardness for - brought an increase of 50% in the life of the material;
- Blasting grinding wheels for cleaning, brought an effective 30% increase in the useful life of the equipment;
- Reduction of rework tools - brought a reduction of approximately 70% of consumption;
- Daily monitoring of the current amount of costs, scheduling what is required;
- Cumulative gain, plotted in Chart 3, above.

FINAL CONSIDERATIONS

Six Sigma is used to solve structural problems. This goal sought, mainly through the execution of improvement projects. Then these projects being the main structure of the methodology, a research was carried out aimed at reducing costs of a machine. Six Sigma was the tool used in this sector of the automotive supplier industry, which is found significant improvements in key performance indicators such as development time and financial results of the projects, an effect that literature assume, among other factors, the Six Sigma projects selected appropriately.

The results suggest that the principles of Lean manufacturing, as part of the methodological framework of Six Sigma, can be more effectively included in the reference model for the company. This is an indication that the incorporation of other theories to the context of Six Sigma is a current trend that needs to be explored further in order to increase its strategic potential.

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