

METHODOLOGY FOR IMPLEMENTATION OF THE LEAN DESIGN, USING THE PRINCIPLES OF THE LEAN MANUFACTURING

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Abstract. *The term Lean Design, as well as other terms correlatos, Lean Enterprise, Lean Logistics, Lean Construction, Lean Maintenance is derived from the term in English Lean Manufacturing. This term Lean Manufacturing is used by James Womack and Daniel Jones in its book the Machine That Changed the World (1990) and in its book subsequente the Lean Thinking (1996), to call an established philosophy business-oriented in the Toyota Production System (TPS). This philosophy looks at with detail for the involved basic activities in the business and identifies what it is loss (wastefulness) and what is the value from the optics of the customers and users. Thus, Lean Design, aim at the maximization of the techniques and stages of a Project Engineering with the application of the techniques used in the Toyota Production System (TPS) with the reduction of the losses and reduction in the cost of the product development, improving the quality and taking care of the necessities of the customer. Lean Design, subject of this work that was developed, basically, on of seven wastefulnesses and activities of Lean Manufacturing.*

Keywords: *Lean Design, Toyota Production System, Lean Manufacturing*

1. INTRODUCTION

Before arguing the Lean Design the agreement of the Lean Manufacturing and in consequence of the Toyota Production System (TPS) is necessary and its origin.

As the proper name indicates, the Toyota Production System (TPS) inside appeared of an automobile company Toyota call. However, the automobile company was born of the philosophy and the enormous persistence of its founders, the Toyoda family, where the embryo was in machines to weave wooden.

In the end of century XIX, the weaving was an important activity in Japan and the government stimulated the creation of small workshops and plants for the country. At this time, Sakichi Toyoda, son of a carpenter, lived in a town of peasants and used its knowledge of carpentry to modernize the old manual sewing press with that its mother, its grandmother and its friends worked and to alleviate them of the stressful work.

This age a time where the alone inventors had to make everything and to learn making. Sakichi Toyoda developed the first electric sewing press, however did not have available electric energy. Thus through attempt and errors and making dirty the hands it concentrated its efforts in sewing presses put into motion for steam engines, common power plant at the time.

This boarding of work if became one of them pillars of the Toyota System, genchi genbutsu. In 1891, Sakichi patented its first automatic sewing press and if it moved for Tokyo to start a new business of sewing presses. In 1893, Sakichi if house and have a called son Kiichiro Toyoda.

In 1896, it develops an automatic sewing press that had capacity to stop immediately when an imperfection occurred, beyond its cost to be much more cheap in relation to the sewing presses produced in Germany and France.

No longer year of 1907, deep Sakichi the company Toyoda Loom Works and some years later, Sakichi travels to the United States and if it interests for the complexity of a new product, the automobile.

With privileged vision business-oriented, deep Sakichi the Toyoda Spinning and Weaving Co. Ltd. e sends its son for the Imperial Tokyo University planting the bases of the Toyota corporation.

Kiichiro Toyoda, although its knowledge in engineering and its formal education, follows the steps of the father and learns making, making dirty the hands, going until the plant soil, at last practices genchi genbutsu. In the year of 1930, Sakichi falece and Kiichiro initiates its work in the development of combustion engines fuel.

In 1932, it establishes the Automobile Division of Toyota Automatic Loom Works and finally, in 1937, Kiichiro obtains to produce the first archetype of automobile and establishes the bases to establish Toyota Motor Company Ltd.

After the Second Great War, from the end of the decade of 40, had fort American intervention in Japan with the restriction of the inflation through the reduction of the credit. Soon a down economy appeared where the strikes had blown up and the unions if had fortified.

Toyota faces the crisis, makes an agreement with its employees of form it to be able to fire one room from its man power while the remain would have lifetime guarantee of job. Kiichiro accepted the responsibility for the failure and asks for resignation of the company whom it established.

Eiji Toyoda, nephew of Sakichi and new cousin of Kiichiro, the same assume the company with spirit that its uncle and cousin. Eiji also believed that the only way to obtain that the things well were made was placing the hand in the mass.

In this point we must remember that in the period of occupation of the forces of the United States in Japan, then after the Second War American engineer W. Edwards Deming was consulting and worked in methods of control of the quality with the industrials of Japan. Deming argued consistently that the productivity was not necessarily diminished for the emphasis in the quality. The philosophy of the "lean" production in good part it was born of this work. The ideas of Deming on quality and productivity had been adopted with emphasis for Toyota in years 50.

The Engineer Head and CEO of Toyota, Taiichi Ohno and its team of engineers had developed its proper version of the strategies of quality control of Deming, surpassing with much creativity some taboos of the "mass production system" that they had predominated in the United States, mainly in Detroit.

Still, at the same time, another young engineer, Masaaki Imai, joined the new strategies developed in Toyota and other industries that they looked to develop quality and productivity, under the concept that it called of "kaizen" that he means "making it better" in Japanese (MAZZONE, 1995). After the return of a trip in 1950 to the plants of automobiles in the United States, Eiji and Taiichi Ohno, if had come across with an immense task, to perfect the process of production of Toyota to equal itself to the one of Ford.

Taiichi Ohno perceived that the employees could not more assume a position simply to press screws, as in the traditional mass production of the American companies. They would have that to use all its potentialities, since they would be a fixed cost for at least forty years.

During its visit to the American companies, Taiichi Ohno perceived that it had a full system of dumb, term in Japanese for no aggregation of value (LIKER, 2005) - losses, and that good part of the specialists did not add value to the car. Then, it grouped the workers and it asked for that they worked in team, looking for the best possible actions for each situation. After the teams are being functioning adequately, the next step was the continuous and gradual perfected, kaizen.

At this moment, Toyota opted to drastically reducing the immense supplies producing small lots e eliminating financial costs, being worried about the quality and eliminating wastefulness during the production and not only in the end of the line. The great difference is that now the work was redefined in function of the product and not more in function of the production line. It had instantaneous transparency and feedback for the employees. Thus, it was surpassed the production in initiated mass 60 years before with the launching the model of Ford.

Still today, almost 60 years after this revolution, Toyota if keeps in the leadership of the automobile industry. In such a way, it can be quick defined that the Lean thought (lean) is a form to eliminate the Change (losses) of the processes being identified what does not add value. Making this of systematic, standardized and gradual form, using kaizen, continuous perfected, beyond always verifying the implementation of these ideas in the soil of plant, genchi genbutsu.

2. ELIMINATION OF THE LOSSES

The Toyota Production System identifies seven losses, according to SHINGO (1996).

2.1. Muda - No aggregation of value

The seven losses:

- Over Production;
- Wait;
- Transport;
- Processing;
- Supply;
- Wastefulness in the movements;
- Wastefulness in the elaboration of defective products;

These diverse losses are not equal in status or effect.

They are superfluous activities that increase lead teams, cause extra movements to get parts and tools, create excess of inventory and supplies or result in some form of wait (LIKER, 2005).

2.2. Muri - Overload of people or equipment

According to LIKER (2005), in some aspects, this loss meets in the opposing extremity to the one of the Change. Muri means to place a machine or a person beyond its natural limits. The overload of people results in quality and security problems.

The overload of the equipment cause interruptions and defects

2.3. Mura - Making uneven

This loss can be understood as the resolution of the others two losses, Muda and Muri. In normal systems of production, to the times it has more work of what the people or machines can carry through and other times has work lack.

The making uneven results in program of irregular production or floating volumes of production which had the internal problems, as stoppages, lack of parts or defects.

Dumb it is resulted of Walls. The making uneven of the production means exactly that it will be necessary to have the hand the equipment, the materials and the people in the highest level of production, that the normal requirements is lesser (LIKER, 2005).

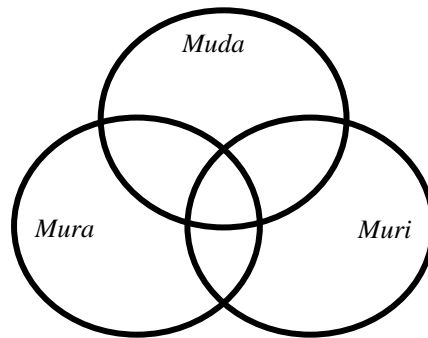


Figure 1: Relation of the losses (Loker, 2005)

3 - WHY TO USE LEAN DESIGN?

It seems simple and obvious that during the development of the product if uses the methodology of the Lean Design, therefore small efforts, expenses of energy, work and reduction of the losses can be reached resulted very favorable in the effective phase production.

The figure presented here illustrates the fact of the “value” or the effort unfastened in previous phases of the effective well the production.

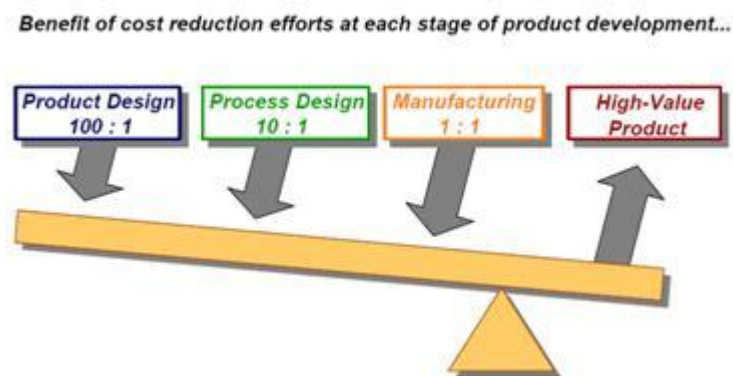


Figure 2: The "Cost Lever" (ETI Group, 2008)

The benefits of the reductions of the losses and the costs applied in the lean design phase result in 100 (one hundred) times its value in the stage of the production. Already the applied ones in the phase of engineering of the process produce a benefit of 10 (ten) times its value in the phase of the production.

In inverse way, if to delay the works of reductions of the losses and the costs of the phase of project for the one of the production, the effort to implement these same works in the stage of the production will be 100 (one hundred) times bigger and with higher cost than if he had been implemented in the project phase.

Thus, it is necessary to work in lean design to maximize the benefits for the customer and the organization.

4 - HOW TO MAKE LEAN DESIGN?

The clear and anticipated definition as much as possible of what the market desires is basic without surpassing the performance, characteristics and product quality. The basic tools of the “Voice of the Customer” are applicable during this first stage.

Tools as the unfolding of the quality function development (QFD), verifications and research of market/customer and methodologies to identify the implicit and explicit necessities also must be used.

As basic methodology of the Lean Design, it is suggested use of some described principles in the sequence.

4.1. “Holistic Vision” as PD method

To develop a holistic vision to the development of products, where the result of the addition of the parts is greater than all, being integrated and maximizing the basic elements.

The basic elements of the system of the development of products, the people, the processes and the technology must entirely be integrated, be lined up and be developed to support mutually.

The people highly qualified, intelligently organized and motivated are the heart of the system of development of products. The processes must be projected to minimize wastefulness and to maximize the capacity of the people use who them.

Finally, the technology must be made to size, with the focused solution and to be selected to maximize the performance of the people and the processes.

When these basic elements of the system are coherently agreed, create a synergic effect. Obviously, other areas inside of the organization also must be lined up in the same way in order to reach the same results.

4.2. Focar in the Customer - MAKE requisite into specifications

The people of the project team use techniques of the value engineering (VE) to generate a great vast e list of innovations and alternatives of the project of a new product.

The Lean companies use successfully this form to generate and to consider a great amount of possibilities, alternatives and solutions, before selecting the concept final.

The project team uses a simple tool to determine optimum concept between cost and performance that the best combination between cost and of perceived value will effectively represent for the customer.

To assure that the choice of the final project really represents this better rocking/balance between necessities of the customer, quality and the cost, the team can and must evaluate the alternative against twenty factors subdivided in five categories:

- Direct work;
- Material right-handers;
- Necessary investments;
- Costs of the project;
- Cost of Plant;

4.3. To create a system of continuous improvement and auto-learning

The learning and the continuous improvement are component basic of each executed work. Toyota carries through this activity adjusting objective of performance each time more rigorous to each new project and learns in both the situations, of real time and to the end of the project “they post-mortem” (called Hansai or reflection). These learning stimulate the specialists to validate and to bring up to date its proper databases of knowledge.

The learning and the continuous improvement - kaizen - are impersonated equally in a process of resolution of problem that creates potential solutions and focus multiples in the countermeasures in the cause root so that in the future, in a new project, they are not happened again the same problems and the new development are executed with bigger performance, quality and productivity.

In a company of Asian origin or more necessarily Japanese, the personification of this improvement is in the compilation of this learning in one dates base (data base) with the proper language of the company.

This data base not necessarily uses powerful computers or the state of the art in computation. Many times this learning is compiled in the form of internal norms of project or in Sekkei Handbooks, or Book of Projects, which can and must be consulted by the area of engineering of product of the company.

4.4. To synchronize processes for simultaneous execution

Truily efficient simultaneous engineering demands that each function subsequent maximizes the utility of the available information from the preceding function when this information if becomes available. That is, the development teams must make everything what they only can with this parcel of the project data that will not move or that the probability to be modified is very low.

In case that contrary, to work with advanced data that will be modified briefly it will lead to an enormous wastefulness and it will really demand a longer duration of what a linear process.

Each function of the development process is projected to move itself ahead simultaneously, constructing and making it the steady data when exactly they will be the consolidated ones and of spreading.

This practical can be called as the simultaneous execution.

4.5. To use standards to create flexibility

This paradox of similarity is in the heart of the quality and efficiency of the Lean system. This principle includes concepts and tools such as the reused, the common architecture and processes standard.

It is crucial to eliminate wastefulness it are of the process of development of products.

The standardized abilities, the standards of project and the processes standard allow the specific personalization of the program, a magnifying of the individual responsibility, a strategy of the human resources in Just-In-Teams, flexible capacities of the development of products. These standards are crucial to put in practical and course the lean capacities.

5. CONCLUSION

In these days of engineering of high technology is very tempting that the controlling, supervisors and coordinators equally divide its time between conference rooms/conferences and its workstations - deskwork -.

As mentioned at the beginning of this work, the boarding of work through attempt and errors and making dirty the hands one of them became in consequence of that pillars of the Toyota Production System and of the lean thought, genchi genbutsu.

These philosophies, inside of Toyota and its group of companies, are practiced in some ways. These examples in action include the expense of a significant amount of time preprogram in it for the manufacture, for the work of benchmarking and the staff of engineering of the product verifying personally the confection of archetypes and in the analysis of the tests and its results.

As Kiichiro Toyoda, "I would have serious reserves how much our ability to reconstruct the Japanese industry if our engineers was of the type who if seat to make the meals without never needing to wash the hands".

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