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Definition of the Guide for Implementation Lean

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1. Introduction

Once the company recognizes the need to change to compete, we need to define a way forward in implementing Lean Manufacturing. This guide consists of 5 phases: Plan, Implement, Deploy, Integrate and Excel. The first four stages are usually implemented from 1 year minimum to 10 years depending on the investment of time and resources in the project. Phase 5 has no end, because Lean is a philosophy that you have to work throughout the life in an organization. The purpose of implementation guide is to assist in the understanding of a comprehensive methodology and defined the steps to follow when we know the tools of Lean Manufacturing but not the sequence to implement the process.
The Guide to the Implementation of Lean Manufacturing is divided into 5 phases:

- Phase 1: Plan, the duration is from 1 to 6 months.
- Phase 2: Apply, the duration is from 3 to 6 months.
- Phase 3: Display, the duration is from 2 to 12 months.
- Phase 4: Integration, the duration is from 2 to 6 months.
- Phase 5: Excel, forever and ever.

2. Steps of phase 1: plan

Phase 1: Plan is the most important phase for the Implementation of Lean Manufacturing as it will largely depend on its success or failure. This phase consists of 18 steps, which will be described in the following paragraphs.

2.1 Step 1: assessment of current status

This is the initial step of implementation and it will be done by an initial team of implementation, where each and every one of their members must know the current status of the organization and help to make a deep analysis of the Manufacturing Assessment Lean in which 16 areas of the organization are assessed. They are next listed: 1. Communication, 2. Workplace Organization and Visual Management, 3. Standard Work, 4. Flexibility of Operations, 5. Continuous Improvement, 6. Error Proofing Devices (Poka Yokes), 7. Capacity for Quick Changes (SMED), 8. Total Productive Maintenance (TPM), 9. Material Control, 10. Production Level, 11. Engineering, 12. Lean Accounting Systems, 13. Quality, 14. Customer Chain, 15. Maintenance, 16. Performances indicators.
Each area to be evaluated consists from 6 to 9 items. All items will be graded from 0 to 5; 0 when the practice is not found on the floor, 0% frequency; 1 is observed only in some areas, 25% frequency; 2 it is common but in most cases, 50% frequency; 3 it is very common with

some exceptions, 75% frequency; 4 it is observed throughout the plant, without exception, 100% frequency; 5 it is observed throughout the plant and is the best in the industry. The result obtained in each area is being summarized in a table. The evaluation obtained will be indicative of the current situation of the organization.

Step 1.2: diagnostics corporation

The sum of the column "Results to Evaluate" determines the organization's current diagnosis. The other diagnostic tool is the Value Mapping that is a graphical tool that helps us to see and understand the material and information flows. A product is considered a wall-to-wall unit inside the plant for identifying those activities that add no value, bottlenecks, major problems, etc. In the process of becoming lean, many manufacturing companies omitted a crucial step: the strategic vision of material and information flow. In many cases companies are rushed to apply the concepts of Lean Manufacturing through kaizen events applied to the process level that may lead to some error in the assessment.

All the efforts mentioned above are most effective when applied strategically within the context of the value chain (defined as "all actions required producing a product or family of products from raw material to customer demand.") Participants should learn how to draw the map of current and future value for a hypothetical plant using the basic concepts of mapping, icons and data needed for mapping. Mapping helps us to analyze the entire plant process, observe more than waste. It allows us to identify sources that cause this waste and use a common language for the manufacturing process. Asking a general strategy for improving the area, otherwise there would be separate efforts in each thread, properly implement Lean Manufacturing principles and fixed to the implementation strategy of the 5 stages of a Flexible Production System (FPS), Establish a proper plan, designing the process of a product or family of products from start to finish, not just one area and see the relationship between material flow and information flow.

Mapping Terms Used:

- **Material Flow**: The movement of material through the plant for the manufacture of products.
- **Information Flow**: The means of communication by which each thread tells what to make or do at all times.

Steps to Draw Mapping:

1. Choose a product family or product. Taking into account the needs of customers, production volumes, profits, and the lifetime of the product (not to exert on products coming out of the market). Families are products that have similar processes or produced in the same production lines.
2. Draw the current state map using the symbols or icons and an example of mapping value, using the symbols.
3. Draw a map to future.
4. Develop Implementation Plan.

Now that we should know a diagnosis of current status can start working with an action plan.

Step 1.3: decide to implement lean manufacturing

After learning more objectively the current state of the organization it will decide whether to continue with implementation. At this point all levels of the plant must be fully convinced of the job they are committing to carry out.

Step 1.4: define goals, objectives, measurements and achievements

The team must define the objectives and goals that are written in a table. This aims at the starting point of the diagnosis of the present, (see Step 1.2). Which is a way of establishing who will be responsible and setting the deadlines dates for each of the objectives. Base your management decisions on a long-term philosophy, even achieving short-term financial goals. Have a philosophical determination that supersedes any decision making in the short term. Work, grow, and compose the entire organization towards a common purpose that is bigger than making money. Understand your place in the history of the company and work to take the company to the next level. Your philosophical mission is the foundation for all other principles. Generate value for customers, society and the economy that is our starting point. Evaluate each function in the company as regards its ability to achieve this. Be responsible; strive to decide our own destiny. Act with the same-confidence and trust in their abilities. Accept responsibility for his conduct and maintain and improve the skills that enable you to produce value added.

Step 1.5: policy statement lean manufacturing

The implementation team will draft a policy Lean where guidelines are established or bases of the form in which we work, how we will evaluate the results, how often meetings were held and who designate those responsible for complying the goals or objectives. Establish the vision, approach to the organization, align performance measures and establish high expectations for success and zero fault tolerance.

Step 1.6: lean organization commitment

After developing the Lean policy, this requires that all high levels of organization charts, as well as those responsible for carrying out assigned tasks, a formal commitment to meet the goals and objectives by signing the policy.

Step 1.7: rules for the equipment

In addition to Lean Policy as defined in Step 5, rules will be developed for teams that will be specific enough so that there are no doubts in the proceedings.

- Select Team Members with the following characteristics: technological curiosity, common sense and inner confidence, strong critical thinking and ability to solve problems, multifunctional equipment, manager/supervisor of the pilot area and functional departments (planning, engineering, quality, production control).
- As Home Team to be carried out: training, the reading of literature is required, attend training in Lean Manufacturing and present a summary/progress to staff.
- Recommended Tools: standardized analysis and simulation tools to consider, camcorders, TVs, etc. and computers, printers and projectors.
- As for the facilities we need to have: finding a room for the implementation team and office area and equipped properly.
- Pilot Area Selection, which should be selected with the following criteria: The area should be representative of the main product to contribute to the competitive strength of the business. Innovation is a good chance for success. The solutions must be usable in other parts of the company, status of the current process, cost and volume of the product, rates of outputs, ground work, volume inventory and processing Time.

Step 1.8: Analysis of objectives and targets

Although, the goals and objectives were established from the step 4 at this point should be analyzed again and have been published Lean Policy and Rules for the teams. This review

will be more objective because as Phase 1 proceeds will be easier to define the objectives for the understanding of the implementation is clearer by using the following: setting objectives and goals, establish the basic principles of Lean, production with one piece flow, standardized work methods, minimize/eliminate waste, production with zero defects, high productivity, improvement goals, reduced processing time, reduced operating costs, increase the use of labour, increasing the flexibility of labour, flexibility of the team and Kaizen.

Step 1.9: investigate the current conditions

The trained teams begin to work with the Present State Examination that was done in step 1, reviewing each of the grades in the areas evaluated and corroborating these evaluations for team members carry out themselves this point.

Step 1.10: lean assessments

For team members working from corroborated evidence by themselves, must be done again Lean Assessment and Collection of current status information. The first step in this phase was to evaluate the entire organization through an assessment tool. Although there are tools developed by different organizations (Ford, one of them), it was developed in line with the regional situation and the work culture in our business environment. The results of this survey serve to guide the implementation process.

Step 1.11: develop matrix and master plan

They built Lean Policy and the Rules for the equipment. Lean Assessment will be a parent and Master Plan using as a guide the goals that were defined, but now with the sum of all this knowledge. The Matrix and Master Plan should be formal and shall contain the names of high levels of the organization, as well as their commitment to compliance firms.
In the official presentation of the project it must contain comparison of baseline conditions with the projection of lean manufacturing, improve productivity at least 20%, improved labour requirements at least 15% (direct and indirect), workspaces reduced by at least 15%, cell distribution, inventory reduced by at least 50%, total time of the improved process at least 50%, implementation of one piece flow, documentation of implementation costs, capital investment, additional expenses, training costs, introduce improvements to the administration management, include all indicators of decision-making and methodology, let the facts speak for themselves and justifying the cost and duration of implementation.

Step 1.12: publish the policy and the matrix or master plan.

Lean policy and the Matrix or Master plan must be published because in this way the whole organization can learn about them. It will now remove the uncertainty about the implementation.

Step 1.13: visually identify targets

After defining the objectives in the Master Plan, location of each one in the area that corresponds to all employees know the plan and timeline for completion. This should make the Value Mapping the organization to visually identify the activities that add value and which do not add value.

Step 1.14: Plan education and training.

Identify all employees involved in the area where is going to be carried out the implementation to develop an Education and Training Plan, which contains the Lean tools

that are to be implemented and the knowledge needed for the project. Training phase is one of the most important and should be the beginning of every implementation. All staff should understand the purposes of this methodology, objectives, consequences, requirements and most importantly, what is expected of each of them and they benefit. One of the factors of failure in the implementation of such programs is undoubtedly the lack of conviction of the people. When staff do not know, do not understand, was not involved, hardly take a cooperative attitude, and you will feel that the status quo is threatened, their paradigms, and most dangerous, feel it will be replaced by a device, machine, a re-arrangement of the distribution, etc., feel therefore that it will no longer be necessary.

The phenomenon with which we are, which is very common is a resistance to change for fear that our shortcomings, inadequacies and bad habits are brought into the open. These attitudes and feelings are normal in any change process; hence a good training is essential. Training was initiated in parallel with staff of the productive area. For the administrative staff designed courses with durations of 2 hours per day, while operational staff was trained using the technique of the five minutes of quality, also known as a single subject lessons. These lessons of one subject were taught by the same administrative staff (trained on a specific topic before) with the help of the implementation team internally and externally.

The lessons of one subject are a very effective and economical (in terms of training) and is not required of a professional coach, involving all staff and can be given, wherever possible, daily, five to ten minutes before the end of the turn and five to ten minutes before the start of the second shift (the plant had only two shifts). We took lessons from a single topic for each one of the most important concepts. Another method used as training for all staff, was the placing of banners on the concepts and tools of lean manufacturing. After being placed blankets, the staff began to ask about the meaning of them, so when you get to the point of a single subject lessons and training with staff, and had many questions to do and many questions, which was the target. This is what is known as advertising prior to implementation. As one quarter through training, placed pictures of the current situation, referring to the type of waste is concerned and what would be the best way to get rid of that waste, inviting staff to get involved and make proposals to remove and keep areas clean and tidy.

Step 1.15: achieving consensus at all levels

Once you complete the Implementation Plan, will meet all involved to explain the whole system work. The consensus should be reached through hierarchical levels of the organization, starting from high levels to down (catch-the-ball). Make decisions slowly by consensus, considering all options, implement decisions quickly (Nemawashi). Do not choose a single direction and follow a path until you have thoroughly examined the alternatives. When selected, move quickly but cautiously down the road. Nemawashi is the process of discussing problems and possible solutions with all stakeholders, to gather their ideas and reach agreement on a way forward.

This process of consensus, although time consuming, helps broaden the search for solutions, once a decision is made, the stage is set for rapid implementation. Build leaders who fully understand the work, live the philosophy, and teach others. Build leaders, instead of buying outside the organization. The leaders must be models of the company's philosophy and way of doing business. A good leader must understand the daily work in great detail, so that he or she may be the best teacher of philosophy of the company.

Step 1.16: education for awareness

In addition to training, is also initiated an awareness campaign through posters may be showing other companies working with the Lean Manufacturing System, and that conditions are going to see our company in the future we have planned. Develop exceptional people and teams who follow the philosophy of your company. Create a strong and stable culture that values the company, values and beliefs are widely shared and lived through a period of many years. Empowering people with skills of teamwork within the company's philosophy to achieve exceptional results and work hard to strengthen the culture continuously will help to reach awareness.
Use computers to perform various functions to improve quality and productivity and improve the flow of the solution of difficult technical problems. The effort takes place when people use tools to improve business. Make an effort to teach people how to work together as teams toward common goals. Teamwork is something that must be learned for becoming a learning organization through reflection (hansei) and continuous improvement (kaizen). Once you have implemented a stable process, the use of continuous improvement tools to determine the cause of inefficiencies and implementing effective countermeasures. Design processes that require almost no inventory. This will make visible the loss of time and resources for all to see. Once the waste is exposed, have employees who use a process of continuous improvement (kaizen) to remove it. Protect the organization knowledge base by developing stable personnel, slow promotion, and very careful succession systems. Use hansei (reflection) in the main reference points and after you have completed a project, openly identify any shortcomings of the project. Develop countermeasures to avoid the same mistakes again. Learn the best practices standards, rather than reinvent the wheel with each new project and each new director.

Step 1.17: communicate the policy

After months of work in Phase 1, plans have been revised and revised again. The policy also has changed during this process and the plan and is completely finished and defined. It is published again. The policy includes the development and deployment of the mission, vision and values. With the help of equipment implementers, internal and external, developed statements of mission, vision and values for the organization. However, these are not just statements, and actually represent the rudder and sails of the ship in which the entire organization moves, so without this mission and vision is to walk aimlessly.

Step 1.18: start formal

The same day that the policy is issued is the formal start of the Plan of Implementation of Lean Manufacturing in the company and formally notified to all levels, the exact start date according to the Master Plan.

3. Steps of phase 2: apply the Implementation

In phase 2, the plan from Phase 1 is implemented. . Phase 2 has duration of 3 to 6 months and consists of 19 steps.

Step 2.1: Initial application

This is very important that the planting team is made up of personnel with extensive knowledge of lean manufacturing techniques, as will be the example to follow and will also

be essential that some members have participated in Phase 1, because it will be a better understanding of the objectives.

Step 2.2: prepare and focus

All work must be done to start based in Phase 1, to do what was planned and not out of schedule.

Step 2.3: working area scrutinizing

Check the area thoroughly where it will be to implement and compare plans, if it is something different, correct the plan, but whenever it is necessary to make any changes should first be changed documents.

- Selection Criteria: The area should be representative of the main product, to contribute to the competitive strength of the business, innovation is a good chance for success and the solutions must be usable in other parts of the company.
- Location of the current process: Cost and volume of the product, rates of outputs, ground work, volume inventory and processing time.

Step 2.4: apply 5S

Apply 5S to work in an organized area. Use visual controls so no problems are hidden. Use simple visual indicators to help people determine immediately whether they are in a normal condition or deviating from it. Avoid using a computer screen where the employees focus outside the workplace. Design simple visual systems at the site where work is done to support flow and pull. Reduce your reports to a single sheet of paper whenever possible, even for their most important financial decisions.

5's technique consists of 5 steps which are:

1. Sort (SEIRI) consists of removing the workstation area or all objects that are not required to perform the task, either in production areas or in administrative areas. An effective way to identify these elements must be eliminated is called red tagging "is a red card expulsion is placed on all items which are considered not necessary for the operation. Then these elements are taken to a holding area. Later, if it was confirmed that they were unnecessary, they are divided into two classes, which are used for another operation and will be discarded useless.
2. Order (SEITON) is to organize the elements we have classified as necessary so they can be found easily. Order maintenance has to do with improving display of items of machinery and industrial installations. Some strategies for this process of "everything in place are: painting floors, clearly defining work areas and locations, with silhouettes of tables and modular shelving and cabinets to have in place things like a trash, a broom, mop, bucket, etc., ie, "A place for everything and everything in its place."
3. Clean (SEISO) means to remove dust and dirt from all elements of a factory. From the point of view of Total Productive Maintenance (TPM) involves inspecting the equipment during the cleaning process. It identifies the problems of leaks, failures, faults or any type of defect. Cleaning includes, in addition to the activity of cleaning work areas and equipment, application design to avoid or at least reduce the dirt and make safer work environment.
4. Standardize (SEIKETSU) aims to maintain the cleanliness and organization achieved through the implementation of the initial 3's. The only standardize work continuously obtained when the three principles above. At this stage or phase (should be made

permanent), the workers who carry out programs and mechanisms designed to enable them to benefit themselves. To build this culture may use different tools, one of which is the location of job site photographs in optimal conditions so that they can be seen by all employees and remind them that this is the state which should remain, one is development of rules in which they specify what should be done every employee with respect to your work area.

5. Discipline (SHITSUKE) means to prevent breaking the established procedures, only if it implements discipline and compliance with rules and procedures already adopted will enjoy the benefits they provide. Discipline is the channel between the 5 S's and continuous improvement. Implies: control periodic surprise visits, employee self, respect for themselves and for others and quality of working lives: Create a culture of sensitivity, respect and care of company resources, Discipline is a rule to change habits and the morale in the workplace increases.

Step 2.5: develop criteria, prepare assessments for the equipment

All team members should work with the same objective and need to develop criteria on can rely on when making assessments.

Project Performance Measurement

- Base: register hour by hour, standardized method, time out, Pareto analysis, collection of quality data, diagram of fish and control of activities.
- Activities for Managers and Supervisors: Identify the basic elements of lean manufacturing, standardized work, the source of quality control, review the performance evaluation of each of these areas and make the necessary adjustment.
- Activities in line / cell of operations: monitor the performance at scheduled intervals of one hour, publish the results daily and monitor statistical trends, rigorously monitor and analyze downtime, develop a list of 10 recurrences and solve major problems identified, conduct a multifunctional training of operators, maintain equipment and tools and maintain at all times the labor organization and cleaning.

Step 2.6: standardize the work and inventory indicators

All methods used in the area should be standardized. Standardized tasks are fundamental to continuous improvement and strengthening of the employee. Use stable, repeatable methods everywhere to maintain predictability, timing, and regular output of your processes. It is the foundation for the method of flow and pull. Capture lessons learned on a process to the point of standardizing best practices today. Allow individual creative expression to enhance the standard practices, and then incorporate it into a new standard so that when a person moves you can train the following people. Start working with inventory on the floor. Standardized work means that all operations are always carried out well and steadily, synchronized with customer requirements. The standard work is created, so that the required levels of quality are achieved and maintained. Within the standard work, labor movements are repetitive and the repeatability released the employee of the need to constantly think about what to do next or adjust their movements. The work is performed in a given sequence, stabilizing, maintaining and controlling quality.

Step 2.7: standardize the worksheets

Worksheets or sheets of process should be standard, contain the same information and the format to everyone involved to find the information in the same location for all processes.

Step 2.8: establish the one-piece flow

Make adjustments if necessary to establish the flow in one piece eliminating the batch system. The following sections present a summary of the changes implemented and the progress with the implementation of programs for Visual Management 5'S, these programs are universal and all organizations and the important fact that they are a important prerequisite. The most important changes deemed necessary to achieve synchronization of flow, reduce inventory and increase value added in the process, fundamental objectives of lean manufacturing.

Pull System called Kanban, is a tool based on the operation of supermarkets, means in Japanese "label statement." The label Kanban contains information that serves as a work order, this is its main function, in other words is an automatic steering device that gives us information about what to produce, how much, by what means, and how to transport. Before implementing Kanban, it is necessary to develop a production level to smooth the current flow of material, it must be practiced in the final assembly line, if there is a large fluctuation in the Kanban process integration will not work and will otherwise disorder, also have to be implanted SMED systems, small batch production, Jidoka, visual control, Poka Yoke, productive maintenance, etc. This is a prerequisite for the introduction of Kanban. Should also be taken into account the following considerations before implementing Kanban:

1. Determine a production scheduling system for final assembly to develop a joint production and labeling.
2. We must set a path that reflects material flow, this implies designate sites for there is no confusion in the handling of materials, making it obvious that the material is out of place.
3. The use of Kanban systems is linked to small batch production.
4. It should be noted that those items of particular value should be treated differently.
5. It must have good communication from the sales department to production for those seasonal items cyclic intensive production, so as to notify you in advance.
6. The Kanban system will be constantly updated and improved continuously.

There are two main functions of Kanban; Production Control and Process Improvement.

Production control is the integration of the different processes and the development of a JIT system, in which the materials will arrive in time and quantity required at different stages of the process and if possible including suppliers.

Process improvement facilitates improvement in the various activities of the company through the use of Kanban, this is done by engineering techniques (waste elimination, organizing the workspace, reducing model changes, use of machinery vs. Use based on demand , multi-process management, device for the prevention of errors (Poka Yoke), error-proof mechanisms, preventive maintenance, Total Productive Maintenance (TPM), reduction of inventory levels).

Step 2.9: standard work manual

Since the flow is established in one piece, it may be necessary to make some changes in the methods and process sheets. Make changes as required and develop the Manual of Standard Work. Toyota's managers recognize that the key is in the details, so ensure that all work is highly specified in terms of content, sequence, time and results. When installing a seat in the car, for example, the screws are tightened in the same order, the time it takes to tighten each screw is specified, and so is the torque which should tighten the screw. This accuracy

applies not only to repetitive movements of the production workers but also the activities of people, regardless of their specialty and their authority.
The requirement that each activity is specified is the first unwritten rule of the system. You put it in raw form, the rule seems simple, something you'd expect everyone to understand and follow easily. But in reality, most managers and their peers outside of Toyota not take this approach to work in the design and implementation, although they think they do. Let's see how the operators in a typical auto assembly plant installed a front seat in the car. They are supposed to take four screws in a cardboard box, take them with a torque wrench in the car, tighten the four screws, and type in a code on the computer to indicate that the work was done without any problem. Then expect the next car arrives.
New entrants are trained by experienced operators, who teach by demonstrating what to do. A senior colleague can be available to assist the operator again when you have difficulty, such as a screw or to enter the code in the computer. This sounds very straightforward, what is wrong with this? The problem is that these specifications actually allow-and even take "considerable variation in the way operators do the work. Without anyone noticing, there is much room for the operator to place the screws back in a different way than does the experienced operator. Some operators can place the front screws then screw back, others to the contrary. Some operators may place each screw, then tighten them all, others can cash them one by one pressing.
All this variation translates into a poorer quality, lower productivity and higher costs. More importantly, it prevents learning and improvement in the organization because it conceals the variations between how the worker does his work and results. In the plants of Toyota, because the operators (new and old, direct and indirect) are a well-defined sequence of steps for a particular job, it is instantly clear when they deviate from the specifications. Although complex and unusual activities, such as: training a work force experienced in a new plant, launching a new model, changing a production line, or changing a part of one plant to another, are designed according to this rule.

Step 2.10: implement specific methods in the area

After standard work, reduced inventories, set the one-piece flow is necessary to formalize the methods that were established in accordance with the requirements of the area where it is working.

Step 2.11: product making quick changes

Make the necessary tests in the areas where you need to make adjustments for changes in product, model, and part number to make the necessary changes. SMED stands for "change model single-digit minutes." These theories and techniques are to make the model change operations in less than 10 minutes. Since the change must take from last good piece to the first good piece less than 10 minutes. The SMED system was born of necessity to achieve JIT production. This system was developed to shorten the preparation time machine, allowing making smaller batches. The exchange procedures were simplified model using common or similar elements commonly used. Facilitate small batch production, reject the formula for economic lot, run each part each day (make), achieve the lot size of 1 pc, making the first piece right every time, changing model in less than 10 minutes.
SMED Three-step approach

1. Remove external time (50%). Much time is wasted thinking about what to do next, or waiting for the machine stops. Tasks reduces planning time (the order of the parts,

when changes occur, what tools and equipment needed, how people speak and materials required inspection.) The aim is to transform a routine event the process, leaving nothing to chance. The idea is to move the external time to external functions.

2. Methods and practice (25%).The study of timing and methods will find the fastest and best way to find the internal time remaining. The nuts and bolts are one of the major causes of delays. The unification of measures and tools can reduce the time. Duplicate common parts for assembly operations will do so this time winning outside of internal operations. For best and effective model changes are required teams of people. Two or more people collaborate in positioning, range of materials and use of tools. The effectiveness is contingent upon the practice of the operation. The time spent is well worth the practice because it will improve the results.
3. Delete settings (15%). Implies that the best adjustments are not needed, so is used to set the positions. It seeks to recreate the same circumstances than last time. How many adjustments can be made as external work is required to fix the tools. The adjustments needed space to accommodate the different types of matrices, dies, punches or tools as required standard spaces.

Step 2.12: quick changes standardized procedure

It is also necessary to validate these changes and so we are gradually reducing waste, and to standardize can be analyzed more quickly when problems arise or when it is possible to make some improvement.

Step 2.13: autonomous maintenance set

Start working on autonomous maintenance, where the operator takes care of your workspace. Total Productive Maintenance (TPM) aims to create a corporate system that maximizes the efficiency of the entire production system, establishing a system to prevent losses in all business operations. This includes "zero accidents, zero defects and zero failures" throughout the life cycle of the production system. It applies in all sectors, including production, development and administrative departments. It relies on the participation of all members of the company from top management to operational levels. Obtaining zero losses is achieved through the work of small teams. The TPM allows differentiating an organization in relation to its competition due to the impact on cost reduction, improved response times, reliability of supplies, knowledge possessed by the people and the quality of end products and services. TPM seeks to:

- Maximize team effectiveness.
- Develop a system of productive maintenance throughout the life of the equipment, involve all departments that plan, design, use, or maintain equipment, in implementing TPM, actively involve all employees, from top management to floor workers.
- Promote TPM through motivational with autonomous small group activities originating: zero accidents, zero defects, zero breakdowns.

The TPM process helps build competitive capabilities from the operations of the company, through its contribution to improving the effectiveness of production systems, flexibility and responsiveness, reduced operating and maintenance costs of "knowledge" industry.

Step 2.14: establish visual control

Start creating a system where only needed to make a point to know if something is working as we want by means of visual control. Visual Controls are a set of tools and visual aids that we facilitate the development of activities necessary to meet an easy and effective way any

activity that requires the development of a product. The purpose is to visually identify the resources (tools, parts, work instructions, and performance indicators of the production system) so that everyone involved can understand in the light conditions and needs of the system. Visual controls are designed by the service departments (engineering, quality, materials) which are respected by all plant personnel, and maintenance is responsible for installing them. Visual controls used are:

- Andon System; communication system between modules of production and service departments.
- Poka Yoke Flags; is used to display performance indicators of the production model and the results per hour.
- Module information; assigned place within the production area to place current and relevant information of the area.
- Kanban; a signal to prevent overproduction and ensure that the parties will be pulled from season to season and from cell to cell when required and in the correct amounts.
- Bottlenecks; workstation which is the restriction of the process in the production module.
- Key operations; a signal that indicates the location of transactions recorded by the quality and Features Product Keys.
- Housekeeping 5's; ensures a safe, orderly and pleasant that promotes and facilitates productive work.
- Work instructions; it is a visual description of the method of each operation on workstations.

Step 2.15: controls test set error (poka yoke)

Identify those points in the process where bottlenecks are generated due to errors or inspections, analyze the work and develop error-proof devices (Poka Yoke 2.3.5) that aid to ensure product quality. The term "Poka Yoke" comes from the Japanese words "poka" (inadvertent errors) and "yoke" (prevent). Poka Yoke device is any mechanism that helps prevent errors before they happen, or makes them very obvious for the worker to realize and correct it in time. The purpose of Poka Yoke is to remove as soon as possible defects in a product either preventing or correcting errors that occur.

Poka Yoke systems involve carrying out 100% inspection, as well as feedback and immediate action when defects or errors occur. This approach solves the problems of the old belief that 100% inspection takes time and work, which has a high cost. Poka Yoke system has two functions: one is to make 100% inspection of parts produced, and the second is whether abnormalities occur can give feedback and corrective action. The effects of Poka Yoke method to reduce defects will depend on the type of inspection is being carried out either at the beginning of the line, self-check or continuous checks.

Step 2.16: analyze results

After it has been applied as 5S, Standard Work, Quick Changeover, Total Productive Maintenance TPM, Poka Yokes, it is necessary to analyze the results and compare with the goals and objectives proposed for Phase 1, recorded and always comparing the results with completion dates.

Step 2.17: experiences learned and refocusing of objectives

Implement all the techniques to brainstorm lessons learned through a format that will serve for consultation so we can refocus the objectives of Phase 1. Here you can use the A3 Report (Appendix B) which is a compilation of relevant information.

Step 2.18: reapply 5S

Make an assessment at this point in the 5S's to make the necessary changes.

Step 2.19: Eestablish a safe program status

Analyze the working conditions and put them all in a safe condition program.

4. Steps in phase 3: deploy

After applying Lean Manufacturing Techniques in the Area of Pilot Area Home or applications must be extended to other areas of the plant or organization in Phase 3, extended or folded that it can take 2 to 12 months and consists of 16 steps.

Step 3.1: additional equipment training and education

Team members who worked in Phase 2 can now be the leaders of the new equipment for the remaining areas of the plant. New members must bring to the area where Phase 2 was to see and discuss Labor System Implemented now they are going to implement.

Step 3.2: publish phase 2 activities in whole plant

To summarize the achievements in Phase 2 to publish in all areas of the plant and that employees see the results.

Step 3.3: improving the implementation plan

Based on the experiences gained in Phase 2, improvements are made in the Master Plan of Implementation that the initial team members consider relevant to the new areas.

Step 3.4: repeat the application of phases 1 and 2 in the other areas

With the experience gained in Phases 1 and 2 for area start implementing Lean repeat all the steps in these two phases in the other areas of the plant.

Step 3.5: Establish advanced flow system one piece

Having completed Phase 2 in all areas is a readjustment of the whole plant to implement the Advanced Flow System A part that is to produce a piece and move to the next process, not to accumulate inventory on the floor. A flexible manufacturing system has several definitions because people try to describe it from their perspective. At a higher level, a flexible manufacturing system is a collection of flexible manufacturing cells. A flexible manufacturing cell, in turn, is a group of related machines that perform a particular process or a step in a longer manufacturing process. A cell can be secreted due to noise, chemical hazards, and demand for raw materials or manufacturing cycle time.

It can also be a group of manufacturing machines dedicated to a single purpose that offer flexibility to meet the variable flow of material between stations and different combinations of stations using simple operations. In both cases, the end result is the ability to manufacture parts or assemblies using the same machine group. A production line with variable use and operation of the stations can function as a flexible manufacturing system. Thus, flexible manufacturing describes any group of machines or facilities in order to move material between them. The whole system is run by computers, which collectively can manufacture different parts and products from start to finish.

Although the acronym for flexible manufacturing system is considered in part generic, used by many other terms and acronyms to describe this kind of equipment for manufacturing:

CIMS (Computer Integrated Manufacturing Systems, System Computer Integrated Manufacturing), CMPM (Computer Managed Parts Manufacturing, Manufacturing Management Computer Parts), VMM (Variable Mission Manufacturing, Manufacturing Mission Variable).
The use of flexible manufacturing systems involves the use of other systems, such as: group technology (GT, Group Technology), for classifying manufacturing parts with similar characteristics, the technology just in time (JIT, Just In Time) , which allows raw materials reach the right place at the right time, the MRP (Material Requirements Planning, planning, product demand), where the incoming material is selected to come to the right place at the right time, and finally CAD systems, in order to allow the use of data and design specifications millimeter in the programming of numerical control machines (NC) and automatic inspection.

Step 3.6: achieving multifunctional operators.

Train operators to be multifunctional, they can perform any operation your work cell (see multifunctional operators). Multifunctional operators mean that a single operator performs several processes at once in a cell. To do this you must meet the following points:

- Clearly define the operations performed by each machine and the tasks performed by each operator.
- After organizing the cell manufacturing system, if some processes do not fit into this system to place these machines in remote areas and to bring people there needed according to the production volume required.
- Train operators to be multifunctional.

Step 3.7: applying total productive maintenance additional

Now that the operators are trained to perform any operation on your cell manufacturing, also need training to care for the machinery they are using, applying the Additional Total Productive Maintenance (See Total Productive Maintenance TPM).

Step 3.8: cycle time management

Perform Value Mapping review, which displays the cycle time and analyze the improvements that have been achieved. Compare the different cycle times of products made to define and can be combined in the process.

Step 3.9: implement jidoka

When operators have a domain of work, are allowed to stop the process when problems occur in the raw material, assembly or defects with the aim of not proceeding with off-specification production. The Japanese word "Jidoka" which means testing in the process. When the production process systems are installed Jidoka refers to the integrated quality assurance process. Its philosophy provides the optimal parameters of quality in the production process, the system compares Jidoka production process parameters against established standards and making the comparison, if the process parameters do not correspond to established standards the process stops, warning that there is an unstable situation in the production process, which must be corrected, this in order to avoid the mass production of parts for defective products, processes Jidoka are comparative systems of the "ideal" or "standard" against current results in production.
There are different types of systems Jidoka: vision, strength, length, weight, volume, etc. depending on the type of product or system design Jidoka to be implemented, as any

system, information is fed as "ideal" or "standard should be the optimal product quality. Jidoka may refer to equipment that automatically stops under abnormal conditions, also used when a team member finds a problem with your workstation. Team members are responsible for correcting the problem - if they cannot fix it, they can stop the line. The aim of Jidoka can be summarized as:

- Ensure 100% quality time.
- Prevent unexpected failures of equipment.
- Effective use of labor.

Step 3.10: implementing fluid production

The processes are now working with Standard Work, Kanban, SMED, TPM, Jidoka, a single piece flow, several techniques have been applied to achieve a Lean Manufacturing System is implemented as fluid production.

Step 3.11: analyze results

Perform work together teams to analyze results and make necessary adjustments.

Step 3.12: establish kanban system

The Kanban system must already be in widespread use in the plant, formally established and do not allow deviations from the procedures. Use pull systems to avoid overproduction. Give your customers the production they want when they want it, and how much they want. Take material to the production line based on customer usage, is the basic principle of just-in-time. Minimize your work in the processing and storage of inventory, supplying small quantities of each product and replenishing often based on what the customer actually takes. Be sensitive to changes in day-to-day customer demand rather than relying on computer schedules and systems to track inventory unnecessary.

Step 3.13: establish integrated reviews, programming

The work of the entire plant should be interconnected by means of computer programs to create sync operations between departments. Use technology and processes only reliable, thoroughly tested that works for your staff. Use technology to support people, not to replace people. Often, the best thing is to develop a manual process before adding the technology to support the process. The new technology is often unreliable and difficult to standardize and, therefore, threatens the current. Actual tests before adopting new technologies in business processes, manufacturing systems, or products. Reject or modify technologies that conflicts with their culture, or could disturb the stability, reliability and predictability. However, encourage your staff to new technologies to consider when looking for new approaches to the job. Quickly implement fully the technology demonstrated in tests that can improve your processes flow.

Step 3.14: analyze results

Share experiences, analyze results and prepare reports according to the Master Plan.

Step 3.15: interface with material requirement planning (MRP II)

At this point there is control of the plant using lean manufacturing and analyzing the results obtained in each step of implementation is time to make the connection or interface with the System of Material Requirement.

Step 3.16: analyze results

Again the results are analyzed.

5. Steps in phase 4: integrate

Phase 4 , Integration may take 2 to 6 months and the objective of this phase is to establish permanent links between all areas and departments of the plant, as well as linkages with customers and suppliers. This phase consists of 17 steps.

Step 4.1: execution or performance of equipment

Here the teams that developed in the first three phases have combined efforts to integrate the entire plant in the Lean Manufacturing System.

Step 4.2: publish phase 3 activities throughout the plant

Since the beginning of phases 2 and 3 will be posted here all the activities undertaken during Phase 3.

Step 4.3: post lean value chain in the box

Formally publish all commitments have been fulfilled and what is the status of the organization by making a comparison with the initial evaluation, the results have been obtained, to what level is and how it is working.

Step 4.4: link between CIM and FMS

Establishing formal links between Computer Integrated Manufacturing (CIM), and Flexible Manufacturing System (FMS, Flexible Manufacturing System) in order to optimize the processes.

Step 4.5: educate and involve all employees

All employees should know the changes that have been implemented and how they work.

Step 4.6: internal integration

The process for separating the functions to use common technology and information, process information, without explanation, or duplicate functions, and allow different points of view work areas.

Step 4.7: analyze results

Analyze the results to this part of the implementation and make necessary adjustments.

Step 4.8: implement concurrent engineering

Here all the engineering departments will participate with their comments, ideas and commitments in the change that is taking place. Concurrent Engineering is the design methodology of a process or product that includes the simultaneous participation of Engineering, Operations, Accounting, Planning, Customers, Sales and other areas. The goal is to reduce the cycle time of introduction and design, and reduce or eliminate subsequent changes and quality problems involving multifunction devices.

Step 4.9: linking process engineering

All changes must be reflected in the Process Sheet and this department should be linked to the information system of the plant.

Step 4.10: analyze results

Doing analysis for translating the information obtained.

Step 4.11: start supplier development programmer

Since we have all the plant working on lean manufacturing, we also need all our suppliers to work with this system and the first step is to make an assessment, determine your condition and make a commitment.

Step 4.12: link to the supply chain

Go appending suppliers and subcontractors to the Supply Chain of the plant to establish more direct control over them.

Step 4.13: analyze results

Analyzing the results obtained.

Step 4.14: apply extended quality function

Apply Extended Quality Function (QFD, Quality Function Deployment) that will help us understand the requirements of our customers to implement a strategy that allows us to satisfy.

Step 4.15: link to clients

Establish the links that allow us to better communicate with our customers and be better informed on how we are delivering our products and know what we can do to meet your expectations.

Step 4.16: analyze results

Analyze the results.

Step 4.17: study the results and revise strategies

In this last step of phase 4, we need to analyze all the work done and what have been the results to make the necessary changes in the strategies.

6. Steps in phase 5: stand forever and forever

Last of Phases, Phase 5, Excel, is forever and forever, must be carried out throughout the life of the organization since it is continuous improvement. This phase consists of 12 steps.

Kaizen (Continuous Improvement) comes from two Japanese words "Kai" means change and "Zen" meaning improvement. So we can say that "Kaizen" means continuous improvement. The two pillars of Kaizen are the teams and Industrial Engineering, used to improve production processes. In fact, Kaizen focuses on people and process standardization. Its practice requires a team of production personnel, maintenance, quality, engineering, purchasing, and other employees that the team deems necessary. It aims to increase productivity by controlling the manufacturing process by reducing cycle times, standardized quality criteria, and methods of work operation.

In addition, continuous improvement also focuses on eliminating waste, identified as "dumb" (any movement, work or unnecessary inventory in the process), in any form. If a process produces defective items to be scrapped or reworked, labor, materials, time and movement are all wasted, but remember that not only wasted work that adds value to the product are waste operations that are necessary but do not add value to the product, and also useless in the process operations (walking and waiting times), operations that were carried out to produce a paper to be reworked or wasted. The Kaizen strategy begins and

ends with people. With continuous improvement, a direction to guide people to improve their ability to meet expectations of high quality, low cost, and delivery in time, continuously.

Kaizen works as a team and not individually to try to achieve the objectives. If we take the equation of world class in Figure 3.10, we see that this is immersed in an environment called Kaizen. Against the Western perception of Kaizen, which has reduced the whole concept of the simple syllogism of "continuous improvement" is actually more a philosophy than we need to return because of its importance for our purposes. The best writing on this subject is Dr. Masaaki Imai (1989), in his book, "Kaizen: The Japanese competitive advantage", rescues the basic principles of Kaizen:

- Innovation, the real secret of success lies not only in constant improvement; new solutions must be found to old problems. It is easy to cite examples of companies with which to hear their names immediately come to mind expectations of innovation. It is necessary to break with patterns and paradigms and inject large amounts of creativity to our normal lives if we really want to resume our way of doing things.
- Continuous improvement; it is also true that we all remember products or companies that were the great innovation and yet they have disappeared. A simple but representative example is the format and the domestic VCR Beta. Where are they now? How long they stayed on the market? Why did they disappear? Simply because they lacked continuous improvement.
- Process oriented; this is an interesting topic especially if we recall the total employee involvement and commitment that we want to cultivate it. When Kaizen says we should orient more to process the results, means that we must focus our systems to recognize and reward the effort and dedication rather than performance measures. Sadly not even have metric of the effort and much less for the results.
- Humility management; this is a difficult subject, given the excessive political dimensional imbalance. Within many organizations, the political dimension occupies an important than the sound foolishly or human. Let us ask again what it is the Japanese secret for success.
- Creativity; definitely creativity is the basis of innovation and continuous improvement. Policy development work, systems of suggestions and provision of resources, should focus on cultivating the creative thinking of employees. Rigid policies (cows are sacred to Tom Peters, 1988) and rigid systems dramatically hinder creativity in employees.

Step 5.1: Transformation of equipment

In this last phase, and the teams have gained an experience that has led from the formation, regulation of its function to performance or enforcement to genuine transformation.

Step 5.2: publish phase 4 activities throughout the plant

Publish all the activities of phase 4 on the ground. Any person should realize the changes and improvements that have taken place.

Step 5.3: break your paradigms

When it has been made of the existing control is necessary to consider new challenges and try to think about what you never thought to analyze things and getting away from the conventional view that there are ways of doing and thinking totally different paradigms break.

Step 5.4: new ideas for future improvement

Encourage all staff to contribute ideas to improve and create work teams to give them up to ideas.

Step 5.5: establish flexible manufacturing system (FMS)

Having a manufacturing system that allows the flexibility of the process, equipment, machinery, areas do not require staying in the same position, which are movable and can be restructured. The correct process will produce the correct results; create continuous process flow to bring problems to the surface (redesign work processes to achieve high value-added, continuous flow). Strive to reduce to zero the amount of time that any project needs to work instead of sitting idle and waiting for someone, work on it. Click to move material flow and information and to join the process and people together so that problems arise immediately.

Step 5.6: investing in research and development of new methods and technology

To be competitive will also be necessary to devote part of their profits to research and develop new methods and technology to improve products and processes.
Technology Analysis Group

- Assembly line, identify the stages of product assembly, determine the sequence assembly, determine the percentage of sales distribution based on cost and production volume, determine the requirements of the tools, cell manufacturing, sequence the process, material properties (size, type, shape of raw material).
- Phase analysis plan
- Identify the number of possibilities and combinations (Suggestions for improvement).
- Identify common as each product family.
- Vision Cell / Line
- Product flow, locate the production flow of a piece, locate the progressive sequence of construction of the product, the use of material inputs and should be first in first out, operator activity, create an environment that forges standardized methods, put the parts and tools in the correct order the sequence to follow (5S), minimize any activity that does not add value, flexibility, assemble: development of universal tool, Manufacturing: development of SMED / OTED (Single Minute Exchange Die) / (One Touch Exchange Die), Visual Factory, material in point of use / Kankan, production with zero defects, establish quality control source and poka yoke.

Step 5.7: computer integrated manufacturing system

Keep updated and linked all systems.

Step 5.8: operators specializing in automation

Operators are also encouraged to participate in all innovations. The introduction of automated equipment should have personnel with expertise in this type of equipment.

Step 5.9: exchange of experiences.

Always exchange experience helps them gain more knowledge and ideas that can be tested. Lessons learned from past deployments, Lean is not a magic formula, a robust and reliable guidance, short term benefits / immediate and methodology flexible/adaptable

Step 5.10: post results

Publish the results and make sure to publicize any changes to be implemented.

Step 5.11: books and publications productivity.

It is very important that progress be made known outside the plant through leaflets, newspapers, magazines, since it is a way to establish a commitment to Lean.

Step 5.12: celebrate success!

Conclude that it has reached this point is very important because all the people who worked for months or years will feel the satisfaction of having reached a goal that not only crossed a road, but they achieved what they set out from the Master Plan and can continue working on continuous improvement.

7. Important organizational and technical factors for a successful implementation

Below are the most important organizational factors to have a success lean manufacturing implementation:

a. **Training.** The training has other synonyms factor used in the industries that define this term, for example: training, education, cross training, etc. Training is one of the key organizational factors to successfully implement techniques LM.

b. **Employee involvement.** Any work unit cannot supply itself with all aspects needed for optimal operation. To be considered for the organization, department, work area as part of a system, it must consider all members of the same as a unit or a whole. Typically, the organization is divided into three levels of work, which are: managerial, administrative and operational. A cornerstone for the successful implementation of LM is the total involvement of both the production floor personnel, as senior executives. So that it is effective, staff must share the vision and be properly trained in its grounds LM. The involvement of employees is the most important human factor for the category, in most cases refers to the level operator, but in some others, supervisors and department managers. (Wemmerlov & Johnson, 1997), argue that this factor is necessary for the planning and implementation techniques LM.

c. **Teamwork**. Increasingly, companies encourage teamwork training (quality circles, teams consisting of product development, etc.). A task force is a self-directed team that organizes people in a way, be responsible for a certain performance or area. The team takes on many of the responsibilities previously assumed by other people and gives emphasis to the start of the delegation of authority, which is another organizational factor is explained below.

d. **Empowerment**. The English word "empowerment" means strengthening or empowerment, is the fact to delegate power and authority to employees and give them the feeling that they are masters of their own work. The delegation of authority leads to entrust the job to the right person to take you out and to make decisions. It is important that the company delegated authority to its workforce and let them know their limits of authority. To be autonomous, it is important that the workforce possesses various skills, such as the ability of diagnostic, analytical skills, decision making skills, etc. One feature of empowerment is that the maximum benefits from information technology are achieved.

e. **Compensation system**. Systems of compensation, reward or recognition develop pride and self-esteem and workers are vital to achieve the goals of the company. People with authority are an inherent sense of pride in their achievements and contributions to the company. Recognition systems, both psychological and concrete can increase these

feelings. Often these systems in an environment of LM should be more oriented teams in their recognition of job performance and specific achievements. In a case study, communication and rewards were affected by lack of mutual respect and trust and thus impeded the progress of the organization during the design and implementation of techniques for LM, and (Steud Yauch, 2002). Various compensation systems such as point systems, systems for production, systems and product quality, etc. The application of them is in accordance with the needs and objectives that the company has.

f. **Management support.** The factor "management support" is an important pillar in the design, development and continuity of the LM techniques. When making a plan to implement the ME in a company, it is necessary that the conception of the idea is approved and encouraged by the highest levels of the company. The origin of the idea of applying the ME, not necessarily arise from the strategic plans of the company, but it must be incorporated into them if they are to implement a change of this magnitude. The facts that simply approve the implementation of the ME without taking the real involvement, participation and support both physically and financially, has a tendency to lead to unsuccessful implementation of the LM. The support and management support with planning and developing a strategic direction of a program I offer reliability and continuity to all employees involved in this deployment.
g. **Communication**. Communication within any organization is essential for good performance and system feedback. If you do not have a clear dissemination of information, it is possible that the changes do not reach all areas involved in the organization or even the plans of activities are covered, as well as the improvements are not approved by all involved. Communication systems play an important role as they should be effective.
h. Resistance to change. He has performed in companies when there are significant changes in number of employees there is a denial, resistance and/or non-acceptance of change to be implemented. It is necessary when performing the program and implementation plan of the LM in the training factor, deepened the concept of advantages and disadvantages of this tool, and so that the employees involved seeing that change being made is for the benefit company and all employees. It is necessary to consider that if a company worked a long time under a production system and now want to switch to another system, there is resistance to this change. It is very common to hear "we've always done it", "so we're fine," "that does not apply in this company", etc. One of the reasons for employee resistance is personal, involving a desire for change, for example, motivation, custom operating systems already defined and training. Another common reason is the culture of the organization, since this is the one that guides the conduct of workers and there may be some fear of not complying with the activities of radical changes in the way I do things in certain transactions, fear that their position is affected (downsizing).

The objective of this manuscript is on technical factors affecting the successful implementation of the LM techniques in order to make a recommendation for a better method of application. The results of this investigation following the meta-analytic methodology identified the following technical factors impacting the successful implementation of the LM techniques:

a. Planning and Analysis / Documentation and Program / Plan Implementation,
b. Methodology for the implementation of techniques,
c. Reducing the time of model change,

d. Distribution of Manufacturing Cells,
e. Using Technology,
f. Evaluation and monitoring,
g. Clear and precise objectives,
h. Adequate systems for measuring and monitoring the implementation,
i. Sustainability.

Each of these significant factors, linked with a percentage improvement in the place where I applied the techniques to determine the success of the technique.

We can conclude that it is very difficult for companies wishing to implement any of these techniques, what organizational factors should be considered for successful implementation, because there are a lot of them, this research has discovered and provided what organizational factors are needed for successful implementation. Based on the information given in the previous chapter, we present the model we recommend for the implementation of Lean Manufacturing and explain how the model was validated.

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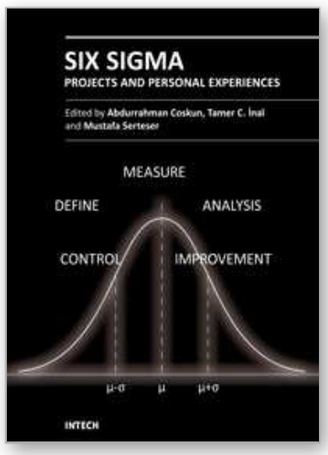

Six Sigma Projects and Personal Experiences

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In the new millennium the increasing expectation of customers and products complexity has forced companies to find new solutions and better alternatives to improve the quality of their products. Lean and Six Sigma methodology provides the best solutions to many problems and can be used as an accelerator in industry, business and even health care sectors. Due to its flexible nature, the Lean and Six Sigma methodology was rapidly adopted by many top and even small companies. This book provides the necessary guidance for selecting, performing and evaluating various procedures of Lean and Six Sigma. In the book you will find personal experiences in the field of Lean and Six Sigma projects in business, industry and health sectors.

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