Implementation of Lean Manufacturing Strategies at Your Organization

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Abstract

Lean Manufacturing is the systematic elimination of waste by focusing on production costs, product quality, JIT delivery, and operator's involvement. In the 1950s, Taiichi Ohno, developer of the Toyota "just-in-time" Production System, created the framework for Lean Manufacturing and waste elimination. Ohno defined waste as "***any human activity which absorbs resources but creates no value***." Largely, Lean Manufacturing represents a fundamental paradigm shift from traditional "batch and queue" mass production to production systems based on product aligned "single-piece flow, pull production." Whereas "batch and queue" involves mass-production of large inventories of products in advance based on potential or predicted customer demands, a "single-piece flow" system rearranges production activities in a way that processing steps of different types are conducted immediately adjacent to each other in a continuous and single piece *flow*. If implemented properly, a shift in demand can be accommodated immediately, without the loss of inventory stockpiles associated with traditional batch-and-queue manufacturing. Japanese manufacturers embraced Lean in the 1950's, today companies embrace Lean Manufacturing for three fundamental reasons. First, the highly competitive, globalized market of today requires that companies ***lower costs*** to increase margins and/or *decrease prices* through the elimination of all non-value added aspects of the enterprise. Second, ***meeting rapidly changing customer "just-in-time" demands*** through rapid product mix changes and increases in manufacturing velocity in this manufacturing age is a key. Finally, goods must be of ***high and consistent quality***. Lean manufacturing facilitates these three goals. In this paper an overview of how a lean manufacturing strategy was effectively implemented at a typical US automotive manufacturing plant. Guidelines and recommendations for effectively implementing this strategy at other automotive manufacturing plants were successfully developed.

1. Introduction

Toyota Production System (TPS), also known as *lean manufacturing*, is the most successful and widely copied manufacturing system in recent years. Lean manufacturing has been recognized as a powerful competitive advantage for Toyota. Toyota's unparalleled success in manufacturing quality and efficiency provide potent testimony of not only a powerful manufacturing system, but also suggests upstream capabilities in product design and development Hence, TPS is a well documented and widely used example for lean manufacturing strategies.

James Womack's 1990 book, "The Machine That Changed the World," lean manufacturing is defined as a theory that can help you to simplify and organize your working environment so that you can reduce waste, and keep your people, equipment, and workspace responsive to what's needed in just in time.

Lean manufacturing is based on improving process and system efficiencies and removing wasteful steps that don't add value to the end product. There's no need to reduce quality with lean manufacturing – the cuts are a result of finding better, more efficient and more cost effective and productive ways of accomplishing the same tasks. To improve the efficiencies, lean manufacturing adopts a customer-value focus, asking "What is the customer willing to

pay for?" Customers want value that meets their specific needs. They shouldn't pay for your waste or inefficient processes.

2. Pre-Assessment to Implementing Lean Strategies

For successful implementation of lean strategies, organization must assess their manufacturing facility prior to any steps for implementing these lean strategies. There is a set of Questions typically asked prior to any process improvement steps: These questions are:

- Does your job depend on someone else to finish a task before you can start on your own job?
- Do you have a large inventory of unsold stock? Just in case a customer may order it.?
- Do you have more workstations than you need for a particular job?
- Do you order materials months in advance of when they are actually needed for consumption?
- Is your process flexible enough to quickly and effectively accommodate any product modifications requested by your customers to meet their specifications?.

Therefore, how can you reduce waste and run production more efficiently? And how can you keep up with the changing demands of consumers?

The idea of lean manufacturing is just as applicable to offices and other work environments as it is to manufacturing plants. It's helpful to relate words like "inventory," "customers," and "production" to whatever you're processing - data, documents, knowledge, services, and so on.

3. Assess Your Process Capability First

The focus of lean manufacturing is “process optimization” by eliminating waste. This helps cut costs and meet customer expectations. With a lean philosophy, manufacturers benefit from continuous improvement efforts. Making rapid and irregular changes that are disruptive to the production and workplace, it is advisable to make small and sustainable changes so that the people who actually work with the processes, equipment, and materials will be willing to take it forward. This systematic and simple approach is very effective across all types of industries.

Waste is anything that doesn't add value to the end product. In lean manufacturing, there are 10 recently identified categories of manufacturing waste that should be monitored, eliminated or at least reduced: Pre-assessments of the manufacturing facility is highly recommended prior to any plan of deploying your lean strategy. The following audit and questions must be asked thoroughly and accurate responses to these questions must be analyzed and documented. Continuous improvement efforts and recommendations will then be deployed. The questions should focus on the 10 wastes as follows:

1. **Overproduction** – Do you provide more data or information than is needed? Do you create reports more often than required for example? do you spend unnecessary amounts of time formatting these reports? Are you producing more than consumer’s demand?
2. **Waiting** – Do you spend too much time waiting for information or data from others, before you can do your work? Do you have lag time between production steps.
3. **Inventory** - Do you have a large stock of materials? Are your supply levels and work-in-process inventory too high?
4. **Transportation** – Do production activities flow efficiently? Could you combine deliveries, or deliver things more quickly?
5. **Over-processing** – Do you needlessly work on something more than once and inefficiently?
6. **Motion** – How is work passed along in your team? Do people understand what they're required to do at each step? Do people and equipment move between tasks efficiently? .
7. **Defects** – How often do you find mistakes? Do you make the same mistakes on a regular basis? How much time do you spend on finding and fixing production problems and mistakes?
8. **Workforce Underutilization** – Do you or your employees use their working time wisely? Do you spend most of your time on activities that add value and are a high priority?
9. **Improper Utilization of Technology-** Do you train your employees on all new software and equipment, do employees use this advanced technology efficiently and for work-related purposes only?
10. **Working to the wrong Metrics –** Do your employees know what is exactly expected from them and use the right tools and processes to get the expected results? is the Workforce given the right information or instruction to the right job to produce the expected deliverables

Simple, small, and continuous improvement efforts are added together, they can lead to a higher level of efficiency throughout the whole system. Although the aim of lean manufacturing is to remove as much waste as possible by continuously improving the processes, total waste elimination will be difficult to achieve

4. Major Stages of Lean Manufacturing Process

Stage 1 – Waste Identification

Waste Identification is the first step in defining the problems and where they exist. DMAIC is the five-step approach that makes up the Six Sigma tool kit, and its sole objective is to drive costly variation from manufacturing and business processes. The five steps in DMAIC are *Define*, *Measure*, *Analyze*, *Improve*, and *Control*. As the backbone of the **Six Sigma** methodology, DMAIC delivers sustained defect-free performance and highly competitive quality costs over the long run.

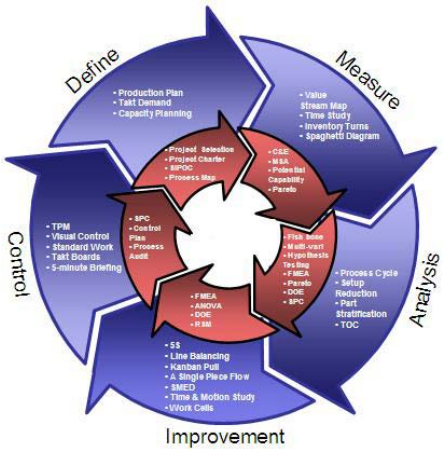

Figure 1: The DMAIC Technique used by lean strategists, (11)

Waste always exists, and no matter how efficient your process is, it can always be improved. Lean manufacturing relies on a continuous improvement technique known as **Kaizen.** One of the tools used to find this waste is **Value Stream Map** (VSM). Value stream mapping is a **lean manufacturing** technique used to analyze and design the flow of materials and information required to bring a product or service to a consumer. At **Toyota**, where the technique originated, it is known as "material and information flow mapping". It can be applied to nearly any **value chain**. VSM shows how materials and processes flow through your organization to bring your product or service to the consumer. As you continue to analyze the VSM, you'll be able to identify the value added processes and non-value added ones and try to eliminate them.

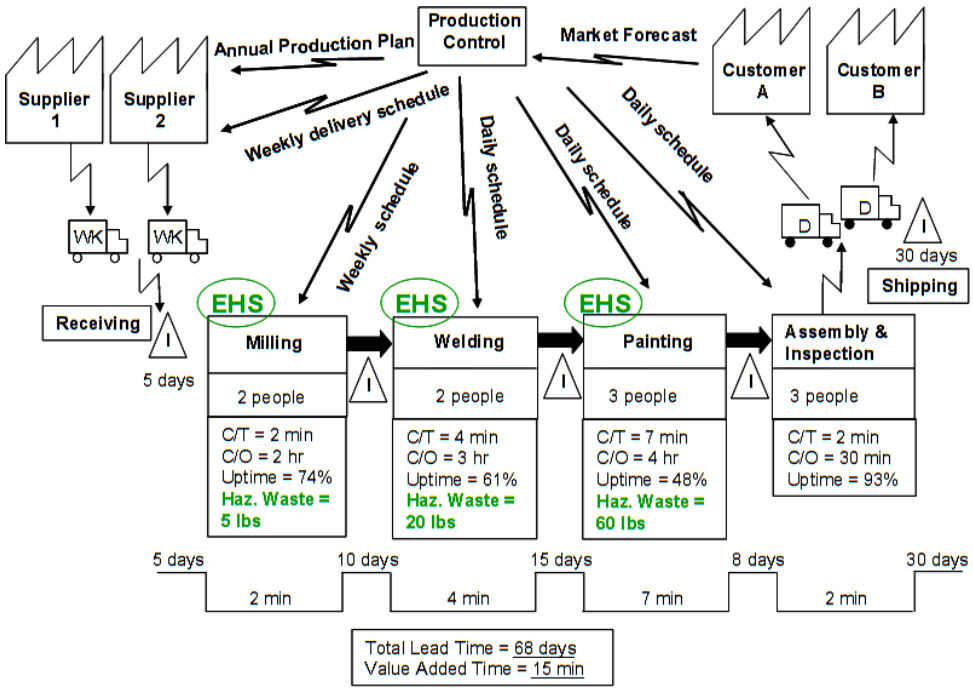

Figure 2: Value Stream Mapping a lean technique (1)

Stage 2 – Analyzing the waste, and finding the root cause

For each waste you identified in the first stage, figure out what's causing it by using Root Cause Analysis. Root cause analysis (RCA) is a class of **problem solving** methods aimed at identifying the **root causes** of problems or events.

Basic elements of root cause using Management Oversight Risk Tree (MORT) Approach Classification. RCA usually consider analyzing the following factors:

- **Materials**: Defective raw material, Wrong type for job, Lack of raw material
- **Man Power**: Inadequate capability, Lack of Knowledge, Lack of skill, Stress, Improper motivation.
- **Machine / Equipment**: Incorrect tool selection, Poor maintenance or design, Poor equipment or tool placement, Defective equipment or tool)
- **Environment**: Disordered workplace, Poor job design and/or layout of work, Surfaces poorly maintained, Inability to meet physical demands of the task, Forces of nature
- **Managemen**t : Lack of management involvement, Inattention to task, Task hazards not dealt with properly, Other (horseplay, inattention....), Stress demands, Lack of Process, Lack of Communication:
- **Methods**: No or poor procedures, Practices are not the same as written procedures, Poor communication
- **Management system**: (Training or education lacking, Poor employee involvement, Poor recognition of hazard, Previously identified hazards were not eliminated

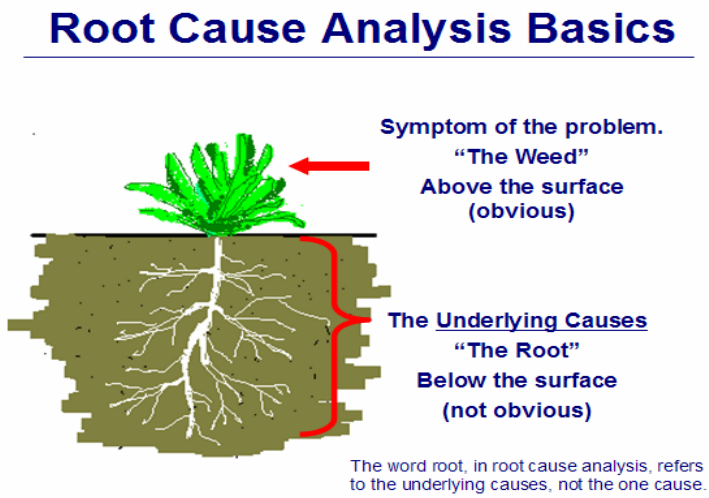

Figure 3: Basics of RCA (10)

If a machine is constantly breaking down, you might think the problem is mechanical and decide to purchase a new machine. But Root Cause Analysis could show that the real problem is poorly trained operators who don't use the machine properly. Other effective tools for finding a root cause include **Brainstorming** and **Cause and Effect Diagrams** (ISHIKAWA)

Stage 3 – Solving the root cause, and repeating the cycle

Using an appropriate problem-solving process, decide what you must do to fix the issue to create more efficiency.

Quality Tools for Process Improvement

The following set of tools, are widely used to help you reduce waste further:

- **Just in Time** – This is the core idea of lean manufacturing and is based on the "pull" model. To minimize stock and resources, you only purchase materials, and produce and distribute products when required. You also produce small, continuous batches of products to help production run smoothly and efficiently. By reducing batch size, you can also monitor quality and correct any defects as you go. This reduces the likelihood of quality being poor in future batches.
  (In manufacturing, a key way of doing this is to use Kanban, below.)
- **Kanban** – This is one of the key ways to involve people in the lean manufacturing process. Here, you support the Just In Time model by developing cues in the system to signal that you need to replace, order, or locate something. The focus is on reducing overproduction, so that you have what you need, only when you need it.
- **Zero Defects** – This system focuses on getting the product right the first time, rather than spending extra time and money fixing poor-quality products. By using the Zero Defects system, you'll reinforce the notion that no defect is acceptable, and encourage people to do things right the first time that they do something.
- **Single Minute Exchange of Die (SMED)** – This helps you build flexibility into your production. For example, in the automotive industry, it could take days to change a line to produce a different car model. With SMED, the assembly process and machinery are designed to support quick and efficient changeovers. (Here, a "die" is a tool used to shape an object or material.)
- **The 5S's Philosophy** – Lean manufacturing depends on standardization. You want your tools, processes, and workplace arrangements to be as simple and as standard as possible. This creates fewer places for things to go wrong, and reduces the inventory of replacement parts that you need to hold. To accomplish a good level of standardization, use the 5S System.

The 5-S Program

Step 1: ***Seiri*** – Separate (Segregate & Discard)
Step 2: ***Seiton*** – Simplify (Arrange and Identify)
Step 3: ***Seiso*** – Sanitize (Clean Daily)
Step 4: ***Seiketsu*** – Systems (Revisit Frequently)

Step 5: *Shitsuke* – Standardize (Motivate to Sustain

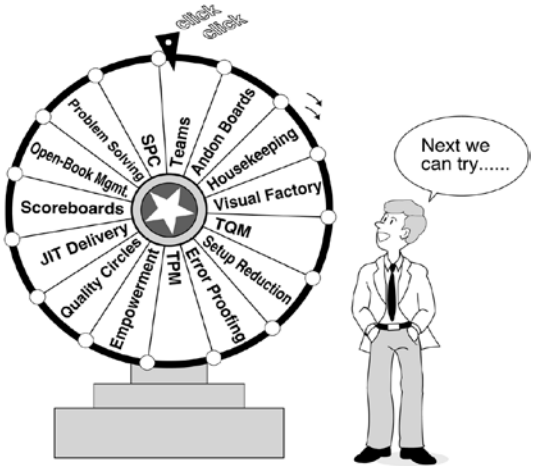

Figure 4: Quality Tools used to eliminate waste (muda) (12)

Ten Commandments of Continuous Improvement

Continuous improvement efforts are the bases for lean manufacturing. Manufacturing wastes are easily discovered and eliminated with continuous improvement efforts at the early stages of production: The following are

1. Abandon fixed ideas they are time consuming
2. Think of ways out of the box to make it possible
3. No excuses needed to adopt the continuous improvement process
4. Go for the simple solution, it saves time, money and effort, not the perfect one
5. Correct mistakes right away, correct an error before becoming a mistake
6. Use your wits, not your wallet
7. Problems are opportunities for improvement
8. 5 Y's **(**Repeat "why?" five times**)**
9. Seek ideas from experts they know better
10. There is no end to improvement

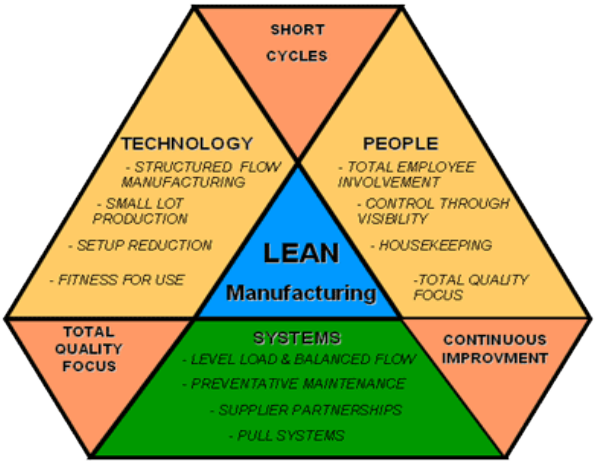

Figure 5: Pillars of Lean Manufacturing-Twelve Elements of Lean, TPS-1990

How to transform your organization to a Lean Enterprise

1. Begin with **action** in the technical system and follow quickly with **cultural** change.
2. Learn by doing first and training second.
3. Start with value stream **pilots** to demonstrate **lean** as a system. .
4. Use value stream mapping to develop future state visions.
5. Use **Kaizen** workshops to teach and make rapid changes.
6. Organize over **value streams**.
7. Make it mandatory.
8. A crisis may prompt a lean movement, but may not be necessary to turn the company around.
9. **Be opportunistic** in **identifying opportunities** for big financial impacts.
10. Realign **metrics** with value streams perspective.
11. Build on your **company's roots** to develop your own way.
12. Hire or **develop** lean leaders and develop a succession system.
13. Use experts for teaching and getting quick results.

5. Conclusions

The purpose of "Lean transformation" is to create a culture where "Lean Thinking" is the norm and doing things better, faster and without error defect or omission becomes the only performance standard – in other words, a way of life. However, Implementation of Lean strategies will not be possible without the support of senior management to agree and discuss their lean vision. Senior management must identify a lean leader and set a plan and layout project objectives. The plan must be communicated to the workforce, select the lean committee and train its members on various lean tools, bench mark other existing lean strategies. Start with 5 S's to begin a pilot project for 3-4 months. Roll out pilot to other locations of the organization. Gather results of the pilot, evaluate and analyze data and suggest improvement and continue to implement the successful results across the board.

Organizations must often look beyond the shop-floor to find opportunities for improving overall processes, cost and performance. At the **system engineering** level, requirements are reviewed with marketing and **customer representatives** to eliminate the non-value added activities that are costly. Organizations must focus on the customer, their specific expectations and what they perceive as value. Continuous Improvement efforts should be a daily routine to eliminate waste. Companies must also create the ability for products or activities, to flow through a process map (VSM) in shortest amount of time possible, establishing disciplines linking customer's Demand directly to processes, transactions, resources, materials or information..

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