



What is Lean Manufacturing? The Essence of a New Method

Introduction

The methods and philosophies of Lean Manufacturing were originally developed by Toyota (under the leadership of Taichi Ohno) in their car production operations. Today, this is called the Toyota Production System, and is being adopted by progressive companies in all types of service, manufacturing, and distribution companies.

The five core concepts that completely define the Lean Enterprise were introduced in the ground breaking book "Lean Thinking" [1996 by Womack and Jones]:

1. Specify value in the eyes of the customer
2. Identify the value stream and eliminate waste
3. Make value flow at the pull of the customer
4. Involve and empower employees
5. Continuously improve in the pursuit of perfection.

We will examine each of these concepts to connect the technical practice of lean methods on the plant floor to the enterprise wide results. When fully implemented, the enterprise changes include cultural transformation within the company, a dramatic improvement in financial performance, and an increase in quality seen by the customer.

[1] Specify value in the eyes of the customer

Anything that does not produce value in the eyes of the customer is waste. Why? Because the customer is not willing to pay for it, waste reduces the margin of the manufacturer.

[2] Identify the value stream and eliminate waste

Waste cannot be eliminated unless it is identified, because most waste is hidden, in plain sight, and stubbornly remains invisible. Finding the waste is a two step process. First, the current state value stream is mapped. The process of mapping makes all the process steps (value and waste) visible. Second, the waste must be identified. There are 7 types of waste, and this list is used as a guide (filter) to see the waste, and mark it for elimination.

The 7 Wastes

1. Overproduction.
2. Waiting
3. Conveyance
4. Processing
5. Inventory
6. Motion
7. Correction. Defective product is either re-worked or discarded by a replacement product. Both methods of correction consume valuable resources and reduce margin.

Two Categories of Muda (Waste)

- **Type One Muda.** Creates no value but is unavoidable with current technologies and production assets. Activities that cannot be eliminated immediately.
- **Type Two Muda.** Creates no value but can be eliminated immediately or quickly through Kaizen.

It is important to recognize the 2 categories of waste, primarily because the reduction and elimination of Type 1 Muda requires a sustained effort over a long period of time.

Where to Look for Waste

- **Conventional View.** Look for waste in material & labor use
- **Lean View.** Look for waste in the flow of materials, flow of information, underutilized resources, facilities, and people.

What is "Lean manufacturing"?

Lean Manufacturing is a disciplined management philosophy that focuses on the systematic reduction and eventual elimination of the seven wastes. By eliminating waste (muda), quality is improved, production lead time is reduced and cost is reduced.

[3] Make value flow at the pull of the customer

Typical production systems are push, where production is scheduled to a forecast that is disconnected from customer demand. This directly causes each of the 7 types of waste. Lean manufacturing embraces the operational



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concept of pull flow, where the customer demand directly affects production rate.

Methods to establish pull flow

- **Workcells.** A cascading series of flow loops, usually at the workcell level, where material is depleted and replenished, where empty slot are filled on the output side, and creating empty slots on the input side.
- **Paperless Flow Control.** Kanban Cards and 2-bin systems control material flow.
- **The Visual Factory.** The process and flow paths are made visible by visual markers, including visual FIFO Queues marked on the floor, and colored tags, bins and markers.
- **Control Point(s).** Where flow is regulated
- **Capacity Planning and Capacity Control.** Rule based mechanism for prioritizing work orders, triggering releasing to production and allocating resources where needed.
- **Flexibility.** EOQ=1. An Economic Order Quantity of One. A flexible production system supports producing a greater diversity of products at ever decreasing batch sizes, without sacrificing efficiency. Counter-intuitively, smaller batch sizes reduce costs because downstream processes that are negatively affected respond quickly. Thus, defects can be identified and corrected quickly.

[4] Involve and empower employees

Much more than a technical initiative, lean is a cultural initiative. In a factory that is not lean, the processes and flow are broken, but people don't realize it. So when the process does not work, the response of the workers is to blame each other and do extra work to compensate for the short comings of the broken process. In a lean enterprise, the "Visual Factory" makes the process visible, so when something goes awry, the workers recognize that it is actually the process is "broken" so they work together to take corrective action. This is empowering to workers at all levels in the organization. When correctly implemented, a lean manufacturing initiative is the catalyst for the total cultural transformation of the enterprise. From the CEO or Owner, all the way down to the person who

sweeps the factory floor, everybody must change their work habits. Everyone has a role that is valuable and contributes directly to the value that the customer is willing to pay for.

[5] Continuously improve in the pursuit of perfection.

The Japanese term for continuous improvement is Kaizen. Achieving continuous improvement is dependent on identifying the opportunity (made possible by the visual factory), acting on it (a cultural imperative grounded in attitude and trust), implementing the changes, and closing the loop to make sure the changes actually produced a result. Since most waste is Type 1 Muda, it is not easily identified, and is not easily or quickly eliminated. Thus, a daily systematic method is needed to root out defects and take corrective action. Two simple lean techniques that can be practiced daily to achieve continuous improvement are the 5 whys and the 5Ss.

The 5 Ss

Sort means to separate needed tools, parts, and instructions from unneeded materials and to remove the latter.

Simplify means to neatly arrange and identify parts and tools for ease of use.

Scrub means to conduct a cleanup campaign.

Standardize means to conduct *Sort*, *Simplify*, and *Scrub* at frequent, indeed daily, intervals to maintain a workplace in perfect condition.

Sustain means to form the habit of always following the first four Ss participations.

The 5 Whys

The 5 whys is a practice of questioning a problem to the void, with the intent of getting to the root cause(s) of a defect of problem. Any problem can have more than one cause, where the causes are usually different from what is thought to be the problem at the outset.

Motivating Factors

Why would a company want to launch a lean manufacturing initiative?

1. **Increased Capacity.** Company wants to increase sales (as much as double) without proportionately increasing manufacturing space, human resources and equipment.

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2. **Reduced Lead Time.** Company wants to reduce the lead time to manufacture while improving on-time delivery performance.
3. **Same Day Shipment.** Company wants to have the most popular products ready for immediate delivery.
4. **Improved Margins.** The savings from the reduction of waste goes directly to the company's bottom line.
5. **Improved Quality.** The company wants to decrease defects seen by the customer.

Objective – Add Value to the Customer

The primary objective is to satisfy the customer's need for value, in a manner that will also improve the bottom line and while improving customer service and quality. Lean serves the customer interests and company interests at the same time. The overall objective is satisfied by meeting the following specific objectives:

- **Improved Efficiency.** By eliminating waste, increase number of units that could be made per day by the same number of employees.
- **Improved Flow.** The flow of materials on the factory floor are controlled and streamlined. Visual indicators let each worker know what needs to be done next.
- **Improved Control.** Established better methods to control production capacity and production schedule.
- **Improved Quality.** The product delivered to the customer is the highest possible quality.
- **Faster Delivery.** Faster flow through the factory results in reduced dock-to-dock time.

Key Actions

The lean manufacturing initiative should focus on several key areas.

- **Visual Factory.** Reorganize factory layout to have simple product flow with visual inventory and visual status of customer orders.
- **Eliminate Waste.** Improve several operations that took a lot of time and slowed production.
- **Material Flow.** Workflow carts enable each worker to move (heavy) assemblies without help, while making the flow visual.
- **Kanban and Queues.** Tasks are designed such that it is obvious to workers (and man-

agement) what needs to be done, empowering each person to take action themselves.

- **Supermarket.** Establish a small inventory of standard finished units that can be shipped on the same day as the order is taken.

Benefits of Lean Manufacturing

- Greatly increased capacity with:
 - no increase in plant area.
 - only incremental increases in labor.
 - very small capital investment.
- The Visual Factory reveals problems immediately to both workers and management.
- Quality improves naturally on a daily basis
- Reduced latent defects and warranty costs
- Improved customer service and experience

Lean Summarized

Lean is basically about minimizing waste (with the goal of elimination) with a workforce that is flexible and open to change. This requires a culture that is only possible when the right kind of working conditions exist: an environment that supports personal growth and Lean Thinking.

Eliminating waste optimizes the flow of both materials and information. The flow of materials and information is designed, such that the right materials are in the right place at the right time in the required quantity, no more, no less.

Systemic problems require systemic analysis and systemic solutions. A holistic approach to problem solving is essential to producing a result with a big impact. To transform a company into a lean enterprise, quickly and efficiently, requires a very systematic and disciplined approach to analysis and implementation.

The phrase "Lean thinking" was first introduced in the book "The Machine That Changed the World: The Story of Lean Production". By James P. Womack, Daniel T. Jones, and Daniel Roos. The book is an analysis of the automobile manufacturing industry worldwide, contrasting manufacturing methods ranging from craft production (Mercedes) to mass production (Ford Model T) to lean production (Toyota). The Toyota way (Lean) is the winning combination.