

**LEAN PRODUCTION SYSTEM: A REVIEW**

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**Abstract:** We know that wastes are being generated by all manufacturing activities necessarily. It is not possible to convert 100% material and energy inputs into final outputs. Some inputs end up becoming waste. When the waste generated exceeds the maximum assimilative capacity of the environment it becomes pollution. The paper focuses on LEAN production system, which aims at elimination of wastage.

*“Lean manufacturing” is a leading manufacturing philosophy being applied in many industrial sectors viz. small and large scale where improving product quality, reducing production costs, and being “first to market” and quick to respond to customer needs are critical to competitiveness and success. Lean manufacturing focus on creating a continual improvement culture that engages employees in reducing the intensity of time, materials, and capital necessary for meeting a customer’s needs. As lean manufacturing focus on elimination of non-value added activities and wastage from the industries it thereby also improves the performance of the environment.*

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**Keywords:** Lean, non-value added activity, customer, quality, manufacturing, waste

**I. INTRODUCTION**

Lean Manufacturing is a manufacturing philosophy to reduce waste in manufactured products. By the series of engineering reviews basic idea of lean is to reduce cost systematically throughout the product and production process. It is a crucial insight that, most costs are assigned when a product is designed.. This reduces project risk, that is, the cost to the engineer, while increasing financial risks, and decreasing profits. Most of the good organizations develop and review checklists to review and analyze product designs. To eliminate costly requirements, the requirements are reviewed with marketing and customer representatives at system engineering level. Shared modules may be developed, such as multipurpose power-supplies or shared mechanical components or fasteners. Requirements are assigned to the cheapest discipline. For example, adjustments may be moved into software and measurements away from a mechanical solution to an electronic solution. Another approach is to choose connection or power-transport methods that are cheap or that use standardized components that become available in a competitive market. In Production Engineering, the process usually begins with a team review of the materials and processes. The team includes a cost accountant, manufacturing and design engineers. Quite often, parts can be combined into a single part which can possibly reduce fabrication and assembly costs. The tooling cost and any production machinery costs are estimated and financial feasibility is established with return on investment. Reuse of existing machinery and capabilities is often essential for the industries.

Lean Manufacturing, simply defined, is a method of doing more with less. Specifically, Lean Manufacturing is producing high quality products with minimal available resources, minimum floor space, work-in-process (WIP) inventory, finished goods inventory, material movement, non-value-added activities, and human effort. Lean Manufacturing encompasses elements of total quality management (TQM), just-in-time (JIT), etc. within a system designed for flexibility and maximum customer satisfaction. Lean always focuses on maximum satisfaction of the workers with reduced wastage. The lean manufacturing approach is the most comprehensive of the popular production management improvement initiatives because it addresses product, process, and human related issues in the production system. Studies have shown that, while many companies claim that they are "lean" or managing production according to TQM, JIT, etc., few are actually doing so. Further, many industries know about the concepts of lean but it is quite difficult to understand the necessary operations needed for successful implementation of the same.

**II. WHAT IS LEAN MANUFACTURING?**

James Womack, Daniel Jones, and Daniel Roos coined the term “lean production” in their 1990 book ‘The Machine’ that changed the World to describe the manufacturing philosophies established by the Toyota Production System. In the 1950s, the Toyota Motor Company determined a collection of advanced manufacturing methods that aimed to minimize the

resources it takes for a single product to flow through the entire production process. Inspired by the waste elimination concepts developed by Henry Ford in the early 1900s, Toyota created an industrial culture focusing on the systematic identification and elimination of all waste from the production process. In the lean context, waste was viewed as any activity that does not lead directly to creating the product or service a customer wants when they want it. In many industrial processes, such “non-value added” activity can comprise more than 95 percent of the total activity as a result of time spent waiting, unnecessary usage and touches of the product, overproduction, unnecessary movement, and inefficient use of raw materials, energy, and other related factors. Toyota’s success from implementing advanced manufacturing methods has lead hundreds of other companies across the globe to apply and implement the techniques to improve production processes.

Lean production typically represents a shift from conventional “batch and queue,” functionally aligned mass production to “one-piece flow,” product-aligned pull production. This shift requires highly controlled processes operated in a well maintained, ordered, and clean operational setting that incorporates principles of just-in-time production and employee-involved, system-wide, continual improvement. To accomplish such shift, companies employ a variety of advanced manufacturing tools and techniques to lower the intensity of time, material intensity, and capital intensity of production.

### **III. THE BENEFITS OF LEAN MANUFACTURING: WHAT LEAN THINKING HAS TO OFFER THE PROCESS INDUSTRIES?**

According to *T. Melton* a question was raised that- How many people in the manufacturing industry can truly say that they have not heard of LEAN? Not many. Yet how many of these believe in lean production, have implemented lean, are the passionate change agents who have convinced senior stakeholders/ members that lean is the way forward for their industry? Less, in fact very less, Lean system is a revolution - it is not just about using tools, or changing a few steps in our manufacturing processes, it is about the complete change of our businesses, how the supply chain management operates, how the authorities direct, how the managers manage the things, how employees, go about their daily work, Everything. So what is this revolution and how is it impacting the process companies? The background of lean thinking is based in the history of Japanese manufacturing techniques and processes which have now been applied world-wide within many types of industry.

### **IV. WHEN DO COMPANIES IMPLEMENT SEVERAL OR ALL OF THE LEAN METHODS?**

Several companies implement lean for the following reasons:

- Reduced inventory levels (raw material, work-in-progress, finished product) along with associated carrying costs and different existing loss.
- Decreased use of materials (product inputs, including energy, water, metals, chemicals, etc.) by reducing requirements of material and creating less wastage during manufacturing.
- Equipment optimization (capital equipment utilized for direct production processes and support purposes) using lower capital and resource-intensive machines to reduce costs.
- Reduced need for industry facilities (which includes physical infrastructure primarily in the form of buildings, structures and associated material demands) by reducing the space required for product production.
- Increased production speed (the time required to process a product from initial input raw material to delivery as a final product to a consumer) by eliminating process sequence, movements, waiting times, and downtime.
- Enhanced production flexibility (the ability to alter products and processes rapidly to adjust according to customer needs and changing market conditions) enabling the implementation of a pull production system, just-in-time oriented system which lowers inventory and requirements related to capital.
- Decreased complexity of products (complicated products and processes that increase opportunities for variation and error) by reducing the number of parts and material types in products, and by eliminating unnecessary process steps and equipment with features which are not required.

# Lean Manufacturing

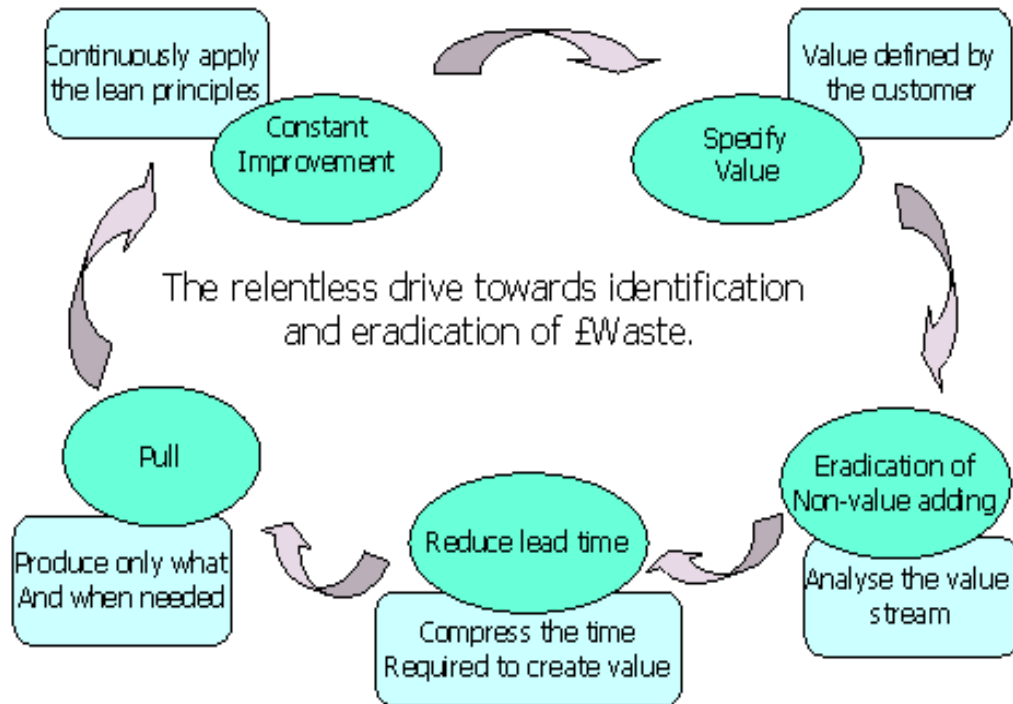


Fig. 1:- Lean Manufacturing

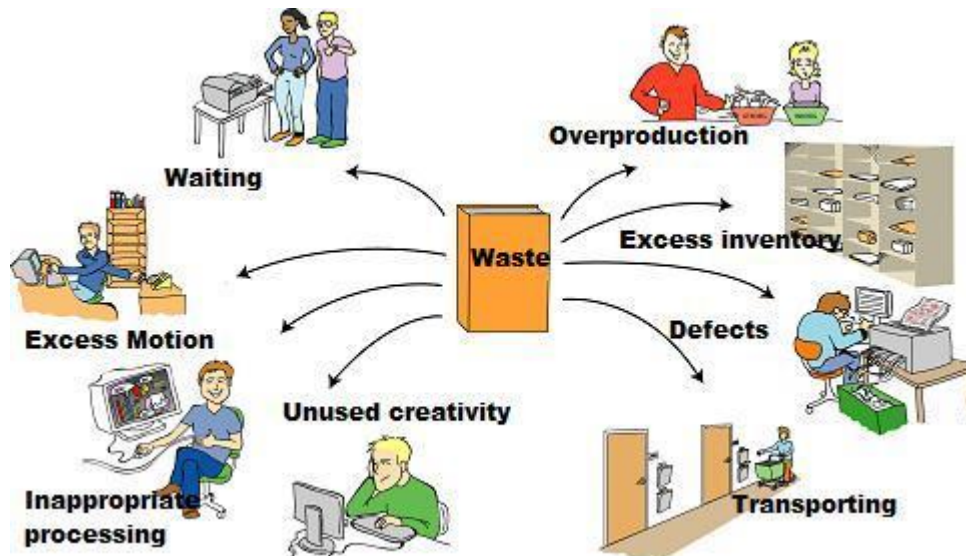


Fig. 2 Eight Types of Manufacturing Waste Targeted by Lean Methods

## V. LEAN TERMS AND DEFINITIONS

- **Batch and queue:** The mass production process of making large lots of a part and then sending the batch to wait in the queue until the next operation in the production process begins.
- **Bottleneck:** Any part of a manufacturing or a production line that adversely affects throughput.
- **Cell:** It is an arrangement of machinery, tools, equipments and personnel designed to most efficiently complete a production sequence.
- **Cellular Manufacturing:** An approach in where manufacturing work centers (cells) have the total capabilities needed to produce an item or group of similar items.
- **Chaku-Chaku:** It is a method of conducting one-piece flow, where the operator starts from machine to machine, taking the part from one machine and loading it into the next.
- **Changeover Time:** It is the time that elapses between the completion of one production run and the beginning of another production run.
- **Constraint:** It defines anything that limits a system from achieving higher performance.
- **Cycle Time:** The amount of time to accomplish the standard work sequence for one product, excluding waiting/ queue time.
- **Inventory:** It is the term used for the money the system has invested in purchasing things it intends to sell.
- **Just-in-Time:** A production scheduling concept that calls for any item needed at a production operation – whether raw material, finished item, or anything in between, to be produced and available precisely when needed.
- **Kaikaku:** It is a Japanese term for “radical improvement of an activity,” designed to eliminate waste from an industry.
- **Kaizen:** The incremental and small continual improvement of production activities aimed at reducing waste.
- **Kanban:** A card or sheet used to authorize production or movement of an item.
- **Kanban System:** A system that controls WIP or production inventory and movements through the visual control of operations.
- **Large Lot Production:** The manufacture of the same product in large quantities during a single, designated period of time in production process.
- **Lead Time:** The total amount of time it takes to complete an order for a customer.
- **Lean Supplier Network:** It is a buyer-supplier relationship where designated lean production protocols, supporting sustained interactions between members, help to produce a competitive advantage.
- **Mistake Proofing:** The term in Japanese is known by the name POKA-YOKE which is a technology and procedure designed to prevent defects and equipment malfunction during manufacturing processes.
- **Monument:** A production machine or tool that is difficult and/or costly to move due to its size or other physical constraint. Often, materials must instead be brought to the monument in batches.
- **Muda:** The Japanese term for any human activity which absorbs resources, but creates no real value, i.e., “waste”; activities and results to be eliminated.
- **Non-Value-Added:** These are those activities or actions taken that add no real value to the product or service, making such activities or actions a form of waste.
- **One-Piece Flow:** A situation in which products proceed, one complete product at a time, through various operations in design, order-taking, and production, without interruptions, backflows, or scrap. Also known as single-piece flow.
- **Point-of-Use:** A system in which all necessary supplies, chemicals, etc. are within arm’s reach of the worker, and positioned in a logical sequence of use.
- **Pre-Production Planning (3P):** It is a lean method for product and/or process design. 3P designs and implements production processes, tools, and equipment that support one-piece flow, are designed for manufacturability, and achieve appropriate cost, quality, and lead time. Also known as “Production Preparation Process”.
- **Pull Production System:** A production system in which nothing is produced by the upstream supplier until a need is signaled by the downstream customer.
- **Right-sized:** The matching of production tooling and equipment in a scale that enables its use in the direct flow of products such that no unnecessary transport or waiting is required.
- **Queue Time:** The time a material spends waiting in line for use in the production process.

- **Supply Chain:** A group of all suppliers involved in the manufacture of a product, beginning with the simplest part and ending with the production of the final product.
- **Takt Time:** It is described as the available production time divided by the rate of customer demand.
- **Value Stream:** The set of specific actions required to bring a specific product through three critical management tasks of any business: problem solving, information management, and physical transformation. Value Stream
- **Mapping:** A process mapping method used to document the current and future states of the information and material flows in a value stream from customer to supplier.
- **Visual Controls:** Displaying the status of an activity so every employee can see it and take appropriate action.
- **Work In Progress (WIP):** Production material in the process of being converted into a saleable product

## VI. ORGANIZATIONS' METHODS TO IMPLEMENT LEAN

There are numerous methods and tools that organizations use to implement lean production systems. Eight core lean methods are described briefly below. The methods include:

1. Kaizen
2. 5S
3. Total Productive Maintenance (TPM)
4. Cellular Manufacturing
5. Just-in-time Production / Kanban
6. Six Sigma
7. Pre-Production Planning (3P)
8. Lean Enterprise Supplier Networks

Most organizations begin by implementing lean techniques in a particular production area and then expand use of the methods over a reasonable period of time. Companies typically tailor these methods to address their own unique needs and circumstances, although the methods generally remain similar. In doing so, they may develop their own terminology around the various methods.

## VII. LEAN GOALS AND STRATEGY

The important goals of lean manufacturing systems differ between various authors. While some maintain an internal focus, e.g. to increase profit for the organization, others claim that improvements should be done for the sake of the customer/consumers.

Some commonly mentioned goals are:

- **Improve quality:** To stay competitive in today's marketplace, a company must understand its customers' wants and needs and design processes to meet their expectations and requirements.
- **Eliminate waste:** Waste is any activity that consumes time, resources, or space but does not add any value to the product or service. See Types of waste above.
- **Reduce time:** Reducing the time it takes to finish an activity from start to finish is one of the most effective ways to eliminate waste and lower costs.
- **Reduce total costs:** To minimize cost, a company must produce only to customer demand. Overproduction increases a company's inventory costs because of storage needs.

The strategic elements of lean can be quite complex, and comprise multiple elements. Four different notions of lean that are being identified are:

1. Lean as a fixed state or goal (being lean)
2. Lean as a continuous change process (becoming lean)
3. Lean as a set of tools or methods (doing lean/toolbox lean)
4. Lean as a philosophy (lean thinking)

### VIII. CONCLUSIONS

The Total Lean Management Model takes into consideration and aligns ALL the pillars of Lean which are – TFM, TPM, TQM, TSM and THM in a systematic way under one umbrella, making Lean understanding, learning and execution a smooth methodology. Creating WORLD CLASS ORGANIZATIONS – begins with the basic requirement of having a good 5S in the workplace, followed by identification, reduction and if possible elimination of the 7 Muda's/wastes across the value chain of customers to suppliers.

The following steps should be implemented to create the ideal lean manufacturing system:

- Design a simple manufacturing system
- Recognize that there is always scope for improvement
- Continuously improve the system design for lean manufacturing.

A fundamental principle of lean manufacturing is demand-based flow manufacturing. In this type of production, inventory is only pulled through each production center when it is needed to meet a customer's order. The benefits of this goal include:

- Decreased cycle time
- Less inventory
- Increased productivity
- Increased capital equipment utilization

The core of lean is founded on the concept of continuous product and process improvement and the elimination of non-value added activities from any type of organization. "The Value adding activities are simply only those things the customer is willing to pay for, everything else is waste, and should be eliminated, simplified, reduced, or integrated", as was said by Rizzardo in 2003. The main aim/objective of the lean production system is to focus on waste, minimize it, reduce it to minimum and increase productivity with minimum use of resources at lowest possible cost.

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