

## What is Lean Manufacturing?

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Lean manufacturing is a manufacturing system which was started by Toyota and is now used by many manufacturers throughout the world.

Lean Manufacturing is a way to notice and remove waste i.e. non-profit activities by continuous improvement using the non-stop flow of the product to the customer with perfection.

Waste is defined as anything that does not add any value to the product. It is anything that the customer is not ready to spend money for.

Manufacturing of a product is completely dependent on designing a manufacturing system that leads to minimization of costs and maximization of profit. The fundamentals of manufacturing processes are Man (labour), Materials and Machines (equipments) and a perfect manufacturing system involves the complete utilization of these resources in a systematic manner.

### NON-PROFIT MANUFACTURING ACTIVITIES

The Lean Manufacturing concept is applied to eliminate the non-profit activities in all production processes i.e. customer relations, designing of products, supply chain management, inventory etc. Its aim is to reduce human efforts, less inventory, faster manufacturing of products in minimum time and space availability to satisfy customer demand and produce high quality products in an efficient and cheapest manner involved.

Following are the non-profit activities in a lean manufacturing system include:

#### 1. Excess Production

When the production exceeds the demand of the product the a situation of excess production arises. It adds up the inventory cost of the excess products produced for storage. It is the result of producing to speculative demand.

Causes for Excess production include:

- Just-in-case logic
- Misuse of automation
- Long process setup
- Unleveled scheduling
- Unbalanced work load
- Over engineered
- Redundant inspections

#### 2. Delay

For a machine to process delay time or the non productive time should be removed completely. The

principle is to maximize the efficiency of the worker rather than maximizing the usage of the machines.

Causes of non productive time include:

- Unbalanced work
- Unplanned maintenance
- Long process set-up times
- Misuses of automation
- Upstream quality problems
- Unleveled scheduling

#### 3. Inventory

This is the material between operations due to large lot production or processes with long cycle times.

Causes of excess inventory include:

- Protecting the company from inefficiencies and unexpected problems
- Product complexity
- Unleveled scheduling
- Poor market forecast
- Unbalanced workload
- Unreliable shipments by suppliers
- Misunderstood communications
- Reward systems

#### 4. Processing

It should be minimized by asking why a specific processing step is needed and why a specific product is produced. All unnecessary processing steps should be eliminated.

Causes for processing waste include:

- Product changes without process changes
- Just-in-case logic
- True customer requirements undefined
- Over processing to accommodate downtime
- Lack of communications
- Redundant approvals
- Extra copies/excessive information

#### 5. Transportation

This does not add any value to the product. Instead of improving the transportation, it should be minimized or eliminated.

Causes of transportation waste include:

- Poor plant layout
- Poor understanding of the process flow for production
- Large batch sizes, long lead times, and large storage areas



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## **6. Movements**

Movements of the workers, machines, and transport due to the wrong location of machines, raw materials, tools and parts leads to delay in production process so the operation itself should be improved.

Causes of useless movements include:

- Poor people/machine effectiveness
- Inconsistent work methods
- Unfavorable facility or cell layout
- Poor workplace organization and housekeeping
- Extra "busy" movements while waiting

## **7. Errors in production**

This leads to complete rejection of the products and complete loss of the investment made in the production of the rejected products. Identification of the fault in the production process which leads to the defects should be carried out instead of correcting the defects of the products.

Causes of errors in production process include:

- Weak process control
- Poor quality
- Unbalanced inventory level
- Deficient planned maintenance
- Inadequate education/training/work instructions
- Product design
- Customer needs not understood

## **8. Ineffective use of resources**

When the resources present are not utilized properly, it leads to a loss in manufacturing process in terms of low production, high cost of production process, poor quality and larger production time involved.

Causes of ineffective use of resources include:

- Old guard thinking, politics, the business culture
- Poor hiring practices
- Low or no investment in training
- Low pay, high turnover strategy

All kinds of non-profit activities in the production process belong to one of the categories above. Those that understand the concept deeply view waste as the singular enemy that greatly limits business performance and threatens prosperity unless it is relentlessly eliminated over time. Lean manufacturing is an approach that eliminates waste by reducing costs in the overall production process, in operations within that process, and in the utilization of production labor. The focus is on making the entire process flow, not the improvement of one or more individual operations.

## **TOOLS OF LEAN MANUFACTURING**

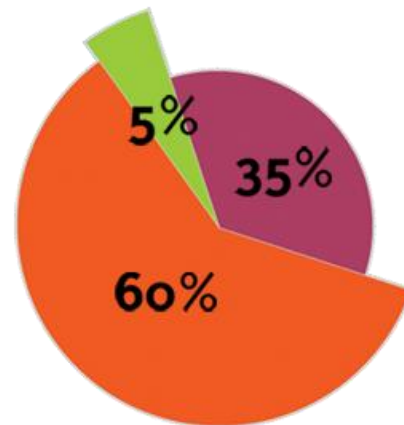
The basic elements of lean manufacturing are waste elimination, continuous improvement, pull system, one-piece workflow, cellular manufacturing and 5S's. When these elements are focused in the areas of cost, quality and delivery, this forms the basis for a lean

production system.

### **1. Elimination of waste**

Waste is anything that doesn't add value to the product. Seeing whether the process is adding value to the product or not is the best way to identify wastes.

Out of the complete processes in an industry only about 5 % actually add value to the product. Rest of the process does not add any value. Rest 35% activities are such that even though this doesn't add any value but still it cannot be eliminated as it is necessary. For eg. Inventory cannot be completely reduced, scrap materials cannot be made zero, it may take few minutes to load unload and load for next operation etc. So focus should be on complete elimination of waste activities and reducing the necessary non-value adding activities.



### **2. Continuous Improvement**

Japanese looks at improving their work every time they do it. This led to the development of concept called continuous improvement. Japanese rather than maintaining the improvement they have achieved they concentrated in continuously improving their work. This improvement can be in any field like quality, error proofing, lead-time reduction etc. So the focus should be on how you can improve your work than the same done last time.

Improvement is classified into innovations and kaizen. Innovations are those improvements which cause drastic changes. These occur due to huge technological advancements in the field of research and development. These are mostly done by high level engineers. Kaizen include small small improvements done by lower order employees.

In order to achieve continuous improvement the work culture of the workers should be modified. The workers should be aimed at improving their work each time they do it.

### **3. Pull system**

Manufacturing system can be divided into two

systems:

a) **Push system** – Here the products are made according to the market forecast and not according to the current demand. So here the information flow is in the same direction as the product flow. So there may be chance of piling of finished goods as there are always fluctuations in demand. Thus the product is pushed through the production line.

b) **Pull system**- Here the product is made according to the customer demand. So the information of the quantity and type of product flow is in the opposite direction to that of the product. Here no piling of finished products occurs as the production is according to the customer demand. Hence the customer pulls the product through the production line.

#### 4. **One-piece flow**

One piece flow is one of the important techniques in implementing lean manufacturing. Traditional batch production in mass production is replaced by one piece flow in lean manufacturing. Here batch size is reduced to almost one. This reduces the total lead time and also reduces waiting between operations or queuing.

The lead time can be reduced to almost 40% of the lead time when it was batch production. Also it can be noted that it takes about 85% less time for the first part to be produced. Thus product can be produced according to current demand quickly.

#### 5. **Cellular manufacturing**

In traditional mass production machines are arranged according to its functions. But in cellular manufacturing machines are arranged according to the processes involved in production. The plant layout is designed in such a way that transportation between machineries is reduced to minimum. For the implementation of such a good plant layout deep knowledge of processes as well as proper analysis of processes involved in production is necessary.

#### **CELL ADVANTAGES OVER FUNCTIONAL DEPARTMENT**

1. Shorter Lead Time
2. Improved Quality - Quicker problem identification
3. Improved Quality - Less potential rework or scrap
4. Less Material Handling
5. Improved Coordination
6. Reduced Inventory
7. Departmental conflicts eliminated
8. Simplified Scheduling
9. Less Space Required

#### 6. **The 5 S's**

It is the Japanese method of keeping the work place

clean and tidy. This helps in reducing many unnecessary movements. The 5S's are:

•**Sort (Seiri)** - Perform "Sort Through and Sort Out," by placing a red tag on all unneeded items and moving them to a temporary holding area. Within a predetermined time the red tag items are disposed, sold, moved or given away.

•**Set in Order (Seiton)** - Identify the best location for remaining items, relocate out of place items, set inventory limits, and install temporary location indicators.

•**Shine (Seiso)** - Clean everything, inside and out.

•**Standardize (Seiketsu)** - Create the rules for maintaining and controlling the first 3S's and use visual controls.

•**Sustain (Shitsuke)** - Ensure adherence to the 5S standards through communication, training, and self-discipline.

#### **KEYS TO LEAN SUCCESS**

Following are some considerations to successful lean implementation:

##### 1. **Prepare and motivate people**

- Widespread orientation to Continuous Improvement, quality, training and recruiting workers with appropriate skills
- Create common understanding of need to change to lean

##### 2. **Employee involvement**

- Push decision making and system development down to the "lowest levels"
- Trained and truly empowered people.

##### 3. **Identify and empower champions, particularly operations managers**

- Remove roadblocks (i.e. people, layout, systems)
- Make it both directive yet empowering

##### 4. **Atmosphere of experimentation**

- Tolerating mistakes, patience, etc.
- Willingness to take risks

##### 5. **Installing "enlightened" and realistic performance measures, evaluation, and reward systems**

Do away with rigid performance goals during implementation

- Measure results and not number activities/events
- Tie improvements, long term, to key macro level performance targets (i.e. inventory turns, quality, delivery, overall cost reductions)

After early wins in operations, extend across ENTIRE organization.

#### **COMPARISON BETWEEN TRADITIONAL AND LEAN MANUFACTURING**

For years manufacturers have created products in anticipation of having a market for them. Operations have traditionally been driven by sales forecasts and

firms tended to stockpile inventories in case they were needed. A key difference in Lean Manufacturing is that it is based on the concept that production can and should be driven by real customer demand. Instead of producing what you hope to sell, Lean Manufacturing can produce what your customer wants with shorter lead times. Instead of pushing product to market, it's pulled there through a system that's set up to quickly respond to customer demand.

Lean organizations are capable of producing high-quality products economically in lower volumes and bringing them to market faster than mass producers. A lean organization can make twice as much product with twice the quality and half the time and space, at half the cost, with a fraction of the normal work-in-process inventory. Lean management is about operating the most efficient and effective organization possible, with the least cost and zero waste.

**OVERALL ORGANIZATIONAL CHARACTERISTICS:**

	<b>TRADITIONAL MASS PRODUCTION</b>	<b>LEAN PRODUCTION</b>
Business Strategy	Product-out strategy focused on exploiting economies of scale of stable product designs and non-unique technologies	Customer focused strategy focused on identifying and exploiting shifting competitive advantage.
Customer Satisfaction	Makes what engineers want in large quantities at statistically acceptable quality levels; dispose of unused inventory at sale prices	Makes what customers want with zero defect, when they want it, and only in the quantities they order
Leadership	Leadership by executive command	Leadership by vision and broad participation
Organization	Hierarchical structures that encourage following orders and discourage the flow of vital information that highlights defects, operator errors, equipment abnormalities, and organizational deficiencies.	Flat structures that encourage initiative and encourage the flow of vital information that highlights defects, operator errors, equipment abnormalities, and organizational deficiencies.

External Relations	Based on price	Based on long-term relationships
Information Management	Information-weak management based on abstract reports	Information-rich management based on visual control systems maintained by all employees
Cultural	Culture of loyalty and obedience, subculture of alienation and labor strife	Harmonious culture of involvement based on long-term development of human resources
Production	Large-scale machines, functional layout, minimal skills, long production runs, massive inventories	Human-scale machines, cell-type layout, multi-skilling, one-piece flow, zero inventories
Operational capability	Dumb tools that assume an extreme division of labor, the following of orders, and no problem solving skills	Smart tools that assume standardized work, strength in problem identification, hypothesis generation, and experimentation
Maintenance	Maintenance by maintenance specialists	Equipment management by production, maintenance and engineering
Engineering	"Isolated genius" model, with little input from customers and little respect for production realities.	Team-based model, with high input from customers and concurrent development of product and production process design

**MANUFACTURING METHODS:**

	<b>TRADITIONAL MASS PRODUCTION</b>	<b>LEAN PRODUCTION</b>
Production schedules are based on...	Forecast — product is pushed through the facility	Customer Order — product is pulled through the facility
Products manufactured to...	Replenish finished goods inventory	Fill customer orders (immediate shipments)
Production cycle times are...	Weeks/months	Hours/days
Manufacturing lot size quantities are...	Large, with large batches moving between operations; product is sent ahead of each operation	Small, and based on one-piece flow between operations
Plant and equipment layout is...	By department function	By product flow, using cells or lines for product families
Quality is assured...	Through lot sampling	100% at the production source
Workers are typically assigned...	One person per machine	With one person handling several machines
Worker empowerment is...	Low — little input into how operation is performed	High — has responsibility for identifying and implementing improvements
Inventory levels are...	High — large warehouse of finished goods, and central storeroom for in-process staging	Low — small amounts between operations, ship often
Inventory turns are...	Low — 6-9 turns pr year or less	High — 20+ turns per year
Flexibility in changing manufacturing schedules is...	Low — difficult to handle and adjust to	High — easy to adjust to and implement
Manufacturing costs are...	Rising and difficult to control	Stable/decreasing and under control

**BENEFITS OF LEAN MANUFACTURING**

According to the study conducted in various industries world over the main benefits achieved by implementation of lean manufacturing is as shown below.

- Lead time is reduced by 90%
- Productivity is increased by 50%
- Work in process is reduced by 80%
- Quality is improved by 80%
- Space utilization is increased by 75%

These are areas in an establishment that directly affects its survival. There are many other benefits also which directly or indirectly affects the performance of the industry.

**OTHER BENEFITS**

- Reduced scrap and waste
- Reduced inventory costs
- Cross-trained employees
- Reduced cycle time
- Reduced obsolescence
- Lower space/facility requirements
- High quality & reliability

- Lower overall costs
- Self-directed work teams
- Lead time reduction
- Fast market response
- Longer machine life
- Improved customer communication
- Lower inventories
- Improved vendor support and quality
- Higher labor efficiency and quality
- Improved flexibility in reacting to changes
- Allows more strategic management focus
- Increased shipping and billing frequencies

However, by continually focusing on waste reduction, there are truly no ends to the benefits that can be achieved.

**CONCLUSION**

“LEAN” can be said as adding value by eliminating waste being responsive to change, focusing on quality and enhancing the effectiveness of the work force.

Although lean has its origin in the automobile industry it is being successfully used in other production industries. Lean manufacturing is now

extended to fields like I.T, service etc in order to reduce production cost and meet changing customer needs.

Since lean is completely customer oriented it is here to stay. It is also important as it emphasis customer satisfaction.

Lean has made its way into curriculum of major universities around the world. Many consulting firms

are also functioning for proper guidance to those who are interested in lean.

Lean manufacturing cannot be attained in one day or one week or one month or in a year. It needs lot of commitment and hard work. Also there is no end in lean manufacturing. The more you eliminate waste the more you become lean.