

# Design of Lean Manufacturing

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**Abstract :** This paper is about design of lean manufacturing and this paper reveals how to design lean manufacturing system or how one can implement lean manufacturing in any organization or an industry. This paper contain brief introduction about, lean manufacturing, benefits of lean manufacturing, various elements of lean manufacturing, difficulties in implementing lean manufacturing and structured approach for designing of lean manufacturing including enablers of lean.

**Index Terms** – LM, 3M's, VSM

## 1. INTRODUCTION

Lean production means doing more with less- less time, less space, less human efforts, less machinery, less materials- while giving customers what they want. The Lean or Toyota system relentlessly attacks muda (waste) by involving team members in shared, standardized improvement activities. Lean is a manufacturing or management philosophy that shortens the lead time between a customer order and the shipment of the parts or services ordered through the elimination of all forms of waste. A planned systematic implementation of lean leads to improved quality, better

cash flow, increased sales, greater productivity and throughput, improved morale and higher profits.

The lean house or basic image of lean production is as shown in fig.1. The foundation of lean system is stability and standardization. The walls are just in time delivery of parts and jidoka, or automation with a human mind. The goal (the roof) of the system is customer focus: to deliver the highest quality to the customer, at the lowest cost, in the shortest lead time. The heart of the system is involvement: flexible motivated team members continually seeking a better way.

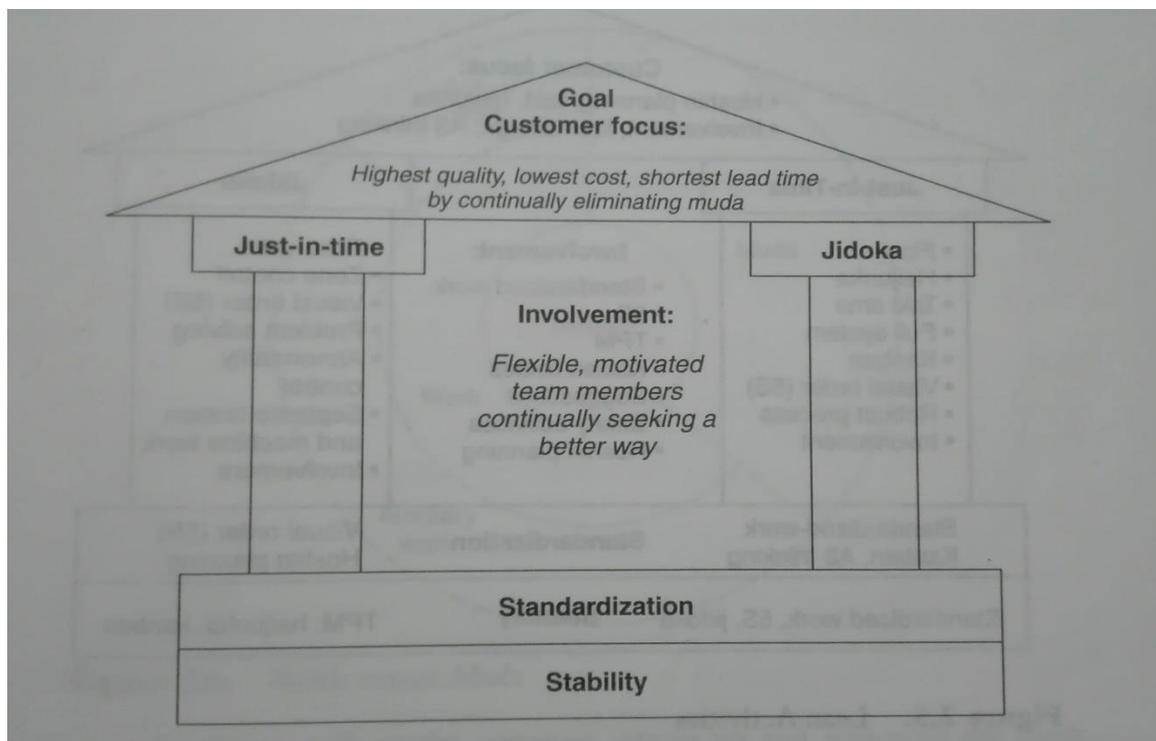


Fig. 1 Lean house

### 1.1. Importance

A systematic way to identify waste and eliminating them and improving efficiency through continuous improvement is known as lean production, more important than the actual improvements that the

individuals made, the true value of continuous improvement is in creating atmosphere of continuous learning and the environment which does not only accepts the change but embraces it. Lean is all about continuous improvement and respecting people by

eliminating the 3 M's from company which are muri, mura and muda.

Thus it is necessary to understand the concept of lean manufacturing before trying to implement it. But it is difficult to adopt this philosophy without any structured approach, so this topic is important to give knowledge about how to design lean manufacturing system and gives structured approach for successful implementation of lean manufacturing.

### 1.2. Overview

Lean is nothing but the systematic approach to identify the wastes and eliminate them or rather converts them into organizations turnover. Lean manufacturing is

a production practice that considers the expenditure of resources for any goal other than the value added to end customer is nothing but waste, and thus has to be eliminated. Hence, by application of this concept, all resources which do not add value to a product are "waste", have to be identified and should be cut down as much as possible. Muri means overburdening the operators beyond their capacity, mura simply means unevenness, if workload is unevenly distributed over machines or operators we create mura and muda is nothing but waste or non value adding activities. The organizations in the manufacturing industry often go through various losses due to major 7 types of wastes in the company.



Fig.2 7 types of wastes

The types of waste shown in fig.2 includes:

- 1) Transportation (any movement of materials, tools equipment's, products from one cell to another.)
- 2) Inventory (any material, tool, equipment stored within the process and not being worked on.)
- 3) Motion (any movement by operator during process cycle.)
- 4) Waiting (any delay due to man, machine, material.)
- 5) Overproduction (producing more than required or before it is required.)
- 6) Over processing (adding cost and time without providing customer value.)
- 7) Defects (any items that are not produced right first time.)

The use of the term 'Lean' in a manufacturing environment, describes a philosophy that incorporates a collection of tools and techniques into the business processes to optimize time, human resources, assets and productivity, while improving the quality level of

products and services to their customers. Lean manufacturing has emerged rather recently as an approach that integrates different tools to focus on the elimination of waste and produce products that meet customer expectations. Lean Production includes a set of tools and the Lean Thinking which focuses both internally by reducing costs and externally to increase customer satisfaction. The objective of this multi-dimensional approach is the reduction of costs by eliminating the non-value activities.

### 1.3. History

In 1850 Whitney introduced the concept of interchangeable parts. But Henry Ford was the first to truly integrate an entire production process at Highlands Park, MI, in 1913 where he synthesized interchangeable parts with standard work and moving conveyors and created flow production. Ford developed concept of assembly lines and adopted manufacturing strategies to

achieve mass production. In the spring of 1950, a young Japanese engineer named Eiji Toyoda visited Ford's vast Rouge plant in Detroit. Both Japan and the Toyota Motor Company, which his family had founded in 1937, were in crisis. After thirteen years of effort Toyota had only been able to produce 2685 automobiles. By contrast Ford's Rouge plant was producing 7000 per day.

Eiji Toyoda studied every corner of the Rouge, the world's biggest and most efficient manufacturing complex. Upon his return to Japan, Eiji and his production genius, Taichi Ohno, concluded that mass production would not work in Japan. They also concluded, famously that, "there are some possibilities to improve the production system." Thus, they developed the system, which is called as "Lean Production System" or "Toyota Production System"

## **2. LITERATURE REVIEW**

Shah et al. [2]. Lean Manufacturing is widely regarded as an excellent tool for reducing costs and cycle times, and for improving quality in manufacturing operations. Lean Manufacturing is defined to be an umbrella term for a number of techniques like Production Leveling, Pull System, Kanban system, 5S, Small Lot Production, Setup Time Reduction, Total Preventive Maintenance, Line Balancing, flexible manufacturing and Small-group Activities whose purpose is to improve product quality and cost by eliminating all waste in the production system.

Singh et al. [3]. For successful implementation of Lean Manufacturing all the elements must be properly understood, measured and implemented. It is very difficult to take care each of these elements individually without any structured approach.

Kumar et al. [4], studied lean manufacturing elements and its benefits for manufacturing industry. They suggested that lean manufacturing has been the key to improve competitiveness for manufacturing organizations over the globe. According to them there is no short and snappy definition for lean manufacturing but common understanding about lean manufacturing is mainly waste reduction, continual improvement, process improvement and improving supplier customer relationship by reducing lead time. They also suggested that it should be carefully prepared and followed otherwise investment of resource for lean manufacturing implementation will go waste it may result into cost impact and demoralized employees hence, for effective implementation obstacles must be taken care of before initiation and should be backed with action plan to overcome them.

Rajkumar et al. [5], carried out a review on current trends in lean manufacturing and its techniques in which they suggested that lean management practices can help avoiding intense pressure to find new ways to reduce production cost, elimination of waste, enhance high quality of product increase productivity and customer satisfaction. The process in lean implementation is snail-paced and needs to be augmented, so they suggested the major reason for low level of lean management were due to anxiety in changing the attitudes of workers, lack of awareness, and training about the lean management concepts, cost and time involved in lean implementation.

Pettersen [6], studied some conceptual and practical issues about lean production and Pointed out that the Lean principles are applicable to any industry and if this is correct, then the Japanese should logically have distributed the knowledge of these principles throughout all domestic Japanese industry. This does not look like to be the case. The only 'true' Lean producers in Japan are confined to the automobile industry, represented by, e.g. Toyota, Honda and Mazda, whereas other areas of industry are performing at the same level as or worse than western competitors.

Sheth et al. [7], This paper defines concept of Value Stream Mapping and reviews various literatures related on VSM. Value Stream Mapping is a powerful lean tool for identifying the waste. Today, Lean is the buzzword for every organization. Lean means identifying and eliminating waste. An important activity in the journey for lean is the effective management of the flow of products and services through the number of activities involved for providing value to the customer known as value stream. This required a detailed understanding of all the processes involved so that waste can be identified and eliminated.

Kumar et al. [8]. Line balancing and kaizen are effective approaches to improve the productivity and quality. This study has made use of these approaches to improve the productivity on a Wire Harness Assembly line of a company manufacturing wire harnesses for automobiles. As the customer needs product at higher quality, shorter delivery time, higher customer service level and lower price; companies adopt continuous productivity and quality improvement to survive in the increasingly competitive world market. Here, the balance rate has been calculated before and after improvement to show the reduction in manpower requirement and increase in output.

## **3. METHODOLOGY**

Lean Manufacturing is widely regarded as an excellent tool for reducing costs and cycle times and for improving quality in manufacturing operations. Lean Manufacturing is defined to be an umbrella term for a number of techniques whose purpose is to improve product quality and cost by eliminating all waste in the production system.

### **3.1 Elements Of Lean Manufacturing**

1. Production Leveling
2. Pull System
3. Kanban system
4. 5S
5. Small Lot Production
6. Setup Time Reduction
7. Total Preventive Maintenance
8. Line Balancing
9. Flexible manufacturing
10. Small-group Activities

For successful implementation of Lean Manufacturing all the elements must be properly understood, measured and implemented. It is very difficult to take care each of these elements individually without any structured approach. The approach adopted here is to divide all the elements in to seven major elements or enablers, which contains some

of Lean Manufacturing elements. After proper division of all the Lean Manufacturing elements seven such enablers have been identified.

### **3.2 Enablers Of Lean Manufacturing**

1. Value stream mapping
2. Lost Time Analysis
3. Kaizen
4. 5S
5. Standard Work
6. Autonomous maintenance
7. Visual management

### **3.3 Step By Step Approach To Design Lean Manufacturing In An Industry**

3.3.1 To design lean manufacturing or to implement lean manufacturing in an industry first step required to take is to observe the process flow of a productive process, we can observe and study the process flow of a product by using value stream mapping. VSM is used to observe the process flow in an industry which gives us knowledge about how value is getting added into product. In VSM after observing whole process, current state map is plotted. After plotting current state map various non-value added activities and wastes are point out. From current state map we can identify the possible areas of improvement.

3.3.2 Second step in designing lean manufacturing is to perform Lost Time Analysis. Through this we can able to know that how much amount of time is spent in non-value added activities, these activities may be like set up changeovers, tool change, maintenance, loading-unloading etc. Also we can identify bottleneck operation from this analysis.

3.3.3 Third step in designing lean is to work on identified areas of possible improvement, in this we can adopt kaizen approach for making continuous improvement on these areas. In this approach we can take suggestions or ideas from peoples to improve the current practice. We can reduce time required for set up changeovers and we can eliminate bottlenecks in current process by continuous improvement and we can achieve this trough employee involvement.

3.3.4 Next step in implementing lean is to give a support to continuous improvement through 5S activities. The output of design in a lean enterprise is information, theory behind using 5S here is “dirty, cluttered or damaged surfaces attract eye which spends a fraction of a second trying to pull useful information from them every time we glance past. Old equipment’s hides the new equipment from the eye and forces peoples to ask which to use.”

- a. Sort- Make work easier by eliminating obstacles, evaluate necessary items with regards to cost or other factors.
- b. Set in Order- Arrange all necessary items so that they can be easily selected

for use, ensure first in first out (FIFO) basis.

- c. Shine- Clean work place on daily basis completely or set cleaning frequency time to time, keep workplace safe and easy to work.
- d. Standardize- Standardize the best practices in work area, everything is in right place.
- e. Sustain- No harmful to anyone, audits, trainings and disciplines.

3.3.5 Next step in implementing lean is Standard Work, it is the most efficient method to produce a product at a balanced flow to achieve a desired output rate. It breaks down work into elements which are sequenced, organized and repeatedly followed. Standardized work is one of the most powerful but least used lean tools. By documenting the current best practice, standardized work forms the baseline for kaizen or continuous improvement. As the standard is improved the new standard becomes the baseline for further improvements and so on. The improving standardized work is a never ending process.

3.3.6 Next step in implementing lean is to perform autonomous maintenance of equipment’s and machines. It is crucial component of the total productive maintenance. The core idea of autonomous maintenance is to provide the operators with more responsibility and allow them to carry out preventive maintenance tasks.

3.3.7 Last but not least step in implementing lean in an industry is visual management. Visualization is a good thing we all know that and many of us in the lean community practice it, to greater or lesser the degrees of effectiveness among other benefits, making visible such things as pace or quality of work makes it easier to solve the problems and sustain the gains.

## **4. CONCLUSION**

From this paper one can able to get information about lean manufacturing , its elements, benefits of lean manufacturing what difficulties some one may face while implementing lean manufacturing and finally a structured approach to design lean manufacturing system using its seven enablers.

The main objective of lean tool is to identify non value added activity, eliminate it and increase the productivity. This paper present the fact that design of lean and its application is very adaptable in todays world. It can be apply not in manufacturing industries but also in service organization, health care center and etc.

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