

**A REVIEW -“INVESTIGATION ON LEAN MANUFACTURING”**Mohit B.Diwan¹, Pragnesh K. Brahmhatt ²¹ Ph.D. Scholars, Department of Mechanical Engineering, Rai University, Ahmadabad (Guj.), India²Asso.Prof. vishvakarma Govt.Engg.College, Ahmedabad, India

Abstract : Today, numerous companies have a major opportunity to reduce their costs and customer lead time and cycle time through the application of Lean Manufacturing System or Lean Philosophy. Implementation of Lean helps to improve their productivity and efficiency. This paper aim to have a brief study on the literature related to lean philosophy in the manufacturing industries and integrate the different lean tool for getting better productivity in different industries. The outcomes from this review is hope justify the needs of further research in area of Lean Manufacturing, aimed at strengthen its philosophy towards more realistic applications. In addition, the model also shows how lean dimensions in the manufacturing system related to eight types of wastes.

Key words: Lean Manufacturing: Lean philosophy: Lean Tools: Wastes: Lean Implementation

I. INTRODUCTION:

The Lean Production philosophy aims at reducing the operating costs through the elimination of waste. Waste is everything that does not add value to the product of services (Womack and Jones,1996;Modern,1983) and by eliminating the waste, ultimately its will enhance value to the production system to produce a good quality products at customers satisfaction(Moayed and Shell,2009;Sanchez and Peres,2001). Lean production developed by Toyota that focus on the elimination of waste in all forms of material or people waiting time, excess inventory and overproduction, unnecessary processing steps/movement of material or people. It has a widespread application cover all aspects of the manufacturing functions from product development, procurement and manufacturing over to distribution (Womack, *et al.*, 1990). The concept of lean production has become dominant in most organization (Karlsson and Ahlstrom, 1996) and many organizations are adopting it in order to keep their competitive edge in both domestic and international market.

Manufacturing enterprises then tried to implement holistic Lean Production Systems in order to achieve more sustainable results. Nevertheless, most LPS implementations still fall short of the expectations. Several author identified that many companies focus on the visible elements of LPS like methods and tools and tend to change the layouts and processes of their production. However, the critical factors for the sustainable success of production systems are generally rather people-related than technology-related.

This paper aims to briefly study the literature related to lean philosophy in manufacturing industries. The main focus on the role of Lean tools in the established quality improvement and minimum wastages. Effort was made to critically the published research related to Lean philosophy in manufacturing industries.

Objective of lean philosophy:

- Labor costs reduction,
- Shortening product development.
- Shortening production period.
- Reduction of manufacturing and warehouse space.
- Guaranteed delivery of products to the customer.
- Maximum quality at minimum cost.

Thorough literature survey on lean manufacturing and lean assessment has been carried out in order to achieve the objective of this research. The existing and current model of leanness is identified and studied. However, the emphasis of the research is more on the identification of indicators, practices or tools or techniques for the implementation of lean in manufacturing. the literature survey on various data bases such as Scopus, Google scholar, ISI Web of Knowledge and so on.

II. IMPLEMENTING LEAN TOOLS AND TECHNIQUES OF RESEARCH:

Tools (Methodologies) that are part of “lean” are address in literature. Lean has a very extensive collection of tools and concepts. Surveying the most important of these, understanding both what they are and how they can help is an excellent way to get started. There are a lot of great ideas to explore in lean. The Figure No.1 shows some of the common Lean Tools.



Figure No: 1 Lean Tool

Once industries pinpoint the major source of waste, tools such as continuous improvement, just-in-time production, production smoothing and other will guide companies through corrective actions so as to eliminate waste. In the following sections a brief description of such tools is given.

Table No.1 Addition Essentials Lean Tools

5S	Overall Equipment Effectiveness (OEE)
Andon	PDCA (Plan, Do, Check, Act)
Bottleneck Analysis	Poka-Yoke (Error Proofing)
Continuous Flow	Root Cause Analysis
Gemba (The Real Place)	Single Minute Exchange of Die (SMED)
Heijunka (Level Scheduling)	Six Big Losses
Hoshin Kanri (Policy Deployment)	SMART Goals
Jidoka (Autonomation)	Standardized Work
Just-In-Time (JIT)	Takt Time
Kaizen (Continuous Improvement)	Total Productive Maintenance (TPM)
Kanban (Pull System)	Toyota Production System (TPS)
KPI (Key Performance Indicator)	Value Stream Mapping (VSM)
Muda (Waste)	Visual Factory

Just-in-time (JIT) JIT: A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product. JIT is an inventory strategy implemented to improve the return on investment of a business by reducing in-process inventory and its associated Carrying costs

5-S



- SEIRI:- Sorting
- SEITON:- Simplifying
- SEISO:- Sweeping, systematic cleaning or shining
- SEIKETSU:- Standardizing
- SHITSUKE:- Sustaining

Six Sigma.

The term six sigma comes from the field of statistics. Six Sigma approach has broadened to include such things as program and project management tools and rules all of which are complementary to lean manufacturing

Value Stream Mapping

Value Stream Mapping is a method used for business process and product improvement, which originated with the development of the Lean business philosophy. The value stream Mapping is the collection of all of the value-added and non value-added activities that generate the product or service that is required to meet the customer's needs. A value stream map illustrates the flow of materials and information as the product or service moves through the process.

In the lean philosophy, "value" is determined by the end customer. It means identifying what the customer is willing to pay for, what creates "value" for him. The whole process of producing and delivering a product should be examined and optimized from the customer's point of view. So once "value" is defined, we can explore the value stream, being all activities both value-added and non-value added that are currently required to bring the product from raw material to end product to the customer. Next, wasteful steps have to be eliminated and flow can be introduced in the remaining value-added processes. The concept of flow is to make parts ideally one piece at a time from raw materials to finished goods and to move them one by one to the next workstation with no waiting time in between.

Modern Engineering is given closed look towards all the engineering processes like design, manufacturing, supplying and servicing of equipments and machines to the end customers. The faster and robust processes have always been boon of the industry; to cater the ever-changing taste and demand of customers. Prevailing volatile market condition compels the Industry to implement the various lean tools to meet the fierce competition erupted out of global competition, changing customer demands, pressure on time to market etc. Thus, industry may select VSM to as a viable alternative to enhance their competitive edge.

To combat the above situations, Indian manufacturers are all have to implement the Lean Manufacturing System in a big way to join with the global users. The main aim of this research is to reduce the cycle time and to eliminate unwanted facilities and suggest improvement measures from the lean manufacturing perspective. VSM is the tool used for business process & product improvement. The value stream Mapping is the collection of all of the value -added and non value-added activities that generate the product or service that is required to meet the customer's needs

SMED reduces waiting and overproduction by creating shorter machine setup times.

Poka Yoke (Error Proofing) Error proofing is a structured approach to ensure quality and error free manufacturing environment. Error Proofing assures that defect will never be passed to next operation. Poka Yoke means fool proofing, it is all about ensuring that the mistake doesn't happen. Error proofing is a manufacturing technique of preventing errors by designing the manufacturing process, equipment and tools so that an operation literally cannot be performed incorrectly. The basic concept of this is avoiding the problems by correcting the process

Kanban: A method for maintaining an orderly flow of material. Kanban cards are used to indicate material order points, how much material is needed, it should be delivered. Production Kanban are also used to control production.

Kaizen: The Japanese term for improvement continuing improvement involving everyone managers and workers. In manufacturing, kaizen relates to finding and eliminating waste in machinery, labour or production methods. Kaizen is a simple parts-movement system that depends on cards and boxes/containers to take parts from one workstation to another

on a production line. The essence of the kanban concepts is that a supplier or the warehouse should only deliver components to the production line as and when they are needed, so that there is no storage in the production area.

- **The five steps involved in the Lean philosophy:**

Step 1: Specifying Value

Womack and Jones states that value can only be defined by the ultimate consumer and is only meaningful when expressed in terms of a specific product with specific capabilities which meets the customer's needs at a specific price at a specific time. The problem is that while value is defined by the customer, it is created by the producer and many things get in the way when producers try to express how they provide value.

Step 2: Identifying the value stream

Value stream is defined as: all the specific actions required to bring a specific product (whether a good, a service) Identify all the steps across the whole value stream, tracking the sequence of processes from raw materials to finished goods that deliver customer value.

Step 3: Creating flow

Make sure those steps flow better ensures actions, which create value flow properly and eliminate delays and interruption to create a smooth process.

Step 4: The concept of pull

Pull in simplest term means that no one upstream should produce a good or service until the customer downstream asks for it." Because of its responsiveness, this form of small lot, even single item, production means that the plant only makes what is ordered when it is ordered

Step 5: The hunt for perfection

Strive for perfection by continually removing successive layers of waste, which is defined as anything that does not add value to a product or service

Lean manufacturing principles include:

- Pull processing products are pulled from the consumer end (demand) not pushed from the
- production end (supply)
- Perfect first time quality- quest for zero defects revealing & solving problems at the source.
- Waste minimization- eliminating all activities that do not add value & safety nets, maximize use of scarce resources(capital, people and land).
- Continuous improvement- reducing costs, improving quality, increasing productivity and information sharing.
- Flexibility- producing different mixes or greater diversity of products quickly, without sacrificing efficiency at lower volumes of production.
- Building and maintaining a long term relationship with suppliers through collaborative risk sharing, cost sharing and information sharing arrangements.

III. LEAN THINKING:

Lean thinking is the dynamic knowledge driven and customer focused process by which all people in a defined enterprise continuously eliminate waste with the goal of creating value. Womack and Jones describe lean thinking as "the antinodes" to muda. Muda is the Japanese word for waste and specifically "any human activity that absorbs resources but creates no value". The essence of lean thinking is the elimination of muda whenever it exists –within the individual firm but also along the whole supply chain.

There are several typical categories of waste (muda in Japanese) as follows :

1. Defective units (scrap) or rework

The existence of defective units in a process is typically the result of a poor preventive quality system. When an error or defect is passed onto the next operation or even worse to the customer, a loss is inevitably occurred. As a result, something has to be manufactured, assembled or serviced twice, whereas the customer will rightfully only pay once for the goods or service. Thus doing everything right the first time is the most efficient, least wasteful way.

2. over production:

Overproduction consists of making either unneeded excess goods or making needed goods too

early or in excessive quantity. It is also described as making goods just in case rather than Just in Time (JIT). Traditionally, manufacturers have used the concept of Economic Order Quantity (EOQ) which is also known as economic lot size or minimum cost order quantity to determine their optimal manufacturing batches and lot sizes

3. Waiting

Waiting includes delays coming from people, processes, or Work in Progress (WIP) inventory sitting inactive while waiting for instructions, information, raw materials or any other resources. Wasteful waiting ties up capital, increases the risk of obsolescence or damage, and other requires additional handling and movement of goods.

4. Not Use Skills: Not utilizing the talent of employees

5. Transportation: multiple handling or movement of products does not add any value to the product.

6. Inventory

Stock that is sitting without providing value to a product accumulates cost. This is usually a costly way to cover up quality problems such as rework and defects manpower or production scheduling problems excessive lead time and supplier problems

7. Motions

Unnecessary movement of people, products or equipment does not add value to a product. For example workers walking back and forth from the work area to the supply area, moving around unneeded equipment or performing redundant motions can be completely eliminated or automated to speed up the process.

8. Extra process:

Unnecessary processing steps should be eliminated. Combine steps where possible. Over processing is adding unnecessary features that are not value adding in the eye of the customer. Poor process design can lead to producing better products or services than a customer needs or is willing to pay for

Principles behind the lean thinking:

- Customer focus: make sure that all the activities of the organization are driven by the customer needs and expectations
- Eliminate waste with the goal of creating value: elimination of waste throughout the value chain. I.e. those activities which does not add any value to goods or services in the eye of customers or any for which the customer is not willing to pay.
- Pursue knowledge driven enterprise transformation: utilize the ideas and skills of everyone in the organization to implement systematic changes
- Foster a dynamic process of change and capability building: pursue a proactive, relentless process of ongoing change and capability building to ensure the sustains competitive advantage.

IV. CONCLUSION:

A review of literature suggests that the implementation of lean principles is not a onetime look at a process and through implementation, perfect results are achieved. Lean implementation is a journey that takes many years and requires a cultural change. If the principles are applied correctly, significant results can be achieved in the manufacturing process by understanding the use of Lean Tools, performing time studies, and focusing on incremental changes to the process through the use of appropriate Lean Tool. By utilizing the principles of lean manufacturing, and applying them systematically, will help any manufacturing facility drive out the waste that is currently in their process. As it was stated there are no shortcuts to "world class".

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