

“A REVIEW ON IMPLEMENTATION OF LEAN MANUFACTURING TECHNIQUES IN MANUFACTURING INDUSTRY TO DEPLOY GREEN MANUFACTURING THROUGH REDUCTION OF HAZARDOUS WASTE”

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Abstract- Lean manufacturing is a promising tool in current scenario in order to reduce the waste in an effective way in the product processing and in assurance of quality. It is the systematic way of approach in order to provide continuous improvement in all stages of production process towards eliminating waste. In this review article various lean techniques are studied in order to implement the green manufacturing practices. The term Green manufacturing emphasis on developing and manufacturing of products which do not harm environment, employees or even customers who are closely related to that product. Green manufacturing deals with environmental pollution which includes number of manufacturing matters like recycling of wates, energy conservation, waste management, water supply, environmental protection, regulatory compliance, pollution control and a variety of other related issues.

Key Words: Lean Manufacturing, Waste Reduction, Lean Manufacturing, Just In Time(JIT),Flexible Manufacturing System (FMS),Supply Chain Management (SCM),Set Up Reduction, Value Stream Mapping

1. INTRODUCTION

Lean Manufacturing is a promising technique which begins in Japanese manufacturing, which tries to eliminate all the wastes in product from manufacturing stage to final process. Lean thinking continuously shortens the time between the customer's order and shipment by eliminating everything that increase the time and cost. The main aim of Lean manufacturing Design is to create the manufacturing processes and the final product in a way which avoids, reduces or eliminates variability during the project executions.

1.1 Lean Design

Lean Design is defined as a process of designing a Manufacturing system to reduce & avoid the variability of designed characteristics with the normal characteristics of a product, during the process of manufacturing. Typically a Lean manufacturing program is final step for any Lean Manufacturing and even for implementation of Six Sigma process also. Basically the process of Lean Design is done by documenting the flow model of value stream throughout the entire process. From this model the wastes are identified and redesigned to reduce these wastes and meet the required

objective. These Lean Design will results in alteration to the equipments, requirement of training for employees, plant layout, cost and benefit analyses etc. Then by conducting design simulation operations through computer to modify and optimize the design to meet the process of wastage minimization.

Lean Manufacturing is the process to manufacture the product with waste reduction, optimum usage of available materials, resources and for the least possible cost. For that various techniques like

- * Value Stream Mapping (VSM)
- * SMED (single minute exchange of dies)
- * 1 – piece flow
- * Kanban (inventory control via cards system)
- * Poka-Yoke
- * 5S (Separate, Simplify, Standardize, Sustain)
- * Total Productive Maintenance
- * Visual Management
- * Line Optimization
- * Synchronous Manufacturing are used.

1.2. Benefits of Lean Manufacturing

- Total manufacturing time saved
- Less equipment utilization
- Less scrap
- Low inventory levels
- Quality improvement
- Double and increase in profit by four fold .
- Plant space saved
- Better labor utilization
- Safety of operations which reduces the possibility of occurrence of accidents.

2. LEAN DESIGN PERTAINING TO PRODUCT DESIGN

Lean Design should also be considered while developing the new product. The best way to achieve “ Balanced excellence “ which means in product design the focus is to be on adding the waste in both design of product as well as the manufacturing stage. It means both the wastages should be added at the design stage itself. Lean Design is a powerful, integrated, set of team friendly tool to slash the costs from

individual product to entire product lines. There are numerous opportunities to reduce manufacturing cost during the design stage itself.

- Reduce direct material cost – by eliminating defects / wastages
- Reduce direct labor cost – by simple design, Design for Lean Manufacturing & Design for Assembly.
- Reduce operational overheads-minimize impact on factory layout
- Reduce non-recurring design cost–platform design strategies, parts standardization, and design of experiments.
- Reduce product specific capital investment – by production preparedness process matching product tolerances and value engineering.

3. EIGHT IDENTIFIED LEAN WASTES:

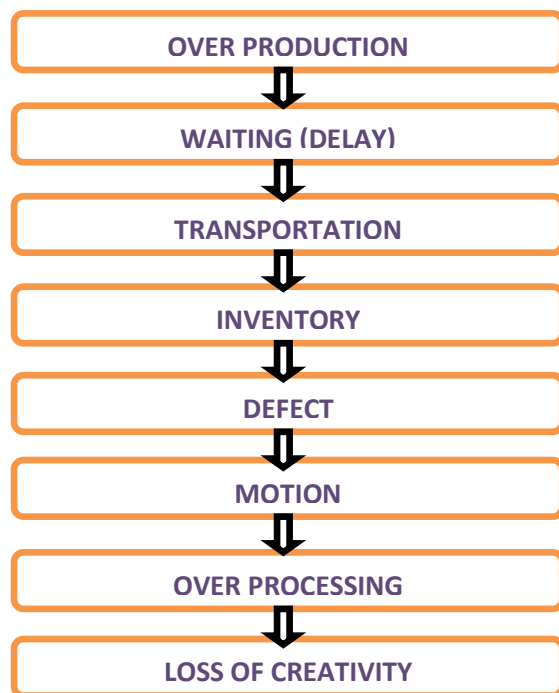


Fig -1: Identified wastes of Lean

4. PRINCIPLES OF LEAN MANUFACTURING

1. Voice of the customer is to be considered and understand the customer needs and requirements.
2. To create continuous flow with direct link between customers & suppliers.
3. To use tact time and pull system to manage the workflow.
4. To reduce the batch sizes and inventories.
5. To instill a continuous improvement competence.
6. To cross – train workers in order to deal with

inherent variability.

7. Selective use of automation.
8. To eliminate waste

The implementation of Lean manufacturing techniques to eliminate the identified wastes throughout the processes from the system. Lean Design & Manufacturing aims to achieve the eliminate manufacturing wastes.

* Over Production: is really highly costly to a manufacturing industry, because it detains the smooth flow of materials and actually reduces the quality and productivity of the process.

* Waiting: whenever goods and finished products in manufacturing are not moving or being in process, the waste of waiting is occurred. Much of the products lead time is tied up in waiting stage for the next operation, usually because material flow in a floor is poor, production process runs are too long and the geographical distance between work centers in floor are too large it occurs.

* Transportation: is wasteful because of movement of goods between work center and the double handling of work do not add values to the customers, they do, however, add significant cost to the organization. .

* Excess Processing: refers to the use of large, complex machine rather than small, flexible ones.

* Excess inventory: it is hiding the problems which occur on the plant floor, which process are identified and resolved in order to improve performance of process. Excessive inventory increases with the lead-time, over consumption of production floor space and delay in the identification of problems.

* Excess motion: refers to the process ergonomics of plant personal at the work center. Excessive bending, walking, over stretching & lifting heavy weight is physically tiring, wastes time, present a safety hazard and lower productivity

* Product Quality: Directly impact the bottom line and includes increased scrap, rework and costs that are associated with quarantining inventory, defects are often a significant percentage in the total cost for manufacturing.

5. TOOLS OF LEAN MANUFACTURING

5.1 Flexible Manufacturing Systems

Flexible Manufacturing System (FMS) is a manufacturing system in which there is some amount of flexibility which allows the system to react in the case of changes, whether predicted or unpredicted. This flexibility is generally considered to fall into two categories, within which are numerous other subcategories such as machine flexibility, routing flexibility etc.

The whole FMS is commonly controlled by a central computer.

How an FMS works?

The following figure shows a schematic layout of an FMS where NC machines of different types is positioned around material handling system

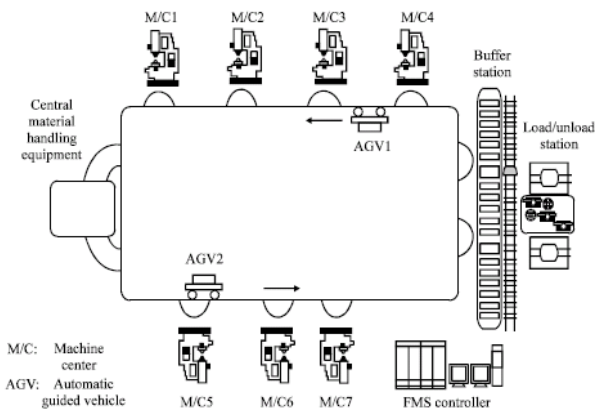


Fig -2: Systematic Layout of FMS

5.2 Six Sigma & Quality Function Development

Six sigma is a highly disciplined process, which helps us to focus on developing and delivering near perfect product and services raw materials to finished products passing through various manufacturing processes. Here sigma (σ) is a statistical terms that measures how far a given process deviates from perfection. The basic idea behind six sigma is that if you can measure how many defects you have in your process, then systematically you can eliminate them out of your process and get as close to zero defects which is possible and dream of any manufacturing philosophy.



Fig -3: Steps involved in Six Sigma Implementation

5.3 Just In Time (JIT)

Just in time is a Japanese manufacturing management method developed in 70's. It was first adopted by Toyota manufacturing Plant by Taiichi Ohno,

who was named as father of JIT. The principle of just in time is to eliminate the sources of manufacturing wastes by getting right quantity of raw materials and producing the right quantity of products in right place at the right time. JIT is a philosophy of continuous improvement.

The American production and inventory control society has defined the just in time as,

“A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. Goals of Just in Time in the realm of reducing wastages-

As one of the main goal of JIT is to reduce the wastages and to increase the productivity, using JIT we can minimize the following wastages.

- 1) Productions wastages
- 2) Waste from waiting time
- 3) Waste due to Transportations
- 4) Waste from process
- 5) Waste from inventory
- 6) Motion waste
- 7) Product defect waste



Fig -4: Concept of Just In Time Production System

5.4 Poka -Yoke

Poka-Yoke is fool proofing, which is the basis of the Zero Quality Control (ZQC) approach, which is a technique for avoiding and eliminating mistakes. Generally this technique is used in manufacturing process but has much wider uses, such as; offices - order and invoice processing, hospitals - drug dispensing, aircraft maintenance - particularly with processes having the potential of inducing catastrophic in-service failures. The term Poka-Yoke is Japanese and can roughly be translated as mistake or fool proofing. It is derived from 'Poka' - inadvertent mistake and 'yoke' - avoid.

5.5 Value Stream Mapping

It is also called product flow analysis by means of which, analyzing all existing product flow is done to determine where the waste exists. The process involves tracking the complete product flow from customer order to product delivery, including all the materials movements and information flow. The analysis is done by physically following the product through all of its operations and recording data. The result is a complete and thorough map of product and information flow, as it currently exists. The next step is to develop a future state map that will show a reduction of non-value added steps in the process. VSM is key tool in the Lean Manufacturing tool box that is effectively used for system design.

5.6 Supply Chain Management

SCM is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. Supply chain activities cover everything from product development, sourcing, production and logistics as well as the information system needed to coordinate these activities.

Objectives of Supply Chain Management

- To provide an uninterrupted flow of materials, supplies and services required to operate the organization
- Minimize inventory investment and loss
- Maintain and improve quality
- Create relationships with competent suppliers

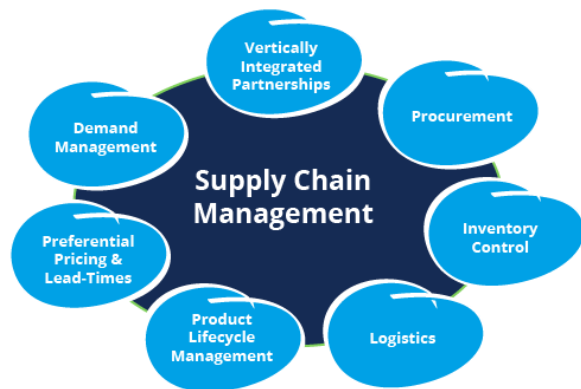


Fig -5: Supply Chain Management Components

5.7 Cellular Design

Manufacturing cells are the key in the manufacturing technology that groups machines, processes and people around the product. Cells are key technology for reducing cost, reducing customer lead time, reducing work in process inventory.

Cellular Design is also called flow manufacturing, is the linking of man and machine to produce a product, start to finish, means complete product or a subassembly to the finished product. The goal for developing cellular design is to physically locate all the required resources to manufacture a product in close proximity to each other within reach if possible. Only by doing this can a product be manufactured in a batch size of one or make “one move one”

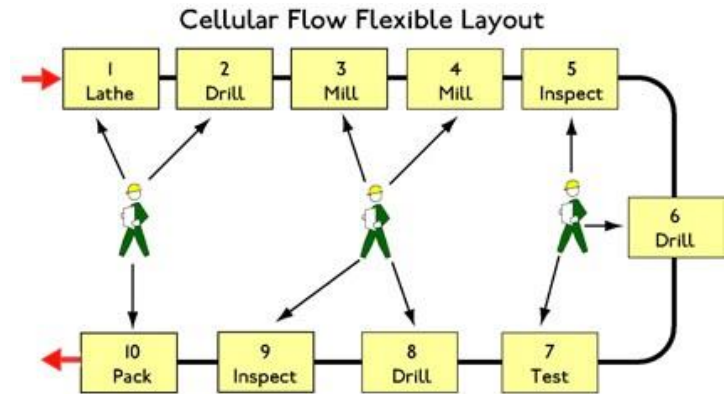


Fig -6: Example of a Functional Layout of Cellular Manufacturing production line

5.8 Setup reduction

It is also called as quick change over. The main aim is to design for the rapid change of tooling when preparing a machine to run with different parts. The principles of setup reduction are to design for waste, out of process and concentrate on value added operations to the machine setup. Some of these the Lean Manufacturing practitioners are saying that all machine setups are technically non-value added. However the goal of setup reduction is the same, to eliminate any movements or work that does not contribute to the process of changing over the machine.

6. STEP TOWARDS GREEN MANUFACTURING

Green manufacturing is an emerging concept which deals with a number of manufacturing matters, including conservation, waste management, Recycling of wastes, water supply, environmental protection, regulatory compliance, pollution control, and a variety of other related issues. Hence waste management is carried out in our research through Lean manufacturing which is a systematic approach for identifying and eliminating waste through continuous improvement, moving the product into pull of the customer in order to be a part of perfection. This Research work focuses on the concept of Lean manufacturing, applying various tools of Lean manufacturing in the real time waste reduction which provides a step towards Green Manufacturing.

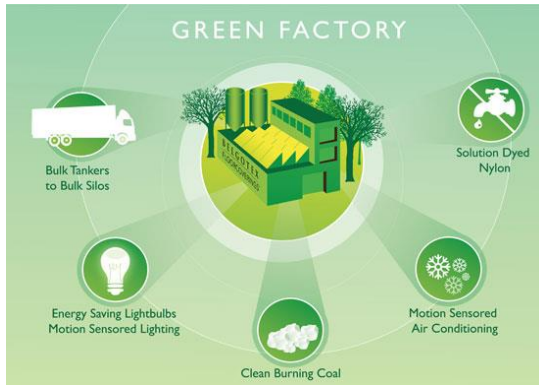


Fig -7: Step towards Green Manufacturing process in Industrial Applications

7. Conclusion

Current scenario greatly emphasis on Green manufacturing due to afraid of hazardous pollution level we face in day to day life. Hence customers are aware of purchasing products that do not affect environment. To solve the above problem Green manufacturing is implemented. It is a flow of manufacturing practices that will help in reducing the hazards that do not harm the environment during any part of the manufacturing process. It emphasizes the use of processes that do not pollute the environment or harm consumers, employees, or other members related to product.

This Review has focused on achieving a step towards green manufacturing through waste reduction by the tools of lean manufacturing.

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