PRODUCTIVITY IMPROVEMENT USING LEAN TOOLS IN PUMP INDUSTRY

A.NAGARAJ[1], M.SARAVANAKUMAR[2], A.HARDY KELVIN [3], V.KUMARESAN [4], S.MADHAVASELVAN [5], S.VISHAL [6]

[1,2] *Lecturer, Dept. of Mechanical Engineering, PSG Polytechnic College, Tamil Nadu, India*
[3,4,5,6] *Students, Dept. of Mechanical Engineering, PSG Polytechnic College, Tamil Nadu, India*

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Abstract - *In its most basic form, lean manufacturing is the systematic elimination of waste from all aspects of an organization's operations, where waste is viewed as any use or loss of resources 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 90 percent of a factory's total activity. Nationwide, numerous companies of varying size across multiple industry sectors, primarily in the manufacturing and service sectors are implementing such lean production systems, and experts report that the rate of lean adoption is accelerating. Companies primarily choose to engage in lean manufacturing for three reasons: to reduce production resource requirements and costs; to increase customer responsiveness; and to improve product quality, all which combine to boost company profits and competitiveness.*

Key Words: **Waste, Industry sector, Productivity improvement**

1.INTRODUCTION

The Toyota Production System (TPS), pioneered by a Japanese automobile corporation, Toyota, has been adopted by practically every country in the world due to its global superiority in cost, quality, flexibility, and quick response. Lean is a manufacturing practise that tries to reduce waste across whole value streams in order to provide greater value to consumers. It is a customer-centric strategy that focuses on the value stream and its optimisation. The utilisation of resources that do not provide customer value is a target for reform or elimination under lean principles.

The primary goal of implementing lean manufacturing is to increase production, reduce lead time and cost, and improve quality in order to provide the maximum value to customers. There are numerous descriptions regrading lean manufacturing in the industries.

1.1 Implementation of lean manufacturing steps

1. **Waste identification in the system:**Many organisations must be aware that their systems contain several hidden and unhidden wastes.

2**. Wastes in the organisation might be of various types:** The types of trash and their causes must be identified. Lean manufacturing believes in addressing the root causes of problems and permanently resolving them. There are numerous tools and techniques that can be used to reduce or eliminate this form of waste.

3. **The next stage is to identify and address the underlying causes:-** Stick to core lean concepts and look for root reasons. Looking at causes may not be sufficient, hence it is necessary to discover the effects of the causes solution on the entire system..

4. **The final step in the lean implementation process is to identify and test solutions:-** After testing, solutions should be implemented. Training and follow-up are critical in each of the steps outlined above. It is necessary to be patient because the implementation process may take some time.

1.2 Waste Types

The following are the seven types of waste:

(1) Overproduction: It is unnecessary to manufacture more than the consumer requires, or to make it too soon before it is required. This increases the chances of obsolescence and creating the wrong thing. It frequently results in high lead and storage durations.

(2) Defects: In addition to physical flaws that directly contribute to the Costs of goods sold, which may include documentation errors, late delivery, production to inaccurate specifications, the use of excessive raw materials, or the development of unneeded scrap. Rework may be required if a flaw arises; otherwise, the product would be discarded. Defects not only waste material and human resources, but they also cause material shortages, interfere with achieving deadlines, create idle time at succeeding workstations, and lengthen the manufacturing lead time.

(3) Inventory: Having excessive levels of raw materials, works-in-process, and finished products. Extra inventory increases inventory finance costs, storage costs, and failure rates. It tends to lengthen lead times, prevents early problem identification, and increases space requirements. It is especially important to remove inventory due to inaccurate lead times in order to undertake successful purchasing.

(4) Transportation: This covers any material movement that adds no value to the product, such as moving supplies between workstations. Transportation between processing stages lengthens production cycle times and makes wasteful use of labour and space. Any movement within the firms could be considered waste. With the distance of communication between processes, double handling and excessive motions are likely to cause damage and deterioration.

(5) Waiting: Idle time for workers or machines as a result of on the factory floor, there are bottlenecks or inefficient production flows. It includes minor delays in unit processing. The waste of waiting happens when time is employed inefficiently. This waste occurs while things are not being moved or worked on. This waste affects both commodities and workers, who both waste time waiting. Waiting time for workers can be employed for training or maintenance purposes, but it should not lead to overproduction.

(6) Motion: Any needless physical motions or walking by workers that diverts them from genuine processing work is included in this category. This could include walking around the manufacturing floor looking for a tool, or it could be superfluous or uncomfortable physical movements caused by poorly designed ergonomics that slow down the workers. It entails inadequate production ergonomics, in which operators must extend, bend, and pick up when such activities may be avoided.

(7) Over processing: It is conducting more processing work than the consumer requires in terms of product quality or features such as polishing or putting finishing in regions of the product that the customer will not see. Over-processing happens when unnecessarily complicated solutions to simple tasks are discovered.

1.3 The Objective of the Paper

- To study the current state of the pump manufacturing industry and the causes of lean wastes.
- Identification of Lean tools that can be used in the industry to assist reduce defects and waste.
- Observing productivity increases as a result of tool implementation.
- Validation using previous information

2. LITERATURE REVIEW

In recent years, the Indian manufacturing industry has seen unrelenting rivalry in terms of cheap costs, higher quality, and various goods with greater performance. To confront the challenges given by the competitive climate, Indian entrepreneurs have realised that manufacturing organisations must incorporate quality and maintenance improvement programmes into all elements of their processes in order to improve their competitiveness.

Lean is a manufacturing concept that believes that any activity that uses resources but does not provide value for the end consumer is wasteful and should be removed. Antony, 2011; Shah and Ward, 2007)

lean production eliminates unnecessary processes, align processes in continuous flow and solve problems through continuous improvements. At operational level lean manufacturing is carried out through a set of lean practices. By implementing these tools and techniques lean manufacturing targets to identify and eliminate numerous wastes exist inside the factory or along the supply chain Sohal (1996),

Apply the lean tool by method time measurement and line balance efficiency and reduce the cycle time in a truck body assembly line and improve efficiency in that product line. Also says that lean manufacturing is a business philosophy that continuously improves the process involve in manufacturing. Santosh kumar et, al.(2014)

Companies recognize that consistent and disciplined application of lean manufacturing strategies with the emphasis on waste elimination and process streamlining can lead to business excellence (Mejabi, 2003; Taj. 2008; Rahman et al., 2010).

Lean is a manufacturing paradigm based on the fundamental goals of Toyota Production System (TPS), which is aimed at continuously minimizing waste to maximize flow (Vinodhet al., 2010),

Applied VSM in a biscuit manufacturing plant and found that application of lean manufacturing resulted in increase in quality, decrease in inventory,increase in timely deliveries better utilization of space and equipments and reduction in lead time. Upadhye et al. [2010][24]

3. METHODOLOGY

The intended technique was used to create the future state value stream map from the present state value stream map. By adopting kaizen, many tools and techniques from the Lean Production System were applied to generate a continuous flow in the line. Several continuous improvements have been achieved to reduce cycle time, lead time, worker count, work in progress inventory, and nonvalue added time.

4. TAKT TIME

Takt time is the maximum amount of time required to develop a product in order to meet client demand. The word "aks" is derived from the German word "pure." Takt, which is determined by consumer demand, establishes the pulse throughout all processes in a firm to maintain continuous flow and capacity unification. The takt time is the amount of time that must elapse between two consecutive unit completions in order to meet demand if a product is manufactured one unit at a time at a constant rate within the net available work time. The amount of time available for work is referred to as net available time.

Example The takt time for the following this to be calculated.

- The month has 22 working days with 2 shifts per day
- 8 hours per shift.
- Breaks add up to 1 hour per shift.
- The OEE is 78%
- Expected customer demand 20.000 parts.

$$\text{Takt Time} = \frac{\text{Workable production Hours}}{\text{Unit Required (customer demand)}}$$

$$= \frac{720}{1000}$$

$$= 44 \text{ min/day}$$

5. OVERALL EFFICIENCY OF EQUIPMENT

Overall Equipment Effectiveness (OEE) is a method of measuring and improving manufacturing process efficiency. OEE has gained acceptance as a management technique for measuring and evaluating machine productivity.

Before

A= Run time/Total time = 78.09%

P = Total components divided by target count = 78.09%

Q = 98.47% of good components/total parts

OEE=A*P*Q=60.04%

After

A = Run time/Total time = 89.28%

P = Total parts divided by target count = 89.28%

Q = Good parts divided by total parts = 98.66%

OEE=A*P*Q=78.64%

6. SMED (Single Minute Exchange of Die)

SMED(Single Minute Exchange of Die) is a system used to dissect and reduce setup times. The innovator of the SMED system is the Japanese mastermind Shigeo Shingo. He showed that setups that took hours could be reduced to twinkles. SMED methodology operation consists of four distinct stages primary Stage Internal and external setup not discerned;

- Stage 1 – Separate internal and external setup.
- Stage 2 – Convert internal into external setup.
- Stage 3 – explain the internal and external setup.

In this we have created a nylon 3D printed jig, because the old metal jig was heavy and high time consuming.

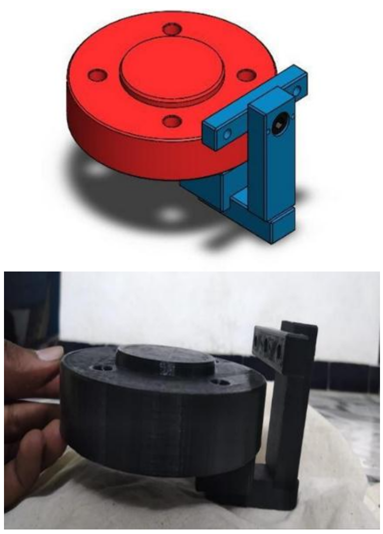

Fig -1: SMED designed model jig and manufacturing of nylon jig (3D printing)

7. FISH BONE

A fishbone diagram is a cause-and-effect discovery tool that aids in determining the causes of flaws, variances, or failures in a process. In other words, it aids in the breakdown. Root factors that may contribute to an effect are identified in successive layers. A fishbone diagram, also known as an anlshikawa diagram or cause-and-effect analysis, is one of the primary techniques used in root cause analysis. A fishbone diagram, as the name implies, is a representation of a fish skeleton. The underlying problem is represented by the fish's head, and the causes are represented by the skeleton's bones to the left: the ribs branch off the back and represent major causes, while sub-branches branch off of the cause and represent root causes. These causes resemble the fish skeleton's bones.

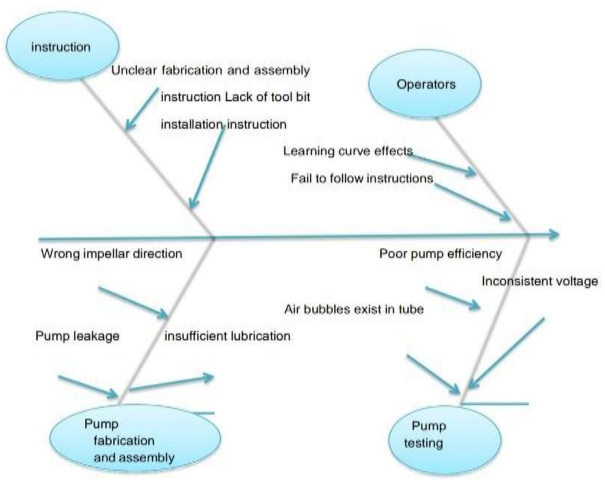

Fig -2: Fish Bone

8. CONCLUSION

The following are some of the salient conclusions that are drawn based on the present studies: It was observed from the current state map that the total lead time for the product is more than value added time. After the improvements been made, Process lead time reduces from 24.4 days to 16.14 days

- Inventory reduces to 8.26 days
- Continuous flow been created wherever possible
- Operators reduced from 7 to 3 in the machine shop by
- Balancing the work content.
- Achieved single piece flow in sub assembly
- Productivity improves to 7.7%.

For practitioners in the pump manufacturing industries, this case study provides us with the privilege to learn a lot from the specific case study problem and it also provides a scope for further research.

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