Lean Manufacturing Technique used for Industrial Improvement

[1] Rohan R. Sangar, [2] Dr. N.H.Deshpande
[1] Student- M-Tech Production Engineering, [2] Professor – Mechanical Department
[1] Mechanical Engineering
[1] Government College of Engineering Karad, Maharashtra, India.

Abstract: Lean manufacturing is a production method which is firstly used by Japanese Toyota Production System and then rapidly used by worldwide industries. Lean manufacturing is a systemic approach, which is part of a company's overall continuous improvement concept. This paper tests the importance of the Lean Manufacturing System. Continuous improvement can be described as a regular activity making it possible to increase the ability to meet requirements. Lean management lightened management, is a production technique that reduces waste within a company. Overproduction, transportation, needless movement and operations are just a few of the types of waste, which this technique seeks to eliminate. Designing and producing sustainable products better and more quickly while respecting the environment is the mainstay of lean management. The focus is on the motivation and expertise of collaborators along with physical installations and financial resources. Set ideas are discarded and thought is given to a system's operation rather than its limitations. Lean manufacturing contents so many tools in current paper. The study also reveals the importance of Lean tools for industry improvement.5S is the base of lean manufacturing, it helps to improve the productivity.

Index Terms: **Lean manufacturing, waste, mainstay, improvement, productivity.**

I. INTRODUCTION

Lean Manufacturing System is systematic approach to identifying and eliminating waste, non-value added activities through continuous improvement by following the product only when the customer needs it called "pull" in pursuit of perfection. It was firstly implemented by the Toyota Production System in 1990s, then all other companies started to implement. Quality always drives the productivity. Improved productivity is a source of greater revenues, employment opportunities, and technological advances. Quality has to become the trend of the organization rather being an inspection tool. We all know that Quality is every employee's job. Over a period of time, we have moved from percentages to PPM and now we are talking of zero PPM. We need to make quality a demand driven rather than a supply-driven commodity.

Lean manufacturing is a production management system which aims to provide the customers: What they want, how they want, where they want, at a competitive price, in the quantities and varieties they want and always of expected quality. The benefits of Lean Manufacturing are waste reduction leading to improved quality, better efficiency and higher profitability. The ultimate aim of Lean Manufacturing is to remove all wastes from industry and produce products of higher quality at lowest cost [1].

II. LEAN TOOLS or TECHNIQUES

2.1 5S

It is the base of the lean manufacturing system. It basically talks about the sorting, systematic arrangement, cleanness, standardization and self-discipline. The elements of 5S are the 1S seiri (sorting), 2S seiton (systematic arrangement), 3S seiso (cleaning), 4S seiketsu (standardization), 5S shitsuke (sustain, self-discipline) these all are Japanese words [12]. There is PEEP concept is used i.e. Place for everything & Everything in Place. This tool helps to reduce the searching time of cutting tools, inserts, spanners, dies etc. 5S create good work environment it affect positively the quality and productivity. It improves the quality and productivity of industry [7].

2.2 Overall Equipment Effectiveness (OEE)

Overall equipment effectiveness is basically of the performance of the manufacturing industries. In OEE we calculate the Availability of machines, Productivity (performance) of machines and Quality of products [9]. The formula of OEE is given below-

$$OEE = Availability \times Quality \times Productivity$$

$$OEE\ \% = OEE \times 100$$

$$Availability = \frac{\text{Net Available time}}{\text{Planned min.}}$$

$$\text{Quality} = \frac{\text{(Ok Quantity + Casting Rejection Quantity)}}{\text{(Ok Quantity + Casting Rejection + m/c Rejection Quantity)}}.$$

$$\text{Productivity} = \frac{\text{O/P Time}}{\text{Net Available Time}}.$$

The world class OEE is 85%, If the OEE of machine is below it then there is chance of improvement is the organization [12]. OEE gives a measurement tool to calculate equipment performance and gives the information for productivity improvements [3].

2.3 Kaizen

It is the important tool of lean manufacturing. Kaizen means continue improvements, permanent change. Kaizen is the permanent solution for the high manufacturing cost, high rejection, high rework and low productivity. Kaizen involves all employee of the organization. In this tool everyone is encouraged to give suggestion continuously, frequently and regularly [2].

Kai stands for change and Zen stands for better, so Kaizen means change continuously for better improvement of each and every person of the industry. Kaizen thinking is the physical phenomena of breakdown quality defects. After completion of kaizen there is reduction in cycle time, improvement in quality, reduction in tooling cost, eliminate rejection, and reduce casting defects [1].

2.4 3M (Muda, Mura and Muri)

It is one of the techniques of the lean manufacturing. These all words are Japanese Muda means waste. There are seven types of waste i.e. transport, movement, waiting, over-processing, defects, inventory and over-production. If these all seven types of waste are reduce or element then there is improvement in production quality and reduces the cost of manufacturing.

Mura is any kind of unevenness, lack of uniformity, irregularity and inconsistency in material flow. The mura causes due to the uneven customer demand, uneven production speed, uneven quality of good parts and uneven distribution of work load. Muri stands for the overburden on worker, employees. In muri the main focus is given to the worker. Worker has excessive stress and heavy lifting work then obviously his efficiency will get decreases. For eliminate muri there must be a good environment, with minimum stress the worker should do work. Pushing machines and tools to the limits of its capabilities, leading to increased wear and tear making noise it decreases the mood of worker. If the organization will take care of worker then the worker will give his full efforts for good production rate with high quality products. After eliminating these 3M the system performance will increases [12].

2.5 Layout Modification

Layout modification increases the production rate. It reduces the production time. By reducing the Ton-meter distance we reduce the production time.

Ton-meter = Distance X Weight X Quantity

Saving Ton-meter = (Old Ton-meter – New Ton-meter)

Process wise, operation wise the flow of job distance calculated, by using above formula the Ton-meter and saving Ton-meter calculated. As many as saving Ton-meter increases the production rate of organization is also increases. It helps to reduce process time [16].

2.6 Suggestion Scheme

The objectives of suggestion scheme are active participation in the productive forces of the organization and to provide opportunity to those having creative bent of mind to translate their ideas into reality. The areas of suggestions are improvement of work procedure, improvement in work efficiency, Cost effectiveness, Scrap utilization, Safety of workers. There is a suggestion box at the main gate of company, where anyone can give suggestions. There is award given to the best suggestion in terms of certificate and the recognition of suggestion will get the reward amount. That reward amount will decide by the management of organization. The standard reward amount is 5% to 10% of cost saving per month. This tools help to save a cost of company as well as improve the quality product.

2.7 Single Minute Exchange of Die (SMED)

The basic aim of this technique is too reduced the setup time of machine to a single minute figure. In SMED separate the internal setup from the external setup. Internal means while the machine is stopped. External means while the machine is running. Convert the internal setup to the external setup. Eliminate the adjustment process. To reduce setup time uses uniform design and same part for various products. Worker should train themselves to master the routine. Use quick fasteners. Setup time reduction improves the production rate. Therefore it is the important tool of lean manufacturing [20].

2.8 Seven Quality Control Tools (7QCT)

It one of the tools of lean manufacturing which basically related with quality of product. The Purpose of it is Simplification of data collection process. It reduces recording error and it is ease of analysis. For improving business results we use 7 QC Tools. Seven Quality Control tools are given as Check Sheet, Stratification (Classification), Pareto Diagram, Cause and Effect Diagram, Histogram, Scatter Diagram, Graphs and Charts. To eliminate defective parts this tool is used. With this tool we can understand the process and relation of output and input process. It analyzes data and finds the conclusion. It identifies real root cause of problem. So it is very important tools of lean manufacturing for industrial growth.

2.9 Total Productive Maintenance (TPM)

Total productive maintenance aim to bring and maintain equipment at good condition. Enhance the maintenance skill of operator and prevent the forced deterioration. There are five types of pillar in TPM- 5S, autonomous maintenance (Jishu Hozen), kaizen, planned maintenance, overall equipment effectiveness (OEE) and training [12]. Corrective maintenance prevents the error, improve maintainability and repair quality, increase safety and reliability. Forced deterioration eliminate by cleaning and replacement of lubricant oil. Maintenance providing help in identifying areas source of problems & hard to clean. Play role in vibration & fluid analysis. The major role is work for new equipment design & set up maintenance standards [3]. TPM contents the training to all operators for improving the quality of maintenance. Kaizen is the one of the pillar of TPM. It improves the production rate, reduced the cycle time and improves quality of product. After implementation of TPM the overall equipment effectiveness increases. The aim of TPM is to optimize the maximum utilization of equipment at reduced manufacturing cost & improve OEE by reducing / eliminating losses [12].

2.10 Value Stream Mapping (VSM)

Whenever there is a product or a service to a customer there is a value stream. Value Stream is the process and series of activities that perform to satisfy customer needs [1]. The output of Value Stream is to create solution that brings value to customer. VSM improve throughput, efficiency, cycle time and customer satisfaction. To manage the Value Stream eliminate Waste, increase Quality, minimize Cost, reduce Lead Time. Value is what the customer wants enough that he will pay to get it [2]. Value Stream Mapping is Step-by-step process evaluation to determine value-add (tied to customer value) activities, non-value-add activities. VSM means to improve the process. VSM is to understand current situation, shows the ratio of Non-Value Added to Value Added Time, exposes sources of waste – not just waste, and shows linkage between the three types of flow (Process, Material, and Information) [3].

2.11 Human Error Prevention (HEP)

Human error prevention is for improvement of work operation, including material, machines and methods. Eliminate work susceptible to human error from the process. Elimination solution can have a great side-effect on cost, productivity and performance. In many cases, process / equipment design must be changed drastically. HEP can be reduce by replacing the human operation with more reliable machines or equipment. Use automation to replace completely a specific human operation with machine. Give support tools to operator like checklist, reminder and sample to help human error prevention. It helps to prevent misreading work order sheet and installing the wrong parts in sub assembly. Late detection means large correction cost for that establish detection technique. Hardware has an important role. Prevent hardware failure. If error is not prevented then apply prevention of occurrence solution.

2.12 Statistical Process Control (SPC)

Statistical process control is a method of quality control. It monitors and controls the process of organization. SPC gives ensure the process efficiency, produce more specific product with less wastage. Key tools of SPC are run chart, control chart, continuous improvement and the design of experiments. Statistical process control has two types of data attribute data and variable data. SPC only identify the problem does not solve the problem. The process control chart is given below-

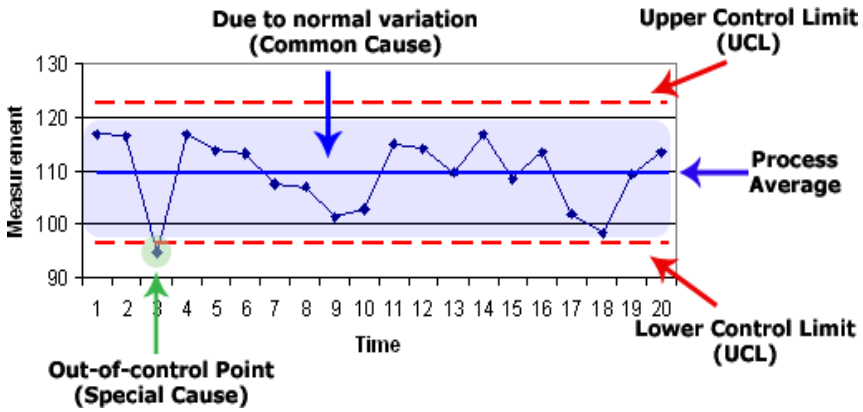

Fig.1. Control Chart [21].

The formula of capability index P_{pk} is given below [21]-

$$P_{pk} = min\left(\frac{\mu - LSL}{3S}; \frac{USL - \mu}{3S}\right)$$

Where,

LSL = Lower tolerance limit

USL = Upper tolerance limit

μ = average value of monitor quality

There are two types of cause in SPC common cause and special cause. SPC is a collection of data, analysis and conclusion of data. So SPC is important for the growth of the industry.

2.13 Inventory Management

Inventory management covers the plan and control of the business. Inventory means excess row material, WIP work in progress, finish goods, consumable tools and materials. The reasons for inventories are improves customer service provide products ready to available. It encourages production, purchase and transportation economies also act like hedge against price changes. It protect against uncertainty in demand. Inventory functions are safety stocks, lot size inventory, decoupling stock, pipeline inventory, transportation and anticipation inventory [2]. The need of inventory is to keep pace with changing market conditions, satisfy demand during period of replenishments, to carry reserve stocks to avoid stock outs, to level out or stabilize production, prevent loss of sales, satisfy other business constraints. Inventory classify as active inventory, inactive inventory and obsolete inventory. Inventory management can find by ABC analysis and EOQ model. Inventory management is important for the industrial improvement.

2.14 Material Requirement Planning (MRP)

MRP make the production schedule of all required material. Material flow according to the production schedule is the base of the material requirement planning. It indicates the types of material and the quantity that has to be purchased from outside, taking into account current inventory levels. What types of materials that needs to be manufactured internally and in what quantity, taking into account current inventory levels. Give time to place these orders, either by purchasing outside or for manufacturing inside. MRP components are master production schedule, bill of materials and inventory status file. The output of MRP is a list of purchase requirements, which will list what needs to be purchased and when a manufacturing schedule, which will list what will be made and when it will be made. The closing stock of parts, components and sub-assemblies after the master schedule has been completed in MRP [1]. The closing capacity available after the master schedule has been completed by MRP. It gives list of anticipated shortfalls in production – these may be due to shortages of parts of capacity. MRP help to increase the profit of industry therefore it is important to industry.

2.15 Kanban

Kanban is the powerful tool of lean manufacturing. It is a Card which indicates standard quantity of production. It is derived from two-bin inventory system. Kanban maintain discipline of pull production. It is authorize production and movement of goods [3]. Types of Kanban are Production kanban- which authorizes production of goods. Withdrawal kanban- It entitles the movement of goods. Kanban square- It is a marked area designated to hold items. Signal kanban- It is a triangular kanban used to signal production at the previous workstation. Material kanban- It is used to order material in advance of a process. Supplier kanban- It rotates between the factory and suppliers [2]. The formula for determining no. of kanban is given below-

$$N = \frac{dL+S}{C}$$

Where,

N = no. of kanban
D = average demand
L = lead time
S = safety stock
C = no. of products

Kanban system is basically generated for replacement of push system with pull system. Kanban play very important role in making a better product flow [1].

III. CONCLUSION

In present paper the importance of lean manufacturing for industrial growth has been discussed. Industry need focuses only few aspects of lean tools such as 5S, Kaizen, OEE, TPM, SMED, 3M, VSM and MRP for driving their manufacturing system towards the success. Lean system needs implementation of lean tools with proper sequence. Lean tools have low cost to achieve productivity & profitability of organization. Lean tools have focus on waste reduction through all organization. With TPM implementation industry get an environment which tries to maximize the efficiency of production system. The overall equipment effectiveness improved with low machine breakdown, less defects, high efficiency of machine and increase production rate. OEE shows exact performance of operator and the efficiency of machine. If SMED implement then there is definitely increase in OEE because there is reduction in setup time. Layout modification saves material travel raw to finish product which indirectly increases production rate. 5S and 3M are the increases the environment and efficiency of operator. Therefore Lean Manufacturing is important technology for Industrial improvement.

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