A REVIEW ON PRODUCTIVITY IMPROVEMENT OF PROCESS INDUSTRIES BY LEAN MANUFACTURING TOOLS

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Abstract— as the world has moved closer to a global economy, competition between manufacturing companies has also become global. This increasingly competitive environment has led to intense study of the companies that are at the top in terms of competitive position. The concepts of lean thinking and lean manufacturing have been described. The concept of lean manufacturing was developed for maximizing the resource utilization through minimization of waste, later on lean was formulated in response to the fluctuating and competitive business environment. The contrast of the before and after the LP initiatives in determine managers potential benefits such as reduced production lead-time and lower work-in-process inventory. The paper seeks to syntheses the literature with an emphasis on identifying the scope for lean in process industry and associated benefits. The review also presents an analysis of the lean tools and techniques that have been applied or have potential application in the process industry and the challenges to implement lean. Also, how it can be a very useful in the productivity improvement by using the Lean tools. As Productivity improvement plays a major part in most of the manufacturing or process industries as it helps in either removing or minimizing the waste elimination.

Keywords— Lean Manufacturing, Process Industries, Productivity Improvement, Lean Tools.

I. INTRODUCTION

Lean manufacturing is the process of eliminating the waste and also it removes the overburden and unevenness in the work. A waste is defined as anything that does not add value to the product. Lean tool techniques when combined with SWOT (strength, weakness, opportunity, threats) analysis help in eliminating wastes within the organization the waste relates to the transportation, inventory, motion, waiting, over-processing, overproduction and defects. Lean manufacturing helps in enhancing production processes and boosting up the employees job satisfaction. Lean manufacturing believes the simple fact that customers will pay for the value of services they receive, but will not pay for mistakes. The concept of lean manufacturing was introduced in Japan, and the Toyota production system was the first to use lean practices. The concept is developed from socio-integrated system. TPS is renowned for its focus on reduction of the original Toyota seven wastes to improve overall customer value, but there are varying perspectives on how this is best achieved. The steady growth of Toyota, from a small company to the world's largest automaker, has focused attention on how it has achieved this success. Lean manufacturing when implemented successfully results in an increase in production the output per person and a reduction in the finished goods inventory and work in process. Main goal of a lean manufacturing system is to produce products of higher quality at the lowest possible cost and in the least time by eliminating wastes it helps in efficient use of layout, improve cycle time, reduce cost and increase overall productivity.

Steps of lean manufacturing implementation

1. Identification of wastes in the system:-Many organizations need to know that they have many hidden and unhidden wastes in their systems.

2. Wastes present in the organization can be of different types: - There is a need to recognize the types of waste and their causes. Lean manufacturing believes in treating the causes and curing the problems permanently. There are various tools and techniques that are quite helpful in reducing or eliminating these types of waste.

3. The next step is to find the solution for the root causes: - One must stick to basic lean concepts and identify the root causes. Looking at causes might not help properly, so there is a need to identify the effects of the solution on the entire system. .

4. The final step in the lean implementation process is to find the solutions and test the solutions first: - Once solutions are tested then they should be implemented. Training and following up are important in each and every step explained above. One needs to be patient because the implementation process might take a long time.

II.DIFFERENT TYPES OF WASTES

1) Overproduction:-
Operations in the company should be stopped after sometime. But when the operations are been continue overproduction is there.

2) Waiting:-
It is also known as queuing, waiting is an idle time produced when two processes are not properly synchronized. Operator kept waiting or simply work slowly whilst the machine cycle.

3) Transport:-
Unnecessary movements or motion of the materials, such as

work is been transported from one operation to another operation.

4) Extra Processing:-
Extra processing means extra operations, such as reprocessing, rework, handling, storage that is present there because of different defects, overproduction, etc.

5) Inventory:-
Inventory waste is excess stock of the requirements necessary to produced goods or services,' just-in-time'. Inventory includes raw materials, work in process & finished goods. It require additional handling & more space.

6) Motion:-
Waste of motion is any waste of Man/Equipment's that does not add value to the products/services.

7) Defects:-
It includes correction of additional work performed on a product or service. Caused by or unclear operation procedure.

III overview

The perfect strive of the manufacturing system can be achieved through successful implementation of lean We can done this by having a knowledge about the adoption principles of lean then what will be the focus of lean in an organization. it will be only a elimination of waste or having a customer focus on the mind or rather both have a lean tools we can analyses the problem and can have an optimum solution to it also how implementation of lean has to be done step by step to have a maximum productivity by reducing cost, improving cycle time and also having a systematic layout planning all these things we can done by having a lean tools and apply them on to the problems.

IV. LEAN MANUFACTURING TOOLS

There are various type of lean tools are available and use this tools and principal, like cellular manufacturing, JIT, continuous improvement, standardization of work, total productive maintenance (TPM), SMED, etc.. We are understood about lean tool one by one in shortly.

1. Cellular manufacturing:

Cellular manufacturing reduce the transportation waste & inventory. Cellular manufacturing also says "one piece flow" process. It is difficult to fulfil the customer requirement with traditional product line, so using the U-shape product line replace traditional product line. Grouping of various types of equipment's which are req. to manufacture the family of parts is Cellular Manufacturing [1]. A route map is made for each & every part family, this route map is provided by Value Stream Mapping (VSM). On based on this route map dissimilar machines are been grouped together to form one cell. Wimberley, had suggested that those dissimilar machines are been clustered in sequential manner in order to meet need of process of a family of product. But many researchers & literature study suggested that U line manufacturing is one of the special type of Cellular Manufacturing system by which flexibility of manufacturing system improves [2].

2. Just in time (JIT):

Just in time is a heart of the lean manufacturing. It's associated with lean techniques. Just in time production gives right part at the right place at right time. It is also known as JIT- production OR Toyota Production System (TPS). IT is a methodology which aims primarily on reducing flow time within the production system & response time for suppliers & to the costumers. It was developed at BRITISH MOTOR CORPORATION (Australia) in SYDNEY in 1950s. Ten it was adopted in JAPAN, between 1960-1970s particularly at TOYOTA.

3. Kanban:

Production smoothing, and setup time reduction are component of any JIT system. "Kanban" is a Japanese word which means card or signal. Which process is running and gives the basic information about manufacturing. It is system which prepare a schedule for lean manufacturing & Just in Time. It is a system which controls the inventory to control chain of supply. An industrial engineer namely Taijchi Ohno at Toyota developed kanban to improve manufacturing efficiency. It is method which is applied to achieve JIT.

4. Production Smoothing:

Production smoothing is the process of the balance the work load over different time period. It provide flexibility to respond rush order. It is help to eliminate over production.

5. Total productive maintenance (TPM):

Total productive maintenance is the techniques for reducing the machine down time and eliminates the defect and scrap. TPM is a fundamental pillar of lean. It is introducing awareness of self-maintenance and also introducing the preventive maintenance of machine. It is a system which maintains & improves the integrity of production & quality system through machines, processes, workers, equipment's which adds business value to the organization. Its aim is to keep all the equipment's in top working conditions which avoids delays & breakdowns in the manufacturing processes.

6. Continuous Improvement:

Continuous improvement such as improve the quality of product and customer satisfaction. Kaizen and 5s are the component of continuous improvement. It is a philosophy which describes as, "Improvement initiatives that increase

successes & reduces the failures". It is a management driven element which makes the effort to change the culture in the workplace. Once if the processes is stable then this tool is req. to find out the root cause of the inefficiencies & then it would be applied to reduce those inefficiencies. Berger [5] overviewed that continues improvement is based on people's inherent desires of quality & worth, & management has to believe which would be going to "pay" in long term. It depends on employee perception, processes for problem solving, tools & techniques, team work, leader motivation & engagement, & motivation. [3] [6] [7] [8]

7. 5s:

It has a five stage of the improvement of the process. It has 5 "S" all "S" gives the different meaning and activity. Seiri, Seiton, Seiso, Seiketsu, and Shitsuke. Is a Japanese word and translate into English these 5S is: Sort, Set (in place), Shine, Standardize, and Sustain. The above list illustrates how to organize a space for efficiency & effectiveness by way of finding & storing the items used, maintaining the items & areas & maintaining the new order.

8. Value stream mapping:

Value stream mapping (VSM) is a paper pencil tool it is identify the value of added and non-added. It is a visual representation of material flow and information flow. Value stream mapping creates a two maps starting with current state map it gives the snapshot of assembly which process running. And after second one is create a future state map for the improvement of the process. It is defined as, "The set of all the specific actions req. to bring a specific product through the three critical tasks of management of any business, namely Problem Solving, Information management & Physical Transformation". Process which requires to coordinates the activities performed by manufacturers, distributors & suppliers to deliver products to customers is known as Value Stream Mapping (VSM). Rother [9].

9. SMED:

SMED (Single-Minute Exchange of Dies) is a system for dramatically reducing the time it takes to complete equipment changeovers. The essence of the SMED system is to convert as many changeover steps as possible to "external" (performed while the equipment is running), and to simplify and streamline the remaining steps. The name Single-Minute Exchange of Dies comes from the goal of reducing changeover times to the "single" digits. [10]

10. Line Balancing:

It is a function of manufacturing-engineering in which whole collection of production-line tasks are divided into equal portions. Monden [11] suggested that the analysis of task time varies due to human factors which lead to U-line balancing problems. The time varies due to improper stability of human beings w.r.t. skill, work rate, motivation & sensitivity of failure of complex process. Chiang [12] & Becker [13] both suggested that sources of variability& the environment are where tasks are being performed. Based on demand, no. of labors & machines within that workstation are been decreased or increased in order to reduce unbalancing of line. Both Machine & Man's flexibilities is achieved by free flow of materials & information in manufacturing processes. [11]

11. Takt Time:

Takt time is the maximum amount of time in which a product needs to be produced in order to satisfy customer demand. It refers to frequency of component that must be produced to meet the costumer's demand. It depends on monthly demand of production, if demand is increased the takt time would decreased & vice versa. Which means output interval increases or decreases.

V. LITURATURE REVIEW

1).As a lean manufacturing is a technique to reduce human efforts and produce defect free product. According to **Jafri Mohd Rohani** et.al. are production line analysis via **value stream mapping** for colour industry, in this article identify and eliminate waste by using team formation, product selection, conceptual design, and time frame formulation through takt time calculation. And use the some lean techniques change over time and 5s and decreased lead time from 8.5 days to 6 days and value aided time decrease from 68 minutes to 37 minutes.

2.)Tomas Rohac (2015) to demonstration with value stream mapping on the plastic product of health care to applying **lean tools are 5-why & Ishikawa chart**, and reduce the lead time and inventory control.

3.)Pravin shaswatat, el. (2015) apply the value stream mapping on bearing industry and reduce the work in process inventory and lead time. This article gives the information about value stream mapping and gives the methodology for the implementation of VSM.

4.)According to Taho yang yiyo kag (2014) suggested and implement lean production system for fishing net manufacturing, use the various lean tools and Simulation method and make to order (MTO) process are apply for the regular shipment. And It also use the VSM tool and produce future state map and increase service level and reduce lead time, also gives the guideline for the implementation of the value stream mapping.

5.)Santosh kumar et, al.(2014) 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.

6.)According to K. Venkataraman (2014) says that various organizations are implement lean manufacturing in recent year for reducing and eliminate waste. In this article, They use the value stream mapping for reducing cycle time of crank shaft. Various type of tools are apply and get benefits, create a current state map of the crank shaft assembly line and also creates a future state map for improving process of crank shaft assembly, here is a three assembly available for producing a crank shaft. And improve the process and reduce waste so that apply three type kaizen, and also used the analytical hierarchical process(AHP) for decision making which process are apply and after than get result of the crank shaft assembly to reduce the inventory, and apply the single piece flow for crank shaft manufacturing and give quick response to the customer demand.

7.)P. Arunagiri et, al. (2014) have suggested identification of high impact lean tool in automobile industry using weighted average method and they study about 91 industry and using 30 or more lean tools used get a result by weighted average method to maximum useful tools in automobile industry, first one is 5s lean tool are preferred to elimination waste.

8.) **Ratneshwar singh et,al.(2013)** suggested TPM implementation in machine shop and reduce break down time and improve performance efficiency. TPM depend on various pillar, like 5s,planned maintenance, quality maintenance, kaizen office, and safety, health & environment are apply one by one and improve the quality of product with over all equipment effectiveness.

9.) **Boppana v. chaudhary et, al.** (2012), implement the lean manufacturing in a pharmaceutical company, in this paper take a case study of the product line is creams and ointment. Also in industry problem was fixed operating cost and inability to supply products. In this paper. They improve the operation with help of lean manufacturing so detect the problem where the waste occurs, and use the lean tool VSM. Prepare a current state map and use the 5-why method for the collect information. And after creatimg future state map for the improvement with the help of 5s tool and also used cellular manufacturing. The result were reduce inventory, and customer satisfaction, and on time delivery, reduced cycle time , decreased non value added time and reduced the floor space area.

10.) **Jennies angelis et, al. (2012)** Lean is a globally competitive standard for product assembly of discreet parts. Successful Lean application is conditioned by an evolutionary problem-solving ability of the rank and file. This is in itself contingent on employee involvement in improvement programs and the implementation of appropriate practices.

11.) **Rachna shah et.al. 2007** Lean manufacturing is an integrated socio technical system whose main objective is to eliminate waste by concurrently reducing and minimizing supplier, customer, and internal variability.

And according to Horacio Soriano-meier et.al.2001 Lean manufacturing and lean production is a synonym of lean management. Lean manufacturing can be achieved through time such that it is not possible to use it as a panacea to solve short term competitive. And also lean manufacturing can be applied in any industry. In this article applying lean management for the hospital and improve the quality by give service to improve the patient's health and satisfaction. In this study by applying the lean tool such like kaizen & 5s for the improving the service level for cleaning and systematic activities.

12.) Dinesh seth at.el. suggest lean manufacturing is the systematic approach to identify and eliminating waste by continuous improvements. In this paper, they minimize the waste in the cotton seed oil industry with the help of value stream mapping tool. Methodology is to take a survey of Indian cotton oil seed industry and take a sample from India and prepare a questionnaire and get feedback by phones and emails. And after preparing of overall supply chain map, they identified the waste and eliminate it with some modification and improve the productivity.

VI.) SUMMARY AND CONCLUSION

From review of different papers, we concluded that successful implementation of Lean Manufacturing System needs some data gathering which in stage use simulation and integration with some lean tools with proper sequences. It can also be used in small scale industries to improve man, machine, method and environment, a core of manufacturing industries We can also suggest some change in steps of processes why using VSM through layout which would may be efficient for workers to use it. By implementing Lean manufacturing techniques excess inventory can be reduce, so we can manage to maintain inventory. We reviewed these all research papers to get details of lean manufacturing tools which can be used in to improve productivity of an industrial equipment manufacturer based in Vadodara, Gujarat, India. It is to be concluded that Lean manufacturing have changed the paradigm of Productivity improvement through systematic and detailed analyzing tools which require continuous efforts of management and workers.

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