Lean Thinking: Reduction of Waste, Lead Time, Cost through Lean Manufacturing Tools and Technique

Denish B. Modi¹, Hemant Thakkar²

¹M.E. [Industrial Engineering], ²Associate Professor, G. H. Patel College of Engineering and Technology, V. V. Nagar, Gujarat, India

Abstract-- Lean manufacturing is now one of the most powerful manufacturing control systems in the current trend. In present competitive and challenging market, industries need to improve their strength and must concentrate on to their process flows. Lean manufacturing is the solution to improve their quality and increasing profit for manufacturing over the international market. Lean manufacturing provides varieties of tools and strategies which can help in identification of waste, reduction or elimination of waste, environmental pollution control, manufacturing product with better quality, lowering the product cost, reducing human effort and reducing product manufacturing time.

This paper demonstrates various lean manufacturing principles, which includes advantages, implementation strategy and hurdles in implementation for manufacturing industry. The study specially focuses on the Green manufacturing which is highly in demand in new era. It indicates the use of processes that doesn’t harm environment, provides safety to consumers & employers. Lean manufacturing is a precise approach for economical utilization of raw product and eliminating waste through continuous improvement, and aimed to provide qualitative product to the customers.

Keywords--Lean Manufacturing, Lean Principle, Lean tools, Lean Benefits, Seven Wastes [MUDA]

I. INTRODUCTION

Lean manufacturing was developed by the Japanese automotive Industry with lean from Toyota and utilizing. The Toyota Production system (TPS) following the challenge to re-build the Japanese economy after world war!! The concept of lean thinking was Introduced to the western world in lean by the book “The machine that changed the world” written by Womack, Jones and Roos. Lean is a philosophy that seeks to eliminate waste in an aspect of a firm’s production activities. Human relation, Vendor relations, technology and the management of material and inventory. Lean Production is an assembly line methodology Developed originally for Toyota and the Manufacturing of automobiles.

Engineer Taiichi Ohno was developing the Principle of Lean production after World War II. His Philosophy, which is focused on elimination of waste and empowering workers, reduced Inventory and Improved Productivity. Instead of maintaining resources in anticipation of wheat might be required for future Manufacturing. As Henry ford did with his production line the management team at Toyota built partnerships with suppliers.

In effect under the direction of engineer Ohno, Toyota automobiles became made to order. By maximizing the use of multi skilled employee the company was able to compressed their management structure and focus resources in a flexible manner because the company and able to make changes quickly.

Lean manufacturing a systematic approach to Identifying and eliminating waste through continuous Improvement, flowing the product at the pull of the customer in pursuit of perfection [8].

A. Theory of lean manufacturing:

Lean manufacturing is a philosophy to provide better quality of products with lower cost and on time with lesser efforts. Lean Manufacturing is defined as “A philosophy based on Toyota production system and other Japanese Management Practices that strives to shorten the time line between the customer order and the shipment of the final product by consistent elimination of waste”.

Lean manufacturing aims for Identification and elimination of waste in all aspects of a business and there by enriching value from the customer perspective.

Lean manufacturing is the production of goods using less of everything compared to traditional mass production, less waste, human effort, manufacturing space, investment in tools, inventory and engineering time to develop a new product. Lean production cuts costs & inventories rapidly to free cash which is critical. It also supports growth by Improving Productivity & quality, reducing lead times and freeing huge amount of resources.
B. Taiichi ohno’s 7 waste [MUDA]:

A purposeful classification of the various tools that only lift up cost in production activity gives the following seven types of waste. Figure 1 shows seven wastes.

The objective of lean continuous shorten the time between the customer’s order and shipment by eliminating everything that increase the time and cost.

B. Lean Principles:

The lean principle is approach with manufacturing Industries but can be equally applicable to both service and administration processes.

It’s not a new phenomenon Japanese auto manufacturers have been developing lean for over 50 years. Lean principle is focus on 5 principle of lean.

C. Lean tools/Practices/Techniques:

The basic purpose of LM is to manufacture the product with minimum waste and continuous improvement of all activity and process involved in any form of work.

For that following are key elements which have been recognized like:

1. Kaizen [continuous improvement]
2. 5s
3. Just In Time
4. Visual Management
5. Value stream Mapping
6. Andon
7. Gemba [The real place]
8. Total Productive Maintenance [TPM]
9. TAKE Time
10. Single Minute Exchange of Die [SMED]
11. Cellular layout [flexible operation]
12. Supply chain management [SCM]

Some Technique related with the Lean:

[1] KAIZEN [continuous improvement]

Kaizen process is based on common sense and lowest approach. Kaizen is the Japanese word. The meaning of this word is continuous improvement.
KAIZEN means Continuous Improvement, KAI means Take apart and make new and ZEN means think about so as to help other.

Kaizen philosophy for everything, it is not a big achievement if something successes according to the plan in our lean because such a thing as always already been implement. The probability of successful is low, the thing no one wants to do, no one implements it and therefore there is a value of trying. Then try to verify why failures occurred. Never give up and key to success is in it. Effort of this method is to Implement big and also small changes and after this we are able to achieve more productivity [14].

[2] 5S

5s is a workplace organization technique. It is a way to involve associates in the ownership of their work-space. The 5s is a lean tool which is consists of SEIRI, SEITON, SEISO, SEIKETSU, SHITSUKE taken from Japanese language which plan Reduce waste hidden in the plant, Improve quality and safety, Reduce lead time and cost, Increase profit. It helps create and maintain the efficiency and effectiveness of work area.


JIT Philosophy means getting the Right quantity of goods at the right place and the right time.JIT exceeds the concept of inventory reduction.JIT defined as “Production of the minimum number of units in the smallest possible quantities at the latest possible time, which eliminates the need of the Inventory” Does not mean to produce on time, but to produce ’Just in Time’.

JIT is an optional philosophy which includes

[1] A Setup time improvement system
[2] A Maintenance improvement system
[3] A quickly improvement system
[4] A Productivity improvement system


“Visual management problem can be identified immediately and everyone can initiate Improvement Plans.” Visual Management is promote as a workplace where all associates understand and manage their own work in safe, clean, organized environment that fasters open communication, pride and continuous Improvement. It helps anybody in the workplace to know what the current status is and what to do next. Visual Management conveying information, work environment safety, operations, Storage, Quality, and Equipment.

[5] VSM [value stream mapping]

A value stream is the entire set of activities running from raw material to finished product for a specific product or product family. Value stream maps are powerful visual tool used to identify waste and understand the flow of material and Information. Value stream maps show all actions required to deliver a product. Value added ………….as well as Non value added.

All of the actions and tasks, both value added and non-value added, required to bring an item (an idea, information, product or service) from its inception through delivery.

Value add an activity that transform or shapes raw material or Information to meet costumer requirement.

Non-value adds those activities that TAKT time, resources or space but do not add to the value of the product itself.


Andon is an information tool which provides instant, visible and audible warning to the operations team that there is an abnormality within that area.
Acts as the real time communication tool for the plant floor that brings immediate attention to problems as they occur so, they can be instantly addressed.

[7] Gemba [The real place]
Gemba is a Japanese word meaning ‘real place’ where the real action takes place in business Gemba is the ‘shop floor’ or ‘production place’, where the value adding activities to satisfy the customer are carried out. It is sophisticated tools and technologies to deal with problems that can be solved with a common sense, low-cost approach.

[8] Total Productive Maintenance
Total Productive Maintenance promotes basic preventive maintenance job to operator itself so, that Break-Down time of Machine is reduced [5]. It is a critical element for any successful lean enterprise that raises production machines and equipments.

Effective TPM is a lean tool which eliminates equipment breakdowns, Defects scrap and rework, Safety issues, Mini stoppages, and reduced speed. TPM is a lean tool to optimize the effectiveness of manufacturing equipment are tooling.

[9] TAKT Time
TAKT time is the rate at which production should run to meet customer demand. TAKT reflects the frequency at which the product has to come out of manufacture to meet the customer demand [1].

TAKT Time = operating time per shift/ customer requirement per shift
TAKT provides a simple consistent and intuitive method of pacing production. The idea is to Synchronize the pace of production to the pace of sales.

[10] SMED [Single minute exchange of die]
SMED means “A rapid and efficiency way of converting a process from running the current product to running the next product”. Lean manufacturing target reduction of set up time and change over time because it consumes critical working time and reduced proper utilization of machine and proper time [5]. SMED concept that says all steps should and can take less than 10 minutes. SMED helps achieve lower costs greater flexibility and higher thought out.

Cellular manufacturing is an approach in which equipment and workstations necessary to produce a product are arranged closely to gather to facilitate small lot continuous flow production. The goal is to have the necessary flexibility to produce a variety of low demand product, while maintaining the same productivity obtained with a large scale production.

[12] Supply Chain Management
Supply chain management is the design and management of processes across organizational boundaries with the goal of matching supply and demand in the most-cost effective way.
Supply chain activities transform raw materials and components into a finished product that is delivered to the end customer. Supply chain management is concerned with the efficient integration of suppliers, factories, warehouses and stores so that merchandise is produced and distributed.
SCM aims to supply goods and material in the right quantities, the Right place, at the right time.
In order to minimize total system cost any satisfy customer service requirement.

D. Benefits of lean manufacturing

• Reduction in cost
• Reduction in lead time
• Waste reduction
• Improvement in productivity
• Quality improvement/ reduce defects
• Reduce cycle time
• Reduction of unnecessary activity
• Better labour, space and equipment utilization
• Reduction in work in process [WIP] Inventory

III. CONCLUSION AND DISCUSSION

Lean manufacturing is all about waste reduction, continuous improvement and improving customer-supplier relationship by providing better quality and on time service. Lean manufacturing provides varieties of strategies of improving performance and to compete in this emerging market.

We need to focus on green manufacturing and its main objective is to prevent pollution, protect and provide healthy environment to employees and to the nation. It’s the way of manufacturing which can leads to improvement in providing cost effective product, customer satisfaction and profitable outcome with no disturbance to natural climate. Different lean paper reviewed to observe the benefits by implementation of various lean tools.


The paper suggests Value Stream Mapping (VSM) is an ideal tool to expose the waste and to identify improvement areas. VIPPLANOPT Simulation software is used to substantiate effectiveness. Decisions for implementation like material and money flow leads to desired benefits. Like an experimental analysis of a Motor manufacturing company where, the first machine is 100% busy, the second machine is 74.45% busy and 27.56% idle, like that all machine performance. The fixed terminal board and rotor cover fitting is 99.3% to increase the machine utilization and to increase the productivity. And by modified layout using VIPPLANOPT software which reduced the transportation cost, inventory between the process and part waiting time. For example the distance between 1’st machine and 2’nd machine is 51.6 meters, like that calculate to total modified layout distance is 75.6 meters.

Result shows that further implementation is still required in manufacturing motors. It helps companies to reach their ultimate targeted goal.


This paper shows the lean manufacturing adopted in the Malaysian electrical and electronics industry by providing the practices and the tools for improvement. Companies that want to implement lean manufacturing system need to know what is required for implementation. The manufacturing process is to be carefully judged, it is not a simple procedure to be followed, but innovative ideas needs to apply for implementation.

[3] Rakesh Kumar, Vikas Kumar

Lean manufacturing is mainly waste reduction, continuous improvement, process improvement and improving supplier customer relationship by reducing lead time. It offers various tools to improve manufacturing, selection of tools depends on understanding focus area for improvement, current condition etc. like smaller lot size and reduction of changeover time strategies. Improvement of lean manufacturing is very important aspect. It should be carefully prepared, followed and obstacles must be taken care of, else leads to loss of inventory and harms to ethics of employees. It is a longer process, it is a way of life for improving manufacturing to make more profit, production and customer oriented service.

[4] Sunil M. satao, Dr. G.T.Thampi, Santosh d. Dalvi

Waste reduction is the one of the main goal of green manufacturing which needs to prevent pollution and protect environment. The paper review focused on the objective of green manufacturing, which is achieved through the tools of lean manufacturing.


Only 3% of the industries are undergoing through lean manufacturing philosophy. Mostly found as reluctance of its using and understanding including major of those ideas are from American origin and were only pulled together and part of the TOYOTA production. Hundreds of manufacturing companies had got success by using lean manufacturing. Another example is by business enterprise system giant SAP (Gordon 2007).

Lean is all about stream lining the flow of value through the organization. Improved bottom line performance, greater productivity, increased quality, cost reduction, customer satisfaction, and greater market share are some of the results. All of these tie in to increase in shareholder wealth in the companies.

The paper shows that Small, Medium industries (SME) could face problems in implementing lean manufacturing because of limited resources, compared to large organizations. But by implementing feasible practices and low cost consumption such as 5S, Kanban (without computerized system), employee involvement, they can strengthen the internal capability by appointed lean manufacturing representative who look the overall lean process and conduct in house training for particular principle and practices. Smart partnership between supplier and customer in lean manufacturing could benefit both parties. Authors concluded that the basic lean tools which are feasible to implement in SME and they have proposed the feasible lean model which could help the SMEs to implement lean successfully.

REFERENCES