

A Review on Lean Manufacturing Elements and its Benefits in Context of Indian Industry

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Abstract : With the growing industry field, it becomes necessary for every organization to work upon its weakness and force their strength to improve its working environment. Lean manufacturing offers best tools and technique for improving the competitiveness of manufacturing organizations over the globe. The concept of Lean manufacturing helps in identification of waste, their reduction or elimination to enable smooth manufacturing of superior quality with lesser efforts, time and at low cost. Due to its fruitful features, it is gaining more popularity among manufacturing industries. This paper presents a review on Lean Manufacturing elements, aids, operation strategies and barriers in execution for manufacturing industry.

Key word: lean manufacturing, operation strategies, barriers of lean manufacturing.

1. Introduction

Now a day, all manufacturing companies are seeking for high quality product with lesser use of resources. The aim is to improve the production by removing waste from the system using the best techniques. The Toyota production system formed the basis of lean manufacturing (Herron et al., 2008) which was very effective for identification and elimination of waste that might improve quality of the product as well as the production cost and the time. During 1980's Toyota got popular in all over the world for implementation of various techniques covering a wide range of manufacturing operations such as JIT (just in Time) system. JIT can be excused as a philosophy which aimed at continuous improvement by identifying and rejecting all sorts of waste from the system (Brox and Fader, 2002). During 1990, lean manufacturing gained the huge popularity after the publishing of the record presented by Womack, Ross and Jones "The car that switched the word". During the last two decades, much of researches have been performed on the Toyota Production System by Adler, 1993; Womack and Jones, 1994; Sobek et al. 1998; Liker, 1998; Papadupoulou et al. 2005; Shah et al. 2007; Mike Rother, 2009. By applying lean manufacturing techniques such as Kaizen, poka-yoke, cellular manufacturing, etc., Toyota production system was able to get better quality cars with lesser number of defects resulting higher customer satisfaction. As a Japanese company adopted the precepts of lean manufacturing, other companies also tried to develop, produce and supply the product to client with fewer resources such as textiles, human efforts, machines. Tools, floor space, capital investment and total expenses (Womeck et al. 1990; Ohno, 1998;; Mike Rother, 2009).

Toyota now has become the most successful lean manufacturer, but every industry can benefit from a lean

philosophy. With a lean philosophy, any society can get rid of waste and better its bottom seam, such as Engineers can reduce that complexity of assembly task; Scientists can reduce wasted time running tests, Accountants can speed up end of month reports and even management can improve administration and compliance processes. An industry need to be elastic enough to rapidly take on the changes to reduce the cost of their product and meeting the customer's expectations.

2. Concept of lean manufacturing

Lean manufacturing can be considered as the outlay of resources to reach the target (minimum waste) other than the creation of value for the customer need. Basically, lean manufacturing improves the efficiency of the production processes by doing away with unnecessary work, unevenness in production, maintenance events and so along. It gets rid of non-value-added operations and focus on increasing the output quality. Companies can concentrate on more value-added process and expend more time on improving operational procedures.

Henry Ford made the concept of Just-In-Time (JIT) manufacturing for car production in which he concentrated on decreasing the running costs of stock by eliminating as much stock as possible. The modern rules of lean manufacturing are derived from the Toyota Production Systems. Toyota's philosophy eliminates three types of inefficiency: non-value-adding work, overburdening of workers and unevenness in productivity.

In other industries Lean methodology can be utilized for identifying sources of dissipation and the methods to get rid of them. At once a day's lean technology is spreading throughout the creation and its tools have become the worldwide standards. Every company must adopt these

standards to be competitive in a global economy. Not merely to compete globally, Lean helps in empowering and motivating the employees to enlist for the improvement of their employment.

A manufacturing/production system best characterized as relentlessly eliminating waste from all of its' activities and operations. Lean strives to produce products:

- On-Time Using as few resources as possible
- Better than competitors
- Faster & Cheaper than competitors

3. Strategies of lean production system:

For implementing Lean philosophy within the organization, it becomes important to think about lean, starting with smaller projects turned into bigger projects, under the guidance of an expert. Some of the stages are discussed below:

3.1 Involvement of senior management: For creating any major alteration in the manufacturing system, it is always required that top management should support and do the changes. Carrying out of lean system may contribute to various problems at the beginning stage and consequently it is always required that these issues must be read and solved by top management without effecting lean implementation process.

3.2 Start with small projects: It is important that the Initial project must be small, so that the available resources can be used effectively and lesser risk is linked up with the project and better results will come. Moreover, people associated with that project will discover while doing recommendation.

3.3 Start with restricted performance: By using a limited area initially, Lean implementation can easily be discovered, modified and directed for further execution. After that the continuous use of lean technology will reduce control and mentoring of people involved in lean implementation.

3.4 Hire a professional: For conversion of a conventional organization into a lean organization, a professional mentor should be hired at least at the start to resolve the issues that may arise during installation of lean system and should be handled professionally under the eye of an expert.

4. Elements of Lean Manufacturing

Lean Manufacturing is the “umbrella” under which many manufacturing improvement tools are housed. **Some examples include:**

4.1 SMED/Single Minute Exchange of Die: SMED is the Lean tool that is used to quickly change the machines or

manufacturing processes to produce a specific part number or production of different part number or production of part with different attributes. SMED processes are highly designed and rehearsed to minimize machine downtime. Generally, SMED involves the process of replacing the existing dies with other dies or structures or changing machines by different mechanical structure.

4.2 TOC/Theory of Constraint: A constraint is anything that bounds a system from attaining its goal. While talking about company, a constraint is the major limiting factor that may reduce the amount of throughput the company can achieve. A constraint may be a machine or process.

For a company, there may be many bottlenecks, but the Constraint of the company will be the “Alpha Bottleneck” as it directly effects the throughput of the company. Many companies can have more than one Constraint in which one may be slightly larger than another.

4.3 Standards of Quality: American Automobile Manufacturers uses the quality system/standard, based on ISO 9000, to register their suppliers. But now many quality systems exist to control quality standards throughout the world. For a company to be competitive especially in world markets, it is important, even essential to endorse and qualify for registration into a quality system specific to their industry.

4.4 Total Productive Maintenance: TPM is a powerful program for planning and achieving minimal machine downtime. Equipment and tools are literally put on “proactive” maintenance schedules to keep them running efficiently and with greatly reduced downtime. Machine operators take far greater responsibility for their machines upkeep. Maintenance technicians are liberated from mundane, routine maintenance, enabling them to focus on urgent repairs and proactive maintenance activities. A solid TPM program allows you to plan your downtime and keep breakdowns to a minimum.

TPM is an outstanding program that drives improvement initiatives and facilitates many other Lean activities. Without a strong TPM program, becoming truly Lean would be a difficult if not impossible task in an environment heavily dependent on machinery. Buy-in at the shop floor level is generally quite high as TPM is an exciting undertaking.

4.5 Kanban: In Lean Manufacturing system, Kanban means “Signal.” Kanban is a Japanese term which means “visual record” or “card.” Kanban “signals” are basically used to tell the workers that there is more work to be done. In other words, the presence of a “Kanban Card” or an empty “Kanban Location” is a “signal” to do the work described on

the card either to make the parts or fill the empty Kanban location with the already produced parts.

4.6 Level-Loading & Mixed-Level-Loading (Heijunka, Balancing): Level-Loading is a process of loading the production system according to the demands of the customers. It is a technique that helps in balancing the production throughput according to the demands of customer. Ideally it is based on the consumption of products as per customer's requirements by pulling the products from the production system.

Mixed-Level-Loading is same as Level-Loading which means to supply the customers with exactly what they need and when they need. However, "mixing" includes producing perhaps many different models of products in correct quantities and ratios to satisfy customer demand for a variety of products with shorter than average lead-times.

4.7 Lead Time: It can be defined as the time required from receipt of order until the products are shipped to the customer. Sometimes lead time becomes the biggest difference between the competing companies. If company "A" promising that they will deliver the product to the customer within 6 weeks and company "B" promises that they will take 1-week for delivery means company B have much options to sustain better than company A. Lean Manufacturing has many tools that ultimately reduce Lead-Time and win market share. Oddly enough Inventory in a manufacturing system has the limiting effect of increasing Lead-Time.

4.8 5S: It ensures a workplace with maximum cleanliness, organized and safety of all elements within the working environment. 5S so named for its 5 primary undertakings:

Sort: Eliminate all unnecessary items from the workplace.

Set in Order: Find a place for everything and put everything in its place.

Shine: Systematically clean and inspect everything in the work area.

Standardize: Maintain the improvements through discipline and structure.

Sustain: Supporting 5S efforts through auditing, job descriptions that include maintenance of the system, management support and expectations, etc.

5S efforts almost always improve workplace safety, operator morale, quality, and throughput. It can also be very impressive to visiting customers and prospective clients.

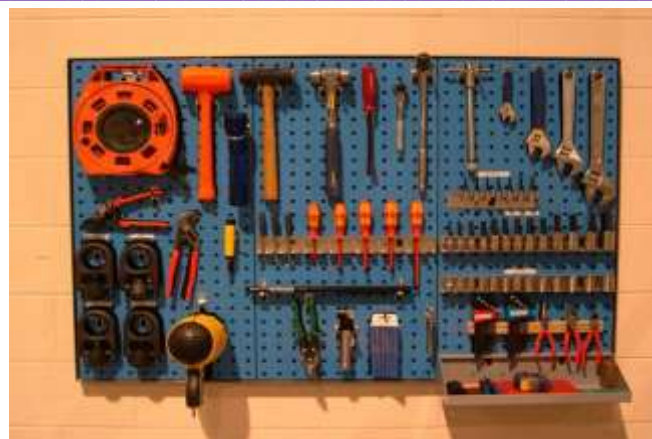


Fig 1: 5S order

4.9 Standardized Work: Standardized Work means a work done by better ways. Standardized Work will generally comprise of improving the existing way by continuously testing the work processes again and again and providing the best way to complete the task. The "current best ways" is an important concept given by standardized work.

4.10 Error & Mistake-Proofing: Poka-Yoke (Japanese) Lean tool for making products correctly the first time. When thoroughly implemented Error & Mistake-Proofing create improvements on many different levels. Even the products themselves may be redesigned to minimize errors in their manufacture.

Tooling and processes are often reworked to produce error-free parts or at minimum catch errors before they become significant defects that require rework or become scrap.

One common and popular example of Mistake-Proofing is the design of the VHS video tape player. A videotape will only fully enter a VCR and play if it is placed correctly into opening.

4.11 Teams: Lean philosophy focuses on grouping of people so that they can work together to achieve common goals. "Empowered Teams" is the goal of lean technology for achievement of the goal of the organization. Two heads are always better than one. Teams will always results with better answers and improvements than a single person can on their own.

5. Advantages of Lean Manufacturing System:

It has been seen that the Lean manufacturing system improves the performance of the organization by reducing waste and defects, lowering cycle time and response time and inventory of work in progress products.

5.1 Reduced cost: Lean Manufacturing organizations helps in reducing cycle times, bottlenecks, machine downtime and increased labour productivity which directly reduced the cost of production.

5.2 Reduced lead time: By reducing cycle time, lead time, machine down time and work in progress inventory of manufacturing and delivery of the product is drastically reducing.

5.3 Waste reduction: A main function of Lean system is to identify and reduce the waste. All the form of waste i.e. overproduction, transportation, defect, work in progress inventory, waiting and motion, over processing are reduced with Lean manufacturing implementation.

5.4 Improved productivity and Multi skill worker: Productivity of the organization depends upon the labour work time. The idle time of workers is reduced and workers are advised to use their full effort productively and eliminate unnecessary tasks or unnecessary motions. Involvement of worker in various Lean tools such as asset up time reduction, quality circles, kaizen circle, layout improvement; value stream mapping, etc. creates better understanding of processes, machines, material flow among the team and progresses core abilities of worker.

5.5 Reduced work in progress (WIP) Inventory: Inventory levels are minimized at all stages of production. Works-in-progress inventories as well as inventory between production stages, are lowered which mean lower working capital requirements.

5.6 Lower Cycle Times and Better Utilization of equipment and space: Reducing waiting times between processing stages and production cycle times, manufacturing lead time as well as cycle time is reduced. Minimizing machine downtime by proper use of equipment and manufacturing space maximize the rate of production though existing equipment.

5.7 Improved Flexibility and Reduced Defects – Lean can produce a more flexible range of products with minimum changeover costs, time and defects by reducing unnecessary physical wastage such as excess use of raw material inputs, costs associated with reprocessing defective items, and unnecessary product characteristics which are not required by customers.

6. Hindrances in Lean Manufacturing execution:

The following may be some obstacles in Lean manufacturing implementation:

6.1 Deficiency of management support: The concept of lean is still not fully developed. Getting pressure from customer side competitor is trying to follow lean practices or others. In this case management just starts only superficial lean and does not force further the result and thus neither lean is implemented nor does it get benefit.

6.2 Resistance to Change: People don't want to change as they are afraid of failure so they do not support the new technology and hence it stops the progress of lean implementation.

6.3 Deficiency of training: Most of the organization facing lack of clear understanding about lean concepts and tools. It is required to provide them a special training so that the organization can easily implement the lean technology.

6.4. Lack of Communication: It is one of the prime obstacles in lean manufacturing implementation.

6.5 No direct financial income: Lean can help in identification and elimination of waste. It does not support any direct financial benefits but reduction of cost.

6.6 Past failures: Without knowing the complete concept of Lean, its implementation is itself a big obstacle. Lack of implementation knowledge may lead to lack of faith in whole philosophy.

7. Conclusions:

In some countries and manufacturing sector, Lean Manufacturing concept has been broadly accepted over the Earth. It results in improvement of operational performance of the system by deeply studying the process parameters, the defects and sources of defect, waste associated with the production processes. Continuous improvement, process improvement and improving supplier customer relationship by cutting lead time is the main aspect of lean system. It has been observed that there is no short and crisp definition of lean manufacturing. Many researchers have studied and presented their different views on lean manufacturing. Common understanding about lean manufacturing is mainly waste reduction. Lean offers an extended list of tools to improve manufacturing and generates the desired advantage to endure in today's competitive scenario. Choice of tools depends upon knowledge about lean techniques, process to improve, current condition, etc. Small lot size requires less work in process inventory and reduces blockage of cash. It directly reduces the cost of capital. Providing flexibility by reducing changeover time results in reduced inventory and reduced reaction time to customer.

The implementation strategy of lean manufacturing is a very important facet. For active implementation, obstacles must be taken care of before practice and an action plan should be implemented to defeat them. Finally, lean Manufacturing is not a one-time activity which can take all the benefits right away, but it should be called for creating an organization in more productive way by improving manufacturing techniques to create the profitable, and customer oriented environment which is the call for today.

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