



Lean Manufacturing Issues and Challenges in Manufacturing Process— A Review

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Abstract: Lean Manufacturing (LM) is considered as a rapid growing manufacturing culture. The companies are facing cut throat competition and so are compelled to continuously perform better than their competitors. Hence the organizations are growing at a faster pace, to enhance their position in the competitive world. Industrial organizations have to adopt the new philosophies like lean. Lean Manufacturing may be defined as the technique which is used for the continuous elimination of all types of waste in the production process to improve the efficiency. Management strategies and philosophies are always difficult and uncertain because change is inevitable and the companies should devise it as per the customer's requirement. The primary competitive measure of lean is "ability to respond to the customer and satisfy his requirements by making the process of the production efficient and waste free".

Key words: Lean Manufacturing Issues, Challenges in Manufacturing Process.

Introduction

Lean is defined as a strategy for achieving significant continuous improvement in performance through the elimination of all wastes of resources and time in the total business process. It evolved from Toyota after world war 2nd as a business strategy due to the limited resources available in Japan, in contrast to the vast resources available to manufactures in the US. Its principles apply to nearly all business operations, from administration and product design to hardware productions. Lean manufacturing is about eliminating waste and non value added tasks. Examples of waste in manufacturing include overproduction, over processing, waiting, unnecessary part movement, excess inventory and defects, as applied to hardware production lean manufacturing focuses on eliminating all sources of waste by applying the following strategies 1. One piece workflow 2. Take time 3. Pull system Lean identifies the bottlenecks in design and development processes that add unnecessary delays and cost. It can help create a more efficient system that reduces time to market without compromising on quality.

Lean has a key role to play in new product development and the improvement of existing products and the improvement of existing products, including idea creation, design for manufacture, assembly and test, rapid prototyping, product portfolio management, market and competitor analysis, risk management, sales forecasting, setting key performance indicators and value analysis to reduce the cost of existing products.

The concept of Lean manufacturing is derived from the methods developed at the shop floor of Toyota, which are described in detail by the authors like Taiichi Ohno and Shigeo Shingo. But these concepts in the form of lean manufacturing system (LMS) got an international recognition, as a result of the book, "The machine that changed the world" written by the researches Womack et al. According to Womack Jones, and Roos, LM uses less of everything compared to mass production-half the human efforts in the factory, half the

manufacturing space, half the investment in tools and half the engineering hours to develop a new product. In addition, it requires keeping far less than half of the needed inventory on site, results in many fewer defects and produces a greater and ever growing variety of products. In short, it is called lean manufacturing because it uses less or the minimum of everything required to produce a product or perform a service. Lean manufacturing is “A systematic approach for identifying and eliminating waste through continuous improvement by flowing the product at the pull of customer in pursuit of perfection”.

Various techniques such as Kaizen, Minute exchange of dies(SMED),Six Sigma, Kanban, Value Stream Mapping(VSM), 5S, Total Quality Management (TQM), Theory of constraints(TOC), Total Productive Maintenance (TPM), Business Process Management (BPM), Visual Management, etc supports the lean transformation in order to remove waste, variability and overburden and deliver improvements in specific areas. Every tool has its own way of eliminating waste; SMED reduces waiting and overproduction by creating shorter machine setup times. Value Stream Mapping draws the actual product flow through the manufacturing resources and can uncover important areas for improvement¹.

Literature Survey

The works on the lean manufacturing are abundant; those that concern lean manufacturing in India are rather limited. Approaches towards lean manufacturing practice have been identified by various researchers.

A case was described where lean principles were adapted for the process sector for application at a large integrated steel mill. Value Stream Mapping was the main tool used to identify the opportunities for various lean techniques. They also described a simulation model that was developed to contrast the “before” and “after” scenarios in detail and in order to illustrate potential benefits such as reduction in production lead time and work in process inventory².

The lean practices was divided into six areas which are process and equipment; manufacturing, planning and control, human resources, product design, supplier relationships and customer relationships. This study confirms that many firms seem to have difficulty in adopting lean tools that concern with external relationships with suppliers and customers even for high performance firms. Empirical results from this study also prove that lean tools in internal areas are adopted most widely in the firms, where the operation and management methods are more direct³.

Lean manufacturing was defined as an integrated system composed of highly inter-related elements and a wide variety of management practices, including Just-in-Time (JIT), quality systems, work teams, cellular manufacturing⁴.

The success of Lean Manufacturing implementation depends on four critical factors: leadership and management; finance; skills and expertise; and supportive organizational culture of the organization. Some researchers also suggested that applying the full set of lean principles and tools also contribute to the successful Lean Manufacturing transformation⁵.

The application of a Multi Attribute Decision Making model, namely Performance Value Analysis (PVA) analyzed the alternatives production system like Traditional manufacturing, Computer Integrated Manufacturing, and Lean Manufacturing among various performance measures. A detailed algorithm of the PVA model is demonstrated using a hypothetical case situation, which shows that Lean Manufacturing System is the best as it results in overall improvement in the performance of the organization⁶.

Semi-structured interview and open-ended questionnaire was used to investigate on how to successfully implement lean manufacturing in Malaysia manufacturing industry. The interview was conducted at a case study company with two managerial who are familiar with lean manufacturing implementation projects. The case study company was selected due to its achievement as a Toyota Production System Model Company awarded by the Malaysia Japan Automotive Industries Cooperation. The finding shows that this case study company used the project approach in their early stage of implementing lean manufacturing projects. The project based is a small scale project where the focus of lean manufacturing implementation is to solve the problems at a small area. They form a team with five full-time members, determine a model line for lean manufacturing implementation project, and then did the continuous improvements effort with focus on reducing the level of inventory. By reducing the level of inventory, this case study company was able to reduce other form of wastes including over production, waiting times, excessive transportation, excessive processing, excessive motion, and defective products⁷.

Existing state production floor was modified by using VSM efficiently to improve the production process by identifying waste and its causes. At the same time, set up time is also reduced considerably. They concluded with evidence of the early results of the programmes as well as a number of key learning points for other organizations wishing to follow similar path. Finally, this research has the proof of advantages when applying lean principles to the garment shop floor. According to our familiarity, it is the prime time that lean thinking has successfully implemented in the garment shop floor. This paper contains its worth for practitioners in the garment industries. Due to increased customer expectations and severe global competition, the Indian garment industries try to increase productivity at lower cost and to produce with best product and service quality. Under these considerations, the authors have implemented lean manufacturing techniques to improve the process environment with reasonable investment. In this paper, the effectiveness of lean principles is substantiated in systematic manner with the help of various tools, such as Value Stream Maps and SMED. Even though, the complete success of the application of lean thinking in the extensive run depends on close understanding between the management and shop floor personnel. Effective management information systems are required for instilling proper organizational values and continuous improvement programs. If these management principles are fully integrated with shop floor principles, then lean systems can be applied efficiently to attain the maximum output. The uneven supply base creates barriers in attaining integration between the links in supply chain ⁸.

Lean manufacturing was implemented in a Bangladeshi garment manufacturing company. For the first few weeks we tried to learn the processes in the garments finishing department. Then study and analysis those processes are performed using some lean manufacturing tools and techniques and found some problems. Eventually some layouts and process flows are proposed that improves the productivity and reduces cost. The better utilization of manpower and factory floor space is also ensured by implementing the proposed layout. At the same time proposals help to develop a good relationship among the workers and will provide an easier way for the management to coordinate and integrate the factory production with the current level of resources. These techniques can be implemented in any garment manufacturing company and it will help them to improve the productivity at same level of resources ⁹.

At the foundry industry where the research collected data, the scenarios simulated suggested to explore alternatives to reduce the time of pouring times through an improvement in industrial lay out and workload balancing including worker's multi skilling training. These procedures can lead to reduce the waste of time and reduce the queuing inside the processes, an agreement with lean manufacturing technology ¹⁰.

Critical lean tools when effectively combined with Work Study Methods, a unique leaner system can be formed which will be the universal solution for any type of industry having any sort of problem regarding the productivity. If implemented in proper order, 100% positive results are assured ¹¹.

The five studied Iraqi manufacturing firm possibilities of establishing the lean foundations are different according to the availability of thinking capital and there is a positive relationship between the thinking capital and lean foundations for all of the studied firms ¹².

Managing the production processes is very important for all kinds of organizations in Syria (General and private organizations, manufacturing and service organizations) ¹³.

The managers of the agricultural machinery sector in Brazil have supported a transition towards the adoption of lean manufacturing practices and they have shown a significant improvement in their business performance including the production cost ¹⁴.

Using lean construction in Gaza Strip reduced the number of steps in the whole project by 57%, the non-value added decreased from 81% to 14% in the project duration, and the total cycle time of the project was reduced by 75% ¹⁵.

The lean manufacturing has a significant impact on cost performance for the studied plants in 7 countries, whereas agile manufacturing has not, and agile manufacturing has a stronger relationship with volume than does lean manufacturing ¹⁶.

The unneeded processing, transportation of materials and WIP inventory wastes are significant in job type PI and raw material inventory was the most prevalent waste for the process industry sector ¹⁷.

The studied company in Iraq has an acceptable (knowledge concerning lean manufacturing, and the basic requirements to apply lean manufacturing are available in this company¹⁸ .

The services call centers for the studied 3 financial services companies in the UK can serve the traditionally competing priorities both of operational cost reduction and increased customer service quality¹⁹ .

Lean makes an organization more responsive to market trends, deliver products and services faster and produces products and services less expensively than non-lean organization. As viewed by Womack and Jones (1994), firms in several industries in North America, Europe and Japan followed this path and doubled their performance through reduction of inventories, throughout times and errors²⁰ .

A planned implementation of lean production system leads to improved quality, better cash flow, increased sales, better productivity, improved morale and higher profits. They further reported that companies earned greater benefits by implementing lean techniques in the office functions in non-manufacturing organizations too, such as banks, hospitals, restaurants etc²¹ .

The producer of world class power and signal distribution system of Mexico, reviewed its existing manufacturing system and identified the need for improvements. The company introduced lean with a view to improve the current performance. It is documented from the study that implementation of lean brought 34% reduction in inventory over a 12 months period and 93.5% uptime. The study showed that the keys to achieving quality in manufacturing include the flexibility of the production system, and involvement and commitment of employees²² .

The first step in implementing Lean thinking in medical care is to put the patient in the foreground and include time and comfort as key performance measures of the system. Having multi-skilled teams taking care of the patient and an active involvement of the patient in the process is emphasized²³ .

The Lean product development, supply chain management, and Lean manufacturing are important areas also in healthcare. The focus on zero defects, continuous improvements and JIT in healthcare makes Lean concepts especially applicable. The establishment of customer interaction is equally important in the manufacturing industry as it is in the healthcare sector²⁴ .

An obvious application of Lean thinking was observed in healthcare in eliminating delay, repeated encounters, errors and inappropriate procedures²⁵ .

Lean thinking in healthcare was advocated and gives an example of how Lean management principles can be applied to health care processes through the use of the Six Sigma methodology, which in many ways resemble the Lean production techniques²⁶ .

Several case stories on Lean thinking initiatives in healthcare sector can be. In a recent publication by the Institute of Healthcare Improvement, two health care organizations in the US showed positive impact on productivity, cost, quality, and timely delivery of services after having applied Lean principles throughout the Measuring Lean Initiatives organization²⁷ .

The effects of Lean was described a process improvement strategy pioneered by Toyota, on quality of care in 4 emergency departments (EDs). Participants in 2 academic and 2 community EDs that instituted Lean as their single process improvement strategy made observations of their behavioral changes over time. They also measured the following metrics related to patient flow, service, and growth from before and after implementation: time from ED arrival to ED departure (length of stay), patient satisfaction, percentage of patients who left without being seen by a physician, the time from ordering to reading radiographs, and changes in patient volume. The results showed that length of stay was reduced in 3 of the EDs despite an increase in patient volume in all 4. Each observed an increase of patient satisfaction lagging behind by at least a year. The narratives indicate that the closer Lean implementation was to the original Toyota principles, the better the initial outcomes. The immediate results were also greater in the EDs in which the frontline workers were actively participating in the Lean-driven process changes. In conclusion, Lean principles adapted to the local culture of care delivery can lead to behavioral changes and sustainable improvements in quality of care metrics in the ED. These improvements are not universal and are affected by leadership and frontline workforce engagement²⁸ .

The adoption of lean manufacturing was investigated in the electrical and electronics industry in Malaysia. A questionnaire survey was used to explore 14 key areas of lean manufacturing namely, scheduling, inventory, material handling, equipment, work processes, quality, employees, layout, suppliers, customers, safety and ergonomics, product design, management and culture, and tools and techniques. The respondents were asked to rate the extent of implementation for each of these areas. The average mean score for each area was calculated and some statistical analyses were then performed. In addition, the survey also examined various issues associated with lean manufacturing such as its understanding among the respondent companies, its benefits and obstacles, the tools and techniques used etc. The survey results show that many companies in the electrical and electronics industry are committed to implement lean manufacturing. Generally, most of them are “moderate-to-extensive” implementers. All the 14 key areas investigated serve as a useful guide for organizations when they are adopting lean manufacturing. This was the first study that investigates the actual implementation of lean manufacturing in the Malaysian electrical and electronics industry²⁹.

Lean manufacturing uses less of everything compared to mass production, half the human effort in the factory, half the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product. In addition, it requires keeping far less than half of the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products³⁰.

The seven wastes was targeted by lean manufacturing initiatives: (1) defects (activities involving repair or rework), (2) overproduction (activities that produce too much at a particular point in time), (3) transportation (activities involving unnecessary movement of materials), (4) waiting (lack of activity that occurs when an operator is ready for the next operation but must remain idle until someone else takes a previous step), (5) inventory (inventory that is not directly required to fulfill current customer orders), (6) motion (unnecessary steps taken by employees and equipment), and (7) processing (extra operation or activity in the manufacturing process)³¹.

The major purposes of the use of lean manufacturing are to increase productivity, improve product quality and manufacturing cycle time, reduce inventory, reduce lead time and eliminate manufacturing waste. To achieve these, the lean manufacturing philosophy uses several concepts such as one-piece flow, kaizen, cellular manufacturing, synchronous manufacturing, inventory management, poka-yoke, standardized work, work place organization, and scrap reduction to reduce manufacturing waste³².

Although explicit application of the five Lean principals to Product Development by academia and industry is lacking, many companies have begun with implementation of the five Lean principles and the set-based concurrent engineering. Further, the study reveals that in most cases concurrent engineering as such could not work in isolation of Lean thinking. Also, application within two aerospace companies showed encouraging results such as clear waste identification, lead time reduction, singles piece flow and cost improvements³³.

The five elements of lean i.e. manufacturing flow, organization, process control, metrics and logistics is to appreciate the synergetic effect of each element on others, towards making an organization lean. Further, a case study on lean manufacturing implementation experience of an Indian manufacturing firm i.e. „plastic injection molded auto-parts“ manufacturer is presented and thus productivity was increased by 25 %, WIP inventories were reduced and defect free production was done due to single piece flow and poka-yoke³⁴.

Lean manufacturing is defined as a technique to improve the productivity by eliminating the wastes. Only 10 percent industries in UK have successfully implemented the LM. The major difficulties companies encounter in attempting lean strategy are lack of direction, lack of planning and lack of adequate project sequencing. It was stated that technical requirement for any organization to apply LM is kanban, TPM, value and the seven wastes³⁵.

Lean production evolved from the TPS over a period of several decades and it is considered to improve the industrial performance by eliminating the wastes. LM is a management philosophy derived from the TPS to address their specific needs in a restricted market in times of economic trouble. It is one of the popular concepts which has been studied and practiced in many companies. Lean production can be described at different levels of abstraction. It is defined as a philosophy based on a set of principles and a bundle of practices. The major difficulty while implementing LM is the typical behavior exhibited by people in the workplace³⁶.

Lean production methods were pioneered by Toyota in Japan. Lean thinking distills the essence of the lean approach into the five principles and show how the concepts can be extended to any industry, in any sector and in any country. It is suggested that for practicing LM, it is necessary to investigate all enterprise processes

for seven kinds of wastes and to classify activities among the three categories viz. value adding activity, non-value adding activity and necessary non-value adding activity. Different steps are made to lean thinking for the removal of the wastage and reducing the no-value activities³⁷.

The origin of LM is based on the TPS. A lean organization thinks more about the customer as compared to running machinery and equipments. LM aims to eliminate waste in all areas of production, including customer relations, product design and company management. The goal is to work smarter rather than harder by incorporating the less human efforts, less time to produce and utilizing the less space in order to become highly responsive to customer demand. To begin with LM, there should be the commitment from the senior management. The education to the team about LM is vital to Lean success³⁸.

Lean manufacturing system is more flexible and responsive to customer requirements. LM is a multi dimensional approach that encompasses a wide variety of management practices including just in time, quality systems, work teams, cellular manufacturing etc. in an integrated system. Traditional manufacturing system works on the principle of inventory, but LM system questions the role of inventory. LM works on the principle of Pull production while traditional manufacturing system works on push production system³⁹.

LM is a manufacturing system developed by Toyota of Japan and is now widely practiced by many manufacturers across the world. It is a systematic approach for identifying and reducing waste through continuous improvement by product flows at the pull of the customer in pursuit of perfection. It believes in using small continuous improvements rather than the rapid improvement. In order to eliminate waste different techniques can be applied like TQM, POKA YOKE, TPM, 5S, JIT etc⁴⁰.

The application of lean thinking has made a significant impact in academic as well as the industrial circles over the last decade. In spite of the successful lean applications many of the barriers are also come in way while implementing LM are the Lack of contingency, human aspects, lack of strategic perspective and coping with variability. For the successful implementation of LM we have to overcome these kinds of barriers which will help us to improve the performance of the organization⁴¹.

Lean implementation is a systematic and continual effort so, it is important to identify and understand the barriers for a smooth transition. The barriers can be found out while implementing LM by two different approaches like quantitative and qualitative study. The quantitative study showed the main barrier like lack of top management commitment, lack of understanding of Lean concept while qualitative study showed inadequate training and communication, employee's attitude etc as some of the important LM barriers⁴².

LM's strategic importance is to assign strategic priorities in the decision making. The various issues which can come while implementing the lean manufacturing technique in any industry are management issues, technical issues etc. Some barriers while implementing lean manufacturing are human aspects, lack of contingency, coping with variability etc⁴³.

Lean manufacturing is the best manufacturing system in the 21st century. The review is based on the SME's definition and characteristics. Large organization is always been ahead in adopting new management system including LM implementation⁴⁴.

SME's play an important role in the economic growth of any country. They provide a brief description of some of the barriers that come in view while implementing lean manufacturing technique in Small & Medium Enterprises (SME'S)⁴⁵.

Conclusion

Lack of Planning, Lack of top management commitment, Lack of Methodology, Unwillingness to learn and see and Human Aspects are the main barriers or problems which can be faced while implementing the Lean Manufacturing. These have already been discussed in the previous section. This paper shows that one the major difficulties companies encounter in attempting to apply lean is not knowledge of particular tools and techniques, perhaps lack of comprehensive and suitable lean knowledge related to probable problems within the companies by the managers, direction, gap and a lack of recognition of lean culture in whole of the organization and planning cause the fails within the implementations. Additionally, some managers try to enhance the implementation by some of the lean tools and mostly try to only implement the "continuous improvement" and explicitly forget another basic lean principle, "respect for people". The managers should know that lean thinking

won't derive during a short time, and they should prepare the context of implementations before every decision making.

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