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A Qualitative Study on the Barriers of Lean Manufacturing Implementation: An Indian Context (Delhi Ncr Region)

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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".

Published works in the lean manufacturing domain indicates several methodologies for implementation of lean strategy and managerial issues related with culture and leadership in the enterprise. Also, literature in the domain and the related investigations indicates that not only it is necessary to implement most of the technical tools, but an organization's culture needs transformation too. Literature survey on LM identifies several tools and techniques of LM like TQM, QC, TPM, JIT, KAIZEN, 5S's etc. It is also established in the literature survey that during the implementation of LM, the industries face various implementation bottlenecks which affects the performance of industry. Although researchers have found some barriers to the LM, it is clearly observed that there is need for a broad technique that can establish relationship between these barriers. Another issue that has not deliberated adequately in research is the issue of a comprehensive methodology that deals with removing of these barriers. In this research paper efforts have been made to identify the barriers to lean implementation and then to develop the relationships among these identified barriers. While literature survey suggested some important barriers in the lean implementation, additional few barriers were indentified through discussions with the subject matter experts from the industry. A comprehensive survey instrument consisting of 30 questionnaires was then used to evaluate the importance of different lean implementation barriers. While, the outcome of survey instrument gives the importance of lean barriers, it could not provide the complex relationship among these barriers, which actually forms a network of mutual relationship.

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I. INTRODUCTION

Lean Manufacturing may be defined as manufacturing philosophy which employs a set of tools and techniques responsible for the continuous elimination of all types of waste in the production process. Lean means "Reduce the Waste". Waste in industry is defined as "anything that does not add any value to the end product from customer's perspective". The goals in implementing the Lean Manufacturing are lower production costs; increased output and shorter production lead times. [Mekong's capital review (2004)]
Waste is defined as anything which adds cost to the product without adding any value to the product. It can be broadly classified as the following.

- Waste which are seen or calculated like machine breakdown.
- Waste which are not calculated in terms of waste like improper transportation of machines and materials. Minor wastes include are papers in management work, due to improper working environment etc.

So to detect and remove these wastes in any industry LM is used. Mainly seven kinds of wastes (figure 1.1) are included in the category which will be discussed below:

- **Overproduction:** Production of products above what actually is required by the customer at that point of need is considered as a waste.
- **Rejection:** The product is not as per the requirement is considered as a scrap and waste.
- **Transportation:** Unnecessary movement of the parts during production which does not add any value to the product is considered as a waste.

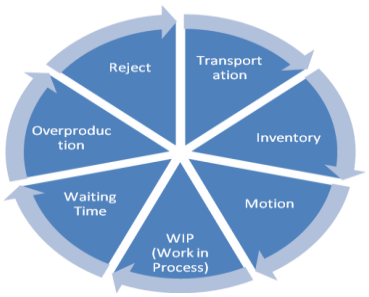

Fig 1.1 7 types of Wastes in Industry [Dixit et al. (2011)]

- **Inventory:** It may be defines as the stocks of parts waiting to be finished or products waiting to be shipped. Inventory of any kind is called a waste.
- **Motion**: Unnecessary movement of the workers on the shop floor is considered as a waste. It has been observed that at an average only 5 % of the motion is useful for processing on work piece.
- **Work in Process (WIP):** It is a direct result of over production and waiting time. It may also be termed as over processing and thus is a type of waste.
- **Waiting Time:** Unnecessary waiting by the worker to begin the next step or the product is waiting to be processed on the next work station is considered as a waste.

Lean Manufacturing Tools and Techniques

Lean manufacturing is based on the continuous identification & removal of all kinds of wastes which are explained above. All the tools for LM aim at identifying different kinds of waste and their sources and then devise methodology to remove these from the system continuously. For highlighting the root causes of the problem and method to remove these, the following tools and techniques are used.

- **Total Quality Management (TQM):** It is a philosophy which is totally based on the customer's approach. It means "SATISFYING CUSTOMER FIRST TIME EVERY TIME".
- **7-Quality Control (QC):** The seven QC tools are used in any industry to solve the problems. The seven QC tools are divided into four stages as given in fig below.

i) Identify the Problem

ii) Development of planning

iii) Formulation of action plans

iv) Continuous small improvements

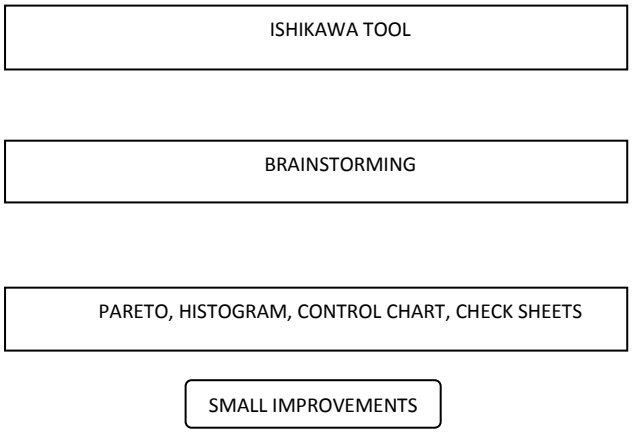

Fig 1.2 QC tools in four stages

Some Techniques for LM are explained below briefly:

- **Just In Time (JIT):** JIT concepts are based on pull demand model. Everything is done when they are actually needed.
- **POKA YOKE**: It is a Japanese technique which means mistake proofing. Innovation is the key for POKA YOKE.
- **KAIZEN**: Kaizen means small continuous improvements. It is a Japanese philosophy. **KAIZEN** helps to decrease the risk in process improvement, which is involved in the lean implementation. It is basically dependent on PDCA cycle which is also called Deming cycle, as depicted in fig. 1.3.

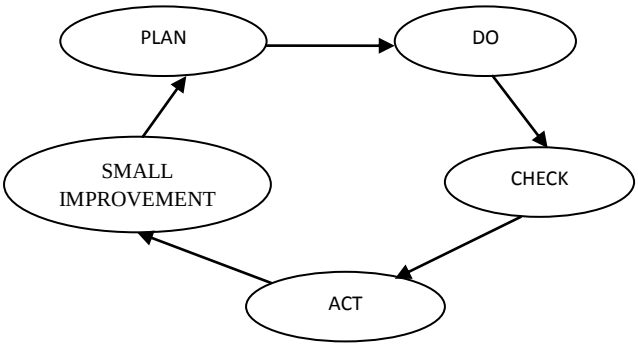

FIG. 1.3 KAIZEN [Dixit et al. (2011)]

- **5S's:** "A place for everything and everything in its place" is the slogan that is usually followed when 5 S is applied. Following five elements are fundamental to 5S.

  (1) **SERI**: Sorting and disposing of unwanted item

  (2) **SEITION**: Organizing

  (3) **SEISO**: Cleaning

  (4) **SEIKETSU**: Standardizing

  (5) **SHITSUKE**: Discipline

II. LITERATURE REVIEW

Bhasin S. & Burcher P. (2006) 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 wastes.

Ciarniene R. & Vienazindiene M. (2012) 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 workplace.

Hines P. & Taylor D. (2000) 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 activities.

Alavi S. (2003) posits that 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 success.

Singh B.K., Bhar C. and Pandurangan V. (2011) state that Lean manufacturing system are 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 system.

Dixit A., Patel S. & Dixit Anupam (2011) state that 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 etc.

Hines P., Holweg M. & Rich N. (2004) state 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 organization.

Nordin N. & Deros B. (2013) suggest that 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 barriers.

Teleghani Mohammad (2010) posits that 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 etc.

Rose A.M.N., Deros B.Md & Rahman, M.N.Ab. (2010) have suggested that 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 implementation.

Yang P. A. and Yu Yu B. (2010) suggest that 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).

Esfondyari Alireza & Osman M.R. (2011) identified some of the barriers in the implementation of lean manufacturing in an case industry. They posit that role of management in implementing LM is very important.

III. RESEARCH GAPS

During the research on the lean manufacturing, tools and techniques of LM has been identified. During literature survey several tools and techniques of LM like TQM, QC, TPM, JIT, KAIZEN, 5S's etc, were identified. It was also indicated that the procedure for implementation of LM is equally an important issue. Past research has indicated that there are many obstacles that come while implementing LM. Many researchers found some barriers to LM. **Teleghani Mohammad (2010)** describes the various issues which can come while implementing the lean manufacturing technique in any industry through his research paper. While he has explained some of the barriers of lean manufacturing, he has not provided the inter relationship between them, nor he has suggested ideas to overcome these. Literature in the domain and the related investigations indicates that not only it is necessary to implement most of the technical tools, but an organization's culture needs transformation too. It is also established in the literature survey that during the implementation of LM the industries face various issues of LM which affects the performance of the industry. Although researchers have found some barriers to the LM and it is clearly observed that no suitable technique has been suggested that can establish relationship between these barriers adequately. Another issue that seems not deliberated adequately in research is the issue of a comprehensive methodology that deals with removing of these barriers. **Esfondyari et al. (2011)** explain some of the barriers which are find out during the implementation of lean manufacturing in an industry. The relationship between these barriers has not been defined by them. Similarly, **Yang et al. (2010)** give the brief description of some of the barriers that come in view while implementing the lean manufacturing technique in Small & Medium Enterprises (SME'S). No suitable technique is suggested by them which provide us the relation between these barriers.

IV. METHODOLOGY

After the literature survey, some barriers were found. But to confirm these barriers in Indian scenario, a survey instrument is required that incorporates all the issues of LM implementation in Indian context. This is discussed below.

Development of Survey- Instrument

The main objective of the questionnaire-based survey was to facilitate industry experts in developing a relationship matrix as a first step towards developing an ISM-based model. This survey instrument had a wide range of research objectives and involved many questions (Appendix A). In this survey the respondents were asked to indicate the importance of 20 listed barriers on a five-point Linker scale. On this scale, 1 and 5 correspond to 'very low importance' to 'very high importance', respectively. The questionnaire was administered to companies from Indian manufacturing industries. In total, about 30 industries (Appendix B) are analyzed and on the basis of the analysis of the survey results following scores and ranks of listed barriers are calculated (Table 1.1). Henceforth the barriers will be designated by their rank numbers, for example, Lack of planning (barrier 1); Human Aspects (barrier 7) etc.

BARRIER	Mean	Rank
Lack of Planning	4.3	1
Lack of top management commitment	4.175	2
Lack of Methodology	4.025	3
Unwillingness to learn and see	3.95	4
Misunderstanding of lean Production	3.825	5
Lack of Contingency	3.65	6
Human Aspects	3.525	7
Lack of Strategic Perspective	3.5	8
Lack of organizational structure	3.35	9
Lack of technological Infrastructure	3.275	10
Widening Customer Requirements	3.2	11
Personal Training	3.175	12
High Cost of Advance Technology	3.15	13
Reduced Manufacturing Lead time	3	14
Social Factor	2.9	15
Resistance to change	2.875	16
Coping with variability	2.85	17
Technological Advancements	2.85	18
Integration And pro-activity	2.775	19
Requirement of alteration in Process Methodology	2.675	20

Table 1.1 **List of the Barriers**

Some of the barriers from the above table will be discussed briefly here.

- **Personal training**

  Lack of training is one barrier that prevents a company from being agile. Training security professionals on different security spheres is helpful to their personal development as well as that of the overall security team. Enterprises must allow analysis of employee capabilities and initiatives to train them in their domain of activities and also towards developing the basic philosophy of lean. Thus, Top management thinking that there is high investment in training of employee and with there is no output from employee in that particular duration is contradictory to lean philosophy [Nordin et al. (2013)].

- **High Cost of Advance Technology**

  With regard to manufacturing technologies and processes, small manufacturing enterprises (SMEs) face problem that their production is not automized; consequently, they rely strongly on conventional production machining facilities. This is consistent with the company strategies and their focus on mainly fabricating customized rather than standardized products. SMEs product batches are generally small, and thus they do not perceive the necessity of investing in big machinery. Similarly production planning technologies of the SMEs contain either traditional planning, not fully integrated planning tools. These are some of the important lean impediments. Whereas a few companies had been investing in mid-size ERPs or other customized IT systems have benifitted immensely from lean [Ciarniene et al. (2012)].

- **Reduced manufacturing lead time**

  To remain competitive, manufacturers are required to produce products in sufficient quantity at lower cost, with high quality and decreasing lead time [Mishra et al. (2012)].

- **Social factors**

  This factor includes environmental pressures, workforce/workplace expectations, and legal pressures [Nordin et al. (2013)].

- **Resistance to Change**
  Any organisation will have some staff that are resistant to change. No matter how beneficial the changes may be, they will oppose them almost on principle, so these staff has to be targeted specifically because their resistance can act as a significant barrier [Yang et al. (2010); Hines et al. (2004)].

- **Copying with Variability**
  Another most important part of the criticism was the inability of lean production systems and supply chains to cope with variability, a key aspect of the lean management. Indeed, in order to add value to the customer, the lean managers seeks to find ways to manage variability and to create capacity by utilizing assets more effectively than in traditional systems. Various lean approaches, such as mixed model scheduling and level scheduling had earlier been developed to do this. However, in the case of demand variability, these approaches have sought to control demand, as the original lean pioneers came from fairly stable demand environments industries. This high-volume and repetitive demand character suits the application of kanban pull scheduling [Teleghani (2010)].

- **Technological advancements**
  To cope up with the today's customers/market need, companies are focused to introduce more efficient and faster and economic production facilities, new soft technologies and inclusion of information technology in new hard technologies [Mishra et al. (2012)].

- **Integration and pro-activity**
  To fulfil the customers' expectations manufacturers have to integrate themselves with them to identify their problems and requirements. Apart from this, they must acquire capabilities just ahead of what may be the need of today. In this way, pro-activity may lead to strategic advances for competing in the turbulence of the global market [Mishra et al. (2012)].

V. 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.

VI. SCOPE FOR THE FUTURE WORK

The ISM methodology is also helpful to understand mutual influences of barriers. It identifies those barriers which support other barriers (driving barrier) and also those barriers which are most influenced by other barriers (dependent barriers). The interrelationship between the barriers is important, without this we can't further analyzed any barrier. The interpretive structural modeling (ISM) methodology is used to evolve mutual relationship among these barriers. ISM will provide the Initial or base model which will be further used for the experimental work.

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