A SURVEY ON THE ADOPTION OF LEAN PRACTICES IN INDIAN MANUFACTURING SECTOR

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ABSTRACT

Lean manufacturing is a production strategy to eliminate waste and non-value added activities in a process while maximizing the value added tasks as required by the customer. The adoption of lean approaches in India has been much slower. Indian industries find many challenges in adopting lean thinking as a standard manufacturing practice. It has been proved from certain studies that implementation of lean thinking in manufacturing sector is highly useful in terms of elimination of waste, proper utilization of workspace, proper organization of workforce, to reduce inventory, to increase productivity and to increase customer satisfaction. This study will guide the Indian industries in selecting lean tools based on the characteristics and expected wastes. The current study comprises of a survey of Indian manufacturing industries. The survey will be useful to explore the current status of lean initiations in Indian manufacturing industries and to prioritize lean practices which are highly useful.

Key words: Lean manufacturing, lean practices, India, Indian industries, Survey

Cite this Article: Singh M.P., Ramphool Meena and Avinash Panwar, A Survey on the Adoption of Lean Practices in Indian Manufacturing Sector, *International Journal of Industrial Engineering Research and Development*, 7(2), 2016, pp. 52–62.

<https://iaeme.com/Home/issue/IJIERD?Volume=7&Issue=2>

1. INTRODUCTION

In the current era of globalization, to compete and to stay alive in the market, adoption of new tools and techniques to produce goods is mandatory. The most daunting issue faced by manufacturers today is how to deliver their products or materials quickly at low cost and good quality, and the Indian manufacturing industries are not an exception. According to Ghosh (2013), in the era of globalization and open market policies, Indian manufacturing companies are also feeling the heat of competition. Competition has intensified across all sectors whether it is service sector, discrete manufacturing or process manufacturing.

Manufacturing sector of India contributes considerably to the gross domestic product (GDP) of the country. It accounted for nearly 17% of the GDP in financial year 2012 (IBEF, 2012). Therefore, considering the importance of role of manufacturing industries in Indian economy, industrial growth and significant contribution to GDP, it is vital for manufacturers of India to strive for operational excellence by adopting world-class practices and restructuring operations to remain globally competitive and to expand profits and productivity. Today Indian manufacturing industry is facing an entirely changed competitive scenario than the past.

One challenge for Indian manufacturing industry is to improve the manufacturing efficiency and supply chain performance (Jaiganesh and Sudhahar, 2013). Inventory turns in Indian manufacturing industries is considerably low and therefore, working capital ties up for longer periods in this sector. To improve quality is also a prominent challenge for the manufacturing industries of India (Poongothai and Arul, 2011; Kumar et al. 2015). Indian manufacturing industries have not adopted advance manufacturing technology to a significant level (Dangayach and Deshmukh, 2003, Seth *et al.*, 2008). Therefore, equipment related problems such as; high energy consumption, high reworks and rejections, frequent breakdowns, high accidents rates and high pollution are common in Indian industries (Dogra *et al.*, 2011).

Adoption of lean manufacturing in India has been started very recently. Hence, the status of lean implementation in India is still ambiguous. Therefore, it is uncertain whether manufacturing industries in India are enthusiastic about implementation of lean, or not. Comprehensive literature search confirms that until now only limited attempts have been made to investigate the status of lean manufacturing in Indian manufacturing industries. This study is the first attempt to fill this gap in research and will examine various aspects of implementation of lean manufacturing in manufacturing sector of India.

The major contribution of this research is in-depth investigation of the status of lean implementation in Indian manufacturing industries and to remove the ambiguity about usefulness of lean concepts for Indian manufacturing industries. This research has attempted to address the issues pertaining to embark lean initiations in Indian manufacturing industry. The survey results will produce an overall picture of lean initiations in Indian industries including most useful lean tools and techniques. The eventual goal of this research is to create opportunities for industrial managers and researchers to improve the overall efficiency of the Indian manufacturing industry by application of lean initiations. This will not only help the managers to plan strategies for the adoption of lean but will also remove the scepticism about adoption of lean.

The rest of the paper is organised as follow: section 2 throw light on literature review of lean and its adoption in Indian manufacturing industries. Section 3 presents

the research methodology used in this work. Results are demonstrated in section 4 and finally this paper is concluded in the last section.

2. LITERATURE REVIEW

Lean thinking was first described in 1990's seminal book called "*The Machine That Changed the World: The Story of Lean Production*". This book describes the changes in automobile manufacturing from craft production to mass production to lean production. The book illustrates the findings of a key research project carried out by the Massachusetts Institute of Technology which investigated productivity and management practices in the world motor industry. The international motor vehicle programme (IMVP) which involved 52 vehicle assembly plants in 14 different countries around the world, was a five-year, \$5 million programme.

Although, lean is primarily applied in 'high volume, low variety' discrete industry [9-14], researchers support universal applicability of lean concepts. Proponents of lean thinking claim that lean can be implemented in a wide range of industries operating under diverse environments [12]. The main idea is to minimize wastes or muda (the Japanese's word for waste) in order to increase the efficiency of production system. This means eliminating over production and inventory, unnecessary movement of material, waiting and delays, over processing, unneeded worker motion, and the defects. Ref. [12] describes 7 classical wastes in a production system.

At operational level can a collection of lean tools and techniques are required to facilitating the actions required to achieve the objectives directed by different lean principles [15]. For example, lean practices such a value stream mapping (VSM), 5S, total productive maintenance (TPM), visual control, work standardization and mistake proofing help to eliminate wastes, whereas *Kanban*, pull production, and production levelling are responsible for aligning production with demand. Lean practices such as *kaizen*, job rotation, and cross functional teams contribute to continuous improvements with constructive involvement of workers. A wide range of lean practices can be found in the extant literature [12, 16, and 17].

Table 1 lists previous studies carried out in context to lean implementation in manufacturing industries in India. Ref. [5, 18-22] have attempted to study the implementation of lean manufacturing in certain process industries in India and illustrated that 'lean' can result in numerous benefits.

Table 1: Previous Studies Regarding Lean Implementation in Indian Industries

Literature	Type of process industry	Type of study	Major findings
[18]	Pharmaceutical	Case study	Integrated production planning system was helpful to implement lean concepts in pharmaceutical firm.
[19]	Steel	Case study	Application of JIT in purchasing resulted in considerable cost savings.
[20]	Steel	Case study	Applying JIT production resulted in release of working capital and decrease in inventory.
[23]	29 continuous manufacturing	Survey	Most important lean tools are TPM, 'automatic line stoppage', VSM,

	industries in India		'workplace organisation' and 'visual control'. Least important lean practices are 'work standardisation', 'multipurpose handling' and <i>takt time</i> . Continuous process industries perceive higher benefits than discrete industries from lean manufacturing. Lack of management support is most prevailing problem in implementing lean.
[7]	comprising 37 respondents from edible oil industry	Survey	Used value stream mapping and proved that there exist several non value added activities in the supply chain of edible oil industry.
[21]	Biscuit	Case study	Used value stream mapping and identified several wastes in the manufacturing of biscuits.
[24]	127 manufacturing industries	Survey	Major reasons of lean implementation in Indian manufacturing industries included reduction of delivery time, reduction in cost, enhancing range of products and due to stiff competition.
[1]	79 manufacturing industries	Survey	Although, the concept of lean is new for Indian industries, still several Indian companies are at advanced level of lean implementation, and by implementing lean they have achieved better operational performance.
[24]	31 large manufacturing industries	Survey	TPM, continuous improvements and inventory reduction are primarily used lean practices in Indian manufacturing industries. Reduction in cost and wastes are the major benefits of lean implementation, while 'lack of understanding', lack of top management support' and 'financial benefits not recognized' are the major obstacles while implementing lean.
[26]	Process	Survey	Level of lean implementation in Indian process industries is very low. Reasons of not implementing lean include unfamiliarity with lean, lack of skills and education, and uncertainty about benefits. The major lean tools implemented in Indian process industries are TPM, 5S, work standardization, SPC and visual control.

Ref. [21] applied value stream mapping in a biscuit manufacturing plant and found that application of lean manufacturing resulted in increase in quality, decrease in inventory, increase in timely deliveries, better utilization of space and equipments and reduction in lead time.

Ref. [20] applied some tools of lean manufacturing in a steel manufacturing unit in India and found a reduction in production cost by 8% and a reduction in lead-time by 50%. Ref. [19] studied the implementation of JIT purchasing in a steel plant in Indian and found that the introduction of this concept resulted in considerable cost savings. Ref. [23] attempted to investigate status of implementation lean tools in India through a survey of 29 continuous manufacturing industries. Authors found that most important lean tools for process industries are TPM, 'automatic line stoppage', VSM, 'workplace organisation' and 'visual control'. Least important lean practices are 'work standardisation', 'multipurpose handling' and *takt time*. Continuous process industries perceive higher benefits than discrete industries from lean manufacturing and lack of management support is most prevailing problem in implementing lean.

The extant literature regarding lean implementation in India is dominated by case studies [19-21]. These case studies provided only case specific results. These results cannot be generalized. Existing literature provide only a few evidence of empirical research regarding lean implementation in Indian manufacturing industries. Furthermore, existing studies provide industry specific results such as ref. [26] for Indian process industries,

3. RESEARCH METHODOLOGY

The main objective of this report is to prioritizing lean practices for Indian industries. To achieve this, data was collected via a questionnaire survey. The survey method is the best data collection technique as it enables us to gather a larger amount of data and information from target respondents within a short period of time.

Survey methodology stresses on quantitative analysis. The focus of the survey is on questions including who, what, where, how much and how many. However, survey method is criticized for its limitation of inability to capture the particulars needed to gain in depth understanding of the mechanics and the causes rooted in the interested processes. Survey approach refers to gathering data in the form of replies to relevant questions from large number of organizations. Data is collected through several means including, telephone interviews, mail questionnaires, or from published information [27].

On the basis of literature review, the questionnaire was formulated. The questionnaire consists four sections

- General information of organisation
- Reason of implementing lean practices
- Reason of not implementing lean
- Lean practices in Indian industries

The target of the study has been the industries operational in western part of India. A structured questionnaire was designed and it was sent to two practitioner and two academicians. Based on the initial feedback received from a pilot questionnaire and subsequent personal interviews held with academicians the final questionnaire was designed. The validation of the questionnaire was done by two managerial persons from major industries one from forging and the other from an automobile sector with

extensive experience on lean implementation in India. The questionnaire was also pre-tested by two academicians with an extensive experience in academia and industry.

A sample of 500 companies was taken from industrial directory (2015) and directory of ISO: 9001 certified industries in India. Primarily, postal survey method was used to administer the questionnaire. Questionnaire was mailed to the target firms. The mail had the invitation letter to participate in survey and the lean assessment questionnaire. Invitation letter contained a brief discussion of lean manufacturing and the need of present study, and also the promise to keep anonymity. Telephonic conversations were also undertaken to get consent of the target respondents and to ensure that they have received the questionnaire. It was observed that initially the response rate was low in spite of repeated reminders. Hence, it was decided to search other means to increase response rate. A few responses were collected through conducting face to face interviews. In some instances, responses were collected through third party channels. These efforts helped, and the response rate increased. To increase the response rate further, emails were sent, followed by a telephonic request for reply. The questionnaire was addressed to higher executives who were responsible for production. Finally, 92 responses received.

It is essential to measure the reliability of the instrument when the variables developed from summated scale are used as predictor components in objective models [28]. In other words, a measuring instrument should provide consistent results, and for it, test of reliability is carried out. Reliability analysis of a questionnaire establishes its ability to yield consistent results. In present study reliability was assessed through internal consistency, which is the degree of inter correlation among the items which build a scale [29]. Cronbach's alpha (reliability coefficient) was used to measure internal consistency [30]. Variables having value of alpha more than 0.60 were considered to be highly reliable.

4. RESULTS AND DISCUSSIONS

We used Google form to create and store the survey. This enabled us to provide an online survey link to potential respondents. Initial emails were sent to 500 Indian industries. In the email, a general description of the research project, its purpose, and the URL link to the survey was provided. Follow-up emails were sent to these target industries after 2 weeks to remind the respondents to finish the questionnaire. Finally, a total of 92 responses were obtained. As a result, the response rate was 18.4 %.

Out of 92 respondents 59 (64%) answered that they are familiar with concept of lean manufacturing. 33 (36%) respondents denied that they are familiar with lean manufacturing. When explained the concept of lean manufacturing and then asked if they think lean practices are useful 71 (77%) respondents replied that they think lean is useful for manufacturing industries in India. However, 21 (23%) respondents denied that lean is useful.

To identify the important reasons of implementing and not implementing lean in Indian industries, a scale containing eight items was developed after a comprehensive literature review. Respondents were asked to rate the reasons of implementing lean on a five point Likert scale. The rankings of reasons of implementing and not implementing lean are shown in table 2 and 3 respectively.

Table 2: Ranking of Reasons of Implementing Lean

Reasons of Implementing Lean	Rank	Mean	Std. Deviation
To improve quality	1	4.15	1.005
To increase customer satisfaction	2	3.86	1.256
Elimination of wastes	3	3.74	1.254
To decrease production costs	4	3.72	1.523
To increase demand management and efficiency	5	3.08	1.365
To increase utilization of space and equipment	6	2.89	1.524
To increase supply chain efficiency	7	2.66	1.369
To facilitate JIT production	8	2.33	1.159

Table 3: Ranking of Reasons of not Implementing Lean

Reasons	Rank	Mean	Std. Deviation
Unfamiliarity with lean/ JIT manufacturing	1	3.66	1.256
Lack of education and expertise on lean	2	3.56	1.562
Cultural barriers	3	3.28	1.652
Lack of interest within the company	4	2.66	1.698
Lack of senior management's interest and support	5	2.37	1.654
Lack of financial resources	6	2.22	1.952
Lean is not useful for the company	7	2.19	1.244
It is infeasible to produce in small batches	8	2.13	1.658
Lean is very complex to implement	9	2.06	1.659
Lack of time	10	1.90	1.253

Nineteen performance improvement practices were extracted from extant literature, which are frequently mentioned in literature as lean practices. As shown in Table 4, among all the lean tools and programs, 5S is the top-ranked lean tool applied in Indian industries with a mean value of 4.56, and a standard deviation of 1.156, followed by quality certifications and work standardization, with mean values of 4.35 and 4.19, and standard deviations of 1.125 and 0.992, respectively. Aside from the top three tools, other widely applied, highly-ranked lean tools and programs include, for instance, visual management, continuous improvement program, statistical process control and changeover reduction (SMED). The relative high mean scores of these tools indicate that Indian industries seem to emphasize on using various lean tools to standardize, improve, and optimize internal operating procedures. Reducing wastes and costs are the obvious priorities of these firms.

Table 4: Lean Tools and Programs Applied, all Respondents as One Group

Lean practice	Rank	Mean	Std. Deviation
5 S	1	4.56	1.156
Quality Certification	2	4.35	1.125
Work Standardization	3	4.19	0.992
Visual Management	4	3.92	1.432
Continuous Improvement Program	5	3.75	1.215
Statistical Process Control	6	3.52	1.365
Change Over Reduction(SMED)	7	3.10	0.989
Cellular Layout	8	2.85	1.421
Energy Management	9	2.65	1.289
Error Proofing (Poka-Yoke)	10	2.41	1.198
Total Productive Maintenance(TPM)	11	2.22	1.564
Pull/Kanban	12	1.89	1.234
PDCA Problem Solving	13	1.81	1.248
Environment Management	14	1.72	0.995
Just In Time	15	1.59	1.365
Supplier involvement	16	1.46	1.523
Benchmarking	17	1.23	1.234
Supplier reduction	18	1.23	1.234
Value Stream Mapping(VSM)	19	1.23	1.234

5. CONCLUSION

The primary objective of this paper was to enhance our understanding of adoption of lean practices in Indian industries. The study has provided important insights into the current status of lean among different industrial sectors in India. This study also provides the reasons of lean implementation in Indian industries. The Indian manufacture recommended lean due to its characteristics of quality improvement and customer satisfaction. Other reasons of lean implementation are waste elimination, decrease production costs, and increase demand management and efficiency. While utilisation of space and equipment, supply chain efficiency and JIT production received very low rating by Indian manufacturers.

This study also provides reasons of not implementing lean in Indian industries. The most strong reason to not implementing lean by Indian industry is “infeasibility to produce in small batches”. In addition to that “unfamiliarity with lean/JIT manufacturing” and “lack of education and expertise on lean” are also strong reason of not implementing lean in Indian industries.

To identify and evaluate the lean status of Indian industries, various lean tools and programs, such as Kaizen, Kanban, value stream mapping (VSM), just-in-time (JIT), visual management, cellular layout, have been included in the study. 5S, quality certifications and work standardization are widely used lean tool applied in Indian industries. The respondent firms were segmented into “automobiles and automobile components manufacturers”, “machine tools and metal products manufacturers” and “electrical goods manufacturers”, each having different sample size. It was found that in India, automobile sector has highest degree of lean implementation compared to machine tools and metal products manufacturers and electrical goods manufacturers. While electrical goods manufacturers had lowest degree of lean implementation.

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