



BARRIERS IDENTIFICATION IN THE IMPLEMENTATION OF LEAN MANUFACTURING IN INDIAN MANUFACTURING INDUSTRIES

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Abstract

Lean Manufacturing system has been adopted by Indian manufacturing industries for the improvement in overall performance of industries by focusing on waste reduction. But still there are many barriers in the implementation of lean manufacturing in Indian industries. Although, the barriers having the maximum impact on lean manufacturing system are identified. Further, an effectiveness index of these barriers has been calculated to show the impact of barriers in Indian industries. This paper has attempted to explore the key barriers in implementation of Lean Manufacturing system in Indian industries.

Key words: Lean Manufacturing; Barriers, Indian Industry, Effectiveness index

I. Introduction

To meet worldwide rivalry and remarkable market changes, industries shouldn't work just on plan, items and administrations yet additionally further develop their manufacturing tasks. Lean manufacturing (LM) practices can be utilized to work on the functional exhibitions. Lean manufacturing fundamentally alludes to manufacturing processes with least waste. Lean manufacturing (LM), "lean" term is presents by Krafcik(1988) to portray a creation framework that utilizes less assets of everything contrasted with creation. As various creators give various definitions for lean manufacturing. A few says lean manufacturing is a way, somewhere in the range of a bunch of standards, a bunch of hardware and strategy, a cycle, an idea, a way of thinking, a training, a framework, a program, a model (Bhamu and Sangwan, 2014).

In the writing, the Lean implementation idea is principally applied with regards to enormous enterprises. Though, the potential outcomes and restrictions of its utilization in little and medium-size enterprises are not portrayed and broke down regularly. Assuming we actually allude to the circumstance in the earthenware business, incidentally, there is an enormous hole in the field of good lean execution rehearses in little and medium-sized enterprises delivering utilitarian ceramics. Against the foundation of numerous accessible strategies and ideas of work, for example, Controlling, reengineering, re-appropriating, TQM, Lean is described by a perspective pointed toward expanding efficiency and manufacturing items in accordance with the assumptions for clients (Szatkowski, 2014). At present, an ever increasing number of associations partner (coordinating) the lean idea with the Six Sigma idea (Urbaniak, 2015). The Lean idea decreases exercises (different signs of waste) that don't enhance cycles and items, and the Six Sigma idea works on the nature of exercises (processes) making added esteem in these items by eliminating different blunders (Chowdary, and George, (2012).). Improvement projects led as a feature of Six Sigma can be utilized to help the improvement objectives of the Lean idea. The Lean idea is broadly depicted, e.g.: among organizations addressing the auto business (Pettersen, J., 2009; Kleszcz, (2018)), IT industry (Pernstal et al., 2013, Bortolotti et al., 2015), or administration exercises (Locher, 2012). In the earthenware business, there are not many distributions in which the creators (Kleszcz, D., 2018) allude to general data connected



with the end of waste and expanded work effectiveness. By implementing individual Lean Manufacturing apparatuses, enterprises append significant thoughtfulness regarding the execution of all preliminary and execution exercises remembered for the systems, with the goal that a given instrument can begin working as quickly as time permits.

Unfortunately, a greater part manufacturing businesses have dismissed taking on LM (Abu et al. 2019). In spite of earlier proof of the advantages of lean execution, there are a few obstructions to it also including insight, lack of substantial advantages, and issues with shop floor workers (Melton, 2005). This may generally be because of: 1) the feeling of dread toward execution cost and the progressive advantages of lean (Bhamu and Sangwan, 2014); 2) the lack of professional stability among workers and the gamble of losing their employment assuming it is non-esteem added (Khaba and Bhar, 2018); 3) the lack of a strong authoritative culture to defeat the apprehension about disappointment, change, conservation, and maintain more prominent obligations (Coetzee et al., 2018); 4) the lack of legislative help which arose as one of the critical variables to the outcome of lean execution in SMEs (Gandhi et al., 2018), and, in particular, 5) the lack of information or preparing (Pearce et al., 2018). With respect to status of these two organizations (lean and non-lean organizations), expectedly the significant inquiries ascend: "How much do perspectives on obstructions to lean execution contrast among lean and non-lean organizations?"

This paper addresses the identification of different barriers in the implementation of lean manufacturing. The aim is associated with the following objectives.

- Identification of different barriers in the implementation of lean manufacturing
- Measurement of effectiveness index of barriers in lean manufacturing.

II. Literature Review

Manufacturing has been recognized as the fundamental driver for advancement of the economy for any country. With the spread of globalization, India is turning into a center for worldwide manufacturing and simultaneously extent of Lean Manufacturing execution is ending up being more extensive in Indian setting. Singh and Rathi (2018) has seen that many companies in India are currently experiencing the intensity of worldwide contest and this has roused them to move forward towards reception of lean manufacturing. Habitually changing customer demand and global climate has been advancing test of endurance and seriousness to all the component of the monetary. The idea of lean manufacturing, right off the bat, is carried out by Toyota Production System (TPS). Shook, J. (2007), summed up lean standards and gave the expression "lean production". Hines and Lethbridge (2008). examined about this advancement of lean. Yilmaz et al. (2022) investigated the benefits, barriers, and success factors focusing on environmental, social, and operational perspectives. They included lean principle and industry 4.0 technologies in manufacturing. In their research, they identified investment cost and technological readiness as a main barrier. Fernando et al. (2022) identified nine barriers in the thematic analysis. Out of which, unclear Industry 4.0 policy, higher-risk investment, insecure data sharing, lack of expertise and lack of incentive are identified as the adoption barriers. Pereira and Sachidananda (2021) found empirical evidence to show the direct relationship between the introduction of industry 4.0 and Lean process and to find the impact it has on organizational performance as a barrier. Vigneshvaran and Vinodh (2020) identified twenty barriers in the integration of lean and Industry 4.0. Out of which increasing competitive pressure, lack of long-term vision, lack of management support, lack of capital fund are founds to be the important barriers that affect the integration of lean and industry 4.0. Rishi et al. (2018) executed the lean method in the manufacturing system of pivot lodging to work on its productivity. Kaizen method is use to build the productivity by lessening the lead time. Khalili



et al. (2017) concentrate on proposed that industries ought to follow nonstop improvement for long haul imminent. Their coactions can expand the exhibition in market. Their implementation can create high customer fulfillment, further developing productivity and quality and decrease in losses, waste and cost. Costa et al. (2018) introduced a review looking at how Quick Response Manufacturing (QRM) can supplement lean manufacturing. QRM additionally upgrades LM on framework dynamic examination, which gives a superior depiction of the factors that meaningfully affect lead time. This assists with diminishing troubles to propose enhancements and measure the additions. Observing usage level of responsibility stations assists LM with finding stowed away squanders. Dora et al. (2016) distinguished the little size of the plant, the customary arrangement, and unbending format make it challenging to carry out lean manufacturing in SMEs. The concentrate likewise assists specialists with expecting possible snags and go to appropriate lengths to manage them during lean implementation. Rathod et al. (2016) worked throughout advancement of process duration and decrease non-esteem added movement by utilizing line adjusting approach for end of walk and stand by underway line. Kumar and Kumar (2015) introduced benefits acquired by the Indian business with implementation of lean manufacturing components. Implementation of Lean Manufacturing decidedly affects execution of Indian industries. Lean Manufacturing has the ability to influence emphatically with worked on functional productivity, quality and worked on hierarchical execution.

III. Barriers in Lean Manufacturing implementation in Indian Context

The aim of lean manufacturing is to help the business objectives. It requests to the shift from regular course of working to a strategy that energizes business greatness practice. This all needs enormous changes to occur inside the association; beginning from change of management point of view, reasonable organization of assets, designation of assets, schooling and preparing of staff, etc. Bhasin (2006) states that implementation of lean manufacturing, similar to some other new framework has many sorts of hindrances which blocks the all through application and incorporating it. As per earlier examinations an assortment of deterrents in implementation of lean has been talked about. Some of them are connected with social, specialized, authoritative and financial variables to the implementation of lean in manufacturing organizations as insisted by Darabi et al. (2012). Regardless of the way that lean is a laid out structure for working on the association in all areas yet at the same time the greater part of the organizations faces hardships in implementation of Lean Manufacturing. Lean production in India for over 20 years yet just few organizations have taken on Lean Manufacturing effectively and can make significant achievement. The goal of this paper is to notice the obstructions and learn activities for compelling implementation of Lean Manufacturing in view of the concentrate in the Indian industries. Top management issues for lean implementation is likewise vital and top management arrangements and demeanor towards lean implementation need some improvement in Indian industries as portrayed by Singh et al. (2020). In writing Individuals boundaries of lean manufacturing implementation has been distinguished as Lack of management center, absence of desire to make need to get moving, absence of management support, absence of long haul vision, absence of work assets , absence of capital asset, absence of correspondence, absence of thought advancement, fair specialists, absence of time, absence of preparing, absence of understanding about Lean, absence of implementation skill, clashes with different Initiatives like TQP,TPM,JIT, dissimilar manufacturing conditions, demand instability, clashes with ERP Implementations, organization culture, representative's impervious to change, center management obstruction, no direct monetary benefit , not perceiving monetary advantages , no monetary focuses, previous experience of disappointment

and sliding back to past state without even a trace of backbone. Table 3.1 show the hindrances in the implementation of lean manufacturing.

Sr. No.	Barriers	References
1	Lack of planning about lean practices	(Abu. et al., 2019) (Chaple et al. 2018) (Sreedharan and sunder, 2018) (Azyan et al. 2017) (Marodin et al., 2013) (Khusaini et al., 2016) (Bhamuand and Sangwan 2014) (Bednarek and Luna, 2008)
2	Resource unavailability	(Abu et al., 2019) (Kleszcz, 2018) (Bajjou and Chafi 2018) (Chaple et al. 2018) (Almanei et al., 2017) (Shrimali and Soni 2017) (Moeuf et al. 2016) (Dora, et al., 2016) (Almeida and Saurin, 2015) (Jadhav, 2014)
3	Lack of incentive	(Fernando et al. 2022) (Abu et al., 2019) (Kleszcz 2018) (Sathydevi et al., 2018) (Chaple et al. 2018) (Almanei, 2017) (Shrimali and Soni 2017) (Mukherjee 2017) (Tyagi et al., 2016) (Dora et al. 2016) (Abolhassani, et al.,2016)
4	Absence of clear communication	Abu et al., 2019) (Kleszcz 2018) (Sarhan et al. 2018) (Almanei, 2017) (Azyan, et al., 2017) (Polacco and Mukherjee 2017) (Jaiswal et al., 2020) (Abolhassani et al., 2016) (Dora et al., 2016)
5	Improper management from top officials	(Abu et al., 2019) (Kleszcz, 2018) (Bajjou et al., 2018) (Sarhan et al. 2018) (Almanei et al., 2017) (Azyan, Pulakanam, et Pons 2017) (Mukherjee 2017) (Alefari et al., 2017) (Jaiswal et al., 2016) (Khusaini, 2015) (Hu et al. 2015) (Kumar 2014) (Jadhav et al., 2014) (Raghunath and Jayathirtha 2013)
6	Less knowledge about lean implementation	(Abu et al., 2019) (Kleszcz, 2018) (Bajjou et al., 2018) (Sarhan et al. 2018) (Sathydevi et T 2018) (Chaple et al. 2018) (Azyan et al., 2017) (Jaiswal and Kumar 2016) (Abolhassani et al., 2016) (Khusaini, 2015)
7	Unclear about Industry 4.0 technologies	(Fernando et al. 2022) (Abu et al., 2019) (Bajjou et Chafi 2018) (Sarhan et al. 2018) (Chaple et al. 2018) (Tyagiet al.,2016) (Jaiswal et Kumar 2016) (Moeuf et al. 2016) (Hu et al. 2015) (Jadhav et al., 2014) (Raghunath and Jayathirtha 2013)

IV. Evaluation of effectiveness index

On the basis of literature review seven important barriers in lean manufacturing implementation has been identified. On the basis of these barriers, a questionnaire has been developed for the analysis. The chief-executives/managing directors/general managers/works managers/senior executives were contacted in person for getting their response. Questionnaires were e-mailed to some Indian manufacturing industries, along with a covering letter, self-addressed and a stamped envelope. In total, questionnaires were sent to 130 Indian manufacturing industries.

Out of the 130 questionnaires, 47 filled up and complete questionnaires were received. three questionnaires were incompletely filled and were discarded for further analysis. This gives a response rate of 36.15% which is good for such surveys (Malhotra and Grover, 1998). In most of the cases, the addressee filled the questionnaire on their own but in some cases; some senior executives of the companies also filled the questionnaires on behalf of addressee.

The analysis of the results is summarized in the following table 4.1. It indicates the difficulties experienced by Indian manufacturing industries in lean implementation. In order to investigate the barriers faced, the respondents were asked to submit and rank the greatest barriers they experienced through the survey form.

For breaking down degree of effectiveness in cloud manufacturing of the organization, reaction of the business personals was taken on various boundaries of effectiveness issues in Likert size of 1 to 5 (1-Very low, 5-Very high). Score of various barriers in analysed are given in Table 4.1. For figuring effectiveness index, above all else mean worth is taken into the thought. After determined the mean worth the position, backwards rank and weight for each issue is chosen. For doling out the weight on various barriers in lean implementation, the most elevated and least upsides of five-point Likert scale for example 5 and 1 are planned 100% and 0% individually (Chand et al. 2014). For every one of the cloud manufacturing boundaries the effectiveness a weight is allocated. The models for weight (W_i) is as under:

$W_i = \text{Assign } +1$, if rate score $> 60\%$ (Mean value >3).

= Assign 0, if rate score is between 40-60% (Mean worth somewhere in the range of 2 and 3).

= Assign - 1, if rate score $< 40\%$ (Mean worth <2)

Number of sections of last segment ($W_i \text{ Log } K_i$), gives effectiveness index of barriers. Hypothetically, effectiveness index worth might run between - 2.924 to 2.924. Calculation of effectiveness index is delineated with the assistance of a worksheet as displayed in Table 4.1.

4.1 Measurement effectiveness Index:

Sr. No.	Barriers	Mean	Rank	Inverse Rank (Ki)	Log Ki	Weight (Wi)	Wi. LogKi
1.	Lack of planning about lean practices	3.85	1	7	0.8450	+1	0.8450
2.	Resource unavailability	3.58	2	6	0.7781	+1	0.7781
3.	lack of incentive	3.26	3	5	0.6989	+1	0.6989
4.	Absence of clear communication	3.04	4	4	0.6020	+1	0.6020

5.	Improper management from top officials	2.95	5	3	0.4771	0	0.00
6.	Less knowledge about lean implementation	2.87	6	2	0.3010	0	0.00
7.	Unclear about Industry 4.0 technologies	2.45	7	1	0.00	0	0.00
Effectiveness Index = $C_j = \sum \{W_i \text{Log } K_i\} = 2.924$							

Table 4.1: Illustration for Effectiveness Index among barriers.

V. Results and conclusion

This paper presents the results of a survey conducted on the Indian manufacturing industries with the main purpose of identify the barriers during the implementation of lean manufacturing practices and comparing the barriers had been faced to implement lean practices.

It found the effectiveness index of barriers, based on response from management and employee has been calculated is 2.924. Effectiveness index of barriers. shows that presently it is high as maximum value can reach up to 3.7021. On the basis of this analysis, it is observed that most of barriers (Lack of planning about lean practices, resource unavailability, lack of incentive, absence of clear communication) effectiveness in lean implementation have good score except improper management from top officials, Less knowledge about lean implementation and Unclear about Industry 4.0 technologies. Therefore, industries need to focus on barriers Improper management from top officials, Less knowledge about lean implementation and Unclear about Industry 4.0 technologies for lean implementation. This approach can be utilized by the organization to benchmark its performance with national and international standards by focusing on the identified issues. It can also help to improve the overall efficiency of the company in the competition of lean manufacturing. On the basis of this analysis, organizations can develop their own lean manufacturing strategies to improve the effectiveness in lean manufacturing thereby improving the competitiveness in global market.

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