

Lean Practices in SMEs towards Improvement in Production Performance: A Research

Bhuvaneshwari Alias Sunita Kulkarni. M., Anand.H.Mishrikoti

ABSTRACT--- *Practicing Lean manufacturing in organizations of any type brings various advantages for example, reduced waste, improved operating efficiency, desired performance evaluation etc. Meanwhile, implementing the Lean strategies is a stimulating task. In literature, numerous frameworks and policies are developed and proposed, suitable for a specific organization and for any kind of SMEs, still the implementation exercise remains burdensome. SMEs are nowadays in the zone of highly practiced Lean implementation as they form one of topmost strength of economies. Here, in this article an effort is made to gather and highlight the recent Lean practices adopted/developed with several modifications to suit the working environment in SMEs. For a quick glance at the Lean methods proposed in different production/manufacturing industries even with some amount of success, information is provided in Tabular form. One highlighting outcome from this review is that, currently, in developing countries implementing Lean methods in SMEs is a biggest opportunity while in underdeveloped countries, the adaptation is very rarely reported. Use of machine learning techniques like artificial neural networks has just begun in this field of interest, hence exploring at a larger scale is required. Simulation methods are a few to name and its practice may or may not be worth requiring different levels of strain.*

Keywords— *Lean; SMEs; performance; organization; management; production.*

I. INTRODUCTION

In Japan an engineer named Taichi Ono working in Toyota founded Lean production system when he studied the idea of Ford Production System. After several stages of proliferation, Toyota production system came into existence to persist in a condition of least available resources with main focus on avoiding waste in every aspect across the production phase [1], [2]. In Lean manufacturing one uses fewer of the whole thing i.e. half the manpower, inventory, defects, time for marketing and manufacturing space. This is to become increased alertness towards customer need with production of quality products in the best economical and efficient manner. Different parts of organization is affected by Lean and rather can be accepted as novel management view point. It is slightly complicated and cumbersome to introduce the philosophy of Lean. While implementing the

Lean in any organization/ stakeholders with conflicting interests, many factors are required to be considered [3]–[5].

Implementing Lean in SMEs (small and medium sized enterprises) pose a challenge task. SMEs demand the cost of implementation and succeeding benefits of Lean adoption to be highlighted upfront afore they are capable to commit. In addition, SMEs comparable to huge organizations are with narrow resources and even in numerous cases the requirement of lengthy term commitment in leaderships lacks [6]–[9]. Lean in SMEs is famous for its famous goal of removing waste from the service providers and industrial shop floors. Using Lean helped Toyota company to sustain even in a harsh environment of automobiles which were highly competitive and lead the company to be even challenging. Lean, recently has much more evolved by new innovative thoughts which are pushed ahead to find provision of solutions returning increased value in much more efficient ways. This is achieved by reduced human effort, inventories and time, fewer resources, reduced energy, and less residues. In current production environment with high competitions require highly productive with sensitive systems for production and also economically effective [10]–[14]. These systems which provide high values with less environmental influence can make the system thriving. These aspects are related to reducing all kinds of wastages on all of its appearances and shapes, and those with cases difficult to deal with which seems to be invisible. Nevertheless, the aforementioned scenario has to be accomplished without increasing any kind of production costs along with negligible environmental concerns which may be even hidden as in many cases. This is applicable and is true for long and short spanning processes such that sustainability is sincerely tracked and achieved ethically [15]–[18]. Thriving some of the advantages and innumerable research works being continuously published in this area, this article focuses to collect the works pertinent to Lean implementations in SMEs throughout the world. The main highlight of this article in this regard is giving an overview of innovative developments reported in literature and providing some future directions..

II. A REVISIT TOWARDS LEAN STRATEGIES IN SMES

Tinoco et al. [19] developed a lean management (LM)

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Bhuvaneshwari Alias Sunita Kulkarni. M. Department of Mechanical Engineering, Government Engineering College, Huvinahadagali 583219, Karnataka India. (bhuvaneshwarikulkarni1968@gmail.com)

Anand.H.Mishrikoti, Department of Mechanical Engineering, KLS Vishwanathrao Deshpande Institute of Technology, Haliyal, 581 329, Karnataka India. (anandmishrikoti@gmail.com)

method of value-stream suitable in Minnesota related to manufacturing company. The tool employed permits the firm to record the inventory level, lead time (current), and cycle times. Using this, the value added and lead time (total) ratio was analyzed. The unvalued product/activity was tried to reduce in the flow line during the production process. One study reported by Kumar et al. [20] was on LM in SMEs (small and medium sized enterprises) in Indian scenario as a case study. In their study they tried to avoid the flaws in the product in order to improve the bottom line outcome. Using several methods of LM and six sigma (SS) called by framework of lean sigma as shown in Figure 1, in which total productive maintenance (TPM) was also employed. The result was finally a good increase in reduced flaws in final product leading to huge financial savings. Ray et al. [21] identified and developed lean index for companies processing wood which were nine in number. The lean index with low of 2.33 and upto high value of 12.0 was found to be 5.07. The result indicated that inherently, the primary operations of wood products are leaner than secondary operations. Compared to total variance of the resources utilize the process throughput parameters were found to be twice.

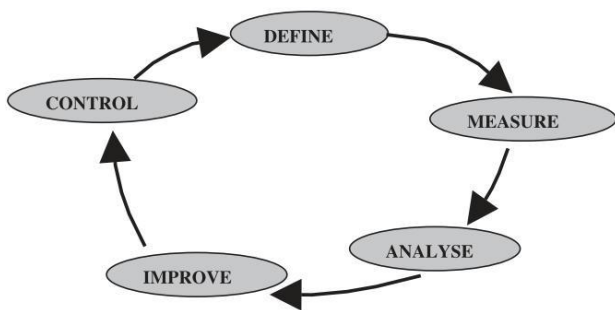


Fig. 1. Framework of lean sigma [20]

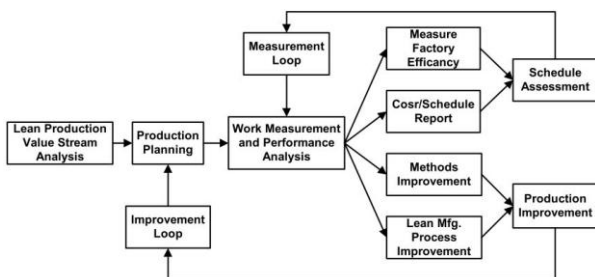


Fig. 2. Relation between factor efficiency and production practices [23]

Table 1. Details of SMEs performance evaluation using lean matrices

Method / tool	Target area	Location	Remarks	Reference
Value-stream mapping	Manufacturing company	Minnesota	Visualization of process activities during the flow and chances to avoid waste is enabled	[19]
Current state	Manufact		Process capability, standard deviation,	[20]

map, TPM, 5S system,	uring company	India	key metrics, yield and equipment effectiveness increased	
Factor analysis	Wood products	Virginia	The significant factor found was energy consumption which contributed leanness to wood products	[21]
Performance measurement system (PMS)	Manufacturing company	New Zealand	The PMS followed must not be static. However it should change in order to reveal the strategy and business policy of the organization in which it functions.	[22]
Embedding lean metrics into simulation model	Production systems	General	Secondary lean metrics need to be applied for manufacturing performance measurement	[23]

Survey instrument	Small industries	North Karnataka	The critical factors need to be implemented for quality management in industries	[24]
Survey samples	Automotive industry	Malaysia	The main obstacles identified are lack of knowing lean system and attitude of employees	[25]

III. A GLIMPSE OF LEAN PRACTICES IN PERFORMANCE EVALUATION & RESULTS

Peter and Lanza [5] demonstrated the reasons for implementation of lean methods in automotive industry which are depicted in Figure 3. Using three different methods (study) of optimization and case studies of the production area the comparative analysis were made. In Figure 4 the targets achieved using three studies are shown for the production system. The analysis provided an idea of severe interdependencies of many approaches in relation to important target and production figures. Bednar [26] used partially the lean method meant for business practice in a



production industry and identified some importance methods which are not suitable for industries having mass production products. Hustad and Olsen [27] conducted several case studies in SMEs which are practicing ERP (enterprise resource planning) system particularly focusing activities, issues, key actors in enterprises ERP cycle. This system is found to be financially costly and risky for SMEs. Meier et al. [7] classified performance indicators depending upon how important they are in measuring delivery and planning performance and a glimpse of same is shown in Figure 5. Karim and Zaman [28] developed an effective method in order to implement LM strategies and a metric system using CPM (continuous performance measurement). The method helped in selecting proper lean tools, identify waste, and chose appropriate performance indicators.

Rojasra and Qureshi [29] implemented 5S LM strategy in a plastic industry located in Gujrat. The implementation prevented the loss of tools and products and improvised discipline among the workers, usage of area for work, and reduced accidental losses. Matt and Rauch [30] studied the role and applicability of lean methods in SMEs of Italy. They also identified critical success factors and issues related to implementation in industries. The improvement in productivity is shown in Figure 6 after implementing the lean method in small industries. Susulawati et al. [31] conducted a survey of literature and developed Performance Measurement and Improvement System structure for LM. The structure consisted of measurements which reflected aims and LM strategies built for monitor and encourage lean behavior resulting in improved measurements. Few relevant studies reported on SMEs practicing lean methods are by Ali et al. [4], Mehta et al. [32], Graham et al. [35], Cochran et al. [37], Gangal et al. [16]. Wagner et al. [17] introduced the influence of industry 4.0 on LM related systems, Roriz et al.

applied LM tools in cotton industry, J P et al. [39] adopted LM tools in printing industries, Priyaadarshini et al. implemented lean thinking in machine tool industry, Gálová et al. [41] used engineering LM methods in Czech SMEs, Zhan et al. [42] used green and lean method in

Chinese organizations, some others also used lean tools for SMEs in Brazil and more recently Marodin et al. [44] employed Lean production methods with operational performance in automobile industries of Brazil.

Table 2. Details of SMEs performance evaluation using lean matrices

Method/tool	Target area	Location	Remarks	Reference
Simulation method (Plant Simulation)	Machine tool/plant manufacturing firm	General	Using simulation methods the lean methods can be optimized easily	[5]
Questionnaire	Mass production companies	General	Industries get closer to their target by alterations in the basic methods of lean	[26]

Method/tool	Target area	Location	Remarks	Reference
Interview	Several SMEs	General	Experienced vendors can misuse SMEs. Same is true for consultants	[27]
Systematic lean operation depending on continuous improvement methods	Production company	General	CPM matrices provided proper efficiency and effectiveness to evaluate performance continuously	[28]
5S	Plastic industry	India	Efficiency of production system improved in a week from 67% to 88.8%	[29]
Interview	Small industry	Italy	In small enterprises implementing lean method is still a challenge	[30]

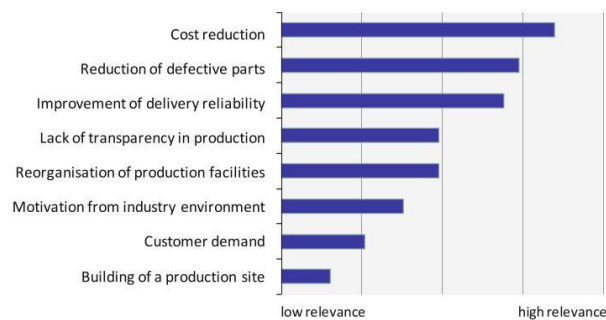


Fig. 3. Reasons leading to lean methods implementation [5]

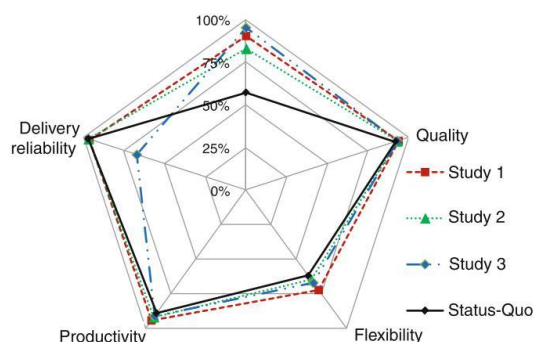


Fig. 4. Improvement in production using optimization methods [5]

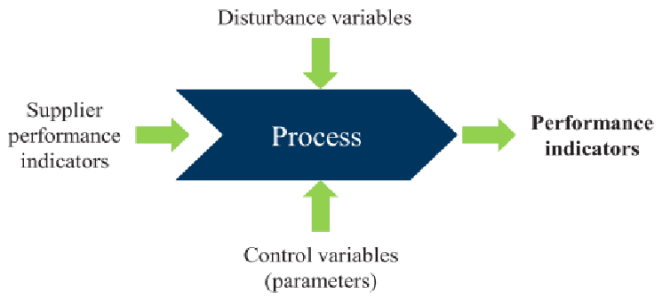


Fig. 5. Factors influencing process and indicators [7]

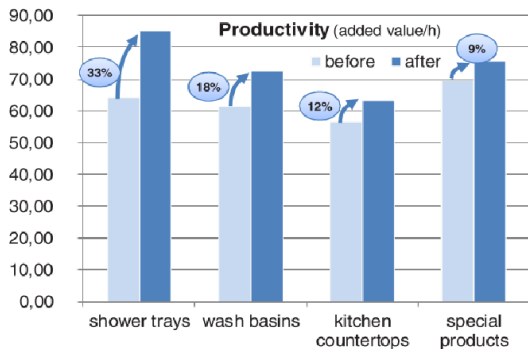


Fig. 6. Increased productivity due to lean implementation in small industries [30]

Table 3. Summary of important implementations followed in SMEs and their outcomes

Method/tool	Target area	Location	Remarks	Reference
Degree of leanness from one of the elements belonging to J4000 element and of the company	Industrial segments	Brazil	Relation between leanness degree and firm size does not exist. The developed method provides better idea for lean practice in the firm	[45]
Identification of issues related to LMs supporting socio-technical ergonomics	Any industry	General	the proposed method find the gap between LM strategies and status of socio-technical ergonomics	[8]
Framework comprising all	Any	France	Framework improves performance and	[46]

component for SMEs	SME	Location	benefit of the organization	Reference
Implementing critical success factors	Manufacturing industry	Oklahoma	Several critical issues exists in SMEs	[47]
Conceptual framework of ten different success factors	Automobile industry	India	There exists a strong relation between operational performance and LM	[48]

Table 4. A glimpse of LM method adopted in SMEs

Method/tool	Target area	Location	Remarks	Reference
Questionnaire	Small and medium industries	India	Adopting TQM in Indian SMEs is required at large scale	[49]
Questionnaire	Small industries	Kenya	Fundamental and financial management aids to enable the entrepreneurs to create informed investment assessments	[50]
Implementing lean thinking	Manufacturing sector	India	The work guides in choosing lean tools depending upon characteristics and waste	[51]
Simulation (Visual SLAM)	Manufacturing industry	General	The redundancy in resilience principles impacts highly in the performance of system	[52]
Survey	Tool industry	India	Assembly section in LM system did not show any	[53]

			improvement	
Interview	SMEs	Gener al	Advantage when differentiating supporting and non- supportive team of management	[54]

IV. FEW LEAN TOOLS REPORTED RANDOMLY IN LITERATURE

Wide kind of Lean methods/tools and strategies exists which are used by the investigators in their study. Few of them are mentioned below with their role in performance improvement:

1. 5S: this method adoption helps in avoiding waste which is obtained from improper organization of work floor/area like avoiding time in search of a tool
2. Kaizen: it couples the mutual talents in an enterprise in order to obtain a product which can continuously avoid waste during the production process
3. Kanban: this also assists in avoiding the wastage during overproduction and from inventory. Kanban implementation avoids the use of physical objects like using of indication cards for signaling instead of using physical inventory.
4. Muda: it eliminates anything which does not increase/add any kind of value to the product as the name "Muda" itself suggests avoiding waste
5. Overall Equipment Effectiveness: this offers providing baseline and a method to track movement of avoiding wastage during a production process. An OEE of 100% shows that the production is perfect which means that only good parts are manufactured with no stoppage and high speed
6. Value stream mapping: it is a tool which maps visually the production flow process. It also provides the current/future status of processes which earmarks the chances for improvisation. VSM discloses wastage during the present ongoing processes and gives a roadmap further.
7. Total productive maintenance: it forms a joint responsibility for parts which encourage higher participation from work floor employees. Sometimes at right time this tool can effectively improve the production rate by increasing time, decreasing time cycles and avoiding defects.
8. Andon: performs like a real-time tool for communication at the work floor which could bring sudden care to issues when they occur in order to get immediate solution
9. Heijunka: this decreases leading times as very part/variant being produced faster and inventory
10. Gemba: stimulates the understanding of manufacturing problems in the real world thoroughly and deeply at a first glance and communicating with work floor workers.
11. Root cause analysis: it assists in ensuring of eliminating an issue surely by using corrective actions at the root level of the problem

12. Visual factory: it gives a proper status/condition of the production processes and makes it definitely available and much clearer to all

V. CHALLENGES IN IMPLEMENTATION OF LEAN IN INDIAN SMEs

The following challenges are observed in Indian SMEs faced for implementation of Lean practice. These facts are commonly observed and is also reported in literature.

1. Lack of knowledge in benefits of Lean practice in SMEs is most common
2. Negligible awareness Lean strategies, tools, and methods
3. Facing large scale resistance from practicing Lean by the work force
4. Concentrated attention over individual task while the combined objectives for development of the SME is ignored as a whole
5. Even if the implementation is under process the following problems are ahead:
 - a. Use of methods/models with no proper definition according to characteristics of individual industry
 - b. Poor strategy for implementation
 - c. Shortage of important resources needed for practice
6. No skills and training among the work force for proper implementation
7. During a project execution, the officers at middle level and board of directors do not support properly
8. Improper understanding of the purposes and concepts in practicing lean
9. In India another additional challenge faced in SMEs is the differences in culture
10. Lack of proper communication
11. Lean practice requires the flexible working environment to be flexible
12. Initial cost of implementing Lean in SMEs is costly which hinders its use in India
13. The reward obtained with the implementation of Lean is lacking
14. The consultations required for Lean practice in SMEs are not available

VI. CONCLUSION

The purpose of this article is to give the readers an insight into the ongoing practice of industrialists/researchers to implement lean manufacturing methods in SMEs in different areas of world. Innumerable number of research articles are published in English language journals reporting the development and proposal of wide kind of strategies to improve the performance of several classes. Many of the famously adopted case studies belonged to Indian SMEs

which shows the need of applying lean tools and creating awareness. The most interesting part was the application of lean tools in automobile industries as it is majorly adopted. This shows the use of lean tools in automobile industry which involves production of hundreds of parts. Even



printing, machine tool, tool industry, wood industry, cotton industry etc. have also successfully implemented lean manufacturing. Further, the SMEs need to practice few hard and soft aspects like 5S, last planner, and teamwork of lean which does not demand huge investments. For construction companies A3's, 5S and 5 Whys lean tools which need reduced monetary investments can be instigated in construction SMEs. The rate of flowing LM method need to be increased by increasing more awareness among the employer and employees. Campaigns and courses should be conducted to disseminate the models which are in house developed in view of individual use.

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