Indian MSMEs–Review of Dynamic Capabilities with Lean Production

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Indian MSMEs must respond quickly to the fast-changing requirements using dynamic capabilities gained while adopting strategic changes like flexibility and a lean management system (LMS). The present research aims to review the depth and effect of LMS and the understanding of lean philosophy in Indian MSMEs. First, a systematic literature review (SLR) approach using a four-stage process cycle of Plan-Do-Check-Propose (PDCP) applied with a unique integration of Plan-Do-Check-Act (PDCA) in a Plan-Do-Check-(Analyse/Propose) (PDCP) during analysis and synthesis of the data. The SLR captures the need for lean manufacturing practices and its advantages in MSMEs with critical lean barriers. Next, the Government of India (GOI) measures to promote LMS and "Lack of awareness of lean manufacturing competitiveness scheme (LMCS)" among Indian MSMEs are reported. Finally, the study concludes with gaps and improvements needed to strengthen the effectiveness of the schemes, together with the requirement of studies to appraise the direct effects of GOI promotional measures on MSME's performance in a longer perspective.

Keywords: Indian MSME, Lean Manufacturing, LMS, Dynamic Capabilities, Lean Barriers, Systematic Literature Review

1. Introduction

MSME (Micro Small Medium Enterprise)'s are recognised as the emergent and key sector of the Indian economy. Moreover, being one of the largest employment industries in India, it also requires low capital costs compared to large industries (Jewalikar and Shelke, 2017). Therefore, MSMEs play a significant role in India's industrial economic growth like the rest of the world. This sector contributes more than 90% of total industrial enterprises in India and takes the bulk of 45% of gross industrial product contributing 40% of total export (NABET, 2018; Shrisha and Kiran, 2019). However, Indian MSMEs strive for fierce competition in the present dynamic market conditions because of fast-changing requirements and rapid technological changes. They are also finding it hard to grow the business for easy access to global and domestic markets. Significant challenges that the MSMEs face includes:

- Access for ease for doing business, thanks to the numerous regulations and permissions
- Rapid product and technology change
- Uncertain demands and low production capacities

- Problems with economies of scale
- High global competition
- Supply chain problems
- Fund shortages
- Different manufacturing strategies.

The competitive environment affecting MSMEs is decided by demand dynamics (Kharub and Sharma, 2017). To overcome these challenges, manufacturing MSMEs must be flexible to adopt new changes rapidly and effectively (Singh *et al.* 2016). In the current scenario, the pandemic outbreak has also provided golden opportunities for MSME's to enter into the global supply chain supporting China plus one policy by multinationals (Chaudhary *et al.* 2020). Previous studies indicate that many manufacturing MSMEs have identified the need to implement a lean management system (LMS) as an ideal tool/system to deal with highly competitive environments and are very effective manufacturing practices accepted worldwide (Anand and Kodali, 2008).

1.1 Lean Manufacturing

The term "lean", first introduced in *The machine that changed the world* (Womack *et al.* 1992), compared bulk production systems from the US and Europe with the Lean Production System from Japan. As a result, it got revealed that reduced human efforts, less space, reduced inventory, and reduced new product development time in case of LMS adoption (Womack *et al.* 1992) – an idea first implemented at Toyota, Japan by Taiichi Ohno, the father of the "Toyota Production System" (TPS). LMS aims to remove waste leading to improved lead times and reduced resources. Furthermore, it identifies non-value-added processes or practices from the design stage until the final product, considering the customer perspective (Jewalikar and Shelke, 2017). Figure 1 explicates the five principles/steps of the lean management process (Do Doanh, 2017).

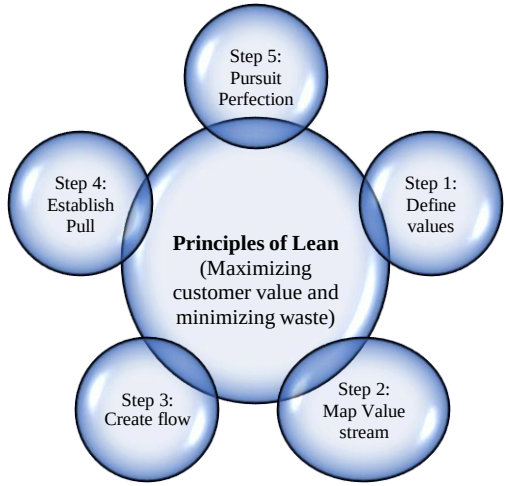

Figure 1 *Lean Process (Do Doanh, 2017)*

1.2 Aim of the Study and why SLR

To find out the best-suited methodology, a comparison of the six different review methodologies is reproduced in Table 1. After critically reviewing all six, the systematic literature review (SLR) was found to be the best suitable review for our scope of the study, a systematic, scientific, and reproducible approach accepted worldwide (Thomé *et al.* 2016). Also, SLR is a methodology to determine and evaluate critically relevant studies with collection and analysis of data (Liberati *et al.* 2009).

Table 1 *Overview of Six Kinds of Literature Review*

Approach	Scope	Authors	Contribution
"Systematic Review"	Systematic, scientific, transparent, reproducible, and adopted worldwide. Covers studies with published articles in the defined period. Selection, exclusion, and synthesis/analysis criteria with clear conclusions.	Tranfield *et al.* 2003; Denyer and Tranfield, 2009; Thomé *et al.* 2016; Sangwa and Sangwan, 2018; Alkhoraif *et al.* 2019	Guidelines in conducting SLR in healthcare and comparing it with management and operation research. Conducted SLR to assess lean and organisation performance. Assess lean implementation in SMEs.
"Integrative Review"	Its distinctive form of review generates new knowledge of the topic reviewed. These are generally semi-structured or unstructured critical reviews that handle mature topics.	Torraco, 2005; Snyder, 2019	Guidelines to write an integrative review. Overview on different types of review
"Narrative Review"	It contains a vast quantity of studies involved, direct or indirect. Summarises the methods used with outcomes and identifies gaps as critique from previous research.	Croninl *et al.* 2008; Bhamu and Sangwan, 2014	Step by step guide to understanding critical elements of literature review. Review of Lean management literature.
"State of the Art Review"	It focuses on the technical area and recent research on the selected topic. It gives a new viewpoint on recent issues and identifies future research needs.	Garza-Reyes, 2015	State of the art review in New lean green concept
"Conceptual Review"	Formulate a theoretic literature review of the available concepts and their correlation, and propose a framework relevant to the research topic.	Mostafa *et al.* 2013; Bhamu and Sangwan, 2014	Review of LM literature. Study various lean implementation initiatives.
"Critical Review"	Extensive literature review and in-depth evaluation of the topic, resulting in a framework.	Jasti and Kodali, 2015	Lean supply chain planning framework

Many researchers have identified MSME's routine as a dynamic approach towards their day-to-day targets and firefighting activities to meet the company's objectives and customer demands. However, this leaves no or the least attention towards strategic decisions like lean implementation for improvements. Hence, this SLR aims to study and analyse literature in the domain of LMS implementation in Indian MSMEs, followed by a descriptive analysis of case studies from the selected literature to gain more insights. As such, the aim of the study is as follows:

1. Need for lean adoption and the main barriers for lean adoption in Indian MSMEs to become competitive?

2. What is the status of awareness on proposed and implemented lean measures by GOI to promote Indian MSMEs?

The abbreviations used are as follows

Term	Meaning	Term	Meaning
MSMEs	Micro Small Medium Enterprises	**SOP**	Standard operating procedure
GOI	Government of India	**TPM**	Total productive maintenance
LMS	Lean Management System	**AHP**	Analytical Hierarchy process
LM	Lean Manufacturing	**PDCP**	Plan-Do-Check-Propose
NABET	National accreditation board for education and training	**PDCA**	Plan-Do-Check-Act
TPS	TOYOTA Production System	**MRP**	Material requirement planning
QCI	Quality council of India	**LMCS**	Lean Manufacturing competitive scheme
SMED	Single minute exchange of die	**DEMATEL**	Decision-making trial and evaluation laboratory
R and D	Research and development	**NMCP**	National manufacturing competitiveness program.
JIT	Just in time	**SAP-LAP**	Analytical tool: Situation actor process – Learning action process
LR	Literature review	**ROI**	Returns on Investment
SMEs	Small and medium enterprises	**WIP**	Work in process
CNC	Computer numerological control	**5S**	One of the lean tools to keep the workplace tidy and clean
OEE	Overall equipment efficiency	**MCDM**	Multi-criteria decision-making
SLR	Systematic literature review	**INR One Crore** = USD 1,33,345 (as on 1 October 2021)	

The remaining study features are as follows: Section 2 represents data collection, methodology, and classification of studied literature. Section 3 expands a review of selected papers in pursuit of dynamic capabilities and the need for lean adoption in Indian MSMEs, along with LMS benefits and GOI measures' status to promote MSMEs. Finally, insights from the review and case studies identify the challenges, gaps and analyse the current situations. In Section 4, the review findings are discussed, followed by Section 5 that provides a conclusion. Lastly, Section 6 lists the limitations and leads to future research directions.

2. Review Methodology and Data Collection

A systematic literature study adopts a four-stage Plan-Do-Check-Analyse/Propose (PDCP) approach to ensure proper transparency and depth in the review process (Tranfield *et al.* 2003; Denyer and Tranfield, 2009). These four stages remain stated in Figure 2.

An initial search on *lean manufacturing* had resulted in several research articles; hence sorting was essential. Subsequently, data screening was done based on database, keywords, relevant full-length articles to confine the scope of the study. Finally, final sampling using a forward and backward search was conducted from 2009 until 2021. As an essential part of SLR, Figure 3 defines the “Inclusion and exclusion” criteria.

Stages	Scope	Details	Article section
Plan	Problem identification and setting of the research question	Many studies have highlighted several basic shortcomings and the improvement areas in LMS implementation in MSMEs. MSMEs give less attention to LMS, and there is a dearth of awareness about the advantages of lean and the need to evaluate lean with organisational performance.	Section 1
Do	Select articles using keywords and databases.	Inclusion/ Exclusion using keywords, language, period, and relevance of scope towards Indian MSMEs.	Section 2
Check (Analysis)	Analyse and categorise the literature.	Insights are captured by analysing and synthesising the reviewed literature and the case studies using the PDCA approach.	Section 3
Propose (Reporting)	Interpret and report findings with future research directions.	The reporting of the findings and identified future research directions.	Section 4

Figure 2 *Four Different Stages of SLR*

Criteria	Description
Inclusion	• Topic: Related to LMS in Indian MSMEs • Language: English • Period: The Year 2009 to 2021. • Articles from peer-reviewed leading journals
Exclusion	• Book Chapters, Conference papers, • Without word Lean, LMS, Dynamic capabilities, Indian MSMEs, GOI

Figure 3 *"Inclusion and Exclusion" Criteria used in the study*

An initial search from 2009 to 2021 by using keywords "*Indian MSMEs + Lean manufacturing + Dynamic capabilities"* resulted in the identification of 447 articles. Further addition of two keywords, "*Barriers + GOI",* narrowed the search to 120 articles. These 120 articles were selected for full abstract reading and further funnelling by exclusion on book chapters, conference papers. Finally, a total of 30 full-length articles, including peer-reviewed journals and relevance, were selected for systematic review (Section 2). This sampling approach of selecting the final 30 articles is in Figure 4.

Criteria	Description	No. of Articles
Inclusion	Keywords: "*Indian MSMEs + Lean manufacturing + Dynamic capabilities"*	1510
	Period: 2009 to 2021	447
	Addition of Key words "*Barriers + GOI" and* Articles from peer-reviewed leading Journals and sorted by relevance	120
Exclusion	Duplications, Book Chapters, and conference paper	98
	Abstract reading and selection for content analysis	90
	Selection of relevant articles in the Global and Indian context with backward and forward search to cover the entire period and fulfil the aim of the study.	30

Figure 4 *Process of Sampling Approach While Selecting the Final 30 Papers*

The review is categorised and synthesised in subsections using a unique approach of the PDCA cycle (Deming and Edwards, 1982) and integrated with the four phases of SLR. A similar approach was applied earlier by (Chong and Puvanasvaran, 2019) to assess the feasibility of lean adoption practices for SMEs in Singapore.

2.1 Classification Summary of the Selected Articles

The selected articles were first classified as shown in Table 2 using a chronology of publication, the focus of study, type of study, and the study's key findings to understand the depth of Lean adoption studies in the Indian MSMEs.

Table 2 *Classification of Articles*

Authors	Location	Lean tool / Focus of study	Type of study	Key findings of the study
Malik and Kotabe, 2009	South India	Manufacturing flexibility	Survey (India + Pakistan SMEs.)	• Manufacturing flexibility has resulted in a positive influence on organisational performance.
Singh and Khanduja, 2010	North India	SMED	A case study at a foundry	• Cycle time reduction in set up time of die-casting tools.
Upadhye *et al.* 2010	North India	OEE, VSM, SMED, POKA-YOKE, and Kaizen	Case Study in TCL: Tier 1 auto parts manufacturer	• LMS implementation model using case study has revealed • Set up time reduction • Cycle time reduction • Improvement in OEE • Reduction in Rejections • Increased production capacity.
Panizzolo *et al.* 2012	Western India	SMED, TPM, JIT	Case study (4 Indian MSMEs)	• Authors conclude many operational benefits like • Improved delivery performance • cycle time reduction, • Productivity improvement.
Mathur *et al.* 2012	Northwest India	Scheduling model	Case study: Spring manufacturing SME	• Set up time reduction by simple machine rearrangements.
Mor *et al.* 2013	North India	Juran's Method, 5S	Case study: Automotive MNC	• Downtime reduced by 4% • Productivity improved by 2.5%.
Jain *et al.* 2014	North India	TPM	Survey: Literature review	• Highlighted need for TPM to improve overall efficiency and compete in the global market
Ravikumar *et al.* 2014	India	Lean consultants	Survey: 200 MSMEs all over India: 82 respondents	• Critical constraints for implementation of Lean
Thanki and Thakkar, 2014	Western and Eastern India	Lean implementation	Survey: Pilot study in Indian MSMEs	• The authors suggested there is a greater need for the implementation of Lean.
Ghaleb *et al.* 2014	India	Lean six sigma	Survey	• Lists advantages of lean Six sigma
Hu *et al.* 2015	India	Practising lean In SMEs	Systematic literature survey	• SLR to fill gaps from previous research
Kharub and Sharma, 2016	North India	Critical success factors of QM tools	Survey	• Model construction to help identify key factors for success in implementing QM practices.
Ravikumar *et al.* 2016	India	To evaluate the execution of lean in Indian MSMEs	Survey and evaluation of six MSMEs using SEM and TOPSIS	• Suggested a systematic approach to improve productivity and performance of MSMEs • Management and leadership are the most important factors for lean implementation • Important LM initiatives for MSMEs

Shrimali and Soni, 2017	India	Issues of lean implementation	Survey: Literature Review	• Observations on lean implementation, globally
Sahoo and Yadav, 2018	India	Study of lean implementation	Survey: 121 Indian MSMEs	• Identification of internal and external constraints are identified.
Panwar *et al*. 2018	India	Lean implementation requirements	Survey: Indian Process industries	• Importance of lean in the process industry.
Sangwa and Sangwan, 2018	India	Study approaches in the leanness evaluation	SLR	• Identify various approaches of Leanness assessment • Framework for Leanness assessment
Tiwari and Tiwari, 2018	North India	Determination of lean barriers	Survey: 39 Indian automobile MSMEs	• A conceptual framework for identifying lean barriers
Shrimali and Soni, 2018	India	Applications of lean tools	Survey: Indian MSMEs	• Highlighted standard lean practices observed in MSMEs
Yadav *et al*. 2018	Western India	Barriers to lean implementation	Case study: Two MSMEs from Rajasthan	• Highlighted key barriers
Jodlbauer and Strasser, 2019	India	MRP / Smooth scheduling	Lean philosophy: Conceptual framework	• A conceptual framework to address dynamic demand
Ravikumar, 2019	India	Evaluation of lean performance in Indian MSMEs	Survey: Group of six industries using AHP	• Contribution factors for successful lean implementation
Rathi *et al.* 2019	India	Lean Six sigma constraints in Indian MSMEs	Survey: Literature and Prioritisation of lean six sigma constraints	• Prioritisation and categorisation of twenty-one barriers of lean six sigma.
Gupta *et al.* 2019	North India	Dematel Six sigma hybrid framework	Case study: Indian MSME	• Prioritising the highest effective corrective action for process improvements
Matharu and Sinha, 2019	North India	Study of constraints of lean adoption	Lean philosophy: SAP-LAP framework	• To attend competitiveness and face uncertain demands.
Saini and Singh, 2019	North India	Impact of lean on organisation performance	Survey: 183 Northern MSMEs using statistical tools	• Performance improvement by applying lean practices.
Jaiswal *et al.* 2020	India	Study on Implementing barriers for lean	Survey: MCDM approach	• Significant barriers to lean adoption.
Akhtar and Ansari, 2020	North India	TPS in Indian MSMEs	Review + survey of 120 companies	• Listing the constraints and facilitators for TPS implementation
Bhattacharya and Ramachandran, 2021	India	Importance of lean manufacturing techniques in Indian MSMEs	Multi case study	• Importance of adoption of lean techniques in Indian MSMEs • Various tools in different clusters and their associated challenges.
Mishra *et al.* 2021	India	Benefits and constraints of LSS during and post COVID.	Descriptive study; survey of 127 LSS experts and CEO/ owners of MSMEs	• Highlighted constraints like cost, limited resources, and skill in implementing LSS during and after covid.

Out of the selected 30 articles, 8% dealt with Lean philosophy, 66% were survey-based, and the remaining 26% were strong on case studies which confirm most of the studies were focused using surveys followed by the case studies. On the other hand,

research papers with a quantitative approach were limited throughout the study. Similarly, most of the case studies and surveys are centred towards the Northern, Eastern, and Western parts of MSMEs of India, and very few studies with the southern part can be seen.

3. Analysis and Synthesis

The analysis stage from four stages review (PDCP) is categorised and synthesised using the PDCA process, which is the novelty of this review. The framework of this analysis is established on "Deming's PDCA (Plan-Do-Check-Act) cycle" (Figure 5), which is one of the well-known continuous improvement tools used in quality management (Deming and Edwards, 1982).

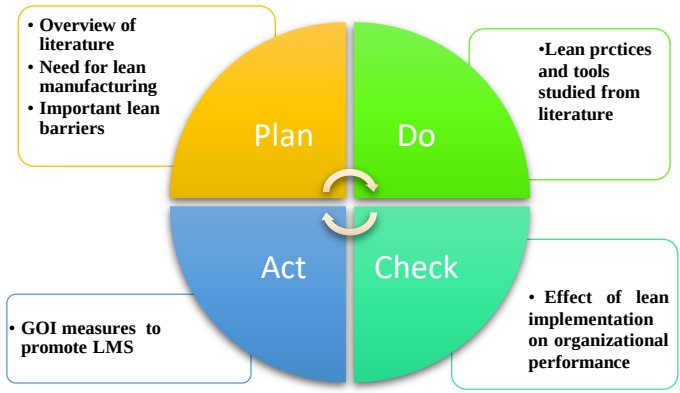

Figure 5 *Content Analysis of Literature using PDCA Cycle*

3.1 Sequential Overview

The following sequential overview of the literature has helped understand the progress and extent of lean implementation in Indian MSMEs anther specific key challenges.

- Malik and Kotabe (2009) studied the dynamic capability perspective for MSMEs and identified it as inconsistent. Their model identifies organisational learning, reverse engineering, and production flexibility to attain dynamic capabilities. In addition, the study highlights that support from government policies enhances the performance of MSMEs (Malik and Kotabe, 2009).
- One of the constraints of high set up time in Indian die casting MSMEs was addressed by "Single Minute Exchange of Die" (SMED), the engineering and management lean tool to achieve fast changeover to reduce high set up time (Singh and Khanduja, 2010). Furthermore, applying different lean tools such as 5S and Poka-yoke (described in Figure 6) have been proposed as future developments to decrease the change-over-time; positively affecting the product fulfilment and profitability of the companies.
- Upadhye *et al.* (2010) discussed the problems of Indian MSMEs and identified the importance of LMS to sustain in a competitive market. Their suggested implementation model for LMS in MSMEs evaluated M/s TCL using SAP-LAP analysis. Evaluation of lean tools like OEE, VSM, SMED, POKA-YOKE, and

Kaizen had shown a great deal of improvement in OEE, Set-up time, Cycle time, rejection reduction, and capacity improvement (Upadhye *et al.* 2010).

- Panizzolo et al. (2012) examined the effects of lean adoption at four Indian MSMEs. Significant improvements in delivery lead times, complaints, orders on a date, reduced cycle time, and firm performance were observed. However, complexity was noticed where the rapid change and new product design came into the picture; hence implementation lead time for lean practices had come up as one of the challenges.
- Mathuret al. (2012) identified that competence in implementing lean tools and lack of attention in daily firefighting were challenges for implementing lean practices in Indian MSMEs. Hence a simple scheduling model was suggested, along with simple changes in machine layout and work instructions. As a result, productivity improvement was observed; however, complex processes could not be evaluated (Mathur *et al.* 2012).
- Juran's lean methodology had studied low-productivity-related problems like extra processing, more waste or rework, line balancing issues, and significant change over time (MOR *et al.* 2013). Implementation of Juran's lean tools in a partially computer-integrated shop floor in Korea shows improvement in productivity by 2.5% and a reduction in waste by 4% over a20-day study. The study highlights limitations of investment as far as Indian MSMEs are concerned.
- TPM was suggested as one of the critical lean tools to facilitate productivity and worker's efficiency by achieving equipment efficiency through maintenance function (Jain *et al.* 2014). An exhaustive review of 148 articles in this field has highlighted the need for TPM in Indian SMEs to improve OEE to achieve global competitiveness.
- A survey of 200 Indian MSMEs with 29 constraints was carried out by (Ravikumar *et al.* 2014) using SPSS as an analysis tool. Total responses from 82 companies were analysed using a comparison of responses from three lean consultants. The study has highlighted organisational constraints and dominating issues (Ravikumar *et al.* 2014).
- Lack of lean training, awareness, inadequate process improvement tools, unpredictability, and investment issues were identified as significant hurdles for adopting lean practices despite GOI promotion to improve competitiveness. The statistical tool with cluster analysis was used; however, the study was confined mainly to India's western region and need to be further explored (Thanki and Thakkar, 2014).
- Lean six sigma was considered a business improvement tool to reduce waste and production costs and increase productivity and the quality of the products (Ghaleb *et al.* 2014). A comprehensive study (Hu *et al.* 2015) using previous research presented answers for how lean has been adopted, used, the impact of lean and critical enablers for lean in Indian MSMEs.
- Challenges like selecting QM tools, cost implications, and awareness of tools while implementing TQM were studied and addressed (Kharub and Sharma, 2016). They developed a framework linked with four classified critical success factors (Strategic, Tactical, Operational, and Quality tools) for identifying critical factors for the fruition of QM practices in Indian MSMEs.

- (Ravikumar *et al.* 2016) have identified various important factors for LMS initiatives and LMS implementation and come up with Management commitment and leadership as the most important factors while implementing lean in Indian MSMEs (Ravikumar *et al.* 2016).
- An SLR (Shrimali and Soni, 2017) identified essential success factors and critical constraints related to people, organisation, and technology. They summarised knowledge gaps, knowledge on lean tools, financial issues, and resource constraints. Finally, future research was suggested to resolve these constraints by awareness, training, and identifying resource requirements.
- A qualitative study by (Sahoo and Yadav, 2018) for process improvements, flow optimisation, and waste elimination revealed a significant positive impact on firm operations in MSMEs; however, it is not an easy task and faces many barriers like workmen attitude, insufficient knowledge, and awareness, top management commitment, insufficient resources, shortage of funds, lack of training. Going for new technologies and dealing with workers' attitudes towards accepting the change was suggested as a significant challenge to address in the future (Sahoo and Yadav, 2018).
- Lean implementation problems of Indian process industries were analysed by (Panwar *et al.* 2018). They conclude favourable influence of lean tools on operational performance like delivery on time, productivity, reduction in waste, yield, rework, reduction in WIP and cost. However, the study also highlights the limitation of the pull system in the process industry.
- Lack of SLR of literature on leanness assessment concerning organisational performance was addressed by (Sangwa and Sangwan, 2018), first by identifying various approaches of leanness assessment and secondly by providing a framework for leanness assessment (Sangwa and Sangwan, 2018). A study of the most easily approachable lean tools in MSMEs by (Shrimali and Soni, 2018) presented value stream mapping, standard operating (SOP), 5S, Poke-Yoke, continuous improvement (Kaizen), visual display management, SMED as commonly used lean practices.
- Key constraints and inadequate lean planning were identified as critical factors while studying Indian automotive SMEs. Confirmatory factor analysis resulted in refined factors like improper lean implementation methods, improper lean measurement, selection of lean tools, driving force, funds, and attitude to accept change as key constraints to lean implementation in Automotive SMEs. (Tiwari and Tiwari, 2018). Similar constraints such as uncertain leadership, shortage of resources, and poor communication by leadership were addressed by evaluating lean implementation barriers using the case studies. A model of an integrative structure was used, which was the first effort to identify lean constraints using a mathematical model (Yadav *et al.* 2018).
- Conceptual framework using a real case study to address dynamic demands to overcome the assumption of infinite capacity available in Indian MSMEs has revealed a new semiautomatic production planning approach with adjusting capacity. It is an extension of the MRP system with automation to generate job lists, schedules, and PO from the system (Jodlbauer and Strasser, 2019).

- Uncertainty and questions about the outcome of lean implementation on an organisation's achievement were studied using statistical data analysis of a total of 183 MSMEs of north India. Evaluation results concluded that lean practices could play a considerable part in the survival of MSMEs in the competitive market. TPM, JIT, 5S, and supplier management were key to firm performance; however, the study limits to the North Indian context and need to be evaluated from a broader perspective. (Saini and Singh, 2019).
- The depth of lean implementation concerning financial constraints in Indian MSMEs was studied using the interpretive structural model and AHP. The study highlighted eleven critical factors for successful lean implementation. Important factors included strong driving leadership, good communication skills, and training (Ravikumar, 2019). A similar study by Rathiet al. (2019) using AHP has resulted in a dearth of management commitment as a top hurdle while applying lean six sigma.
- Six sigma implementation framework using multi-criteria decision-making tool with the actual case study of Indian MSMEs producing public address system has resulted in significant improvements in quality level (Sigma) with minimum resources (Gupta *et al.* 2019)
- The Government of India (GOI) started a lean manufacturing competitive scheme (LMCS) to facilitate lean adoption in Indian MSMEs in 2009. The study used SAP-LAP analysis to answer essential questions about lean adoption as an effect of GOI measures (Matharu and Sinha, 2019). Lean manufacturing is an unavoidable tool to attain reduced cost, delivery on time, product quality, and growing competitiveness in MSMEs.
- Addressing lean barriers has become an essential factor for lean adoption, and hence the study of systematic evaluation to identify and eliminate critical barriers was done by (Jaiswal *et al.* 2020). Interdependence analysis using grey DEMATEL for 16 lean barriers has revealed limited funds, lack of management determination, concerns to adopt innovation, and leadership missing as four significant barriers to adopting lean practices. Similar challenges were identified while applying TPS was studied in Indian MSMEs. Only five practices, 5S, KANBAN, JIT, Training, and quality control, were popular within MSMEs (in Northern India) and highlighted the decreasing trend to adopt TPS (Akhtar and Ansari, 2020).
- The importance of lean manufacturing techniques to gain market competitiveness and productivity improvements were presented using a multi-case study approach in five years, highlighting their results of reduction of cost, improvement in quality, and work performance. An advance digital production (ADP) system was further suggested in Industry 4.0 (Bhattacharya and Ramachandran, 2021).
- A descriptive study by (Mishra *et al.* 2021) to find out LSS implementation specifically during Covid and post Covid times has suggested the framework to find out favourable and unfavourable factors for LSS implementation. Cost, limitation of resources, and skill, along with non-priority during Covid time, were major constraints reported in the study (Mishra *et al.* 2021).

In summary, implementing lean management tools is crucial for MSMEs to attain competitiveness. Most studies highlighted the importance of lean application and impediments to lean implementation in MSMEs. Moreover, there is a need to evaluate the long-term effect of LMS on organisational performance and to remain competitive in the global market.

3.2 Need for Lean Manufacturing

Lean manufacturing tools were found to succeed and answer competitiveness problems where manufacturers can streamline their processes. The identified need for lean manufacturing from studies is outlined in Table3.

Table 3 *Need for Lean Manufacturing in Indian MSMEs*

Sr. No	Need for Lean Manufacturing	Authors	Related Lean Tools
1	Elimination of waste	Mor *et al.* 2013; Ghaleb *et al.* 2014; Panwar *et al.* 2018.	Poke-Yoke, 5S, TQM, and lean six sigma reduce defects through overall process improvement, saving raw material requirements with Muda and customer complaints.
2	Cycle time reduction	Singh and Khanduja, 2010; Upadhye *et al.* 2010; Akhtar and Ansari, 2020.	SMED to save changeover time. 5S, Kanban, and JIT reduce product cycle time and scheduling and waiting time.
3	Set-up time saving	Singh and Khanduja, 2010; Upadhye *et al.* 2010; Mathur*et al.* 2012; Panizzolo *et al.* 2012.	SMED, VSM, OEE, and 5S are suggested to decrease machines' set-up time and processes.
4	Productivity improvement	Singh and Khanduja, 2010; Shrimali and Soni, 2017; Panwar *et al.* 2018.	Refers to worker's productivity by removing idling time and eliminating unintended processes and rework.
5	Work-in-process reduction	Yadav *et al.* 2018; Ravikumar, 2019; Saini and Singh, 2019.	JIT and Kanban reduced inventories between two processes, saving on colossal inventory carrying costs.
6	Improvement in quality and the Sigma levels	Panizzolo *et al.* 2012; Ghaleb *et al.* 2014; Kharub and Sharma, 2016; Yadav *et al.* 2018.	TPM, TQM, and lean six sigma were suggested to reduce rejections, improve sigma levels and overall quality performance.
7	Improvement in the firm performance	Sangwa and Sangwan, 2018; Yadav *et al.* 2018; Saini and Singh, 2019; Akhtar and Ansari, 2020; Bhattacharya and Ramachandran, 2021.	Manufacturing firms acquire the flexibility to manufacture a range of products with improved Productivity, cycle time, continuous improvement drive, and WIP reduction while practising the lean tools.

3.3 Important Lean Barriers Revealed from the Study

Need for lean manufacturing demands for lean implementation in Indian MSMEs. However, MSMEs are still struggling to implement lean on a full scale. Therefore, despite many researchers having identified different challenges and classified them into several categories, the following seven key challenges were prioritised from the studied literature (Section 3.1).

1. **Management Commitment:** Researcher, including (Tiwari and Tiwari, 2018; Yadav *et al.* 2018; Rathi *et al.* 2019; Ravikumar, 2019) has highlighted, If management intent is not visionary, it will not support and create the need or urgency of lean tools in the organisation. Management involvement is key to success right from roadmap setting, selection of lean tools, and resource provision. Hence lack of management commitment is the top barrier while implementing lean tools in Indian MSMEs (Tiwari and Tiwari, 2018; Yadav *et al.* 2018; Rathi *et al.* 2019; Ravikumar, 2019)

2. **Shortage of Funds:** The fund flow is another critical barrier in lean adoption. Funds are required for resource planning, training of the employees, and hiring of lean consultants (Ravikumar *et al.* 2016). Unfortunately, lean tools many time do not yield direct financial returns on investment (ROI) but help indirectly to eliminate/reduce waste; hence many organisations are not keen to invest upfront in the implementation of lean tools (Kumar *et al.* 2014; Tiwari and Tiwari, 2018; Jaiswal *et al.* 2020).
3. **Hesitation to Adopt Technology and Change:** Human intervention is essential for LMS implementation (Mostafa, *et al.* 2013). Fear of failure, resistance to change from routine practice, job insecurity, low competence, and high investments are discussed as the common causes for hurdles in lean adoption. These barriers can be removed by proper communication and awareness training, in short, by motivating environment (Gupta and Jain, 2013; Shrimali and Soni, 2017; Tiwari and Tiwari, 2018; Sahoo and Yadav, 2018).
4. **Poor Leadership:** Apart from top management interest, poor leadership is the cause of failure to lean adoption. A strong and committed leader can drive the change adoption in organisational culture by pointing the right direction of continual improvement to employees. Therefore, to implement lean successfully, management should hire a competent leader (Sahoo and Yadav, 2018; Yadav *et al.* 2018; Alkhoraif *et al.* 2019; Jaiswal *et al.* 2020).
5. **Lack of Awareness and Poor Selection of Lean Tools:** Many researchers identified insufficient knowledge of lean tools as one of the critical barriers to address. Training and awareness of lean tools are vital to the employee and organisation, without which they will not pick the correct lean tool. Moreover, insufficient knowledge of lean tools will always lead to improper implementations and sometimes failures (Srinivasaraghavan and Allada, 2006; Mathur *et al.* 2012; Shrimali and Soni, 2017; Sahoo and Yadav, 2018; Tiwari and Tiwari, 2018; Jaiswal *et al.* 2020; Bhattacharya and Ramachandran, 2021).
6. **Lack of Education and Poor Communication:** Clear communication throughout the value chain is required to implement lean tools successfully (Brown *et al.* 2006). Inadequate knowledge and poor communication to supply chain partners were analysed as the main hurdles from converting batch to lean process. Lack of education on lean tools can be addressed through proper awareness and training (Thanki and Thakkar, 2014; Sahoo and Yadav, 2018; Rathi *et al.* 2019).
7. **Lack of Resources and Infrastructure:** Resource can be defined as Men, Machines, Money, Technology, Time, and communication. Lack of skill, new technology, or time will become the main hurdle in proper lean implementation. The role of top management and GOI is important here to create a favourable infrastructure for lean implementation (Thanki and Thakkar, 2014; Tiwari and Tiwari, 2018; Jaiswal *et al.* 2020; Mishra *et al.* 2021).

The above key lean barriers can help Indian MSMEs to address these challenges for the successful implementation of LMS. Moreover, the covid 19 pandemic in today's global conditions has added a new challenge of "lack of priority on implementing lean tools", which remains a contemporary challenge above all (Mishra *et al.* 2021).

3.4 Tools and Practices under Lean - Discussed in the Studies

Different researchers and large industries suggest the number of lean tools (Figure 6); however, MSMEs use certain lean tools from the list, which seems best suitable for mass production and require less investment and resources.

SMED	Single-minute exchange of dies mainly reduces changeover/set-up time drastically.
JIT	Just in time, i.e., processes are organised when required, a pull concept originated from TPS and generally reduced delays and time in the system.
Kanban	It is a visual card and two-bin system that reduces idle time and part of JIT.
Kaizen	Its continuous improvement drives for reducing/eliminating waste, improving productivity, and quality improvement.
5S	The workplace is kept clean and tidy with a 5S system: "sort, set in order, shine, standardise, and sustain". This practice helps to reduce time and waste.
TQM	The dynamic process of total quality management for reducing rejections and errors facilitates a smooth supply chain.
TPM	Total productive maintenance focusing on the "Overall Equipment Efficiency" (OEE)
Value Stream Mapping:	Value-added processes concerning customers are defined initially through the activity flow chart, and nonvalue added processes are identified for elimination.
Visual Management	It is a visual display of expectations in work instructions, Do's and Don'ts, Standards, or Procedures that helps workers facilitate work with minimal training.
Waste elimination	It is a determinant part of an LMS to add value and profitability by identifying and eliminating waste.
Poke-Yoke	In other words, mistake-proofing is a practical approach to prevent mistakes.
Lean Six Sigma	Reduce waste and rejections by applying a combination of the lean and statistical six sigma tools.
Line balancing	Its process synchronises operator and machine time to match the required output rate of the product.
Cellular layout	The layout is made suitable to group equipment as per process need and for similar products.
OEE	Overall, equipment efficiency takes care of machine downtime, efficiency, and productivity.
SOP	Standard operating procedure for deskilling of work. Visual display with the operating procedure.

Figure 6 *Lean Tools/Practices Discussed in the Studies*

Despite different lean tools discussed above, LMCS covers only eleven lean tools and needs to be revised to add new lean tools like TQM, lean six sigma, waste elimination, line balancing, OEE, which are now practised in Indian MSMEs and can benefit them in a greater perspective.

3.5 Effect of Lean Implementation on Organisational Performance

A total of eight case study articles were selected to evaluate the implementation of lean tools in the state to examine the barriers and effects of the Lean execution in MSMEs resulting in performance improvement. Summary results are in Table 4.

Table 4 *Evaluation of lean from Various Case Studies Discussed in Studied Literature*

Author	The Objective of the Study	Lean Tools Applied in Case	Lean Tools Implementation Area	Result of Study
Singh and Khanduja, 2010	To exhibit the importance of rapid changeover of die casting tools in Indian foundry.	SMED: Single minute exchange of dies	Indian Foundry (Escort Piston) implementing SMED model in Bahadurgarh, North India	Application of the SMED model has resulted in the reduction of 48% of the time for the set-up of die-casting tools compared with earlier data before implementation.
Upadhye *et al.* 2010	Identify issues of MSMEs and study the effect of LMS implementation using a case of TCL	OEE, VSM, SMED, POKA-YOKE, and Kaizen	TCL – Tier 1 Auto component: Crankshaft manufacturing from North India.	Observed improvements in Machine set-up time by 50%; OEE improvement by 10%; Cycle time reduction by 15%; Rejection Reduction by 25%; Production capacity improvement by 15%.
Panizzolo *et al.* 2012	Lean production applications	SMED, TPM, JIT	Western India Company A: Syringe manufacturer Company B: Small scale ball bearing company Company C: Export-oriented Company D: Leader in breaks and clutches	Concludes improvements in many operational benefits like delivery performance, cycle time reduction, productivity, quality, customer complaints, set up times were noticed after implementing lean practices in all four companies.
Mathur *et al.* 2012	Proposal of simple scheduling model and its application in spring manufacturer for productivity improvement	Scheduling model, SMED, Lot size optimisation, Sequencing, SUR	SS Spring manufacturing SME Jaipur, India	Using SMED and SUR, a Set-up time reduction of 22% was achieved by the company; similarly, substantial productivity improvement was seen by applying economic batch sizing and simple sequencing as well as machine rearrangements.
Mor *et al.* 2013	To study various issues concerning productivity in a partially integrated manufacturing firm and address them with Lean tools	Standardised work, 5S technique, Kaizen, Line balancing	Automotive MNC to deal with poor productivity problems in North India.	Juran's Pareto, as well as cause-effect principles, were used to identify major troubling machines and initiate the actions which have reduced total downtime by 4% and resulted in a 2.5% productivity improvement.
Yadav *et al.* 2018	To find out Barriers for Lean implementation through 3 case studies	JIT, 5S, SMED, Visual controls, Lot size-reduction	Three MSMEs Dealing with Surgical needles, Water purifiers and Ball bearing in Rajasthan, India	Company A and B noticed an improvement in downtime, reduced cycle time, reduced work-in-process, set-up time, and productivity for

				18 months implementation of lean.
Gupta *et al.* 2019	To propose a framework to demonstrate the adoption of six sigma.	Dematel; Six sigma hybrid model	Quality and productivity enhancement of Small-Scale manufacturing in India	Improvement in sigma levels by prioritising the highest effective corrective action for process improvements and effective tools to MSMEs for decision making.
Bhattacharya and Ramachandran, 2021	To study the results of LMS implementation under the LMCS scheme	5S, Kaizen, SOP, Visual management, Training	23 MSMEs in brass, Pump, Machinery, Packaging, Textile, and garments selected from cluster under LMCS scheme.	Resulted in reducing production cost, Productivity improvement, and an average of INR 28.35 Lacs realisation per unit in cluster after completion of 18-month of lean adoption.

Along with many tangible benefits, many researchers studied the results of LM practices evaluating the KPI of the organisations and ultimately firm performance. Enhancing competitiveness in terms of speedy response to dynamic changes, efficient business processes, and revenue generation with reduced waste, reduced cycle time, improved productivity, improved quality, enhanced delivery performance, and less downtime were positive outcomes seen from the identified case studies. In addition, MSMEs can reduce their manufacturing costs by selecting and implementing lean tools irrespective of size and type of industries, from Indian foundries (Singh and Khanduja, 2010) to the export-oriented MSMEs (Panizzolo *et al.* 2012). Ultimately overall organisational performance of MSMEs improved after adopting LMS.

3.6 GOI Efforts to Promote LMS in Indian MSMEs

GOI encourages MSMEs under lean manufacturing competitiveness schemes (LMCS) and start-up India to adopt lean benefits through a structured lean program. Identifying industry clusters followed by a lean awareness program, providing and helping them through lean consultants, international consultants, progress monitoring, and financial aid to encourage LMS implementation and these are vital steps under LMCS (Bhattacharya and Ramachandran, 2021). Government policies and promotions, MSMED act, SMED Organizational learning and awareness, collaboration with experts, use of statistical tools to find barriers, flexibility at a strategic level, employee empowerment, awareness workshops programs, lean manufacturing competitiveness scheme (LMCS), provision of common facilities like R&D lab are some of the promotional measures by GOI to address lean barriers. (NMCP, 2013; Thanki and Thakkar, 2014; msme.gov.in, 2016; Matharu and Sinha, 2019).

GOI published guidelines for lean implementation in 2013 and provided financial aid under LMCS (msme.gov.in, 2016; Matharu and Sinha, 2019). As a result, around 3732 MSME beneficiaries were reported for the 2009-2013 plan (msme.gov.in, 2016). However, it was observed that while large enterprises are adopting LMCS, the MSMEs were staying out because of a lack of awareness of benefits (NMCP, 2013). In addition, looking at the size of MSMEs in India, the financial aid is small, and there is a need

for further study to understand the direct impact of GOI promotional schemes on the benefit of Indian MSMEs.

In the recent period, GOI's increased in the percentage share of MSMEs to 60% in total exports under Atma nirbhar Bharat Abhiyan. However, at the same time, a pandemic has hit all over the world, including India; hence the effectiveness of such plans are really at stake (Mukherjee and Mukherjee, 2021). Hence, GOI will have to put substantial efforts to establish a mass awareness campaign for lean adoption in MSMEs.

4. Discussion and Findings

Lean adoption can be seen as a definitive solution for Indian MSMEs to become competitive and sustain competition from Indian large industries and global players. Most of the studies focus on identifying critical lean barriers and the effects of lean implementation. This SLR study mainly focuses on analysing selected literature to understand the status and depth of adopting LM practices in Indian MSMEs to face dynamic conditions and attain competitiveness.

The study started with a four-phase SLR (Section 2) in a specific domain of lean manufacturing practices in Indian MSMEs and GOI promotional schemes. Selection and review with four-phase SLR (PDCP) with the integration of the PDCA cycle for analysis is the unique attempt of the study.

Classification of literature (Section 2.3) has helped arrange the studies concerning author, year, the focus of the study, type of study, and outcome of the study. Around 66% of total studies have used a survey-based approach followed by actual case studies with 26% and lean philosophies in 8%. Hence, most studies are centred on a survey-based approach, and very few studies have applied quantitative methodology. Moreover, most of the studies are focused on the MSME's in the Northern, Eastern, and Western regions of India, and similar studies need to be extended to the southern part of India to cover all regions.

Overview of literature (Section 3.1) has resulted in a need for lean manufacturing in Indian MSMEs (Section 3.1), and also in understanding pertinent barriers for adopting lean tools Section (3.2) in MSMEs**.** Therefore, the following seven key lean barriers were prioritised and discussed in detail, which can help Indian MSMEs to identify and address relevant barriers while implementing LMS.

1. Management commitment
2. Shortage of funds
3. Hesitation to adopt technology and change
4. Poor leadership
5. Lack of awareness and poor selection of lean tools
6. Lack of education and poor communication
7. Lack of resources and infrastructure.

The type of lean tools used and suggested in studies discussed (Section 3.4) highlight all-new tools like TQM, lean six sigma, waste elimination, line balancing, OEE other than 11 tools covered under the LMCS scheme. Insights from case studies are discussed under (Section 3.5), which helped understand the benefits of lean adoption to improve global competitiveness and overall organisational performance. Positive results of LM practices can be seen irrespective of the size and manufacturing

organisation; however, there is scope to study implementation effect over a longer period as a continuous improvement cycle.

GOI measures to promote LMS under the LMCS scheme and Government policies and promotions and awareness drive are discussed in (Section 3.6), highlighting the need for mass campaign drive and wide coverage of lean tools to implement promotional schemes effectively.

5. Conclusion

LMS is key for Indian MSMEs to respond to changing market conditions and attain global competitiveness. Lean philosophy is a widely accepted practice worldwide. Its lack of awareness on lean tools and hesitation to change and adopt lean need to be addressed by teaching/training lean philosophy.

Lean reviews and surveys in various industries, including processes in Indian MSMEs, had shown a positive impact on operations as well as firm performance, and we could witness a fair amount of lean benefits data; however, the direct impact of GOI schemes and benefits concerning awareness to MSMEs and performance of MSMEs need to be studied in more detail.

Case studies evaluated the benefits of LMS implementation followed by awareness about lean tools and their tangible benefits in cycle time reduction, inventory reduction, waste elimination, productivity improvement, quality improvement, delivery performance, and overall cost reduction, leading to improved organisational performance. In addition, intangible benefits like reducing stress, ease of flow, and efficient business processes are other advantages.

The finding of this study and future research directions will help lean practitioners and researchers while understanding and aligning measures to address the identified constraints of LMS implementation in Indian MSMEs.

6. Research Limitations and Future Research Directions

Although there is a fair amount of literature available in lean manufacturing, the literature on the direct impact of GOI promotional measures in lean implementation was found scarce. It is worth researching this domain in detail. Most of the case studies are from Eastern, Western, and northern parts of India as far as the MSME field is concerned, and in limited numbers; hence the scope of studies concerning MSMEs of the southern part needs to be evaluated.

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