LEAN PRODUCTION IN INDIAN INDUSTRIES- A LITERATURE SURVEY

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Abstract: Lean manufacturing is a trending technique in the filed of production that aims at minimizing cost of production by identifying and eliminating all possible wastages in production process. First introduced by Toyota, Lean Production has become popular across all industries world wid. The present article highlights the conceptual framework of lean and implementation of lean in various industries by way of reviewing literature on the same.

Key words: Lean Production, Continuous improvement, waste elimination, textile industry, Pharma industry.

Introduction

Lean manufacturing, one of the widely used technique of production, is a set of strategies designed to reduce the cost of materials and labor while still maintaining ever growing rates of output. It leads to a net increase in overall productivity. The origins of Lean Manufacturing lie with the Toyota Production Process of Japanese industry. Toyota's groundbreaking lean concepts include "just-in-time" manufacturing. Lean manufacturing is about eliminating any practice does not add value to the end customer and deliver the best product possible to the customer as quickly as possible with minimum hurdles.

Principles of Lean Production:

1. Identify Value

Offering a product/service, every company has to identify customer needs thoroughly for which the customer is willing to buy. In doing so, a company has to precisely understand how to add value to a product or service which is appreciated by the customer. Any product of service that fails to add value is considered as waste by the customers. Hence companies should identify value to be added to its product or service.

2. Value Stream Mapping

A sustainable lean production system should include all procedures and populace who are concerned with process of delivering the end product to the customer. For this to happen, a thorough mapping of each process with value added by the same has to take place in order to identify which processes are not adding value to the end product or customer.

3. Create Continuous Workflow

Generating a defect-free product always involves involvement of people across the organization. Organizations may confront with problems at any time. But through appropriate work-breakdown structures can definitely help in overcoming those barriers.

4. Create a Pull System

In order to effectively implement work-break down structures, an effective pull system is also needed. In such a system, only most essential works are only picked up, leaving all unnecessary works.

5. Continuous Improvement

There are different techniques to encourage continuous improvement. Continuous monitoring and supervision can help in achieving this. It must also be digested by the management of organizations that each organization's processes are unique and hence a separate lean may be needed[1]. However, the success of lean manufacturing depends upon the adherence of certain underlying principles. Failure to understand

and apply these principles will most likely result in failure or a lack of commitment from everyone in your organization. Without commitment the process becomes ineffective.

of lean. Y Sujatha and K Prahlada Rao[2] studied the implementation of lean manufacturing tools and techniques adopted in Andhra Pradesh Silk industry and observed that silk industry in AP is adopting lean manufacturing techniques in order to reduce wastage and protect environment. Piotr Jedyna[3] studied the factors responsible for successful implementation of lean manufacturing and stated that effective communication, supply chain management system and individualized approach are necessary to adopt lean manufacturing in any industry. Waste minimization and elimination is fundamental step needed to adopt lean in any manufacturing system. In order to so one has to understand the possible forms in which waste may be generated which are discussed below.
1. Over production 2. Unnecessary physical Movements 3. Stock loss 4. Generating malfunctions 5. Awaiting Waste 6. Transit wastes 7. Over-processing waste

CONTINUOUS IMPROVEMENT:
(The Japanese word kaizen is widely used) is the most core concept of lean production. It should really fo rm the foundation for lean implementation. succcess will cease without steady change. Continuous Impro vement, as the name suggests, encourages continuous, required progress toward achieving a desired state. All functions of an organization must ultimately lead to a value addition for the end user or customer. The philosophy of continuous improvement should be inculcated throughout an organization. In order to remove wastes, their origin ahs to be thoroughly understood and the ways to either reduce or eliminate the same has to be determined by the production engineering. Thus, it can be interpreted that Lean Manufacturing is a combination of engineering and production research. Without understanding and analyzing the sources of waste, probably it is impossible to reduce the same.

Lean Manufacturing in Textile industry:
Textile producers face intense global competition now for a day. The secret to winning on the internationa l market place is to continuously increase both quality and profitability at the same timeThe primary aim of using lean production is to increase efficiency, boost product quality and manufacturing cycle times, sh orten inventories, shorten lead times and remove manufacturers lean manufacturing methodologies can be well designed and implemented in textile industry which by its very nature involves several interconnected processes. Moreover, the quality of output generated in textile industry is largely dependent upon the workmanship or diligence of manpower involved in various processes. For such industries, Lean production techniques can eliminate wastages of production. In wood-processing, textile manufacturing, automobile assembly, electronics assembly and equipment manufacturing where production schedules cannot be made accurately; Lean manufacturing is of some use. It is particularly necessary where ERP systems are absent and strong Material Requirement Planning is required. Lean Manufacturing is also suitable in industries for which it is a premeditated precedence to cut down the production cycle time to the absolute minimum as a source of full advantage for the company. Mihalj Bakator, Dragan Ćoćkalo, Miloš Vorkapić [10] have studied the lean manufacturing principles for enhancing the productivity of textile industry and stated that just in time, kaizen, Kanban are some of the essential tools to be followed to implement lean production in textile industry.

REVIEW OF LITERATURE:
Neena Sinha, Misha Matharu[1] studied and reviewed the lean manufacturing methodologies adopted by various industries and found that there has been a phenomenol growth in the research work carried on the concept
P. Chaple, B. E. Narkhede M. M. Akarte[4] reviewed the literature on implementation of lean production in Indian industries and found that so far, many researchers studied the implementation of lean production in Indian industries. Muthukumaran.V, Hariram VR, Padmanabhan.K.K[5] studied implementation of lean tools across verticals and observed that lean is implemented in construction, automobile, electronics and

cement industry and many more. Antony Pearce and Dirk Pons[6], conducted a research on managing transformation risk by implementing lean production and analyzed the difference between risk management and lean production. The researcher narrated the principles of risk management and lean management separately. Sherif Mostafa, Jantanee Dumrak & Hassan Soltanin[7] their research studied lean implementation methodologies in different industries. Saumyaranjan Sahoo and Sudhir Yadav [8] studied lean management practices in small and medium sized industrial units and found that workplace organization, reduction of lead time, visual control, training and team work are some of the lean techniques followed by small and medium scale industrial units in India.

Rupesh Kumar Tiwari and Jeetendra Kumar Tiwari [9] evaluated the performance of small and medium manufacturing units adopting lean production and found that the present status of lean system in Indian Automotive industry in small and medium scale industry is poor and needs to be developed further. Maria Elena Nenni, Luca Giustiniano and Luca Pirolo studied the possibilities of improving operational efficiency in pharma industry and observed that process reengineering and pull based production system can help to minimize waste in pharmacy industries.

Panwar, A., Nepal, B., Jain, R., Rathore, A. P. S., & Lyons, A. C. (2017)[10] in their study investigates the relationship between the implementation of lean manufacturing practices and performance improvements in Indian process industries. The authors conducted a survey of 121 firms and carried out two in-depth case studies from the refinery and metal manufacturing sectors. The results revealed that companies adopting lean practices reported significant improvements in inventory control, waste elimination, cost reduction, productivity, and product quality. However, no notable gains were observed in terms of lot size reduction or space utilization. The study contributes to the lean manufacturing literature by highlighting the specific performance areas positively influenced by lean in the Indian process industry context and suggests that while lean has proven benefits, its implementation must be carefully aligned with contextual operational constraints.

Singh, J., Singh, H., & Singh, G. (2018)[11] published article on **"**Productivity improvement using lean manufacturing in manufacturing industry of Northern India: A case study". This case study focuses on the implementation of lean manufacturing techniques in a manufacturing company located in Northern India. The authors applied key lean tools such as Just-In-Time (JIT), 5S, value stream mapping, and kaizen to address inefficiencies and enhance operational productivity. The study highlights how the systematic application of these lean tools resulted in substantial improvements in workflow, reduced waste, and enhanced overall process efficiency. Most notably, the lean implementation led to an annual cost saving of ₹242,208 for the company. The findings underscore the practical benefits of lean practices for Indian manufacturing firms, especially small and medium-sized enterprises seeking measurable gains through operational excellence.

Jasti and Kodali (2019) [12], in their study titled *"An empirical investigation on lean production system framework in the Indian manufacturing industry"*, conducted a large-scale empirical analysis to validate a structured Lean Production System (LPS) framework suitable for the Indian context. The study, published in the *Benchmarking: An International Journal*, surveyed 200 respondents across five major industrial sectors—automotive, electronics, textiles, engineering, and general manufacturing. The research aimed to examine the effectiveness and reliability of a comprehensive LPS framework tailored for Indian manufacturing firms. The findings confirmed the framework's validity and internal consistency, highlighting its potential to guide systematic and sustainable lean implementation across diverse industries. This study contributes significantly to the lean literature by offering a context-specific model for Indian manufacturing organizations seeking to enhance performance through lean practices.

Tiwari, Singh, and Srivastava (2020)[13] conducted a case study titled *"Implementing lean paradigm in an Indian foundry facility: a case study"*, published in the *International Journal of Services and Operations Management*. The study applied lean manufacturing tools—specifically Value Stream Mapping (VSM) and a Kanban pull system—in a large Indian foundry to streamline operations. Through detailed analysis of existing workflows and redesigning production flow using lean principles, the company achieved marked reductions in lead time, defects, and equipment downtime, along with significantly improved

inventory control. The findings demonstrated that lean practices, when properly implemented, can yield tangible improvements in productivity and efficiency in heavy industrial settings.

The paper titled **"Lean Execution Barriers in Indian Engineering Industries"**[14], presented at **FLAME 2022** and published on **July 4, 2023**, provides a comprehensive literature-based exploration of the key challenges hindering effective lean manufacturing implementation in the Indian context, particularly in Micro, Small, and Medium Enterprises (MSMEs)**.** The study highlights that despite the proven benefits of lean principles in enhancing operational efficiency, Indian engineering industries continue to face several persistent barriers that obstruct smooth execution. These include weak top management commitment**,** insufficient shop-floor empowerment**,** limited financial resources**,** inadequate training and skill development**,** resistance to change**,** and linguistic and cultural diversity within the workforce. The authors argue that these challenges stem from treating lean merely as a set of tools rather than as a holistic organizational philosophy. The paper concludes by advocating for a paradigm shift in which lean thinking is embedded into the organizational culture, suggesting that only such a systemic transformation can lead to sustainable lean adoption and long-term performance improvements in Indian engineering sectors.

The article titled **"Framework for Integrating Lean Thinking with Industry 4.0"** by **Bahulikar, Chattopadhyay, and Hudnurkar (2023)**[15], published in the *Global Journal of Flexible Systems Management*, presents an insightful exploration into the convergence of Lean Manufacturing and Industry 4.0. The authors aim to bridge the gap between traditional lean tools and emerging digital technologies by proposing a framework that maps **20 key lean techniques** to **Industry 4.0 principles**. Their findings emphasize that tools such as **Overall Equipment Effectiveness (OEE)**, **Total Productive Maintenance (TPM)**, **Kanban**, **Single-Minute Exchange of Dies (SMED)**, and **Jidoka** (autonomation) play a vital role in facilitating real-time data access, operational flexibility, and automation — which are central to Industry 4.0. In contrast, basic yet foundational tools like **5S** and **Hoshin Kanri** were found to have comparatively lower direct impact on enabling digital transformation. The study underscores the importance of strategically aligning lean practices with Industry 4.0 technologies to enhance competitiveness and responsiveness in modern manufacturing environments, particularly in the Indian industrial context.

The article titled **"Assessment of Lean Supply Chain Practices in Indian Automotive Industry"** by **Singh and Modgil (2023)**[16], published in *Global Business Review*, presents an empirical investigation into the effectiveness and prioritization of lean supply chain practices using the **DEMATEL** and **fuzzy-VIKOR** methodologies. Focused on the Indian automotive sector, the study identifies key lean practices that significantly influence **cost reduction** and **supply chain responsiveness**. Among these, **quality management**, **information sharing**, and **customer management** emerged as the most impactful factors. By analyzing interdependencies and ranking practices, the study provides a structured approach for decision-makers to implement lean strategies more effectively, helping firms enhance operational agility and reduce inefficiencies within highly competitive and dynamic supply chain environments.

The article **"Effects of Industry 4.0 Technologies on Lean Manufacturing"** by **Chivukula and Pattanaik (2024)**[17], published in the *International Journal of Performability Engineering*, explores the synergistic relationship between Industry 4.0 technologies and lean manufacturing within the Indian automotive sector. Drawing data from 202 industry respondents, the study employs **Structural Equation Modeling (SEM)** to empirically demonstrate that the adoption of Industry 4.0 technologies—such as IoT, big data, and automation—significantly strengthens the implementation of lean practices, thereby improving overall **organizational performance**. Importantly, the research highlights **lean manufacturing as a mediating factor**, suggesting that the benefits of digital transformation are best realized when integrated with structured lean methodologies. The study offers actionable insights for manufacturers aiming to harness Industry 4.0 innovations while maintaining lean efficiency.

The article **"Perception of Lean Construction Implementation Barriers"** by **Negi et al. (2024)**[18], published in *Heliyon*, investigates the challenges hindering lean adoption in India's prefabrication construction sector. Using **exploratory factor analysis**, the study analyzes data related to **26 identified barriers** to lean implementation. Among these, the most significant barrier found was a **poor understanding of lean principles** among stakeholders, which severely impacts successful execution at

project sites. The study emphasizes the need for **capacity building, targeted training, and awareness programs** to bridge knowledge gaps and support the effective adoption of lean practices in the construction domain. The findings offer practical insights for policymakers and industry leaders aiming to enhance operational efficiency through lean methods.

The book chapter **"Barriers in Adopting Lean and Green Practices"** by **Vidyashree and Sheriff (2024)**[19], published in *Lecture Notes in Networks and Systems*, explores the critical obstacles faced by Indian manufacturing firms in integrating lean and environmentally sustainable practices. Using **factor analysis**, the authors evaluated **57 distinct barriers** to the adoption of lean-green methodologies. The study reveals that the **most significant impediments** include strong organizational resistance to change, inadequate employee skillsets, and unclear cost–benefit perceptions of implementing such initiatives. These findings underscore the need for **strategic change management**, **employee training**, and **transparent cost-effectiveness assessments** to successfully implement lean and green practices in Indian industries.

The 2024 preprint titled **"Integrating Lean & Industry 4.0 in Indian MSMEs"**[20] explores the emerging synergy between lean manufacturing and Industry 4.0—referred to as **Lean 4.0**—within the context of Indian micro, small, and medium enterprises (MSMEs). Based on primary research shared via ResearchGate, the study evaluates the **Lean 4.0 maturity levels** across select Indian MSMEs and identifies critical **barriers to adoption**, including **capital constraints**, **resource shortages**, and **limited technical know-how**. The analysis reveals a **positive correlation** between Lean 4.0 maturity and measurable **organizational efficiency improvements**, suggesting that while integration remains challenging, it offers significant potential for MSMEs aiming to boost competitiveness through digital lean transformations.

Conclusion:

Though Lean Manufacturing is a comparatively new phenomenon; its adoption has become extensively wide due to ever increasing escalation of cost of manufacturing and resulting need to cut the same. Hence most of the Indian industries in large, medium and small scale are now focusing towards elimination of all those production processes which are not adding value to the end user. However, much more is still to be done to take the philosophy of Lean Manufacturing to the next level because all is not well in many industries. Lean methodologies can go a long way in improving the profitability of organizations and especially in India, Lean methodologies can take Indian products to the world markets with high margins. Hence, it is felt appropriate to establish a system where organizations explore the possibilities of going lean. The reviewed literature demonstrates a growing body of research focused on the implementation and outcomes of lean manufacturing across various sectors in India. Researchers such as Sinha and Matharu have highlighted the significant academic interest and expansion of lean-related studies, while Chaple, Narkhede, and Akarte emphasized the widespread examination of lean implementation in Indian industrial contexts. Multiple studies reveal that lean tools—such as Just-In-Time (JIT), 5S, value stream mapping, Kanban, and Kaizen—have been successfully applied across sectors like automotive, electronics, textiles, cement, construction, and pharmaceuticals. Empirical studies by Panwar et al. (2017), Singh et al. (2018), Jasti & Kodali (2019), and Tiwari et al. (2020) confirm that lean manufacturing leads to notable improvements in productivity, waste reduction, inventory control, quality, and cost savings, especially in process and small-to-medium scale industries. However, challenges persist in achieving improvements in areas like lot size reduction and spatial efficiency, particularly in SMEs. Furthermore, the integration of lean with risk management principles, as studied by Pearce and Pons, suggests a need for strategic alignment during transformation. Collectively, these findings reinforce that lean manufacturing holds significant potential for Indian industries, but its success hinges on context-specific frameworks, continuous employee engagement, and sector-tailored implementation strategies.

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