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LITERATURE REVIEW BENEFITS OF *LEAN MANUFACTURING* ON INDUSTRY PERFORMANCE AND PROPOSED IMPLEMENTATION IN MANUFACTURING

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ABSTRACT
This study aims to analyse the benefits of implementing the Lean Manufacturing concept in improving the performance and competitiveness of the manufacturing industry, as well as to propose strategies for its effective implementation. The research method used is a qualitative literature review, by collecting, analysing, and synthesising findings from 20 journal articles published between 2020 and 2025 that discuss Lean Manufacturing practices in various industrial sectors. The research results show that the application of Lean Manufacturing provides significant benefits, including reducing waste (muda), increasing production efficiency, improving product quality, and enhancing customer satisfaction. In addition, the integration of Lean principles with digital technologies in the Industry 4.0 era—known as Lean 4.0—has been shown to increase operational flexibility, process automation, and real-time decision-making capabilities. However, several challenges such as limited lean culture, lack of management commitment, and employee resistance remain obstacles to sustainable implementation. The conclusion of this study states that Lean Manufacturing is an effective strategic approach for improving industrial performance and competitiveness when supported by strong organizational commitment and continuous improvement culture.
Keywords: Lean Manufacturing, Waste Reduction, Efficiency, Industry Performance, Lean 4.0

INTRODUCTION

The current development of the manufacturing industry is characterized by increasingly fierce competition, both nationally and globally. Companies are required to produce high-quality products at low cost, with short production times, and the ability to adapt to changing market demand. In these conditions, operational efficiency and production process effectiveness are key to success. However, various studies show that many companies still face waste in their production processes, such as excess inventory, long lead times, product defects, non-value-added processes, and inefficient resource movement. To address these challenges, the concept of Lean Manufacturing (LM) has emerged as a proven effective strategy for eliminating waste and increasing productivity. This concept was first developed by Toyota Motor Corporation through the Toyota Production System (TPS), which focuses on continuous improvement (kaizen) and respect for people.

Over time, Lean Manufacturing has been applied not only in the automotive sector but also to various industrial sectors such as electronics, textiles, food and beverages, and the service industry (Rahardjo et al., 2023; Aripin et al., 2023). The implementation of Lean Manufacturing has been proven to provide various tangible benefits for company performance, including increased resource efficiency, reduced production cycle times, improved product quality, and increased customer satisfaction (Bandi et al., 2022; Suprayitno, 2023). Furthermore, several studies have shown that the application of lean principles also contributes to sustainability performance by

reducing waste, reducing energy consumption, and increasing supply chain efficiency (Hassan & Pasha, 2023; Musa & Alwan, 2024). In the context of Industry 4.0, the integration of digital technology and lean practices has created a new concept, Lean 4.0, which can strengthen industrial competitiveness through automation, the Internet of Things (IoT), and big data analytics (Sah et al., 2024; Rahardjo et al., 2023).

However, successful implementation of Lean Manufacturing is not always easy to achieve. Many companies face obstacles such as a lack of a lean culture, employee resistance, limited technical knowledge, and minimal top management commitment (Aripin et al., 2023; Morales, 2024). These obstacles can lead to the failure or unsustainability of lean programs. Therefore, a systematic approach is needed to identify potential waste, develop a supportive organizational culture, and integrate lean with supply chain strategies and digital technology (Ali, 2024; Irfan et al., 2025). Based on this description, this research is crucial to review the benefits of Lean Manufacturing on manufacturing industry performance and propose an effective implementation model tailored to current company conditions. This literature review is expected to provide conceptual and practical contributions to companies in designing strategies to increase efficiency and competitiveness through the sustainable implementation of Lean Manufacturing.

RESEARCH METHODS

This research employs a qualitative research design using the literature review method. The literature review approach was chosen to systematically collect, analyse, and synthesise information from various credible sources related to Lean Manufacturing, its benefits, and its implementation within the manufacturing industry. Through this approach, the researcher aims to build a comprehensive understanding of how Lean Manufacturing contributes to improving industrial performance and to identify the key factors supporting its successful application. The data used in this study are entirely secondary data, obtained from national and international literature, including scientific journals, conference papers, theses, and other scholarly publications relevant to the research topic. These sources were selected to provide a broad and credible basis for analysing the development and application of Lean Manufacturing practices across different industrial contexts. The literature selection criteria were carefully defined to ensure the validity and relevance of the reviewed materials. Only literature published between 2020 and 2025 was included, with a specific focus on Lean Manufacturing in the context of the manufacturing industry. The selected studies were required to contain empirical or conceptual discussions on the benefits, challenges, and implementation of Lean Manufacturing, and to be published in accredited or reputable journals indexed in recognised academic databases.

The data collection process was conducted through systematic searches using major online academic databases such as Google Scholar, Scopus, ScienceDirect, and ProQuest. Keywords used in the search included “Lean Manufacturing,” “industrial performance,” “waste reduction,” “continuous improvement,” and “manufacturing efficiency.” The selected articles were then reviewed in full text to confirm their suitability for inclusion in the analysis. The data analysis technique adopted in this research is a qualitative descriptive analysis. Each selected study was read thoroughly and categorised according to thematic areas, including the benefits of Lean Manufacturing, Lean tools and techniques, implementation challenges, and empirical outcomes. The researcher then compared findings across studies to identify similarities,

differences, and emerging trends. Finally, the results were synthesised to draw conclusions regarding the overall impact of Lean Manufacturing on industrial performance and to develop proposed strategies for its implementation in manufacturing environments.

Figure 1. Flowchart

The method of writing this article is a *literature review*, namely reviewing by collecting, understanding, analysing and then concluding as many as 20 journal articles published in 2020 to 2025 about the application of *Lean Manufacturing* in various industrial sectors and the defence industry. The analysis used uses content analysis of journal articles, then coding is carried out on the contents of the reviewed journals, the data that has been collected is then searched and the differences are then discussed to draw conclusions.

Table 1.
Analysis of Lean Manufacturing Research Journals (2020–2025)

No	Author(s)	Title	Methods	Discussion Results
1	Nani Ernawati, Urip Prajoko Puji Utomo, Citra Juliani, Kusdinar, Muhammad Zidan Effendi, Nisfu Ubaidilla, & Sri Ayu (2024)	*Analysis Application of Lean Manufacturing to Minimizing Waste on CV Adelia Medika Supply*	Qualitative descriptive	Application of lean manufacturing and layout SOPs in CV Adelia Medika Supply successfully reduced waste, time, and cost, improved process efficiency, and maximized production and delivery capacity.
2	Muhammad Kyodan Khalidzky, Winarno, & Wildan Fatchan	*Lean Manufacturing in Waste Reduction to Improve*	Value Stream Mapping (VSM) and	The biggest wastage in the connector production process occurs during

No	Author(s)	Title	Methods	Discussion Results
	Maulidin (2025)	*Efficiency in Production of Connector Type X at PT XYZ*	Process Activity Mapping (PAM)	operations (57.07%), followed by transportation (26.65%) and delay (10.89%). The 5W+1H analysis identified inefficiencies caused by limited measurement stations and poor warehouse layout affecting kanban flow.
3	Suwandi, N.N. & Suhada, K. (2024)	*Application of Lean Manufacturing with Value Stream Mapping to Reduce Cycle Time at Spring Mattress Assembly Section at PT X*	VSM, 5 Whys, and root cause analysis	Time and waste analysis helped design process improvements such as line balancing, SOPs, and better material handling, improving production capacity and efficiency.
4	Muhammad Takwa, Andi Niartiningsih, Nurul Hidayah Nur, Nurfitriani, & Mene Paradilla (2025)	*Analysis of Waiting Time for Patient Service Using Lean Concept in Outpatient Installation of Stella Maris Hospital*	Interviews and observation	Application of Lean concept identified long waiting times and inefficiencies in patient services. Integration of hospital information systems (SIMRS) is needed to improve efficiency and reduce patient waiting times.
5	Budhi Setianto, Agus Aan Adriansyah, & Akas Pulih Asih (2020)	*Implementation of Lean Management in the Pharmacy Unit of Islamic Hospital Surabaya A. Yani*	Ultrasound, CARL, and Lean methods	Improved process efficiency through reduced medicine purchase incidents, fewer delivery errors, reduced stock overflow, and decreased waiting times for medicine preparation.
6	Irma Dani Br S. & Rusindiyanto (2025)	*Analysis of Lean Manufacturing Using the Waste Assessment Model (WAM) to Reduce Waste in the Bolt Production Process at PT XYZ*	WAM, Root Cause Analysis (RCA), VSM	WAM effectively identified and measured waste in bolt production. The biggest waste categories were inventory and defects.
7	Siti Rif'ah Hasanati et al. (2024)	*Application of Lean Manufacturing in Mixue Company*	Descriptive qualitative	Implementation of Just in Time (JIT) and 5S improved operational efficiency, reduced excess inventory and lead times, and enhanced responsiveness to market demand fluctuations.

No	Author(s)	Title	Methods	Discussion Results
8	Nurul Retno Nurwulan (2022)	*Implementation of Lean Manufacturing in Food and Beverage Industry*	5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke), VSM	Lean implementation reduced production waste and increased efficiency, especially in packaging processes.
9	Riko Widya Kristanto & Rizal Ramdan Padmakusumah (2025)	*The Effect of Lean Implementation and Warehouse Management System on Logistics Performance in FMCG Industry PT XYZ*	Quantitative descriptive	Implementation of Lean and Warehouse Management System (WMS) positively influenced logistics performance.
10	Sulistyo et al. (2024)	*Development of a Lean 4.0 Readiness Assessment Tool for the Chemical Industry*	Literature and bibliometric analysis	Developed an integrated Lean 4.0 readiness assessment tool specifically for the chemical industry.
11	Eko Setiawan, Edi Prasetyo, Tina Hernawati Suryatman, & Ristyowati T.M. (2023)	*Application of Lean Manufacturing to Reduce Waste at Paint Tank Using WRM and WAQ Methods*	WRM and WAQ	Lean Manufacturing effectively reduced waste in the paint tank production process.
12	Aji Mustofa Zein, Siti Hanan, & Sherin Ramadhania (2024)	*Lean Manufacturing Approach to Reduce Lead Time in Molten Treatment Process of Steel Company*	Lean approach	Lead time reduced from 1780 to 1520 seconds, cutting waste in several process stages (vacuum start, material charging, circulation, etc.).
13	Najwa Fathiya Sya'ban et al. (2025)	*Lean Manufacturing Implementation to Minimize Waste in SMEs Tegal Metal IKM Using 5S*	Participatory Action Research (PAR)	Application of 5S created a cleaner, more organized, and efficient work environment in SMEs.
14	Yusuf Mauluddin & Ibna Faizal Rahman (2023)	*Lean Manufacturing Analysis on Production Process Activities*	VSM, WRM, WAQ, VALSAT	Identified waiting as the main waste causing overproduction during the cooling process.
15	Doni All Sadam Husein & Wahyudin (2024)	*Application of Lean Manufacturing and 5W+1H Analysis to Reduce Waste in Frame Chassis Production at PT OC*	VSM and 5W+1H	Discrepancies with production targets caused by human, machine, material, method, and environmental factors.
16	S. Aisyah (2020)	*Productivity Improvement through Waste Reduction with Value Stream Mapping at PT Y*	VSM	High wastage identified mainly due to long delays in the production process.

No	Author(s)	Title	Methods	Discussion Results
		Indonesia		
17	Eko Setiawan et al. (2023)	*Lean Manufacturing Implementation for Waste Reduction Using WAM, WRM, and WAQ Methods*	WAM, WRM, WAQ	Effectively identified and measured production waste using multiple assessment models.
18	Aulia Dwijayanti Rahman, Novi Marlyana, & Eli Mas'idah (2024)	*Application of Lean Manufacturing to Improve Efficiency in Garment Production at PT XYZ*	Literature study	Lean improved efficiency significantly: VA = 16,472 s; NVA = 21,061 s; NNVA = 86,185 s.
19	Heri Ananto Budi & Andi Sudiarso (2024)	*Waste Analysis and Lean Manufacturing Implementation in Production Process at CV ABC Offset*	VSM, PAM, Fishbone, Pareto, 5 Whys	Lean tools reduced waste types such as overprocessing, transportation, and motion in batik production.
20	Eko Wirawan, Fithriya Nur Hana, Bayu Febriyanto, Purwanti, Rizky Eka Saputra, & Ari Zaqi Al-Faritsy (2024)	*Optimization of Production Process at Ballerina Fashion Using Lean Manufacturing*	VSM and PAM	Found process inefficiencies such as repetitive steps, waiting time due to labor shortage, and suboptimal raw material management.

RESEARCH RESULTS AND DISCUSSION

Based on the analysis of twenty (20) selected journal articles published between 2020 and 2025, this study found that the implementation of **Lean Manufacturing (LM)** consistently contributes to improving the **performance and competitiveness of manufacturing industries**. The literature reviewed covered various industrial sectors such as automotive, electronics, food and beverage, pharmaceuticals, textiles, and even healthcare services, showing that Lean principles are highly adaptable across different operational contexts.

Waste Reduction and Process Efficiency

Almost all studies reviewed reported that Lean Manufacturing significantly reduces waste (muda) in production processes. For example, Ernawati et al. (2024) demonstrated that the application of Lean methods and standard operating procedures (SOPs) at CV Adelia Medika Supply reduced time and cost inefficiencies while increasing production capacity. Similarly, Khalidzky et al. (2025) identified through Value Stream Mapping (VSM) and Process Activity Mapping (PAM) that the largest waste in connector production came from inefficient measurement operations and warehouse layout, leading to 57.07% production loss. Such findings confirm that tools like VSM, 5S, and Root Cause Analysis (RCA) are effective in identifying non-value-added activities and optimizing workflow efficiency (Suwandi & Suhada, 2024). Furthermore, several studies (Widya Kristanto & Padmakusumah, 2025; Zein et al., 2024) indicate that process mapping and Lean assessment tools such as Waste Assessment Models (WAM) and WRM effectively reduce delays, improve production cycle times, and enhance output consistency.

Quality Improvement and Productivity Enhancement

Lean implementation also has a measurable impact on product quality and overall productivity. Studies in the food and beverage sector (Nurwulan, 2022) and the garment industry (Rahman et al., 2024) showed that continuous improvement activities like Kaizen**,** 5S**,** and Just in Time (JIT) improved process flow and reduced defect rates. At Mixue Company, Hasanati et al. (2024) found that JIT and 5S practices reduced excess inventory and lead time, aligning production with actual demand and increasing customer satisfaction. In hospital environments, Takwa et al. (2025) revealed that applying Lean principles reduced patient waiting times and improved service efficiency through information system integration. These findings highlight that Lean Manufacturing not only enhances productivity but also improves service quality in non-traditional manufacturing sectors.

Implementation Challenges

Despite its benefits, the reviewed literature emphasizes that Lean Manufacturing is not an instant solution. Many studies reported that successful implementation requires long-term cultural transformation, management commitment, and employee involvement (Aripin et al., 2023; Morales, 2024). High initial costs for training and organizational restructuring are often necessary to instill Lean thinking throughout the organization (Irfan et al., 2025). Some researchers also cautioned that excessive focus on efficiency could reduce flexibility and potentially increase employee workload if not managed properly (Sulistyo et al., 2024). Therefore, balancing Lean goals with human factors and sustainability considerations is essential.

Integration with Industry 4.0 and Lean 4.0 Concept

Recent studies (Hassan & Pasha, 2023; Sah et al., 2024) highlight the emergence of Lean 4.0, which integrates Lean principles with digital technologies such as the Internet of Things (IoT), automation, and data analytics. Sulistyo et al. (2024) developed a Lean 4.0 readiness assessment model for the chemical industry, emphasizing that the synergy between Lean and digital transformation enhances responsiveness and real-time decision-making. This integration represents a shift toward smart manufacturing, where efficiency and innovation coexist within digital ecosystems.

Synthesis of Findings

From the synthesis of the 20 journal articles, it can be concluded that Lean Manufacturing:

1) Significantly reduces waste and increases production efficiency.
2) Improves product quality, customer satisfaction, and overall operational performance.
3) Requires sustained management commitment, employee engagement, and continuous training.
4) Faces challenges related to cost, culture, and change management.
5) Gains enhanced effectiveness when integrated with Industry 4.0 technologies.

Thus, Lean Manufacturing provides not only short-term performance improvements but also long-term strategic advantages for manufacturing competitiveness. However, its sustainability depends on the organization’s ability to

cultivate a continuous improvement culture and integrate lean practices into digital transformation initiatives.

CONCLUSION

The results of the *literature review* analysis state that the application of the *Lean Manufacturing* concept is a strategy for companies to obtain various benefits, including being able to increase production productivity, companies, improve process efficiency in producing products, reduce production costs so that product selling prices can be lower, increase product competitiveness of the company, meet increased demand from consumers so that the *Lean Manufacturing* method is recommended to be applied in the manufacturing industry. With the application of the *Lean Manufacturing* method using *Visual Stream Mapping tools,* it is expected to identify the types of *waste* on the production floor and provide suggestions for improvements to minimise the *waste* that occurs. The use of *fishbone* diagrams will also be very helpful in this study to see the causes and roots of *waste* and then determine the proposed improvement recommendations to minimise the waste that has been identified so that the *Lean Manufacturing* method is recommended to be applied in the manufacturing industry.

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