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Implementation of Lean Manufacturing Methodology and Its Application: A Literature Review

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Abstract. This study aims to investigate and analyze several previous works of relevant literature on the Lean Manufacturing technique in international journals. The methodology used to review the previous studies was carried out through a survey based on descriptive, qualitative, and bibliographical surveys in International Journal with restriction to the period of publication from 2017 – 2022 published on databases and electronic journals in English with the scope to examine and analyze in-depth the extent to which literature used to discuss results in the selected papers of applying the Lean Manufacturing technique in several case studies. After conducting a survey, only thirty-three articles were found with the theme of the application of Lean Manufacturing and its technique in manufacturing companies. Twenty-one techniques/tools of Lean Manufacturing were found problem-solving for waste time elimination, reducing process cycle times, and implementing process improvement. It is concluded that the most used methodology in waste reduction is Value Stream Mapping.

Keyword: Lean Manufacturing, Literature Review, Waste Reduction

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1. Introduction

Through continual improvement initiatives, industries nowadays aim to decrease and eradicate waste in order to boost production output while maintaining quality and providing customers with timely service [1]. By cutting expenses and non-value-added tasks, these operational enhancements hope to increase net profit by optimizing efficiency and effectiveness across the production system [2].

The effectiveness of a business process in generating and promoting commodities relies on several factors, including the formulation (business plan) and implementation of the company's strategy (business process management) [3]. Including Lean Manufacturing into product planning is one way for manufacturing and engineering businesses to achieve these goals [4]. Lean Manufacturing is helpful in decreasing the amount of usability wasted by products, which can happen when a business cannot develop a production method that offers advantages or value (product value) to consumers [5].

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In order to prevent the firm from achieving its full potential in terms of profitability and competitiveness, this wasteful state leads to the wastage or underutilization of corporate resources. This means that businesses operating in certain industries are forced to consider factors other than only the quantity and placement of goods that have found success in particular market niches (market segmentation) [6]. However, by taking into account the environment, corporate social responsibility, resource usage, time, and operational expenses during the product creation process (product development)[7].

For every business to thrive, expenses must be cut; cutting costs simply means getting rid of losses. Lean Manufacturing's (ME) primary goal is to reduce losses in a methodical manner while focusing on the idea of value creation [8]. While some businesses have been successful in applying lean methodology, many others have failed to reap the rewards of this adoption due to their inability to maintain lean thinking over an extended period of time.

With these viewpoints, it is clear that corporations are becoming more competitive globally and have begun implementing new production techniques like lean manufacturing to stay ahead of the game [9]. Given these viewpoints, it is clear that businesses are becoming more competitive globally and are beginning to use new production techniques like lean manufacturing. Several sectors have undergone stages of [10]. By implementing the Lean principle, certain sectors have undergone processes of both physical and cultural transformation [11]. Lean Manufacturing is a productivity model that aims to enhance efficiency by minimizing or eliminating non-value-added activities and waste in manufacturing processes [12], [13].

The current study conducts a comprehensive examination and evaluation of the literature by analyzing articles that specifically address the topic. The study is structured into many areas, including the objectives, the existing knowledge, the methodology adopted, the categorization technique used for article analysis, and a section dedicated to discussing the analysis of the results and the conclusions obtained.

2. State of Art

The state of the art comprises the pertinent concepts and theories related to the study issue. Its purpose is to supply the study with principles that contribute to a contemporary understanding of the foundational content for the research. This article aims to present an overview of the fundamental principles that led to the development of the Lean Manufacturing strategy and its practical implementation.

2.1. Lean Manufacturing

Lean Manufacturing, sometimes referred to as lean production, was created to increase efficiency and reduce costs by eliminating waste in the manufacturing process. [14]. The success of Lean Manufacturing may be attributed to the Toyota engineers who pioneered the use of innovative production techniques such as pull production, Just-in-Time, and Kanban. These engineers made

improvements to the traditional mass production model, resulting in a new and more efficient manufacturing pattern [15].

The Lean concept behind the model facilitated the detection of inefficiencies in the manufacturing process, the minimization of operational expenses, and guaranteed prompt delivery of requested items [16]. The main objective of the Lean Manufacturing methodology is to optimize the efficiency of the production system by removing many types of waste, such as idle time, excessive inventory, unnecessary production, unnecessary motions, transportation, unnecessary processing, defects, and underused workforce [8]. Furthermore, it is essential to incorporate a Kaizen system, which involves continuously improving and refining processes, while also clearly defining the value and establishing standardized procedures [17].

3. Research Methodology

To accomplish the specified aims in this study, a decision was made to utilize an article that centers around a specific case study. One of the aims of this work is to use a case study to see whether any tools or approaches of Lean manufacturing have a positive impact on minimizing and eliminating waste.

The current investigation proceeds systematically to accomplish the proposed objectives:

Initial phase: The investigation was primarily centered on the implementation of waste reduction practices in manufacturing organizations that employ the Lean Manufacturing model or concept. Next step: construct a classification model. In the third phase, employ the developed categorization model. Stage four involves the arrangement and delivery of the literature evaluation, utilizing the established categorization approach. The fifth step involves doing an in-depth examination and evaluation of the issue, as well as presenting recommendations for future investigation.

4. Results and Discussions

Based on the gathered data, it is evident that the principles and implementation of lean manufacturing are not just reliant on managers, but require the participation of all individuals within the business in order to accomplish the company's goals, resulting in a reduction of waste. Table 1 presents many authors' perspectives on the subject of "manufacturing," highlighting key ideas.

LM has been the subject of intense research in the last twenty years due to its extensive uses and multitude of advantages. This methodology has been extensively employed by several studies with the objective of eradicating all types of inefficiencies from the value chain, including but not limited to cycle time, materials, labor, and energy waste. The wastes that occur in this context are inherent to the overall production system, but they are classed as hidden wastes, which disturb the impact of production operations. Therefore, it is necessary to reduce these wastes by using

Lean Manufacturing. Table 1 displays many LM approaches utilized across diverse industrial industries. Several studies utilize LM in various industries such as the automotive, power, and aerospace industries, as well as in small and medium businesses (SMEs) and other sectors. The table provided (Table 1) is a summary of the author's study on how the application of Lean Manufacturing (LM) contributes to reducing waste that does not add value (non-added value) to the organization in different domains.

Table 1 Examination of the Impact of the LM Method and its Application in Diverse Fields

No.	Author(s)	Focus of Study	Findings and Contributions
1	[34]	Develop strategies to minimise losses and enhance equipment utilisation, while also suggesting alternative ways to address corporate challenges and selecting the most effective options.	The measurement indicates that the availability rate is 88.82%, the performance rate is 93.70%, and the quality rate is 98.20%. Consequently, the OEE values obtained are 81.73%. The underlying reason is examined through the utilisation of the FMEA (Failure Mode and Effect Analysis) technique, specifically focusing on the RPN (Risk Priority Number).
2	[18]	Identify the kind of waste in the order fulfilment process; establish accurate and detailed mapping tools to minimise waste; suggest the underlying causes of waste and develop improvement plans; assess the difference in lead time before and after implementing production process enhancements.	Reducing waste, particularly excessive production and transportation, has a direct impact on reducing carbon emissions.
3	[19]	The ergonomic situation was evaluated using several methods, including Rapid Upper Limb Assessment (RULA), Strain Index (SI), and Rapid Entire Body Assessment (REBA). Additionally, lean manufacturing tools such as Value Stream Mapping (VSM) and analysis of the 7 wastes were employed to improve productivity by eliminating unnecessary processes.	During the implementation of changes, it is feasible to take into account both ergonomic circumstances and production performance.
4	[20]	The objective of this research is to analyse and integrate the role of human resources in the internal processes of Indian manufacturing firms in order to successfully adopt lean manufacturing. It also offers a realistic scenario of lean manufacturing implementation, where all relevant factors related to HR and internal practices have been taken into account to formulate the research problem.	The study identifies six essential input components and three output elements, suggesting that these aspects must work together to maximize the advantages of implementing lean concepts. This study suggests that the structural model outlined may be used as a framework for integrating human resources with internal procedures to efficiently adopt lean principles, leading to the most effective usage of resources.
5	[21]	Propose a novel method for validating cost savings in a textile company. This method involves the use of two combined Lean Manufacturing (LM) tools, namely Value Stream Mapping (VSM) and Kanban. The goal is to minimise the amount of waste generated during manufacturing and evaluate the efficiency of cost reduction in the inventory of completed goods by implementing a novel accounting method..	The value stream mapping revealed the primary areas for waste reduction, particularly in the inventory of finished items. The study also documented the concurrent utilization of two Lean Manufacturing technologies, namely Value Stream Mapping (VSM) and Kanban, within a limited timeframe. This implementation resulted in a notable improvement in inventory turnover, hence positively influencing the operational profitability.
6	[17]	Examine the relationship between the degree of competition in the market and the adoption of lean manufacturing practices. Assess the correlation between lean manufacturing and the utilization of MAS (Management Accounting System) data. Furthermore, examine whether the use of MAS information functions as a mediator in the connections among market rivalry, lean manufacturing, and performance.	Utilizing information from Management Accounting Systems (MAS) helps improve the association between organizations' procedures and performance. Moreover, it can provide empirical data to support the contingency hypothesis, which suggests that MAS are deployed to assist managers with achieving certain organizational outcomes or objectives.
7	[22]	Assessment of the impact of LM on waste reduction at arjo di desa sugar factory. the study's specific objectives are focused on total productive maintenance, mistake-proofing, workplace organization (5s), continuous quality improvement, and worker involvement.	Researchers recommend implementing lean manufacturing tools effectively by improving maintenance, training, prevention, and error-proofing and control measures, based on research findings.
8	[10]	To assess the effects of deploying LM technologies, such as People integration, stability and standardization, JIT, and Jidoka, on the operational performance of firms in Zimbabwe.	Just-in-Time (JIT) facilitates the uninterrupted movement of things and materials across the system, while minimising the amount of inventory in various stages of production. This

No.	Author(s)	Focus of Study	Findings and Contributions
			has a positive effect on employee motivation, leading to increased dedication and productivity.
9	[23]	Create a clustering technique and task mutuality index to optimise the assembly tasks in a fixed layout assembly production line. Additionally, evaluate the Overall Equipment efficacy (OEE) data to assess the machine's efficacy. Measurements are conducted by actually monitoring the circumstances in the field.	The analysis reveals that the availability rate is 88.82%, the performance rate is 93.70%, and the quality rate is 98.20%. Consequently, the overall equipment effectiveness (OEE) is calculated to be 81.73%.
10	[24]	By implementing the lean manufacturing approach, the organisation aims to enhance the efficiency of the production process for the water pump housing KVN 21073-13007015. This improvement will enable the organisation to expand into new markets.	Six Sigma has the ability to resolve issues without requiring significant financial commitments. Moreover, the economic impact totaled $5612.90. The time it takes to recoup the costs of implementing changes is 2 months. The use of lean production principles yielded favourable results. Currently, a strategy is being formulated to implement further components of lean manufacturing.
11	[25]	Furniture Study with the aim of increasing productivity.	LFF and LM assist in analyzing and solving problems, thereby offering new insights for the company, such as creating templates for setting up for all drilling machines and standardization.
12	[35]	To evaluate the condition of the production process across the whole value chain of a fish and shellfish industry, employing it as a case study. Furthermore, the aim is to pinpoint any waste or MUDA that has a detrimental effect on the quality and production of the items.	The organization conducted an analysis of the fresh fish line to evaluate the present status of the process. The study facilitated the identification of non-value-added processes, which constitute 37.7% of the total processing time. These responsibilities are linked to inventories in processes, excessive movements resulting from flaws in plant distribution, and bottlenecks that occur during the filleting process.
13	[11]	The aim of this study is to examine the environmental elements that contribute to certain results, as well as the influence of Total Productive Maintenance and other lean manufacturing methods on the sustainability of the environment. Furthermore, the objective of this study is to ascertain the lean manufacturing methods that are valuable for implementation and to provide practical recommendations for enhancing a company's environmental sustainability performance.	The correlation between lean techniques, environmental pressure, and environmental certification effort enables organizations to evaluate the efficacy of applying Lean Manufacturing (LM) strategies, such as Total Productive Maintenance (TPM), while striving for environmental certification. Manufacturing plants may adopt TPM to facilitate their greening process and increase their chances of obtaining environmental certification. Following implementation, TPM integrates into the company's initiatives for reducing pollution emissions and recycling trash. Companies that use TPM for environmental goals typically demonstrate heightened environmental consciousness.
14	[12]	The objective is to identify applicable lean manufacturing frameworks for small and medium-sized enterprises (SMEs) in order to minimise expenses and enhance operational effectiveness. Additionally, this study aims to furnish SMEs with illustrative instances of lean manufacturing techniques and enhancement initiatives for educational purposes.	Proposes a concise and systematic five-step implementation framework for lean manufacturing, specifically tailored for small and medium-sized enterprises (SMEs), with a particular focus on process improvement. The success elements for implementing LM in SMEs include the commitment of top executives, the establishment of project improvement teams, and the training of appropriate individuals.
15	[8]	The goal is to optimise resource allocation efficiency through the utilisation of the line balancing tool. This involves analysing the current performance of the sector and proposing a model for improvement to minimise downtimes and raise the overall productivity of the business.	The implementation of the Line Balancing approach effectively eliminates two major sources of waste that have a significant economic impact on the organisation. Additionally, it results in a notable boost in production line efficiency, which rises from 55.88% to 76.79%. Furthermore, employees gained increased responsibility and autonomy over the resources, techniques, and tools inside their own work zones. Following the implementation of the suggested enhancements, the firm observed a significant surge of more than 20% in the quality, performance, and efficiency of its manufacturing line.
16	[4]	In order to reduce waste in the steel procurement process, the value stream mapping approach will be employed.	By implementing the value stream mapping approach in the procurement process of the steel sector, the procurement lead time may be reduced from 41 days to 21 days, resulting in a 50 percent drop in procurement lead time. Initially, 62 percent of activities were categorised as non-value-added time, while 38 percent were classed as value-added time.

No.	Author(s)	Focus of Study	Findings and Contributions
17	[14]	To examine the impact of technological innovations on the production process in terms of achieving economic, social, and environmental sustainability. Additionally, to explore how the shift towards a green perspective in production processes, which involves the implementation of lean techniques, affects these processes.	The transition towards a more ecologically conscious production necessitates the alteration of the existing production system, especially in the area of production that incorporates technology advancements.
18	[7]	The objective is to implement a lean framework called dynamic value stream mapping (DVSM) that utilises Industry 4.0 technologies to digitalize lean manufacturing. This involves integrating lean tools with Industry 4.0 technologies. Additionally, a smart lean-based production scheduling and dispatching model will be developed to optimise the flow along the value stream map (VSM) and reduce manufacturing lead time, thus achieving lean targets.	This research demonstrates the capacity of DVSM to regulate the movement of intelligent goods and dynamically rearrange or prioritise them in real-time to prevent obstruction or delays across the value stream.
19	[13]	The aim is to analyse the use of Lean and Green methodologies and technology in order to improve social, economic, and environmental outcomes, hence influencing overall business performance..	There is a strong connection between Lean and Green, and many Lean practices and tools can have a positive impact on environmental sustainability. This connection can be beneficial for both academics and practitioners in the manufacturing industry, as it allows them to take advantage of the combined effects of Lean and Green for achieving sustainable development.
20	[27]	The aim is to delineate the decision-making process and sequential steps necessary for the implementation of either Lean manufacturing or Six Sigma in the Moroccan aeronautics industry.	This study provides a set of metrics and guidelines for aeronautics management to efficiently integrate Lean principles and Six Sigma approaches concurrently. Within the Moroccan aeronautic industry, a comparable proportion (14%) of companies had embraced Six Sigma, much like those who had implemented Lean or both Lean and Six Sigma simultaneously. Nevertheless, a significant proportion (71%) had first adopted Lean manufacturing. The choice to adhere to this sequence was justified by the necessity to initially acquire proficiency in the basic methodologies of Lean before advancing to the more complex techniques of Six Sigma.
21	[28]	To examine the effects of implementing LM on the triple bottom line indicators of corporate sustainability, namely the economic, environmental, and social dimensions.	This research proposes that the more the extent to which LM is implemented, the higher the economic, environmental, and social performance of the SMEs. Manufacturing SMEs should prioritize considering the environmental and social components of their company activities, rather than only focusing on economic performance.
22	[2]	In order to analyze the sales and production data from the previous year, the Value Stream Mapping (VSM) approach is employed to identify the target product family for enhancement.	The manufacturing process timeframes and the amount of quality errors were reduced, resulting in a 29% drop in total workmanship after one year.
23	[29]	The objective is to create a unified framework that merges LM (Lean Manufacturing) with BOM (Bill of Materials). This integrated framework will be used to a specific case study in order to attain manufacturing excellence, while also guaranteeing economic and environmental sustainability.	Blue Ocean production has the potential to significantly enhance the environmental efficiency of the production system. This research also contended that the combined implementation of both methodologies leads to a more than 50% enhancement in environmental performance. This is achieved by reducing production times without compromising the quantity of production.
24	[30]	The objective is to evaluate the application of a collaborative robotic workstation in an industrial setting for assembly tasks carried out by workers with musculoskeletal disorders. This will involve integrating principles of ergonomics and human factors engineering with lean manufacturing principles. The aim is to enhance the ergonomic conditions for workers involved in preassembly, who have physical limitations, while ensuring that production is not compromised.	A novel collaborative workstation was implemented, resulting in enhanced ergonomic conditions and notable reductions in both cycle times and glue use. This research showcases the effective integration of sustainable production systems through the construction of a collaborative workstation.
25	[26]	The study proposes a SEM that examines the relationship between three LM tools—TQM, waste, and RFT—as independent variables, and their association with commercial benefits gained as a dependent variable.	Total Quality Management (TQM) has a direct impact on reducing waste, promotes Right First Time (RFT) practices, and has both direct and indirect effects on the commercial gains obtained. Furthermore, this research provided

No.	Author(s)	Focus of Study	Findings and Contributions
			statistical and empirical evidence to support the claim that Wastes have a direct and beneficial impact on Commercial benefits. The use of waste reduction strategies in the manufacturing process, together with efforts to minimize material and human resource transportation, resulted in a decrease in material costs by preventing accidents and reducing energy loss in conveyor equipment.
26	[16]	This case study analyses the successful use of Lean Six Sigma, a highly efficient problem-solving methodology, in a pharmaceutical manufacturing facility specialising in the production of acetaminophen (paracetamol) tablets for pain relief. The research showcases how a company may enhance productivity, diminish backlog and downtime, eradicate waste, and eventually enhance client delivery deadlines by implementing the Lean Six Sigma problem-solving technique in an organized manner, while strategically utilizing resources.	The Lean Six Sigma approach and technologies are highly effective at precisely identifying the fundamental causes of issues and the factors that facilitate the implementation of continuous improvement. This article effectively employed Lean Six Sigma approaches to identify underlying problems and execute appropriate remedial measures. This led to the resolution of the issues under examination without any adverse effects on manufacturing expenses, production duration, or product excellence.
27	[31]	This study aims to examine the obstacles that impede the implementation of lean manufacturing in the wood and furniture industries, particularly in emerging economies. It also suggests that small and medium enterprises can measure and observe the beneficial effects of lean practices by adopting the necessary activities for lean implementation.	The correlation between RES and the obstacles to implementing lean is both positive and statistically significant. This substantial association indicates that organizations who do not adopt lean practices have limitations in terms of resources, including time, capital funds, and labor.
28	[32]	To assess the alignment of an auto parts manufacturer with Lean Manufacturing (LM) principles, as well as to evaluate their compliance with LM criteria, many methods may be employed. These include analyzing the seven wastes of LM, conducting Value Stream Mapping (VSM), and measuring Overall Equipment Effectiveness (OEE).	The findings of this study may be used to evaluate the efficiency from a practical perspective.
20	[33]	The objective is to optimize the production line by eliminating waste products, enhancing productivity, and eliminating non-value-added tasks.	Productivity has increased by 7.8% by eliminating the need to measure the surface roughness of the hole after machining, prior to assembly. This has also resulted in a reduction in costs associated with faults during the manufacturing process. The implementation of cost reduction measures in the production plan has resulted in a decrease of 33375 USD in total annual costs.
30	[15]	In order to minimize waste during changeover procedures at a ready-meal producer located in South Yorkshire, United Kingdom.	The changeover time experienced a reduction of over 30%, resulting in an increase in OEE to over 70%. Additionally, there was a reduction of 10% in labor expenses. This research demonstrates the use of lean concepts in facilitating the implementation of manufacturing processes that are both more efficient and economically viable in the long term.
31	[5]	To assess the impact of lean manufacturing on an organization's performance at both the organizational and operational levels, and examine how ERP systems moderate the relationship between organizational performance and lean manufacturing techniques..	Total Quality Management (TQM) has a positive influence on an organization's operational performance. In addition, this study discovered that the p-value for the effect of ERP on TQM is 0.017 in terms of operational performance. This indicates that ERP plays a substantial moderating role in the link between TQM and organizational performance.
32	[9]	The objective is to establish a sustainable approach that incorporates lean and smart manufacturing techniques to optimize production processes by removing inefficiencies in the industrial sector. 4.0.	The Method successfully enhanced the production parameters, resulting in a 5.15% and 36.90% reduction in lead time for Industry A and B, respectively. Additionally, it decreased uptime by 3.07% and 12.66% for Industry A and B, respectively. Moreover, it boosted the production capacity by 33% for both Industry A and B.33 and 50% daily, respectively.
33	[1]	To examine the learning intentions of production workers, we will use the Theory of Planned Behavior (TPB) as a framework. Our focus will be on the behavioral intents of direct workers who are participating in lean manufacturing training programs in an automobile parts manufacturing setting.	The connections between the various components and the ambition to learn in the lean training program were effectively identified. The findings suggest that individuals participating in the lean training program are more likely to be motivated to learn if they had a very positive attitude and a strong sense of perceived behavioral control.

The initial search produces 50 items that were published from 2017 onwards. The publications featured in various conference proceedings and international journals were omitted. The number of articles subsequently dropped to 35. The allocation of the 35 articles is depicted in Figure 1 and Figure 2, arranged chronologically.

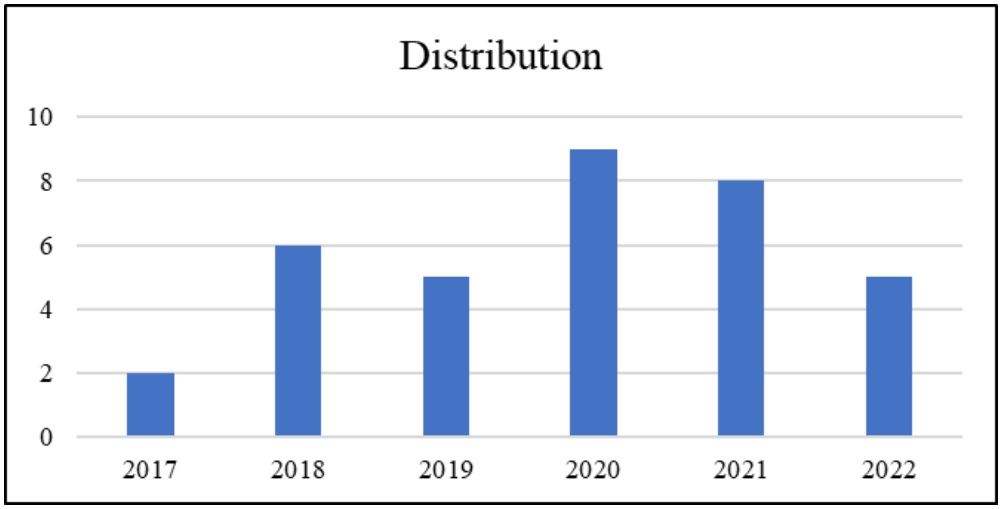

Figure 1 Paper Based on Published Year

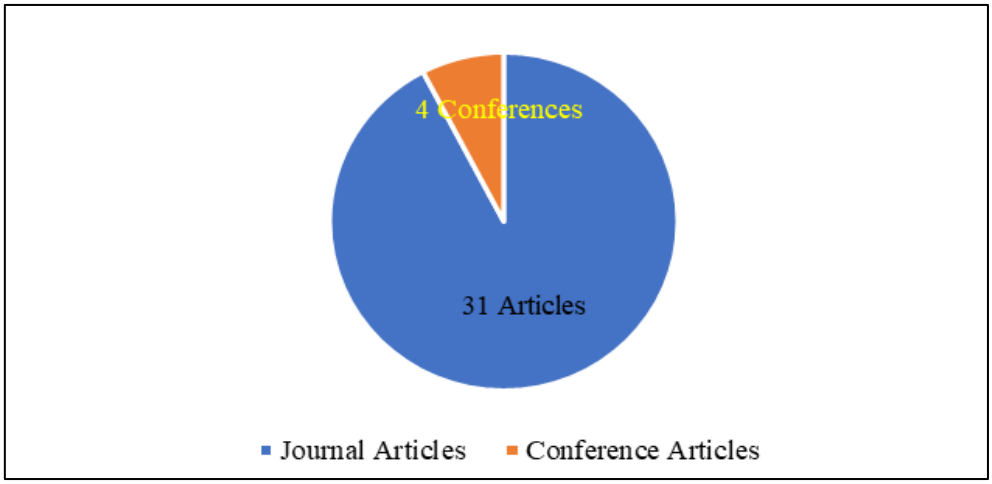

Figure 2 Proportion of the Publication Sources

The report primarily focuses on reviewing the most recent studies, specifically those published between 2017 and 2022. Subsequently, the list is reduced to thirty-three publications that are chosen for the research. Figure.3 illustrates the distribution of publications among different journals.

Lean Manufacturing is a systematic approach that allows for the detection and removal of inefficiencies in production line operations. Based on the findings of several prior research, this technique is executed using a collection of 21 strategic instruments, as indicated in Table 2.

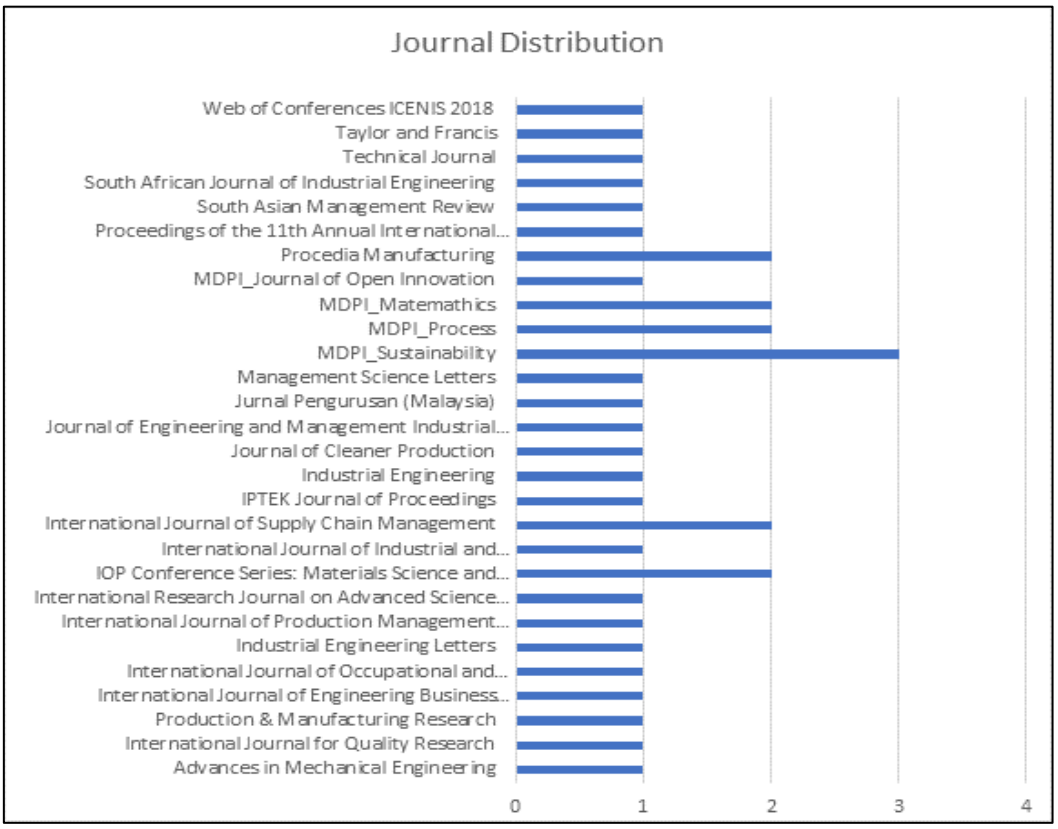

Figure 3 The Proportion of the Publication Sources Published

Table 2 Lean Manufacturing Tools

No.	Method	Authors/ Years
1	Value Stream Mapping (VAM)	Nihlah *et al.* (2018), Oliveira and Junior (2019), Nugroho *et al.* (2020), Huang *et al.* (2020), Koh and Singgih (2020), Guzel and Asiabi (2021), Arjmand and Galankashi (2021)
2	Value Stream Mapping (VAM) and Ergonomic	Brito *et al.* (2018)
3	Value Stream Mapping (VAM) and Kanban	Carvalho *et al.* (2018)
4	Value Stream Mapping (VAM) and Line Balancing	
5	Dynamic Value Stream Mapping	Ramadan *et al.* (2020)
6	Structural Equation Modelling (SEM)	Basu *et al.* (2018), Nawanir *et al.* (2020), Abu *et al.* (2021)
7	Total Quality Management (TQM) and Structural Equation Modelling (SEM)	Alcaraz *et al.* (2021)
8	Just in Time (JIT) and Structural Equation Modelling (SEM)	Maware and Adetunji *et al.* (2019)
9	Just in Time (JIT) and Total Quality Management (TQM)	Ismail *et al.* (2018)
10	Failure Modes and Effects Analysis (FMEA)	Tobe *et al.* (2017)
11	Six Siqma	Elboq *et al.* (2020), Garcia *et al.* (2022)
12	Lean Six Sigma	Klochkov *et al.* (2019), Duc *et al.* (2022)
13	Line Balancing	Qattawi and Madathil *et al.* (2019), Perez *et al.* (2020)
14	Total Productive Maintenance (Green Factory)	Tariku (2018), Chen *et al.* (2019)
15	Value Chain	Jimenez *et al.* (2019), Saetta and Caldarelli (2020)
16	Green Production	Gaikwad and Sunnapwar (2020)
17	Blue Ocean Manufacturing (BOM)	Sadiq *et al.* (2021)
18	Ergonomic	Colim *et al.* (2021)
19	Smart Manufacturing (4.0 Industry)	Tripathi *et al.* (2022)
20	Enterprise Resource Planning (ERP)	Saleem (2022)
21	Theory of Planned Behavior	Lai *et al.* (2022)

5. Conclusion

The primary objective of this paper is to carry out a comprehensive bibliographic evaluation of Lean Manufacturing. According to this research, we may suggest a categorization system for LM that is based on four parameters: technique, scope, principles, and supports. This approach

categorizes all items discovered in the literature. This technique formed the foundation for conducting a comprehensive bibliographical study and conducting a thorough analysis (both quantitative and qualitative) of LM topics in the literature. The primary achievements of this study include an expanded understanding of the topic and recommendations for future research, derived from the analyses conducted in the preceding sections. The following provides a concise overview of this analysis: (a) In LM's work, the research approach mostly consisted of using the Value Stream Mapping method for the bulk of the case studies (70.7%); (b) In relation to lean principles, the primary focus is on pull production/just in time, work in flow/simplification of flow, and the cultivation and education of human resources; (c) The findings indicate the need for further investigation in the future. Therefore, it is evident that while LM is examined in businesses outside manufacturing, there are several other industries that may be analyzed in terms of lean practice.

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