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Lean Manufacturing Practices, Operational and Business Performance: A Conceptual Framework Development through Systematic Literature Review

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Abstract - *The main purpose of this paper is to evaluate the researches that link lean manufacturing, operational, and business performance with a view of identifying studies that contribute criteria for literature classification, discussing the empirical studies and orientation of future research. An in-depth systematic review of literature extends the sustainable manufacturing focus and considers major components of lean manufacturing at the same time. Finally, this paper identifies inconsistencies and contradictions in prior research findings and suggests new opportunities and challenges for future research. The examined articles' practical implications have been organized into eleven themes, demonstrating multiple elements of lean manufacturing that affect operational and business performance. A conceptual framework is built based on the analysis of the articles, which aids in comprehending the notion of lean manufacturing and its importance. A systematic model representing the relationship between lean manufacturing practices, operational and business performance is presented and discussed. The findings indicate that the most challenging issue for the lean manufacturing practice implementation is the lack of knowledge and management support. The main contribution of this study is to provide a thorough assessment of the current state of knowledge on the Lean initiative in manufacturing businesses, as well as a systematic classification of the relevant literature. The findings can be used by academics and management to take performance strategies.*

Key Words: **Lean manufacturing, systematic literature review, conceptual framework, performance**

1. INTRODUCTION

Lean manufacturing came into existence in the 1950s on the shop floor of a Japanese manufacturer, intending to identify and eliminate wastes (increased production, waiting, unnecessary transportation, improper processing, extraneous inventory, unnecessary motions, and flaws) to improve operations (Bouranta, Psomas, & Antony, 2021); for business performance (Negrão et al., 2020); sustainability (Swarnakar, Singh, & Tiwari, 2020) and operational performance (Hernandez-Matias, Ocampo, Hidalgo, & Vizan, 2019). In recent decades, lean manufacturing and performance measurement has grown to key themes with operations management (OM). In today's corporate environment, the importance of the manufacturing sector in contributing to the economy and social development is becoming increasingly apparent. Companies have used several large-scale business acting techniques, like as lean and supply practices, to focus on sustainable production. In the changing environment, manufacturing firms are changing their operations rapidly for continuous improvement together with improved quality, flexibility, and timely customer responses (Fullerton, Kennedy, & Widener, 2014). No doubt, lean manufacturing has been widely used in the manufacturing system for increased operational and performance excellence. Despite that, still possess several limitations, such as the lack of alignment between lean and organizational objectives, lack of justified lean practices for performance measurement, and relevant indicators to evaluate such practices (Cortes, Daaboul, Le Duigou, & Eynard, 2016).

Various studies have been published about lean manufacturing practices and their impact on business performance in general. Although many companies in the economic sectors have implemented lean manufacturing practices successfully, others failed to do so. One thing that was in common of such companies was the inability to measure performance over the medium and long term (Martínez-Jurado & Moyano-Fuentes, 2014). This resulted in an immense interest among researchers to investigate why they are unable to measure performance derived from lean manufacturing practices. In addition, it is not enough for the companies to just implement lean practices to improve performance, but they need to be aware of management responsibility on using such strategies too. Consequently, more studies need to be added to the existing literature to find the consensus on the lean manufacturing- performance relationships.

The work of management scholars has identified three ways in which performance can be managed, focusing on the implementation of lean manufacturing initiatives: (1) output control, which is related to the use of financial and non-financial

performance measures; (2) behavioral control, which is enforced through operating procedures; and (2) social control, which is related to training, visualization, peer pressure, and employee empowerment (Bellisario & Pavlov, 2018). Despite all these contributions by OM scholars, neither of the literature domains have provided a comprehensive review of lean manufacturing in the performance measurement system. As a result, our understanding of the way performance is maintained in manufacturing companies is still unclear. This led us to perform documented evidence of lean manufacturing practices towards performance. We built a comprehensive picture of current understanding and compared it to a holistic OM framework for critical evaluation. More, specifically, the key study objectives were:

- To extract the key lean manufacturing practices used by the OM researchers to measure performance.
- Analyze the extracted lean manufacturing practices to identify the performance criterion.
- To propose a conceptual framework that helps in understanding the lean manufacturing concepts to assess performance.

The rest of the paper is organized in the following way to reflect these goals. The next section explains how we conducted our literature review and shows the holistic LM-performance framework we used to extract and analyze the data. The findings are organized by the elements of the lean manufacturing practices in the next section. The conclusion assesses the findings and highlights key patterns, as well as several specific trends seen in the literature. It also suggests several relevant areas for future research. We conclude with a brief conclusion that restates the research objectives and explains the significance of the publication in the study of lean manufacturing-performance relationships.

2. METHODOLOGY

2.1 Selection of Literature

The current study performed the review of literature based on the methodology suggested by (Tranfield, Denyer, & Smart, 2003) that consists of planning, conducting, and reporting. The first stage of planning the review of articles is motivated by the rationale of the review and taking into consideration the research scope and findings. A systematic literature review (SLR) was conducted on lean manufacturing practices and business performance through a structured process involving different databases and sources (Chugani, Kumar, Garza-Reyes, Rocha-Lona, & Upadhyay, 2017). Previous studies (Garza-Reyes, 2015; Okoli & Schabram, 2010; Siegel, Antony, Garza-Reyes, Cherrafi, & Lameijer, 2019) confirmed SLR as a most transparent and explicit approach for identifying, evaluating, and synthesizing the existing literature and recording the work performed by previous researchers and practitioners at one place.

To meet the objectives mentioned in the previous section, an in-depth analysis of the literature linkages between Lean manufacturing, operational, and business performance was done. A literature evaluation has proven to be an important stage in establishing a study field's structure (Martínez-Jurado & Moyano-Fuentes, 2014). According to Easterby-Smith and Thorpe (2002), a review of literature is a critical step in structuring a field of research, allowing for the creation of a solid foundation for making advances in knowledge, facilitating the development of theory, fully resolving areas of research, and identifying areas that require more detailed research (Snyder, 2019).

Such kind of methodology of following literature review process has been carried out by previous studies in the area of operations management or closely related to the topic, including lean operations (Jasti & Kodali, 2015); lean manufacturing (Gupta & Jain, 2013); lean management (Parkhi, 2019); lean practices and performance (Negrão, Godinho Filho, & Marodin, 2017). The process of the literature review was performed based on the following steps: select, recognize, know, apply, examine, synthesize and evaluate the literature as suggested by (Levy & Ellis, 2006).

The bibliography revised were academic peer-reviewed journals for the period analyzed 2000 to 2021 (**see Table.1**). However, dissertations and thesis, textbooks, magazines, news articles, and unpublished working papers were excluded.

Table -1: Summary of Methodology

Research method techniques	Descriptions
Type of analysis	Quantitative and secondary data
Period of analysis	2000 - 2021
Search engines	Business Source Premier (EbscoHost); Scopus; ABI Inform Database; Elsevier (ScienceDirect); Springer Link; Emerald Insight and ISI Web of Knowledge
Keywords used in search engines	Lean; Lean management; Lean manufacturing; Lean practices; Lean production
Key journals screened	International journal of productivity & performance management; Journal of cleaner production; International journal of production research; Production planning & control; Journal of construction engineering & management; TQM journal; Benchmarking: an international journal

Database	Business Source ultimate; Academic search ultimate; eBook Collection (EBSCOHost)

Search engines like Emerald (www.emeraldinsight.com); ScienceDirect or Elsevier (www.sciencedirect.com); Springer (www.springer.com) and google scholar database (www.googlescholar.com); other library services; Ebsco (www.ebsco.com); and Taylor & Francis (www.taylorandfrancis.com); were used to identify and locate relevant articles. We used search strings like (Lean manufacturing), lean manufacturing and performance, lean manufacturing practices, lean manufacturing, and operational performance. While searching the articles, sometimes to some extent same article used to appear and thus thorough screening or systematic approach was necessary for exploring the literature.

We reviewed the abstract of the articles that we identified through the search strings and were reviewed to ensure coherence and cohesiveness. After the screening process was done, we identified a final sample of 37 articles in the field of lean manufacturing. We left out the lean manufacturing articles that were not relevant or were with unclear abstracts or keywords. Table 2 represents the selection and screening process of articles as suggested by (Morioka & de Carvalho, 2016). The adopted research approach includes three phases and ten processes, as shown in Figure. 1.

Table -2: Systematic Literature Review Process

Process	**Definition**	**Number of articles**
1. Research purpose and objective	Identifying the main goal and purpose of the review	
2. Develop research protocol	Suggestion for the preliminary research question, scope, criteria, quality, and data mining.	
3. Define relevance criteria	Establish research criteria to include the most relevant articles.	Total search results: 180
4. Search and collect literature	Search for relevant articles from top journals	
5. Selection of studies	Reason for the exclusion of studies based on the previously discussed criteria.	Total publication selected: 84
6. Quality evaluation for relevant studies	Assessing the articles for quality based on the methodology.	
7. Data extraction	Systematically extracting the data from each selected article by looking at the title, abstract, and deeper content analysis of the article.	Total publication analyzed: 37
8. Analysis of the data	Using research techniques and obtaining the facts to illustrate the main conclusion of the analysis.	
9. Writing the review	Systematic literature review report writing with sufficient results in detail.	
10. Dissemination	Contribute to the knowledge in the field of a systematic review.	

Source: Morioka and de Carvalho (2016).

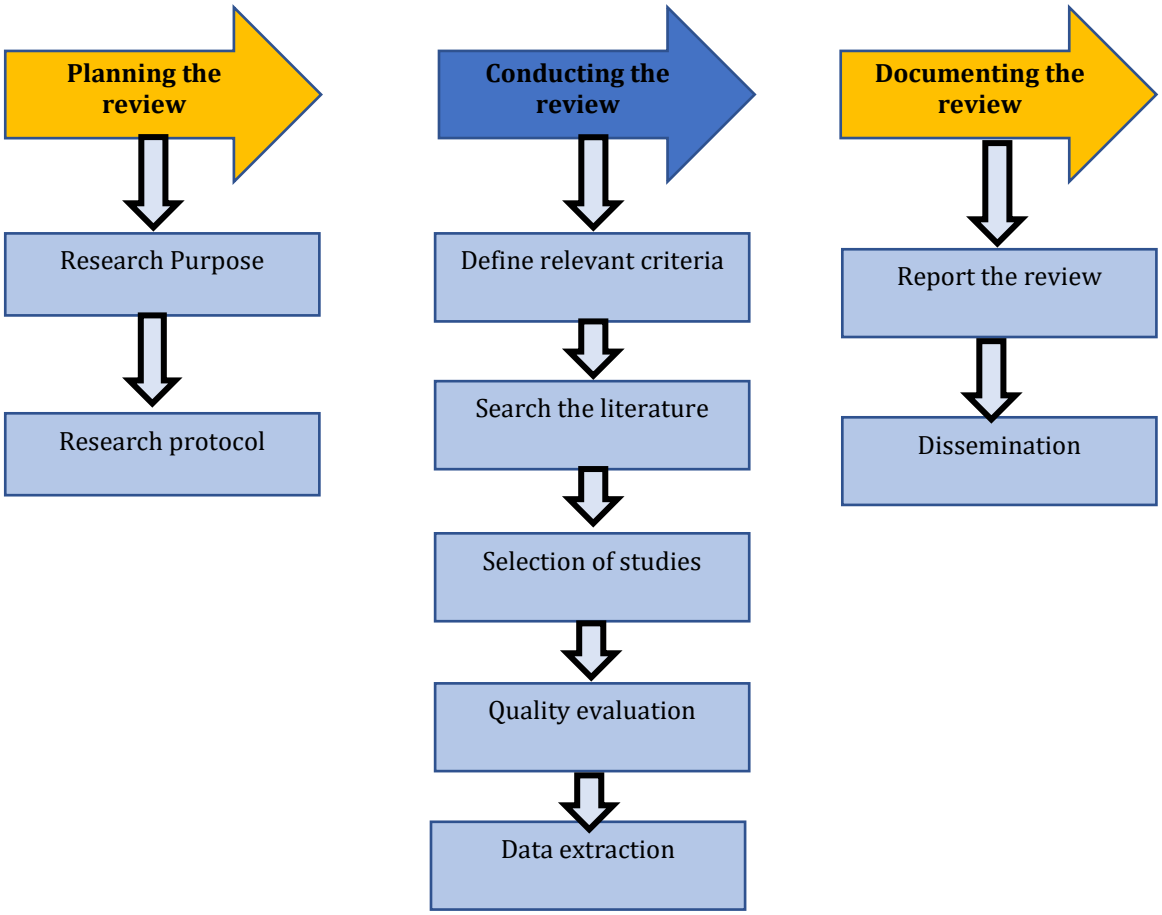

Fig -1: Research Approach

Source: Siegel et al. (2019)

2.2 Literature Selection Criteria

Several criteria were included for getting a reasonable reason to exclude articles from the literature. These criteria include the content of the paper, their publication journal, language, source types, authors, and include a study that only focuses on the business performance of manufacturing companies. For the current study, the publication selection was based within a certain period and in that sense, only articles published between 2000 and 2021 were included. Articles that focus on lean manufacturing and have a key contribution to business and operational performance in manufacturing companies were included. Finally, articles that are published in high-quality journals are only taken into consideration, whereas; articles from books, conference papers, websites, working papers, or any reports were excluded.

3. CONCEPTUAL FRAMEWORK FOR LEAN MANUFACTURING AND PERFORMANCE

The concept of lean manufacturing has been very popular in recent years due to its compatible strategies and its focus on the efficient use of resources (Durakovic, Demir, Abat, & Emek, 2018).

Based on the analysis of the research streams and previous studies investigated and reviewed on lean manufacturing, provides the conceptual framework for the study as illustrated in Figure.2.

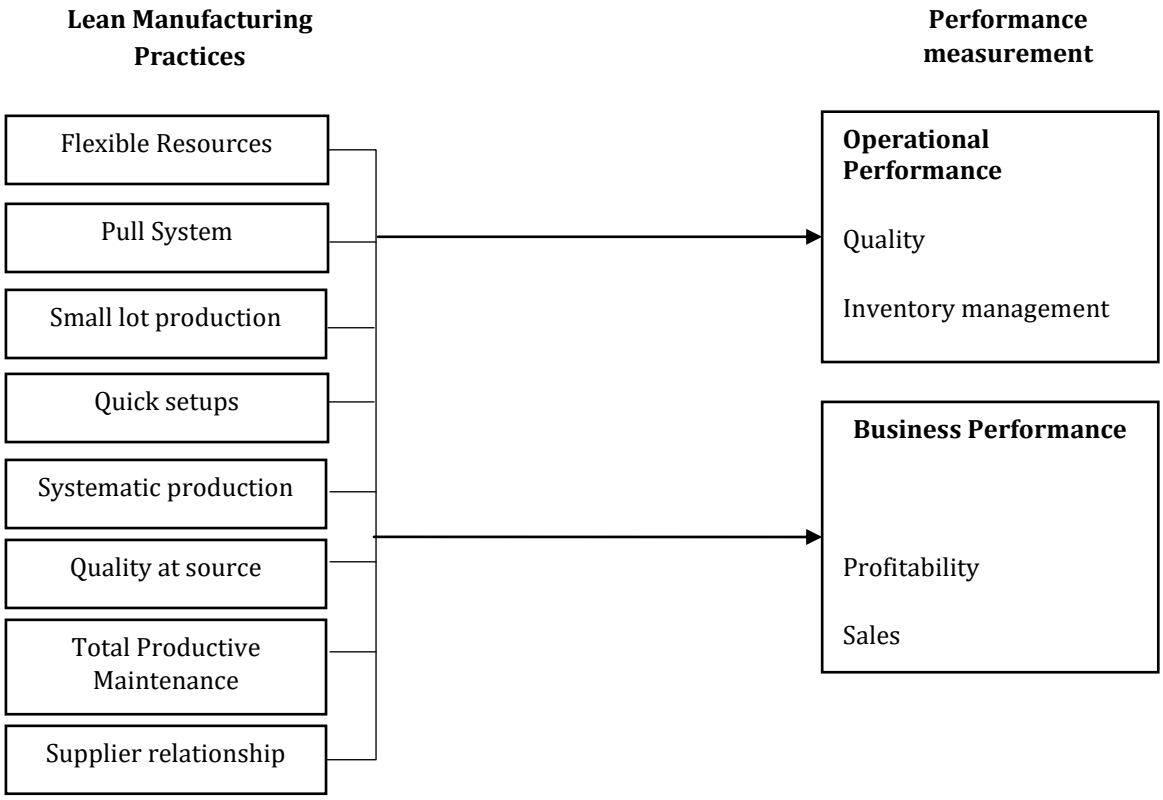

Fig -2: Framework for Lean manufacturing and performance

3.1 Critical Lean Manufacturing Factors

The success factors highlight numerous areas that require further attention in order for firms to effectively implement and sustain Lean efforts (see Table 4). Employee involvement was mentioned in every report as a critical aspect in success. The commitment and support of (top) management is also critical (Duarte and Cruz-Machado, 2013; Cherrafi et al., 2016; Wong and Wong, 2014), and several papers agree that measurements and metrics are required to achieve continuous improvement goals.

Flexible resources, cellular layouts, pull systems, small lots production, quick setups, uniform production level, quality at the source, total productive maintenance (TPM), and supplier networks were recognized as common LM techniques employed in prior research, as shown in Figure 2. Despite the fact that some of the LM features discussed in the literature were not included in this study as independent components, many were integrated into related behaviors.

4. RESULTS

4.1 Lean manufacturing challenges

When looking at the numerous obstacles across different continents (**see Table 3**), it is clear that most organizations are still having difficulty implementing lean manufacturing principles. The lack of uniform measurement and measurements across most considered countries and authors is a prevalent difficulty (Duarte & Cruz-Machado, 2013).

Table -3: Lean manufacturing challenges

Author-Year	Country	Challenges
(Rymaszewska, 2014)	Finland	Insufficient knowledge of production methods lacks lean benefits.
(Abu, Gholami, Saman, Zakuan, & Streimikiene, 2019)	Malaysia	Issues related to knowledge are the key reason for not undertaking lean practices
(Melton, 2005)	UK	The majority of the companies rejected lean due to lack of perception, lack of tangible benefits, and issues with shop floor employees.
(Losonci, Demeter, & Jenei, 2011)	Hungary	Lack of technical knowledge and skills causes the misapplication to lean manufacturing practices.

(Lameijer, Veen, Does, & De Mast, 2016)	Amsterdam	Lack of expertise and know-how on lean implementation had prevented companies to apply the lean-approach.
(Abolhassani, Layfield, & Gopalakrishnan, 2016)	USA	The concern of insufficient knowledge and lack of capital funds to hire lean experts increases the awareness of lean benefits amongst companies.
(Nunes, da Silva, da Silva Moris, & Giannetti, 2019)	Brazil	There are internal barriers like lack of employee commitment and lack of management support and interest that enable the companies to implement lean.
(Caldera, Desha, & Dawes, 2019)	Australia	Companies are struggling with time, financial, and labor resources that restrict them from conducting training on lean management practices.
(Erdil, Aktas, & Arani, 2018)	UK	There are cultural, knowledge, and resource issues that are challenging for the companies to get lean practice benefits.

Most of the authors from developed and developing nations provided a common challenge of lack of expertise and knowledge for restricting themselves from lean benefits. Additionally other authors (Cherrafi, Elfezazi, Chiarini, Mokhlis, & Benhida, 2016) like seemed that lack of awareness, avoid responsibility and ownership, (Kurdve, Zackrisson, Wiktorsson, & Harlin, 2014) apprehensive involvement found businesses challenging for the lean integration and implementation.

4.2 Lean manufacturing critical factors

Table 4 shows an example of critical factors or frameworks developed by scholars and practitioners for the integration of lean and performance. As it has been discussed earlier that the manufacturing sector can play an important role as an alternative to oil companies' dependence for economic growth, it is obvious to investigate strategies to improve manufacturing companies' performance. The identification of the factors that explain the operational and business results which result from lean manufacturing in the medium and long term has sparked the interest of scholars (Moyano-Fuentes, Maqueira-Marín, Martínez-Jurado, & Sacristán-Díaz, 2020). This section examines the research that focuses on this phenomenon, which is organized in the table below by the factors that are important for producing long-term results **(Table 4).**

Table -4: Critical factors on lean manufacturing practices towards performance

Author-Year	Critical Factors
(Cortes et al., 2016)	There is a lack of alignment between lean objective and management strategy; the lack of relevant indicators makes it difficult to measure and evaluate the leanness of a manufacturing process.
(Fullerton et al., 2014)	Lean must be adopted as a part of business strategy instead of only holistic operations;
(Ghosh, 2013)	Lean is about eradicating 'wastes' from the manufacturing system, but yet producing high-quality products that satisfy customers.
(Taj, 2008)	The manufacturing system needs to be more efficient and lean-to remain competitive. Managers rely on accounting metrics heavily to determine efficiency; however, such metrics are not enough for lean operations.
(Yang, Hong, & Modi, 2011)	With increased environmental sustainability, the organization needs to strategize efficiently and gain a competitive advantage.
(Sajan, Shalij, & Ramesh, 2017)	Conflict of interest arises in the organization due to the focus on profits as compared to the employees and environment. Such a situation imbalances the operational and business decisions too complicated.
(Bellisario & Pavlov, 2018)	Lean management as a niche concept has been ignored for evaluating organizational performance through performance management as a holistic approach.

This section presents general characteristics of the previous studies included. Firstly, it was determined how many articles were published by each publisher. Approximately, 180 peer-reviewed articles were published in 48 journals and distributed by the four publishers that were chosen. **Table 5** categorizes research papers on lean manufacturing and business performance into distinct sectors based on where they were published. The investigations covered in the sample papers took place in more than 40 countries across five continents, demonstrating a wide geographic spread. In particular, 108 studies on the automobile industry were conducted in Japan, the United States, India, Mexico, Brazil, and China; 18 studies on the pharmaceutical industry were conducted in India, Lebanon, the United States, Indonesia, Thailand, China, and Malaysia; 15 studies on the textile

industry were conducted in the United States, India, Peru, Pakistan, Bangladesh, and Sri Lanka; and 14 studies on the food industry were conducted in Turkey, Iran, Sri Lanka, Portugal, Indonesia, Medellin, and the United Kingdom.

Table -5: Lean manufacturing in distinct sectors

Sectors	Country (Geography)	Total Academic journals on lean manufacturing
Automobile	Japan, United States, India, Mexico, Brazil, China	108
Pharmaceutical	India, Lebanon, United States, Indonesia, Thailand, China, Malaysia	18
Textile	United States, India, Peru, Pakistan, Bangladesh, Sri Lanka,	15
Food	Turkey, United Kingdom, Iran, Sri Lanka, Portugal, Indonesia, Medellin	14

It reveals that the transportation sector has the highest number of articles (automotive industry). For nearly a decade, this industry has faced severe rivalry and nearly static demand in the United States and Europe. At the same time, growing economies such as China and India have increased their demand. As a result, practically every major automaker has been pushed to court these new markets. Customers in emerging markets, on the other hand, are extremely price and operational cost-sensitive, prompting the automobile industry to look forward to leaning implementation to save costs. However, Lean Manufacturing was first implemented in the automobile industry, and it was quickly adopted by other industries including textiles, construction, service, food, medical, electrical and electronics, ceramics, furniture, and services. All types of manufacturing systems have incorporated Lean Manufacturing, including specific product, process level, and fixed floor plan; batch and rapid manufacturing; continuous and discrete production. It has been used in several industries, from manufacturing to service; from mass manufacturing to high diversity and low production volume; from labor-intensive industries to technology-intensive industries; from construction to assembling; and from medical health care to telecommunication. Although Lean Manufacturing is simple to implement, as there is no single acceptable option for improving performance, and the context of operations is critical.

The identification of Businesses' problems, as well as the implications for Lean and Sustainability, demonstrates why so many businesses have yet to implement Lean, let alone Lean and Sustainability, and why a stronger focus on this type of organization is required. Many businesses are unable to investigate the possibility of incorporating a continuous improvement approach or a sustainable strategy due to a lack of resources. Top management plays a critical role in this since their unwillingness to engage in staff training or quality efforts prevents firms from moving forward with Lean initiatives. Furthermore, without management's full support and dedication, the workforce will express opposition. Because many businesses are struggling to stay afloat, the notion of Lean manufacturing must be made obvious, simple, and tailored to the needs and characteristics of businesses for them to consider incorporating these ideas into their operations.

5. CONCLUSIONS

This study arose from a need to understand how Lean manufacturing manages performance and a lack of systematic understanding of the research at the confluence of lean manufacturing and performance. The study is one of a small number that has looked into the present shortfalls of lean manufacturing implementation in the industry in terms of motivations, hurdles, challenges, and applications. The conclusions are summarized here, and they can help to support the little body of information on the under-researched topic. Finally, our research provided a systematized list of researched and recorded performance management strategies used by lean manufacturing businesses. Although this list is limited to lean manufacturing practices that have been studied and reported in research, and while a specific organization may not require all of them, lean practitioners will find this list to be a useful reference point for an organized set of practices that the field has amassed and that they can use for their operational needs. This research looks into how all aspects of lean may be merged with the continuous improvement program Lean to assist firms to sustain and leverage the benefits of both paradigms. Only a few studies have focused on the integration of Lean and performance as a joint approach and to take a comprehensive perspective of the connected elements, to our knowledge. As a result of these factors, this study fills a research gap identified in Section 1 and finds from a thorough literature assessment that:

- Businesses struggle to properly integrate lean management with performance due to their limited size and resources.
- According to the findings, the primary problems preventing organizations from implementing lean manufacturing processes are a lack of management support and a lack of metrics.

- It has been demonstrated that employee training and expertise is a critical condition for integration to thrive.
- An examination of existing frameworks reveals that present models are general frameworks that predetermine tools that are not suitable for every business, as well as a lack of long-term efforts to maintain integration.
- The environmental, social, and economic benefits of lean are undeniable.

The literature research also reveals that there are still major gaps in the understanding and application of lean and performance. These obstacles can be avoided by encouraging integration through a comprehensive, simple, and general implementation architecture. Many tools have not been adopted, are not mature enough, or are frequently not recognized by the industry, therefore a toolkit for Lean has yet to be built. The authors also emphasize the need for greater attention to the context of manufacturing organizations to help them integrate both paradigms effectively. The dearth of theoretical input in this subject contributes to the resistance to Lean integration. The integration of Lean with business performance can only be possible if these research gaps are addressed.

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