

Exploring Mediating and Moderating Factors Impacting the Relationship Between Lean and Organizational Performance: A Systematic Literature Review

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Abstract: Lean principles are widely recognized for their effectiveness in driving performance improvements. Extensive literature has delved into the study of Lean approaches, exploring their impacts on organizational performance from operational, financial, social, and environmental performance perspectives. Despite this rich body of literature, a comprehensive understanding of the factors influencing the relationship between Lean principles and organizational performance is still lacking. To bridge this gap, this research conducted a systematic literature review, aiming to identify and categorize the mediating or moderating factors between Lean and organizational performance, along with evaluating their effect. The study has pinpointed distinct clusters for mediating factors, such as Green Human resource management and Human factors integration, and clusters for moderating factors, including Operational Intellectual capital, Industry Clock speed, and Industry 4.0. Additionally, this research assessed the specific organizational performance outcomes influenced by these factors. Examining over sixty mediating and moderating relationships, the majority of them show a positive effect on performance. Notably, the findings reveal a predominant focus in previous studies on the relationship between Lean and operational and financial performances, with limited attention to environmental and social performance. This identified research gap underscores the need for future studies to extend the understanding of Lean approaches, particularly in aiding organizations to achieve sustainability goals.

Keywords: Lean, Sustainability, Operational excellence, contextual factors, Industry

1. Introduction

In today's competitive business landscape, organizations must navigate challenges and prioritize competitiveness through the improvement of their organizational performance from operational, financial, social, and environmental performance perspectives. Lean Management stands out as a transformative approach, reshaping operational structures, improving practices, and delivering value to stakeholders (Hosseini-Nasab et al., 2013). In today's literature, numerous studies showcase benefits in improving organizational performance, thanks to implementing the Lean approach (Bhamu & Sangwan, 2014). The primary focus of this article is a crucial aspect that is frequently overlooked—examining the influence of mediator and moderator factors on the relationship between Lean and organizational performance.

2. Theoretical background

The Lean approach, grounded in the principles of the Toyota Production System, serves as a comprehensive management philosophy aiming to optimize organizational processes by minimizing waste. Lean Management involves applying Lean principles to the entire organizational structure, emphasizing leadership, employee

participation, and process optimization, while Lean practices represent the practical implementation of these principles within organizations, by using a wide range of techniques, tools, and methodologies that facilitate the application of Lean principles and drive process improvement (Womack & Jones, 1997). Lean practices also have both soft and hard dimensions, reflecting a holistic approach to organizational improvement (Gadenne & Sharma, 2009). Hard dimensions of lean are systems-oriented and easier to quantify (Gadenne & Sharma, 2009). They focus on tangible, operational changes, such as process optimization, waste reduction, and efficient resource utilization. Instead, Soft lean approaches are more intangible and typically address issues with human resources and behavioral factors (Bortolotti et al., 2015).

2.1. Organizational Performances

Effective organization management relies significantly on performance measurement. To enhance effectiveness, organizations must identify and measure key performance indicators. Recognizing the multidimensional nature of organizational performance, researchers in the literature have proposed subdimensions such as operational performance (OP) and financial performance (FP) (Hadid & Mansouri, 2014; Novais et al., 2020). OP reflects the

ability of the firm to provide what customers want at the time they need it, decrease lead times, and improve service levels (Modgil & Sharma, 2016). The most widely used measures of OP are cost, quality, delivery, flexibility, lead time, and time to market (Cadden et al., 2020; Flynn et al., 2010; Hallgren & Olhager, 2009). FP represents the firm's ability to create value. It indicates whether a company's strategy implementation and execution are contributing to bottom-line improvement. FPs as a key attribute, shape the company's competitiveness, business potential, and economic concerns (Dufera, 2010). FP could be measured through various financial measures such as profit after tax, return on assets (ROA), return on equity (ROE), and earnings per share (Teshome et al., 2020). In contemporary business environments, the significance of organizational performance has evolved, with an increasing recognition of the importance of sustainability performance (Labuschagne et al., 2007). Sustainability performances could be categorized according to the triple Bottom line perspective (Elkington, 1997), into three categories: Economic (ECP), Environmental (EP), and Social (SP). Environmental performances (EP) tracked the impact the magnitude of ecological impacts of economic activities. FP could be measured through various indices: solid wastes, water emissions, energy consumption, raw material consumption, and land use (Yusuf et al., 2013). Social performances (SP) refer to enhancing the quality of life of all the concerned stakeholders (Tsai et al., 2009; Yenesew, 2014). This is measured through Corporate social responsibility project investments, employee wellbeing initiatives, and reduction of accidents. Economic performance (EcP) is one of the pillars of sustainability performance and is equivalent to business performance, which is measured through – productivity, cost reduction, revenue, profit, cash flow, and business growth (Dey et al., 2020).

2.2. The relationship between Lean-Organizational Performances

The majority of empirical studies support the overall positive impact of the Lean approach on a firm's organizational performance. However, in the literature, some studies analyzed the negative or non-significant relationship between Lean practices and organizational performance (Bortolotti et al., 2013; Onofrei et al., 2019). Furthermore, for what concern FP, multiple empirical studies found a direct impact of Lean on financial performance (Hofer et al., 2012; Shashi et al., 2019). It was discovered how lean positively affects profitability, ROA, Return on Investments, Return on Sales, and Earning per sharing (Chanegrih & Creusier, 2018). Lastly, for what regards Sustainability performance, conflicting results have been reported so far. Sajjan et al., 2017 found Lean practices to have a positive link with all three dimensions of the triple Bottom line performances. Meanwhile, some authors found that a positive relationship association between the level of Lean implementation and EP was not supported (Hajmohammad et al., 2013). Longoni et al., 2013 found the negative influence of Lean on employee health and safety. Also Inman & Green, 2018 state that Lean practices alone may not be able to achieve sustainability targets. An initial review of the literature found that only a minority of studies analyze the relationship between Lean and sustainable

performance. Sustainability is and will be one of the central issues in the coming years for the industrial engineering community. For this reason, a literature review that studies the relationship between Lean and sustainable performance may help develop future lines of research regarding this topic.

2.3. Mediating and moderating effect

As shown in the previous section, the relationship between Lean and organizational performance is very mutable. The different impacts of the Lean approach on organizational performance may depend on mediating and/or moderating factors. Recognizing and precisely defining significant interaction effects in causal relationships between variables indicates the maturity of a field of study (Aguinis et al., 2001). A mediating variable is an independent factor that has a substantial impact on a dependent variable by operating through another construct (MacKinnon, 2001). A hypothesized causal link between two variables is thought to be influenced by an intermediary third variable, termed a "mediator" (Chmura Kraemer et al., 2001). Mediating factors act as intermediaries, helping to clarify the mechanisms through which external influences shape the outcomes of Lean initiatives. Moderating variables are crucial elements in research, providing a means to examine and understand how the relationship between an independent and a dependent variable is influenced by other factors (Baron & Kenny, 1986).

2.4. Literature gap and research question

Despite their impact, the existing literature tends to underemphasize the significance of these external factors. The current research, which studies the relationship between Lean and performance, primarily focuses on analyzing the direct relationship between these two, and only some authors (Pont et al., 2009; Hofer et al., 2012; Januszek et al., 2023) analyzed individually moderating/mediating effects without conducting an exhaustive literature review on this subject. This research aims to address this gap by conducting a comprehensive examination of the mediating and moderating effects of external variables, offering a more detailed and refined comprehension of their intricate role in shaping the relationship between the Lean paradigm and organizational performance. Current research studying the relationship between Lean and organizational performance mainly focuses on analyzing the direct relationship between these two factors, and only a few authors have individually analyzed moderating/mediating effects without conducting an exhaustive review of the literature on this topic. The goal of this research is to fill this gap by conducting a comprehensive examination of mediator and moderator effects, offering a more detailed and refined understanding of their intricate role in shaping the relationship between the Lean paradigm and organizational performance. In particular, this research will answer the following research questions.

RQ1: Which are the mediator and moderator factors that influence the relationship between Lean and Organizational performance?

RQ2: How do these factors influence the relationships between Lean practices and organizational performance?

3. Methodology

To achieve the objective of this research, a systematic literature review has been conducted. All the papers have been extracted from Scopus which contains a significant number of renowned databases like Emerald, Taylor and Francis, Springer, IEEE, and Elsevier. The query used was: ("lean" OR "Lean manufacturing" OR "lean practices" OR "lean tools" OR "lean management" OR "lean production") AND ("performance" OR "operational performance" OR "operating performance" OR "economic performance" OR "sustainable performance" OR "environmental performance") AND ("moderating effects" OR "moderating factors" OR "contextual factors" OR "contextual effects" OR "moderator effects" OR "moderator effects" OR "mediation factors" OR "mediating factors" OR "mediation effects" OR "mediating effects"). The number of documents found for it has been discovered (122 articles). After reading all 97 articles' abstracts and applying the eligibility criteria, 27 articles did not meet the research requirements and were classified as Not Analysed. The rejected reason is divided into 4 categories: articles that do not talk about Lean, articles that use the word Lean for its mere significance, articles that do not talk about the Lean-Performance relationship, and articles that talk about the Lean-Performance relationship in the hospital sector. After investigating the 70 articles remaining it has been discovered thanks to the full reading, that part of the current literature investigated how contextual factors impact lean implementation instead of investigating its relationship with performance, so the other 18 articles were rejected by the analysis, as outlined in Fig. 1.

4. Results

Figure 2 shows how the 52 articles included in the final literature review were clustered. Two variables are used to create the four macro clusters of articles. The first variable is related to the Lean approach, and whether it refers only within manufacturing companies or at the Supply Chain level. The second variable distinguishes between articles that analyze the Lean approach as an element that is influenced by mediating and moderating effects, or whether it is the Lean approach that performs the function as a mediating or moderating effect. Through this clustering, the largest group of articles is the one called "LEAN input", with 35 articles (Fig.2). In this group we find articles that analyze the mediating and moderating factors between the Lean approach and organizational performance, with only an internal and not a supply chain perspective. This article will specifically delve into the "LEAN Input" group of articles. Among the 35 articles reviewed, a comprehensive examination of Lean input items was undertaken. The term "Lean input item" is used in this research to define the particular aspect of the Lean approach analyzed in relation to organizational performance. In the articles analyzed, we can see that the Lean approach is considered with different levels of granularity. Few authors zoomed in, looking at the Lean approach with a micro perspective, considering a specific Lean tool (Bortolotti et al., 2013), while most looked at the big picture, studying the broader effect of the Lean approach (Cadden et al., 2020; Kuo & Lin, 2020; Maware & Adetunji, 2020). The choice of method for analyzing the effect of a mediator or moderator factor depends on various factors, including the study design, the nature of the variables involved, and the research question. The most used quantitative methods are Structural equation modeling (SEM) hierarchical regression model (HRM) and ordinary least squares (OLS).

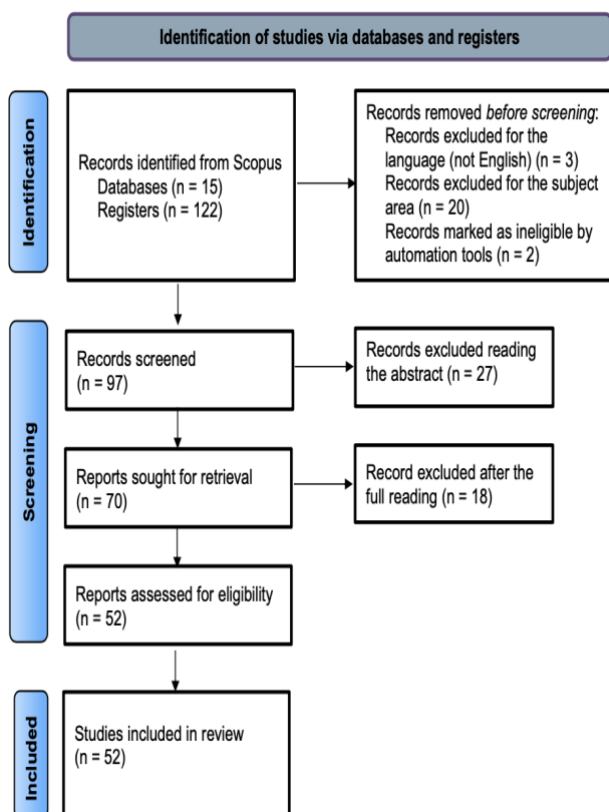


Fig. 1 Prisma Diagrams

52 articles

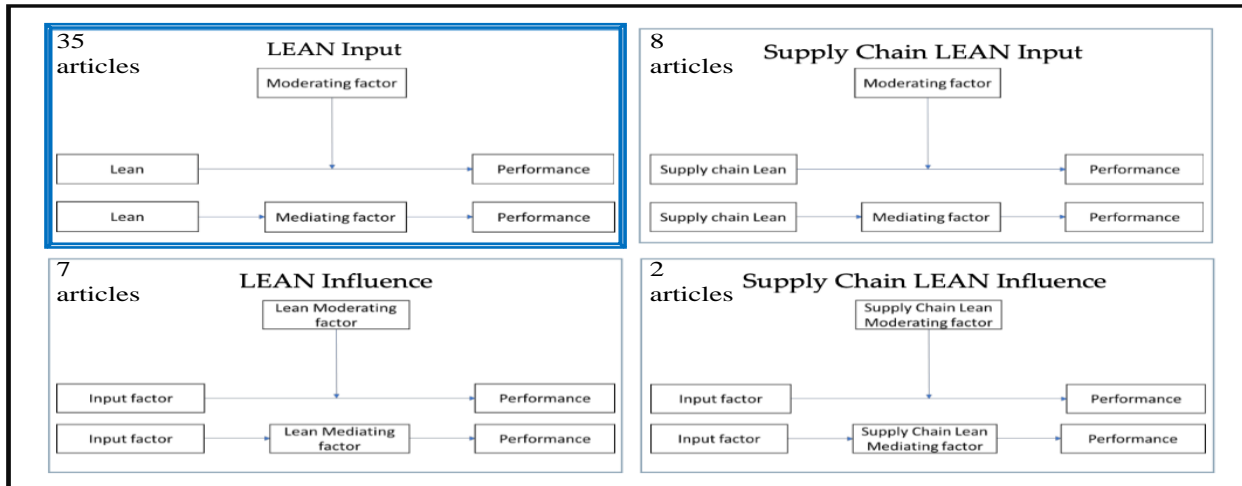


Fig. 2 Type of Lean-performance connection

5. Discussion

Starting from the results examined in the previous section, it was possible to create Figures 3 and 4. Each article in the "LEAN input" cluster was analyzed on three different aspects: what type of mediating or moderating variable acts in the relationship between Lean approach and performance, what type of impact the mediating or moderating effect has (whether positive, negative, or null), and what organizational performance the mediating or moderating effect influenced. Figure 3, referring to mediating effects, and Figure 4, referring to moderating effects, also show the frequencies referring to the number of times a mediating or moderating factor appears, of a given organizational performance, and the type of effect.

5.1. Mediator factor

Part of the mediator factors analyzed in the literature has been categorized into clusters and subclusters, to create a better understanding of the current studies. The biggest cluster of mediator factors is represented by the Lean Practices category which could be divided into Hard Lean practices and Soft Lean practices (Shah & Ward, 2003). Another relevant cluster is Green Human Resource Management, which represents a unique approach to human resource practices that encourages organizations to adopt green initiatives. Another bundle is the Human Factors Integration, which is a multidisciplinary approach that involves integrating human factors considerations into the design, development, and operation of systems, products, and processes. Lastly, there is the Performance Innovations Bundle, which involves enhancing skills and performance, fostering global and local connectivity, and improving productivity and knowledge within a community. Figure 3 shows each mediating factor and its effect on organizational performance. Figure 3 on the left lists all the mediator factors found in the literature review, along with the reference article and a frequency count of how many times a mediator factor was identified in the literature. Within the figure's middle section, are display the organizational performance, which is divided into operational (OP), financial (FP), environmental (EP),

economic (ECP), and social (SP) categories, along with their relative frequency. Meanwhile, the right section of the figure displays the influence of mediating factors on organizational performance, divided into five different levels based on the degree of influence: strongly supported, supported, partially supported, not supported, and negatively supported (MacKinnon, 2001). As a first analysis, it is interesting to note that some mediating factors have different effects in terms of their influence on performance. The Continuous Improvement (CI) mediation factor has been analyzed in 2 different articles, with different results. According to (Ditkaew, 2022) CI positively mediates the relationship between Lean Accounting implementation and OP. Instead according to (Gamage et al., 2017) CI is not a mediator factor. The reason for this contradiction is explained by the different Lean inputs. Similar considerations could be made for Corporate social responsibility which mediating effect change according to the Lean input. The input factors are not the only reason for having discordant results, indeed Green product innovation has no mediation effect when Lean practices a connected with SP and EP but has shown a partial mediation effect in the relationship between Lean practices-Economic Performances (Afum et al., 2021). An additional interesting output to analyze is the imbalance of studies that talk about operations performance, compared to triple bottom line performances (environmental (EP), economic (ECP), and social (SP)). A total of 46 different mediating relationships are displayed in Figure 3, of which 25 are related to operations performance (54%) while the remaining relationships are evenly distributed over the other performance.

5.2. Moderator factor

The 28 moderator factors analyzed in the literature have been categorized into clusters. As for the mediators, the most relevant clusters are described by the Lean Practices with a particular focus on the Soft Lean practices deeply analyzed by (Januszek et al., 2023). The second biggest cluster is the one made by the Industry Clock speed (IC), which is defined as the pace of change in an industry caused by factors such as changes in technology and competition

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(Wiengarten et al., 2012). This concept is closely tied to the dynamic interplay between technology and demand uncertainty. In conclusion, the last clusters are the one of the Operational Intellectual Capital (OIC). OIC represents the firm's operating know-how, embedded in using a system of knowledge-based operating resources exam (Menor et al., 2007). Figure 4 displays the effects of moderating factors according to four different levels of influence: positive moderation, no effect, partial negative, and negative moderation (Baron & Kenny, 1986). Social Lean practices such as work standardization, goal setting, and training are expected to have a positive influence on the connection between Lean and performance (Bortolotti et al., 2015; Matey et al., 2021; Wickramasinghe & Wickramasinghe, 2016). However, the findings show different results. The reason comes from the Lean Input-moderator relationship. Indeed, instructions and objectives can be very supportive of lean by providing employees with opportunities for continuous improvement, given employees have the freedom and authority to act on them,

but at the same time by imposing guardrails and constraints on employees, there is a risk of diverting them from the common lean goals, which could potentially limitate a successful lean implementation (Beraldin et al., 2019; De Treville & Antonakis, 2006). Furthermore, it is pretty interesting to analyze the Industry Clock speed bundle. The results of Maware & Adetunji, 2020 show that Industry Clock speed positively moderates the relationship between Lean and OP, in contrast with the negative results of demand variability and competitive intensity (Bortolotti et al., 2013; Hofer et al., 2012) and also with the observation of Chavez et al., 2013, that concluded that Lean is more efficient in low Industry Clock speed environments. In conclusion in Figure 4, there are 35 different mediating relationships, out of which 23 are related to operations performance, making up 66 % of the total. However, environmental, economic, and social performance are only present with a frequency of 6% each.

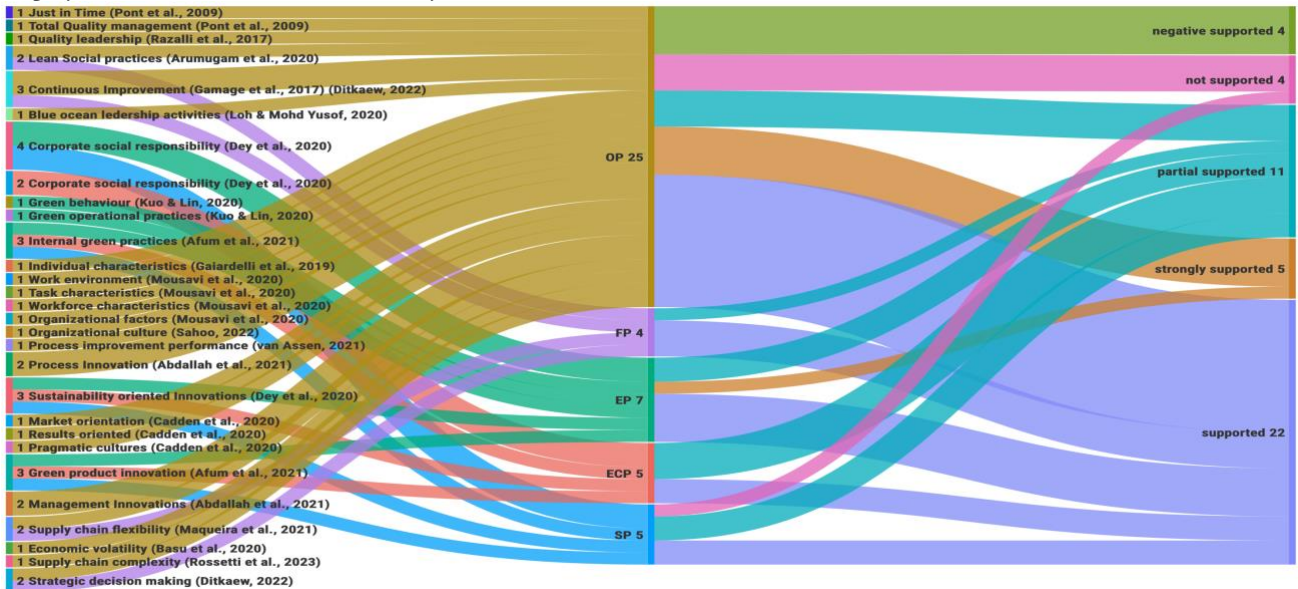


Fig. 3 Relationship graph between mediating effects and organizational performance

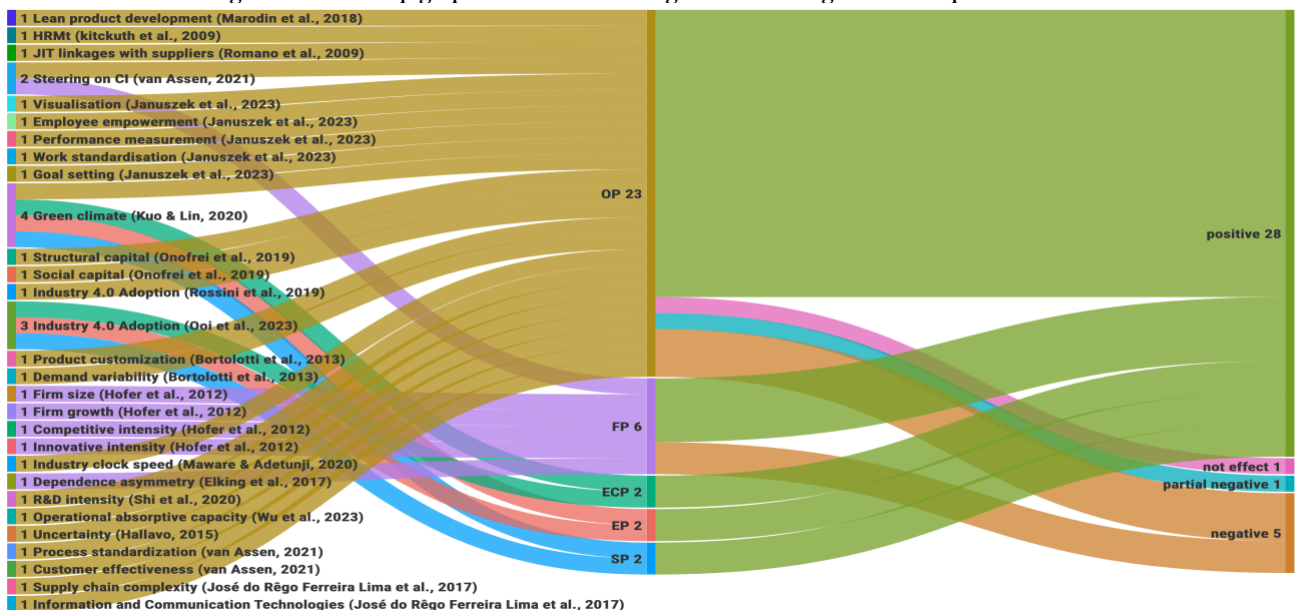


Fig. 4 Relationship graph between moderating effects and organizational performance

6. Conclusion

This article addresses the gaps in the literature exposed in the second section and sheds light on the complexities of Lean manufacturing's impact on organizational performance. Section 5 delves into the first research question (RQ1), exploring the mediator and moderator factors influencing the Lean-Organizational performance relationship. Similarly, Section 5 provides insights into the second research question (RQ2), elucidating how these factors influence the relationships between Lean practices and organizational performance. The analysis presented thoroughly examines each moderator and mediator factor, studying its mediating/moderating role and its effects on the relationship. Some studies explore multiple connections, varying Lean input factors, and output performances. Certain variables demonstrate diverse effects on performances based on the specific Lean input or performances studied in the relationships. This study not only enhances our understanding of the links between Lean and performance but also highlights areas for future research. While the existing literature has made some advancements in validating factors influencing Lean and OP, there is a conspicuous lack of comprehensive studies incorporating sustainable dimensions, just a few studies analyzed the interaction of I4.0 also for sustainability performance (Ooi et al., 2023; Stock et al., 2018). Bridging this gap becomes imperative as sustainable practices increasingly intertwine with operational strategies. Furthermore, the evolving landscape marked by innovations and uncertainty, and the growing influence of green paradigms introduces a domain that requires further in-depth investigation. Assessing similar studies seen before for investigating concepts like Process innovation, performance improvement, and their interaction not only with OP but also with sustainability performance could improve the current research knowledge. These nascent areas not only necessitate in-depth scrutiny but also present opportunities for refining and expanding existing models. Future research related to gaps in the literature that emerged in this study are related to a deeper exploration of how the relationship between the Lean approach and environmental and social performance may be influenced by mediating and moderating factors. As these elements continue to shape the contemporary industrial landscape, delving deeper into their effects will undoubtedly contribute valuable insights. The research limitations of this study are related to the methodology of the systematic literature review. Even the most rigorous article selection methodology may not be able to identify all significant contributions related to the phenomenon under analysis. In conclusion, this article makes valuable contributions to the understanding of the Lean-Organizational Performance link, providing the foundation for future research and practical applications in organizational settings.

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