

Lean and Agile Supply Chain Practices in Indonesian Manufacturing: A Literature Review of Regional and Industrial Variations

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ABSTRACT

This study examines the implementation of Lean and Agile supply chain practices in the Indonesian manufacturing sector, where firms face increasing pressure to balance operational efficiency and responsiveness in dynamic market environments. The study aims to review the application of Lean and Agile supply chain strategies across different industrial and regional contexts in Indonesia, as well as to identify the role of Agility in improving operational performance. A Literature Review approach based on the PRISMA framework was employed using literature collected from Google Scholar, Scopus, and ScienceDirect through Publish or Perish (PoP). The search covered studies published between 2015 and 2026 using keywords related to Lean supply chain, Agile supply chain, Leagility, and Indonesian manufacturing. Following the screening and eligibility process, 21 studies were included in the final review. The findings reveal substantial variation in the adoption of Lean and Agile supply chain practices across industries and regions. The automotive sector demonstrates the highest maturity in Lean–Agile integration through structured and efficiency-oriented operations, while the pharmaceutical industry is dominated by Agile-oriented strategies due to high demand uncertainty and responsiveness requirements. In contrast, agro-industrial SMEs exhibit limited capability to balance efficiency and flexibility, particularly in regions with infrastructural and resource constraints. The review further highlights Agility as a critical integrative capability that enables firms to align Lean efficiency with Agile responsiveness, thereby enhancing operational performance. Overall, the study concludes that isolated implementation of Lean or Agile practices is insufficient for sustainable supply chain competitiveness, and manufacturing firms should instead develop integrated supply chain capabilities that simultaneously support efficiency, flexibility, and responsiveness.

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1. Introduction

Global supply chains are increasingly characterized by uncertainty, demand volatility, and intense competitive pressure, requiring organizations to simultaneously achieve operational efficiency and market responsiveness (Nazari-Shirkouhi & Samadi, 2025). In response to these challenges, the Lean and Agile paradigms have emerged as two dominant approaches to supply chain management. Lean focuses on waste elimination, cost efficiency, and process standardization, whereas Agile emphasizes flexibility, adaptability, and rapid responsiveness to fluctuating customer demands. Both paradigms have been widely adopted in manufacturing supply chains to improve operational performance and competitiveness.

Despite their advantages, the isolated implementation of Lean and Agile practices often results in operational trade-offs. Lean systems may improve efficiency but reduce responsiveness under dynamic market conditions, while Agile systems may increase flexibility at the expense of higher operational costs. Consequently, scholars have proposed hybrid approaches, commonly referred to as Leagile strategies, which seek to balance efficiency and responsiveness within supply chain operations (Karneli et al., 2026). Previous studies have highlighted the potential synergies between Lean and Agile paradigms; however, existing literature remains fragmented, particularly in the context of emerging economies and manufacturing sectors with diverse operational characteristics.

Indonesia represents a particularly relevant context for examining Lean–Agile supply chain implementation due to its rapidly growing manufacturing sector and significant industrial diversity. The country's manufacturing environment ranges from highly structured automotive production systems to resource-constrained agro-industrial small and medium enterprises (SMEs). In addition, regional disparities in infrastructure, technological readiness, and supply chain integration create varying levels of capability in adopting Lean and Agile practices. While several studies have investigated Lean, Agile, or Leagile practices in specific Indonesian industries, a comprehensive synthesis of these findings remains limited. As a result, there is insufficient understanding regarding how Lean and Agile supply chain practices vary across industries and regions, as well as how Agility contributes to operational performance enhancement.

Although prior studies have extensively examined Lean, Agile, and their integration, several important research gaps remain. First, existing studies predominantly focus on conceptual discussions or isolated industrial cases, with limited systematic synthesis in the context of emerging economies such as Indonesia. Second, previous research often treats Lean and Agile as separate or parallel strategies without sufficiently exploring the mechanisms through which these paradigms interact within supply chain operations. Furthermore, while Agility has increasingly been recognized as an important organizational capability, its role as an integrative capability linking Lean–Agile practices to operational performance has not been systematically analyzed across different industrial and regional contexts.

Recent studies suggest that the effectiveness of Lean–Agile integration depends not only on the implementation of operational practices, but also on the development of higher-order capabilities that enable organizations to respond effectively to environmental changes. In this regard, Agility has increasingly been conceptualized as an integrative capability that aligns Lean efficiency with Agile responsiveness, thereby supporting operational performance improvement (Ardiansyah et al., 2026). However, evidence regarding how this capability operates within Indonesian manufacturing supply chains remains fragmented and underexplored.

Therefore, this study conducts a systematic Literature Review to synthesize existing evidence on Lean and Agile supply chain practices within the Indonesian manufacturing sector. This review focuses on studies published between 2015 and 2026 and seeks to address the limited synthesis of Lean–Agile implementation across different industrial and regional contexts in Indonesia. Although previous studies have examined Lean, Agile, or Leagile practices in specific sectors, there remains a lack of comprehensive understanding regarding how these practices vary across industries and regions, as well as how Agility functions as an integrative capability that links operational practices to performance outcomes.

Accordingly, this study aims to analyze regional and industrial variations in Lean and Agile supply chain implementation in Indonesia and to examine the role of Agility as an integrative capability that supports operational performance improvement. By providing a structured synthesis of existing literature, this study contributes to the development of Lean–Agile supply chain research in emerging economies. Specifically, this study contributes by:

1. providing a systematic synthesis of Lean and Agile implementation in Indonesia,
2. identifying regional and sectoral variations in implementation practices, and
3. positioning Agility as an integrative capability that links operational practices to operational performance outcomes.

In addition, the findings offer managerial insights for manufacturing firms seeking to balance efficiency, flexibility, and responsiveness in increasingly dynamic supply chain environments.

2. Methodology

2.1 Research Design

This study adopts a Literature Review approach to synthesize existing research on Lean and Agile supply chain practices within the Indonesian manufacturing context. The review is conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which provides a structured and transparent methodology for identifying, screening, and selecting relevant studies. The use of PRISMA ensures methodological rigor, transparency, and reproducibility, which are essential for high-quality literature synthesis. The review process follows four sequential stages: identification, screening, eligibility, and inclusion, allowing for a systematic reduction of studies based on predefined criteria and ensuring that only the most relevant and high-quality articles are included in the final analysis.

2.2 Data Sources and Search Strategy

To ensure comprehensive coverage of the literature, data were collected from multiple academic databases, including Google Scholar, Scopus, and ScienceDirect. These databases were selected due to their extensive indexing of peer-reviewed journals and conference proceedings relevant to supply chain management and manufacturing research. The search process was facilitated using the Publish or Perish (PoP) software, which enabled systematic retrieval, filtering, and organization of bibliographic data.

The search strategy was designed using a combination of core and extended keywords to capture a broad yet relevant set of studies related to Lean, Agile, and Agility concepts. Core keywords included "Lean Supply Chain," "Agile Supply Chain," "Leagility," "Lean Manufacturing Indonesia," and "Agile Manufacturing Indonesia." To enhance the robustness of the search and align with best practices in systematic reviews, additional keywords were incorporated, such as "Supply Chain Agility," "Lean Production," "Agile Operations," "Hybrid Lean Agile," "Operational Performance," "Manufacturing Industry Indonesia," "Production System Efficiency," "Demand Responsiveness," "Flexible Manufacturing System," and "Supply Chain Integration." These keywords were combined using Boolean operators to refine the search results. For instance, search strings such as ("Lean Supply Chain" OR "Lean Manufacturing") AND ("Agile Supply Chain" OR "Agility") AND "Indonesia" were applied to ensure relevance and specificity.

2.3 Inclusion and Exclusion Criteria

To maintain consistency and ensure the relevance of selected studies, a set of inclusion and exclusion criteria was established prior to the screening process. Articles were included if they were published within the last ten years (2015–2026), written in English, and classified as peer-reviewed journal articles or conference papers. Additionally, the selected studies were required to focus on the manufacturing sector within the Indonesian context and explicitly address Lean, Agile, or Agility (including Leagility) practices.

Conversely, studies were excluded if they were not related to supply chain or manufacturing topics, conducted outside Indonesia, or written in languages other than English. Duplicate records identified across databases were also removed. Furthermore, purely conceptual papers without empirical evidence or practical application were excluded to ensure that the review is grounded in applicable and evidence-based findings.

2.4 Screening and Selection Process

The study selection process followed the PRISMA flow procedure, involving multiple stages of filtering to progressively refine the pool of relevant articles. In the identification stage, an initial search conducted using Publish or Perish across the selected databases yielded a total of 1,000 records. Following this, duplicate entries were identified and removed, resulting in the elimination of 146 records and leaving 854 unique articles for further screening.

In the next stage, titles and abstracts of the remaining articles were reviewed to assess their relevance to the research objectives. A total of 691 articles were excluded at this stage due to lack of relevance, including studies not related to the manufacturing sector, not conducted in Indonesia, or not addressing Lean, Agile, or Agility concepts. This process resulted in 163 articles being retained for full-text assessment.

Subsequently, a full-text eligibility review was conducted to evaluate the suitability of these articles in greater detail. During this stage, 142 articles were excluded for specific reasons, including lack of focus on Lean or Agile practices (43 articles), absence of empirical or applied context (39 articles), incomplete or inaccessible data (32 articles), and lack of manufacturing sector relevance (28 articles). After this rigorous screening process, a final set of 21 articles was selected for inclusion in the systematic review.

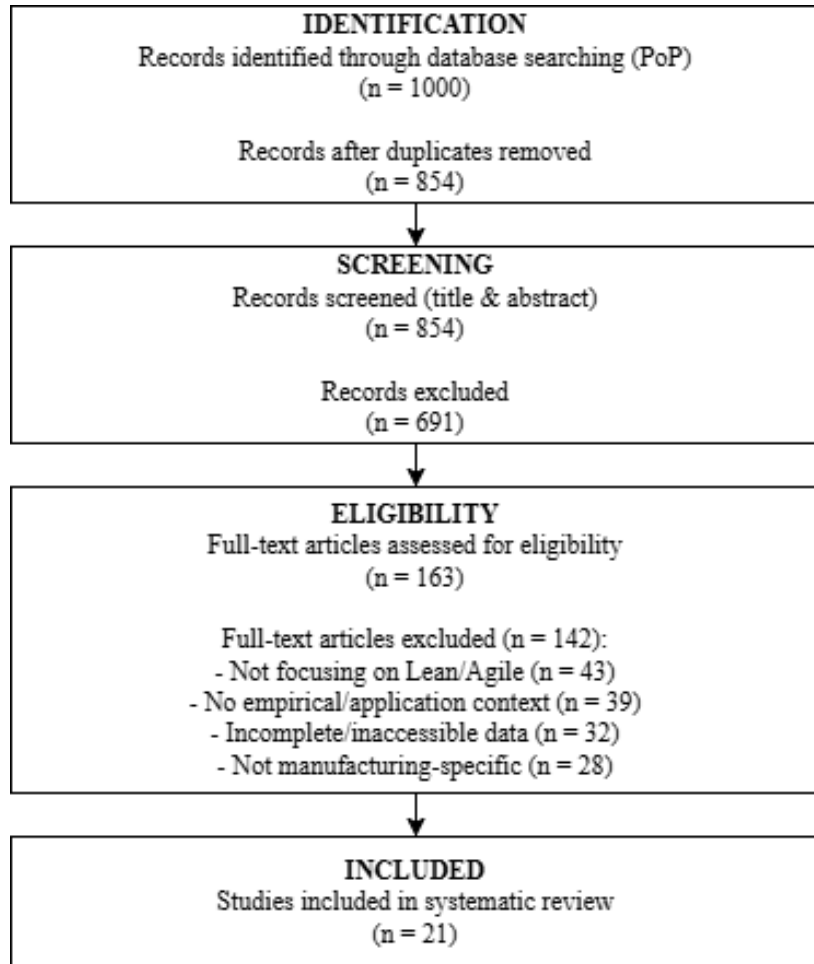


Figure 1. PRISMA Flow Diagram of Lean and Agile Supply Chain Practices in Indonesian Manufacturing

Picture 1 illustrates the study selection process based on the PRISMA framework. The initial search identified 1,000 records from the selected databases. After removing 146 duplicate records, 854 studies remained for title and abstract screening. Subsequently, 691 studies were excluded due to irrelevance to the research objectives. A total of 163 full-text articles were assessed for eligibility, of which 142 articles were excluded based on the predefined inclusion and exclusion criteria. Ultimately, 21 studies were included in the final systematic literature review and formed the basis of the analysis.

2.5 Data Extraction and Analysis

A structured data extraction process was employed to systematically collect and analyze relevant information from the selected studies. The extraction framework was designed to align with the research objectives and to support the identification of patterns across different industries and regions. For each article, key information was recorded, including bibliographic details (author, year, and publication source), industry type (such as automotive, pharmaceutical, and agro-industry), and geographical region (including Jakarta, Bali, Yogyakarta, Aceh, etc.).

In addition, specific attention was given to identifying the implementation of Lean practices (e.g., waste reduction, just-in-time systems, and process standardization) and Agile practices (e.g., flexibility, responsiveness, and product customization). The analysis also captured the presence of Agility capabilities, defined as the integration of Lean and Agile practices, as well as their impact on operational performance indicators such as lead time, efficiency, and responsiveness.

It is important to note that, although a total of 21 studies were included in the systematic review, only 6 studies provided sufficient empirical evidence and comparable data for structured extraction and tabulation. These studies are summarized in Table 1. The remaining studies were conceptual or review-based and were therefore utilized to support theoretical interpretation and qualitative synthesis rather than for direct comparison.

The collected data were analyzed using a qualitative synthesis approach, enabling the identification of recurring themes, similarities, and differences across studies. This approach allows for a deeper understanding of how Lean and

Agile practices are implemented in different industrial and regional contexts, as well as how Agility functions as an integrative capability influencing operational performance.

Table 1. Summary of Empirical Studies on Lean–Agile Practices in Indonesian Manufacturing (n = 6)

Author(s) & Year	Publication Source	Industry Type	Geographical Region	Lean Practices	Agile Practices	Agility / Integration	Performance Impact
Aisyah et al. (2019/2021)	Atlantis Press; Advances in Intelligent Systems Research	Agro-industry (Chocolate SMEs)	Jakarta, Bali, Yogyakarta, Aceh	Quality systems, cycle time reduction, and multifunctional workforce.	Customer service speed, delivery reliability, and response to market changes.	LARG (Lean, Agile, Resilient, Green) integration.	Increased competitiveness, resource efficiency, and maintained lead times.
Sukwadi et al. (2013)	Journal of Small Business Management	Fashion (Garment sector)	Central Java, Indonesia	Elimination of non-value-added activities.	Flexibility and responsiveness to serving unpredictable markets.	Leagile supply chain strategy.	Positive correlation with supply chain and overall SME performance.
Purba et al. (2024)	Jurnal Sistem dan Manajemen Industri (JSMI)	Automotive (Electric Car Industry)	Indonesia (Jakarta context)	Waste elimination in the supply chain and production processes.	Developing products and services that meet rapid consumer demands.	LARG implementation assessment.	Improved operational excellence and industrial competitiveness.
Roma Wibero (2025)	Greenation International Journal of Engineering Science (GIJES)	Automotive	Jakarta, Indonesia	Identification and elimination of non-value-added activities.	Responsive techniques for environmental and market compliance.	Lean-Green Management System (LGMS).	Enhanced profitability, process efficiency, and reduced operational costs.
Meilani & Samat (2024)	Jurnal Optimasi Sistem Industri (JOSI)	Various SMEs (Food, Textile, Footwear)	Various regions, Indonesia	Value Stream Mapping (VSM), 5S, and Six Sigma for waste reduction.	Quick responses to market fluctuations and customer preferences.	Synergy of Lean with Green and Agile initiatives.	Enhanced productivity, cost reduction, and overall business results.
Divsalar et al. (2022)	Decision Science Letters	Pharmaceutical (Medical Equipment)	Indonesia	Cost reduction and asset management optimization.	Quick product development cycles and flexible team structures.	LARG supply chain evaluation.	Increased customer satisfaction through responsiveness and rapid product launch.

Table 1 summarizes the six empirical studies included in the structured analysis of Lean Agile supply chain practices in Indonesian manufacturing. The studies cover various industrial sectors, including automotive, pharmaceutical, agro-industrial SMEs, food processing, textiles, and electrical equipment manufacturing, across several Indonesian regions. The findings indicate that Lean practices are primarily associated with waste reduction, process standardization, and operational efficiency, whereas Agile practices emphasize flexibility, responsiveness, and rapid adaptation to market changes. Furthermore, the reviewed studies consistently highlight the importance of integrating Lean and Agile approaches through frameworks such as Leagile, LARG, and Lean-Green Management Systems. Overall, the evidence suggests that the integration of efficiency-oriented and responsiveness-oriented practices contributes positively to operational performance, including improved productivity, reduced costs, enhanced flexibility, and greater competitiveness.

3. Results and Discussion

3.1 Overview of Selected Studies

Based on the PRISMA screening process, a total of 21 studies were included in the systematic review. However, only 6 empirical studies provided sufficient and comparable data for structured analysis, as presented in Table 1. The selected studies cover a range of manufacturing sectors in Indonesia, including automotive, pharmaceutical, agro-industry, and small and medium enterprises (SMEs), reflecting the diversity of industrial contexts in which Lean and Agile practices are implemented.

Geographically, the studies also demonstrate variation across regions such as Jakarta, Bali, Yogyakarta, Aceh, and Central Java, indicating that regional factors such as infrastructure, market access, and resource availability play a role in shaping the adoption of supply chain strategies. This diversity provides a foundation for identifying cross-sectoral and regional patterns in Lean and Agile implementation.

3.2 Industry-Based Analysis of Lean and Agile Practices

Automotive Industry

Among the reviewed sectors, the automotive industry demonstrates the highest level of maturity in implementing Lean and Agile supply chain practices. This sector is characterized by highly standardized production systems, strong supplier integration, and structured operational control mechanisms, enabling firms to simultaneously pursue efficiency and responsiveness. Lean implementation within the automotive industry primarily focuses on waste elimination, process optimization, continuous improvement, and supply chain efficiency. Studies by (Khazadi et al., 2024) indicate that automotive manufacturers actively apply Lean principles in both production and supply chain activities to minimize non-value-added activities and improve operational excellence.

In addition to Lean practices, the automotive sector also exhibits strong Agile capabilities. Firms increasingly adopt responsive production systems, rapid product development processes, and customer-oriented manufacturing strategies to respond to changing market preferences and technological developments. For example, Agile practices in the electric vehicle industry emphasize the capability to rapidly adjust product specifications and supply chain coordination according to evolving consumer demand (Sharma et al., 2021).

Furthermore, (Aisyah et al., 2021) identified that the Indonesian automotive sector achieved one of the highest implementation scores for integrated Lean–Agile approaches, indicating a relatively advanced level of operational maturity. The integration of Lean and Agile practices contributes to improvements in production efficiency, operational flexibility, industrial competitiveness, and supply chain responsiveness. These findings suggest that industries with highly structured operational systems and strong process standardization are better positioned to implement Lean–Agile integration effectively.

Another important finding is that automotive firms increasingly integrate environmental responsiveness into operational systems, as reflected in the Lean-Green Management System (LGMS) identified by (Wibero, 2025). Similar findings were also reported by (Firmansyah & Maemunah, 2021), who found that the implementation of lean management and green supply chain management has become increasingly important in Indonesian manufacturing and logistics industries. This integration supports not only efficiency improvement but also profitability enhancement and operational cost reduction. Therefore, the automotive sector represents the clearest example of how Lean and Agile practices can be integrated into a cohesive supply chain strategy capable of balancing efficiency, flexibility, and responsiveness simultaneously.

Pharmaceutical Industry

Compared to the automotive sector, the pharmaceutical industry demonstrates a stronger orientation toward Agile supply chain practices due to the highly dynamic nature of market demand and strict regulatory requirements (Argiyantari, 2021). Pharmaceutical supply chains operate in environments characterized by high uncertainty, fluctuating customer needs, short product life cycles, and the necessity for rapid response to healthcare demands. Consequently, operational flexibility and responsiveness become more critical than pure efficiency.

Empirical findings indicate that Agile strategies have a significantly greater influence on supply chain performance within the pharmaceutical sector than Lean strategies (Purnomo & Sulistyowati, 2018). Agile implementation in this industry is reflected through adaptive supply chain structures, rapid product development cycles, flexible team coordination, and responsive distribution systems. These capabilities enable firms to maintain product availability while responding quickly to market and regulatory changes.

Although Lean practices such as cost reduction and asset optimization are still implemented, their role tends to be secondary compared to Agile capabilities. Pharmaceutical firms prioritize responsiveness because excessive focus on efficiency and inventory minimization may increase the risk of supply shortages and delayed response to urgent healthcare demands. Therefore, the pharmaceutical sector illustrates how industrial characteristics significantly influence the prioritization of supply chain strategies.

The findings also suggest that Agile-oriented supply chains are particularly important in industries where customer demand is unpredictable and service reliability is critical (Ariadi et al., 2021). In such contexts, firms require flexible operational systems capable of rapidly adapting to external changes without significantly disrupting overall supply chain performance.

Agro-Industry and SMEs

Agro-industrial SMEs exhibit relatively lower levels of Lean and Agile implementation compared to large-scale manufacturing industries. This condition is largely influenced by resource limitations, lower technological readiness, weak supply chain integration, and infrastructural disparities across regions. Studies conducted by (Aisyah et al., 2021) reveal significant regional variation in the implementation of Lean and Agile practices among chocolate-based agro-industrial SMEs located in Jakarta, Bali, Yogyakarta, and Aceh.

Lean practices within agro-industrial SMEs primarily focus on quality management, cycle time reduction, and workforce utilization efficiency. However, the implementation of advanced Lean tools remains relatively limited due to financial constraints and lack of technical expertise. SMEs often struggle to maintain consistent process standardization and continuous improvement initiatives because operational systems remain heavily dependent on manual processes and limited technological support (Saputra et al., 2024).

Similarly, Agile practices in SMEs are constrained by low production flexibility and weak coordination across supply chain actors. Although firms attempt to improve responsiveness to customer preferences and market fluctuations, their adaptive capabilities are often restricted by inadequate infrastructure and limited access to real-time market information. Nevertheless, empirical evidence suggests that even partial implementation of Lean and Agile practices contributes positively to operational performance and competitiveness (Supriyadi, 2024).

Sukwadi et al. (2013) found that the adoption of Leagile supply chain strategies in garment SMEs positively correlates with supply chain performance and overall business performance. Similarly, (Meilani, 2024) identified that the integration of Lean practices such as Value Stream Mapping (VSM), 5S, and Six Sigma with Agile responsiveness can improve productivity, reduce operational costs, and enhance business outcomes among SMEs.

Despite these benefits, agro-industrial SMEs continue to face structural barriers in achieving full Lean–Agile integration. Regional disparities further exacerbate these challenges. Regions such as Jakarta and Bali generally demonstrate higher implementation capability due to better infrastructure and market access, whereas less developed regions such as Aceh exhibit lower implementation maturity. These findings indicate that contextual and regional factors play a critical role in determining the effectiveness of Lean and Agile supply chain implementation within SMEs and agro-industrial sectors.

3.3 Regional Variations in Implementation

The analysis reveals significant regional disparities in the implementation of Lean and Agile supply chain practices across Indonesia. These disparities are reflected in differences in operational maturity, infrastructure readiness, technological capability, and supply chain integration across regions. Several studies indicate that the level of Lean–Agile implementation is strongly influenced by regional economic development and industrial ecosystem support (Hien, 2023).

The variation in implementation levels can be observed through the LARG (Lean, Agile, Resilient, and Green) implementation index identified in prior studies. The LARG index is generally measured using a scale ranging from 1 to 5, where a score of 1 indicates very low implementation and a score of 5 reflects highly mature and well-established implementation practices. Regions such as Jakarta and Bali demonstrate relatively high implementation maturity. Empirical findings show that Jakarta achieved an average LARG implementation index of 4.35, while Bali recorded an average score of 4.30, indicating relatively advanced adoption of Lean and Agile practices (Aisyah et al., 2019). These regions benefit from stronger infrastructure availability, higher technological readiness, better logistics accessibility, and closer integration among supply chain actors.

In addition, (Meilani, 2024) emphasized that SMEs located in more developed industrial regions tend to achieve better operational outcomes from Lean and Agile implementation due to easier access to process improvement initiatives, technological support, and managerial capabilities. The availability of industrial clusters and market connectivity in regions such as Jakarta and Bali also facilitates collaboration between manufacturers, suppliers, and distributors, thereby strengthening supply chain responsiveness and operational efficiency.

Conversely, less developed regions experience lower levels of Lean–Agile implementation capability. Aceh, for example, recorded an average LARG implementation index of only 3.42, significantly lower than Jakarta and Bali (Aisyah et al., 2019). This lower score indicates weaker adoption of supply chain integration practices, process standardization, and operational flexibility. Several factors contribute to this condition, including limited infrastructure, lower technological

capability, weaker logistics networks, and restricted access to supply chain resources. These limitations reduce organizational capability to implement advanced operational systems required for effective Lean and Agile integration.

Additional studies also support the argument that regional readiness significantly affects supply chain modernization. (Riska & Munawaroh, 2024) identified that manufacturing firms operating in regions with limited digital and logistics infrastructure face greater barriers in implementing responsive and integrated supply chain systems. Similarly, (Nurhijriani, 2025) highlighted that operational flexibility and supply chain responsiveness are more difficult to achieve in regions with weaker institutional and technological support. From a broader perspective, (Ergun, 2025) argued that regional industrial ecosystems play an important role in determining organizational readiness for Lean–Agile transformation, particularly in emerging economies characterized by uneven industrial development.

Another important finding is that studies examining Lean–Agile or LARG implementation in Eastern Indonesia remain extremely limited. Most empirical studies are concentrated in western and central Indonesian regions, particularly Jakarta, Bali, Yogyakarta, and Central Java. Consequently, no comprehensive LARG implementation index for Eastern Indonesian regions was identified within the reviewed literature. This indicates a significant research gap and suggests that the current understanding of Lean and Agile supply chain implementation in Indonesia remains geographically uneven.

Overall, these findings demonstrate that regional development significantly influences organizational capability to adopt and integrate Lean and Agile supply chain practices. Infrastructure quality, technological readiness, institutional support, and market connectivity appear to be critical determinants of Lean–Agile implementation maturity across Indonesian manufacturing regions.

3.4 Integration of Lean and Agile: The Role of Agility

A key finding of this study is the importance of Agility as an integrative capability that bridges Lean and Agile practices. Across the reviewed studies, organizations that successfully combine efficiency-oriented and responsiveness-oriented practices tend to achieve superior operational performance.

For instance, the concept of Leagile supply chain strategy highlights the need to balance cost efficiency with flexibility, enabling firms to respond effectively to market changes while maintaining operational control (Sukwadi et al., 2013). Similarly, integrated frameworks such as LARG demonstrate that combining multiple paradigms can enhance supply chain resilience and performance (Divsalar et al., 2022).

These findings are further supported by recent research emphasizing that the impact of Lean and Agile practices on operational performance is significantly strengthened when mediated by higher-order capabilities such as Agility (F. Budiando et al., 2025). This suggests that Agility functions not merely as a set of practices, but as a dynamic capability that enables the alignment and integration of different operational strategies.

3.5 Impact on Operational Performance

Across all industries, the implementation of Lean and Agile practices is associated with improvements in key operational performance indicators. Lean practices contribute primarily to cost reduction, process efficiency, and waste minimization, while Agile practices enhance responsiveness, customer satisfaction, and adaptability to market changes.

The integration of these practices through Agility leads to more comprehensive performance improvements, including reduced lead time, increased productivity, and enhanced competitiveness (Purba, 2024). These results reinforce the argument that a balanced approach combining efficiency and flexibility is essential for achieving sustainable operational performance in manufacturing systems.

3.6 Discussion

3.6.1 Theoretical Implications

This study provides several important contributions to the existing literature on Lean and Agile supply chain management, particularly within the context of emerging economies. First, the findings reinforce the fundamental distinction between Lean and Agile paradigms, where Lean emphasizes efficiency through waste elimination, while Agile prioritizes responsiveness and flexibility in dynamic market environments. However, consistent with prior research, this study demonstrates that these paradigms should not be treated as mutually exclusive but rather as complementary strategies that can be integrated to enhance supply chain performance (F. A. Budiando et al., 2026).

The results further support the concept of Leagile supply chains, where organizations seek to balance efficiency and responsiveness. Empirical evidence from Indonesian manufacturing sectors shows that industries with structured production systems, such as automotive, are more capable of implementing Lean–Agile integration effectively. This aligns with previous findings that highlight the importance of supply chain design and process standardization in enabling hybrid strategies (Piotrowicz et al., 2023).

More importantly, this study extends the literature by emphasizing the role of Agility as a mediating capability. While prior studies have explored Lean and Agile practices independently or as integrated frameworks, limited attention has been given to the mechanisms through which these practices influence operational performance. The findings suggest that Agility functions as a dynamic capability that enables firms to align efficiency-oriented and responsiveness-oriented practices, thereby enhancing their ability to respond to environmental uncertainty. This is consistent with recent empirical evidence indicating that the impact of Hybrid Lean–Agile strategies on operational performance is significantly strengthened through the development of Leagility competencies (Karsa, 2025).

Furthermore, the study contributes to the literature by providing a contextualized perspective from Indonesia, where variations in industrial maturity and regional development significantly influence the adoption of supply chain practices. Prior studies on Indonesian agro-industry and SMEs highlight the challenges of implementing Lean and Agile practices due to resource limitations and infrastructural constraints. By synthesizing evidence across sectors and regions, this study addresses the gap in understanding how Lean–Agile integration operates in heterogeneous and resource-constrained environments.

3.6.2 Managerial Implications

From a managerial perspective, the findings of this study provide several practical insights for supply chain practitioners in the manufacturing sector. First, managers should recognize that implementing Lean or Agile practices in isolation is insufficient to achieve optimal performance. While Lean practices can improve efficiency and reduce costs, they may limit responsiveness in volatile markets. Conversely, Agile practices enhance flexibility but may increase operational complexity and cost. Therefore, firms should adopt a balanced approach that integrates both paradigms.

Second, the role of Agility as an integrative capability highlights the need for organizations to invest in capabilities that enable coordination and adaptation. This includes developing flexible production systems, enhancing information sharing across the supply chain, and adopting data-driven decision-making processes. Practices such as rapid product development, responsive supply chain design, and cross-functional collaboration are essential to support this integration (F. Budianto et al., 2025).

Third, the study suggests that industry characteristics should guide strategy selection. For example, in highly structured industries such as automotive, Lean practices can serve as a foundation for operational efficiency, with Agile capabilities layered on top to handle demand variability (Aisyah et al., 2021). In contrast, industries characterized by high uncertainty, such as pharmaceuticals, should prioritize Agile strategies to ensure responsiveness to market and regulatory changes (Purnomo & Sulistyowati, 2018).

Fourth, regional disparities observed in the findings imply that policymakers and managers must consider contextual constraints, such as infrastructure and resource availability. Firms operating in less developed regions may need to adopt incremental approaches to Lean and Agile implementation, focusing on building foundational capabilities before pursuing full integration.

3.6.3 Synthesis and Implications for Future Research

Overall, this study highlights that the successful implementation of Lean and Agile supply chain practices depends not only on the adoption of specific operational tools and techniques, but also on the development of integrative capabilities that enable organizations to balance efficiency and responsiveness. Across the reviewed studies, industries with more mature operational systems—particularly the automotive sector—demonstrated stronger capability in integrating Lean and Agile practices, while SMEs and agro-industrial sectors faced greater constraints related to infrastructure, resource availability, and supply chain integration. The findings further suggest that Agility functions as a critical integrative capability that aligns Lean efficiency with Agile responsiveness, thereby enhancing operational performance within manufacturing supply chains.

However, several limitations were identified within the reviewed literature and the SLR process itself. Based on the included studies, most empirical investigations employed cross-sectional designs and lacked longitudinal analysis, limiting

the ability to capture the dynamic evolution of Lean–Agile implementation over time. In addition, the quality assessment revealed that no study quantitatively tested the mediating role of Agility using advanced empirical approaches such as Structural Equation Modeling (SEM) or longitudinal causal analysis. As a result, the role of Agility identified in this review remains primarily conceptual and interpretive rather than statistically validated. Furthermore, the number of empirical studies focusing specifically on Indonesian manufacturing supply chains remains relatively limited, which may restrict the generalizability of the findings across broader industrial contexts.

These limitations provide several directions for future research. First, future studies should conduct quantitative empirical investigations to test the integrative role of Agility in the relationship between Lean–Agile practices and operational performance across different industrial sectors. Second, longitudinal studies are needed to better understand how Lean and Agile capabilities evolve over time in response to environmental uncertainty and market volatility. Third, future research could explore the integration of Lean and Agile practices with other supply chain paradigms, such as resilience and sustainability, to provide a more comprehensive understanding of supply chain performance (Nazari-Shirkouhi & Samadi, 2025; Rolo et al., 2015). Comparative studies across countries or regions may also provide deeper insights into how contextual factors influence the effectiveness of Lean–Agile integration.

From a practical perspective, manufacturing practitioners should assess their organization's agility maturity before pursuing Lean–Agile integration initiatives. Firms should also prioritize the development of flexible operational systems, cross-functional coordination, and responsive supply chain capabilities to ensure that efficiency-oriented and responsiveness-oriented practices can be effectively aligned within dynamic manufacturing environments.

4. Conclusion

This study provides a systematic synthesis of Lean and Agile supply chain practices in the Indonesian manufacturing sector, highlighting significant variations across industries and regions. The findings confirm that Lean practices are predominantly associated with efficiency and cost optimization, while Agile practices emphasize responsiveness and flexibility in dynamic environments. More importantly, the study demonstrates that the integration of these paradigms—through the development of Agility as a mediating capability—is essential for achieving superior operational performance. Industries with higher structural maturity, such as automotive, exhibit stronger capability to implement Lean–Agile integration, whereas SMEs and agro-industrial sectors face constraints due to limited resources and infrastructural disparities.

From both theoretical and practical perspectives, this study underscores that the effectiveness of supply chain strategies lies not in the isolated adoption of Lean or Agile practices, but in the ability to integrate them through dynamic capabilities that enable alignment between efficiency and responsiveness. While the study contributes to the literature by providing a contextualized understanding of Lean–Agile implementation in an emerging economy, it is not without limitations, particularly the reliance on a limited number of empirical studies. Future research should employ longitudinal designs and expand geographical coverage to strengthen the evidence base for Lean–Agile integration frameworks in emerging economies.

References

- Aisyah, S., Jaqin, C., & Purba, H. H. (2019). Identification of lean, agile, resilient, and green (LARG) practices on agro industry Indonesia. *Advances in Intelligent Systems Research*, 173, 62–69.
- Aisyah, S., Purba, H. H., Jaqin, C., Amelia, Z. R., & Adiyatna, H. (2021). Identification of implementation lean, agile, resilient and green (LARG) approach in Indonesia automotive industry. *Journal Européen Des Systèmes Automatisés*, 54(2), 317–324.
- Ardiansyah, S., Prabowo, R., & Hadi, S. (2026). Analysis of Lean Manufacturing and Agile Manufacturing Implementation to Reduce Waste and Improve Productivity in Crankshaft Repair Production (Case Study: PT. Intidaya Dinamika Sejati–Jember). *Jurnal Teknologi Dan Manajemen*, 7(1), 22–30.
- Argiyantari, B. (2021). *Lean supply chain transformation: A strategic approach towards supply chain excellence in Indonesian pharmaceutical industry*. Institut Teknologi Bandung.

- Ariadi, G., Surachman, Sumiati, & Rohman, F. (2021). The effect of lean and agile supply chain strategy on financial performance with mediating of strategic supplier integration & strategic customer integration: Evidence from bottled drinking-water industry in Indonesia. *Cogent Business & Management*, 8(1), 1930500.
- Budianto, F. A., Lubis, M., Mukti, I. Y., & Budianto, S. (2026). Simplifying Enterprise Architecture Implementation: Integrating Lean and Agile Principles through Mini-TOGAF. *Jurnal Ilmiah Manajemen Kesatuan*, 14(1), 227–236.
- Budianto, F., Feri, Z. O., Nurlaila, Q., Suryatman, T. H., & Sitorus, H. (2025). Leagility competencies as mediator hybrid lean agile and operational performance. *Vikalpa: The Journal for Decision Makers*, 50(3), 211–230.
- Ergun, A. M. (2025). *Exploring the evolution of LARG management: A bibliometric analysis in the automotive sector BT - 10th World Congress on Civil, Structural, and Environmental Engineering (CSEE 2025)*.
- Firmansyah, M. A., & Maemunah, S. (2021). Lean management and green supply chain management implementation on the manufacturing and logistics industry at an Indonesia. *Business and Entrepreneurial Review*, 21(1), 11–22.
- Hien, T. N. T. (2023). Trends in the scientific literature on the leagile supply chain: Bibliometric and citation context analyses. *Dalat University Journal of Science*, 13(4S), 69–84.
- Karneli, O., Pazli, P., Suryalena, S., Andin, F. K., & Febrian, A. F. (2026). *Integrated Framework of Green Lean-Agile Management (GLAM) for Ensuring the Long-Term Sustainability of Operational Excellence Initiatives: A Case Study of Crude Palm Oil Industry in Riau Province, Indonesia BT - 4th International Conference on Management and Business (ICOMB 2025)* (pp. 108–122). Atlantis Press.
- Karsa, A. H. A. N. (2025). Integrating Lean and Agile Practices for Enhanced Production Efficiency in Manufacturing: A Comparative Analysis. *Journal of Production Management and Optimization*, 1(2), 43–48.
- Khazadi, F., Radfar, R., & Pilevari, N. (2024). A review of lean, agile, resilient, and green (LARG) supply chain management in engineering, business and management areas. *Decision Science Letters*, 13, 287–306.
- Meilani, D. (2024). Systematic literature review of lean implementation in Indonesian SMEs. *Jurnal Optimasi Sistem Industri*, 23(1), 29–45.
- Nazari-Shirkouhi, S., & Samadi, S. (2025). An integrated model of LARG paradigms to improve healthcare supply chain performance. *Engineering Applications of Artificial Intelligence*, 145, 110204.
- Nurhijriani. (2025). Lean green supply chain management (LGSCM) literature review. *Jurnal Teknologi Dan Manajemen Industri Terapan*, 4(3), 835–841.
- Piotrowicz, W. D., Ryciuk, U., & Szymczak, M. (2023). Framework for measuring leagile supply chain performance: A literature review. *International Journal of Productivity and Performance Management*, 72(6), 1560–1583.
- Purba, H. H. (2024). *Mapping lean, agile, resilient, and green (LARG) practices in the automotive industry BT - 11th International Conference on Sustainable Agriculture, Food and Energy (SAFE 2024)*.
- Purnomo, W. D., & Sulistyowati, N. (2018). The influence of lean and agile strategy on implementation of supply chain management. *International Journal of Latest Research in Engineering and Management*, 2(6), 33–41.
- Riska, & Munawaroh, M. (2024). Supply chain strategy trends: Lean, Agile, Leagile. *International Research Journal of Multidisciplinary Scope*, 5(4), 82–97.
- Rolo, A., Pires, A. R., & Saraiva, M. (2015). Supply chain as a collaborative virtual network based on LARG strategy. *Advances in Intelligent Systems and Computing*, 280, 701–711.
- Saputra, R. G., Saputri, E. R., & Kusumadewi, H. (2024). Largs Performance Integrations In A Laundry Supply Chain. *Journal of Syntax Literate*, 9(7).
- Sharma, V., Raut, R. D., Mangla, S. K., Narkhede, B. E., Luthra, S., & Gokhale, R. (2021). A systematic literature review

to integrate lean, agile, resilient, green and sustainable paradigms in the supply chain management. *Business Strategy and the Environment*, 30(2), 1191–1212.

Supriyadi. (2024). Implementation of LARG in Indonesia's electric car industry. *Jurnal Sistem Dan Manajemen Industri*, 8(1), 61–72. <https://doi.org/10.30656/jsmi.v8i1.7674>

Wibero, R. (2025). The implementation of Lean and Green Management System (LGMS) and Lean and Green Waste Reduction Technique (LWRT). *Greenation International Journal of Engineering Science*, 3(2), 101–104.