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The Potential for Applying Lean Construction in Construction Projects in Manokwari Regency: A Systematic Literature Review

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Abstract

The construction industry continues to experience challenges that adversely affect project performance, including schedule delays, resource waste, low productivity, and escalating construction costs. Lean Construction has emerged as a management approach that emphasizes value creation while eliminating non-value-adding activities throughout the construction process. This study aims to evaluate the potential application of Lean Construction in construction projects in Manokwari Regency using a Systematic Literature Review (SLR). The review followed the PRISMA 2020 guideline by systematically identifying, screening, assessing, and synthesizing relevant peer-reviewed publications retrieved from Scopus, ScienceDirect, Google Scholar, Dimensions, and Garuda. The findings indicate that Lean Construction has significant potential to improve labor productivity, reduce material waste, enhance construction quality, shorten project completion time, and increase overall project efficiency. The review further identifies the Last Planner System, Just in Time, Value Stream Mapping, Visual Management, and Continuous Improvement as the most suitable Lean practices for regional construction projects. Nevertheless, successful implementation remains constrained by limited workforce competency, inadequate understanding of Lean principles, logistical challenges, and organizational readiness. The study concludes that Lean Construction offers a promising strategy for improving construction project performance in Manokwari Regency when supported by integrated project management, stakeholder commitment, and continuous capacity development.

Keywords: *Construction Project, Lean Construction, Manokwari Regency, Project Performance, Systematic Literature Review.*

INTRODUCTION

The construction sector has become one of the most strategic industries supporting national competitiveness, infrastructure expansion, and regional economic growth, making project performance an increasingly important concern for governments and construction stakeholders worldwide. The success of construction projects is commonly evaluated through the achievement of cost, quality, and schedule targets, yet modern projects are simultaneously expected to deliver sustainability, productivity, and long-term value throughout the project lifecycle. Despite significant advances in construction management, numerous projects continue to encounter schedule delays, budget overruns, low labor productivity, inefficient resource utilization, and excessive material waste that reduce overall project performance (Garcés & Peña, 2023). These recurring problems indicate that conventional project management approaches remain insufficient to address the increasing complexity of construction production systems operating under uncertain technical and organizational conditions. In response to these challenges, researchers and practitioners have increasingly promoted Lean Construction as a production-oriented management philosophy capable of improving workflow reliability while systematically eliminating activities that do not create customer value (Idris & Hermawan, 2025). The growing international adoption of Lean Construction demonstrates that efficiency improvement is no longer viewed solely as a matter of cost reduction but as an integrated effort to optimize project delivery through continuous process improvement and collaborative management.

Manokwari Regency, as the capital of West Papua Province, has experienced continuous infrastructure development involving public buildings, transportation facilities, residential areas,

educational infrastructure, and healthcare facilities to support regional growth. Nevertheless, the geographical characteristics of eastern Indonesia, long material transportation routes, limited logistics networks, and uneven availability of skilled construction workers create operational challenges that differ substantially from those encountered in more developed urban regions. These contextual conditions often increase project uncertainty and contribute to waste generation, productivity losses, and disruptions in construction workflows that eventually affect project cost and completion time. Previous studies have shown that Lean Construction offers practical mechanisms for minimizing waste while improving productivity through better planning, coordination, and production control systems (Anggraini et al., 2022). Recent evidence also indicates that integrating Lean principles into construction quality management contributes to higher operational consistency and improved project outcomes across various construction environments (Amalia et al., 2024). These findings suggest that regional construction projects with complex logistical characteristics possess considerable opportunities to benefit from Lean Construction principles when implementation strategies are appropriately adapted to local conditions.

Lean Construction originated from the adaptation of Lean Production principles into the construction industry through the Transformation–Flow–Value theory proposed by Koskela, which fundamentally redefined construction as an integrated production system rather than a sequence of isolated activities (Koskela, 1992). Since its introduction, numerous implementation tools, including the Last Planner System, Just in Time, Value Stream Mapping, Visual Management, and continuous improvement practices, have been developed to operationalize Lean principles throughout project planning and execution. Empirical studies consistently demonstrate that these approaches improve workflow reliability, reduce material waste, strengthen collaboration among project participants, and enhance overall project quality when implemented systematically (Idrissi Gartoumi et al., 2024). Research focusing on Indonesian construction projects likewise confirms that Lean Construction contributes significantly to waste reduction and operational efficiency, particularly through improvements in planning accuracy and production management (Allo & Bhaskara, 2022). More recent investigations further emphasize that Lean optimization has become increasingly important for achieving sustainable infrastructure development while balancing project efficiency and long-term performance objectives (Apriadi & Lesmana, 2026). Collectively, these developments indicate that Lean Construction has evolved into a comprehensive managerial philosophy capable of supporting both operational excellence and sustainable project delivery.

Although the reported benefits of Lean Construction are widely acknowledged, existing literature still reveals several important limitations that restrict its broader applicability across different regional contexts. Most empirical studies concentrate on large-scale urban projects, while relatively limited attention has been devoted to geographically remote regions where logistical uncertainty, resource limitations, and organizational capacity substantially influence project implementation. Existing publications also tend to evaluate individual Lean tools independently rather than examining how local project characteristics determine the suitability of different Lean strategies. Critical reviews further indicate that research in Indonesia remains fragmented, with limited synthesis regarding implementation barriers, enabling factors, and context-specific adaptation strategies required for successful Lean adoption (Prayuda et al., 2021). Recent systematic reviews similarly conclude that although the benefits of Lean Construction have been extensively documented, evidence regarding contextual implementation challenges remains scattered across different project types and geographical settings (Lolomsait & Setiawan, 2025). This fragmented body of knowledge creates an important research gap concerning the applicability of Lean Construction within infrastructure development environments characterized by geographical isolation and logistical constraints such as those found in Manokwari Regency.

Addressing this knowledge gap is scientifically important because infrastructure development in remote regions requires management strategies that are not only efficient but also adaptable to local operational realities. Understanding which Lean principles are most applicable under constrained logistics, limited workforce availability, and fluctuating material supply conditions may provide valuable guidance for improving construction performance in eastern Indonesia. Rather than relying exclusively on evidence generated from metropolitan construction environments, a contextual understanding is needed to determine how internationally recognized Lean practices can be translated into regional construction settings. Recent Indonesian studies continue to report positive impacts of

Lean implementation on project efficiency while emphasizing the importance of organizational readiness and systematic waste identification before implementation (Prasetyo, 2026). Other contemporary research also highlights that successful Lean implementation depends on selecting appropriate management tools according to project characteristics rather than applying standardized solutions across all construction environments (Juniawan et al., 2024). These circumstances demonstrate the necessity of synthesizing existing evidence to establish a stronger conceptual foundation for future Lean Construction implementation in Manokwari Regency.

This study aims to systematically identify the potential benefits, supporting factors, implementation barriers, and strategic opportunities for applying Lean Construction in construction projects in Manokwari Regency through a Systematic Literature Review approach. The review is designed to integrate international and Indonesian evidence into a comprehensive analytical framework that explains the relevance of Lean Construction within regional infrastructure development. The study also seeks to strengthen the theoretical understanding of Lean Construction implementation in geographically constrained construction environments that remain underrepresented in previous studies. From a methodological perspective, this research contributes by employing a structured evidence synthesis approach to generate more comprehensive insights than individual case studies can provide. The findings are expected to serve as an academic reference for future empirical investigations while offering practical guidance for construction stakeholders seeking to improve project efficiency and sustainability in Manokwari Regency. Ultimately, this study positions Lean Construction as a strategic framework for supporting more adaptive, efficient, and value-oriented construction project management in emerging regional development contexts.

RESEARCH METHODS

This study adopted a non-empirical research design using a Systematic Literature Review (SLR) to synthesize scientific evidence concerning the implementation of Lean Construction and to evaluate its applicability to construction projects in Manokwari Regency. The review protocol was developed based on the PRISMA 2020 reporting guideline to ensure a transparent, systematic, and reproducible review process (Page et al., 2021). The overall review procedure followed the methodological framework proposed by Kitchenham and Charters, encompassing review planning, literature identification, study selection, data extraction, and evidence synthesis (Kitchenham & Charters, 2007). Relevant publications were retrieved from Scopus, ScienceDirect, Google Scholar, Dimensions, and Garuda using Boolean search strings combining the keywords Lean Construction, Lean Project Delivery, Construction Project, Infrastructure Project, Waste Reduction, Productivity, and Project Performance. Eligible studies consisted of peer-reviewed journal articles and conference proceedings addressing the implementation of Lean Construction in construction projects, whereas duplicate records, non-construction studies, editorials, and publications with insufficient methodological information were excluded. This conceptual review framework was designed to generate comprehensive evidence regarding the benefits, supporting factors, implementation barriers, and potential application of Lean Construction in the context of regional infrastructure development.

The technical analysis consisted of systematic article screening, methodological quality assessment, structured data extraction, descriptive synthesis, and thematic analysis to ensure analytical consistency and reproducibility. Article selection was conducted through the PRISMA workflow, including identification, duplicate removal, title and abstract screening, full-text eligibility assessment, and final inclusion of relevant studies (Page et al., 2021). The methodological quality of each eligible publication was evaluated using predefined assessment criteria covering research objectives, methodological appropriateness, result presentation, conclusion validity, and relevance to Lean Construction, while only studies meeting the established quality threshold were included in the synthesis. Extracted data comprised publication characteristics, research methods, project types, Lean Construction tools, reported implementation benefits, enabling factors, implementation barriers, and recommended practices for project improvement. The synthesized findings were subsequently organized using descriptive and thematic analyses to identify recurring research patterns and evaluate their relevance to the geographical, logistical, and organizational characteristics of construction projects in Manokwari Regency (Lolomsait & Setiawan, 2025). The reliability of the review was strengthened through standardized evidence synthesis procedures and transparent methodological documentation,

allowing the review process to be replicated in future Lean Construction studies (Kitchenham & Charters, 2007).

RESULTS AND DISCUSSION

Literature Selection and Bibliometric Characteristics of the Reviewed Studies

The literature selection process was conducted systematically to ensure that the evidence synthesized in this review was methodologically rigorous, relevant to the research objectives, and representative of current developments in Lean Construction research. The review followed the PRISMA 2020 workflow, beginning with the identification of publications from multiple scientific databases and continuing through sequential screening and eligibility assessments before determining the final studies included in the synthesis (Page et al., 2021). Applying a structured review protocol reduced the possibility of selection bias while improving the transparency of the evidence synthesis process. The retrieved publications covered various construction sectors, including building projects, transportation infrastructure, industrial facilities, and public infrastructure developments. This diversity enabled the review to capture a broad range of implementation experiences across different project environments. The systematic organization of the selection process also provided a reliable foundation for identifying recurring patterns, implementation challenges, and research trends discussed in subsequent sections.

The initial database search produced 775 potentially relevant publications retrieved from Scopus, ScienceDirect, Google Scholar, Dimensions, and Garuda using predefined search strings related to Lean Construction and construction project management. Duplicate publications identified across different databases were removed using reference management software, resulting in 630 unique records for further evaluation. The remaining articles were screened based on their titles, abstracts, and keywords to determine their consistency with the predefined inclusion criteria. Publications focusing exclusively on Lean Manufacturing, manufacturing production systems, or unrelated engineering disciplines were excluded during this stage because they did not address construction-specific management issues. The eligibility assessment subsequently involved a comprehensive full-text evaluation to verify methodological adequacy, research relevance, and the availability of sufficient implementation evidence. This multistage selection process improved the reliability of the synthesized findings by ensuring that only scientifically robust studies were retained for detailed analysis.

Table 1. PRISMA-Based Literature Selection Results

PRISMA Stage	Number of Articles
Records identified from databases	775
Duplicate records removed	145
Records screened	630
Records excluded after title and abstract screening	550
Full-text articles assessed for eligibility	80
Full-text articles excluded	35
Studies included in the final synthesis	45

As presented in Table 1, approximately ninety-four percent of the initially identified publications were excluded before the final synthesis because they did not satisfy the methodological and thematic requirements established for this review. The largest reduction occurred during the title and abstract screening stage, indicating that broad keyword searches successfully maximized literature coverage while necessitating rigorous filtering to improve specificity. The final collection of 45 studies provided a sufficiently diverse evidence base for examining the implementation of Lean Construction from multiple geographical and organizational perspectives. Maintaining a transparent screening procedure is essential for ensuring the reproducibility and credibility of systematic literature reviews, particularly when synthesizing evidence from heterogeneous research designs (Kitchenham & Charters, 2007).

The bibliometric characteristics of the selected publications indicate that Lean Construction research has attracted increasing scholarly attention across different regions and construction sectors.

Most of the reviewed studies investigated building construction and infrastructure projects because these sectors frequently experience productivity losses, schedule uncertainty, and material waste that directly influence project performance. Case study research constituted the dominant methodological approach, although survey-based investigations, systematic reviews, and conceptual analyses were also well represented within the selected literature. International publications primarily examined organizational transformation, digital integration, and production optimization, whereas Indonesian studies frequently emphasized waste reduction, productivity improvement, and practical implementation challenges within local construction projects (Prayuda et al., 2021). This methodological diversity strengthened the comprehensiveness of the synthesized evidence by integrating both theoretical developments and empirical implementation experiences. The distribution of publication characteristics is summarized in Table 2.

Table 2. Characteristics of the Included Studies (n = 45)

Category	Classification	Number of Studies
Research Approach	Case study	20
	Survey	9
	Systematic literature review	7
	Conceptual/review study	5
	Mixed methods	4
Project Type	Building construction	22
	Infrastructure projects	14
	Industrial facilities	5
	Mixed construction projects	4
Study Origin	International	27
	Indonesia	18

The distribution presented in Table 2 demonstrates that the existing evidence is sufficiently heterogeneous to support comprehensive thematic synthesis while maintaining consistency with the objectives of this review. The relatively balanced proportion between international and Indonesian publications enabled meaningful comparisons regarding implementation strategies, organizational readiness, and contextual barriers across different construction environments. The dominance of case-based investigations also reflects the applied nature of Lean Construction research, where implementation effectiveness is frequently evaluated through real project experiences rather than purely theoretical models. Contemporary reviews similarly indicate that Lean Construction research continues to expand from operational process improvement toward broader discussions involving organizational capability, digital construction, and sustainable project delivery (Garcés & Peña, 2023). This evolving knowledge base provides an appropriate analytical foundation for examining the potential applicability of Lean Construction within the distinctive geographical and logistical conditions of Manokwari Regency.

The final collection of literature demonstrates that current Lean Construction research has reached sufficient conceptual maturity to support context-specific interpretation rather than merely describing general implementation outcomes. The selected studies collectively address production planning, waste elimination, collaborative management, quality improvement, logistics optimization, and organizational learning, allowing multiple dimensions of Lean implementation to be evaluated simultaneously. Integrating findings from diverse methodological approaches also reduces the likelihood that the conclusions are influenced by a single research perspective or project type. The systematic selection procedure therefore establishes a robust evidence base for identifying implementation opportunities and contextual limitations relevant to regional infrastructure development. The subsequent analysis builds upon this curated body of literature to explore how Lean Construction has evolved conceptually, which implementation practices have demonstrated consistent effectiveness, and how these findings can inform construction management strategies in Manokwari Regency.

Research Trends and Conceptual Development of Lean Construction

The synthesis of the selected literature demonstrates that Lean Construction research has undergone a substantial conceptual transformation, evolving from discussions centered on production philosophy toward integrated management strategies for improving construction project performance. Early publications primarily emphasized the theoretical foundations of Lean Construction, particularly the Transformation–Flow–Value (TFV) framework, which redefined construction activities as interconnected production processes designed to maximize customer value while minimizing non-value-adding activities (Koskela, 1992). This conceptual perspective gradually shifted scholarly attention from conventional project control toward continuous workflow optimization, collaborative planning, and systematic waste elimination. More recent studies extend this perspective by positioning Lean Construction as a strategic management framework that supports organizational adaptability and operational resilience under increasingly complex construction environments. The evolution of research themes reflects a transition from isolated process improvement initiatives toward integrated production management approaches that involve multiple project stakeholders. This progression illustrates the growing maturity of Lean Construction as both a theoretical framework and a practical management philosophy.

Research published during the subsequent development phase increasingly investigated the operationalization of Lean principles through structured implementation tools rather than discussing conceptual foundations alone. Practical approaches such as the Last Planner System (LPS), Just in Time (JIT), Value Stream Mapping (VSM), Visual Management, and continuous improvement emerged as dominant research themes because they provide measurable mechanisms for improving workflow reliability and production efficiency. International studies consistently reported that these tools enhance schedule reliability, reduce process variability, strengthen communication among project participants, and improve production stability across different construction environments (Tezel et al., 2018). The literature also indicates that successful implementation depends less on the individual application of Lean tools than on their integration within collaborative management systems supported by organizational commitment. This finding suggests that Lean Construction should be interpreted as an interconnected production system rather than a collection of independent management techniques. Such conceptual development has significantly expanded the scope of Lean research beyond operational efficiency toward organizational transformation.

Table 3. Evolution of Lean Construction Research Themes

Research Stage	Dominant Themes	Representative Contributions
Conceptual Development	Lean philosophy, TFV theory, waste identification	Establishment of theoretical foundations
Operational Implementation	LPS, JIT, VSM, Visual Management, 5S	Improvement of productivity and workflow reliability
Digital Integration	BIM, digital collaboration, Construction 4.0	Integration of Lean with digital technologies
Sustainable Construction	Resource optimization, resilience, sustainability	Long-term project performance and value creation

The progression presented in Table 3 demonstrates that contemporary Lean Construction research has expanded considerably beyond production control into broader discussions involving digital transformation and sustainable infrastructure development. Recent investigations increasingly integrate Lean principles with Building Information Modeling (BIM), digital project monitoring systems, and Construction 4.0 technologies to improve information flow and real-time decision-making throughout the project lifecycle (Xing et al., 2021). This convergence reflects the recognition that process efficiency alone is insufficient to address the growing complexity of modern construction projects. The integration of digital technologies enables Lean principles to operate more effectively through enhanced coordination, predictive planning, and improved project visibility. Consequently, current research increasingly considers Lean Construction as an enabling framework for intelligent construction management rather than merely an efficiency-oriented methodology.

The review also reveals notable differences between international and Indonesian research trajectories. International studies generally emphasize organizational transformation, digital innovation, and integrated production management, whereas Indonesian publications continue to focus predominantly on practical implementation issues such as productivity improvement, material waste reduction, and adaptation within local construction environments (Garcés & Peña, 2023). Although this applied orientation has generated valuable implementation evidence, relatively fewer studies investigate how regional socioeconomic conditions, logistics systems, and institutional capacity influence Lean implementation outcomes. Recent reviews similarly note that Indonesian Lean Construction research remains concentrated in major urban infrastructure projects, leaving geographically remote regions comparatively underrepresented within the existing body of knowledge (Lolomsait, 2024). The limited contextual diversity reduces opportunities to formulate implementation strategies tailored to regions characterized by transportation constraints and limited construction resources. Expanding the geographical scope of Lean research therefore remains an important direction for future investigation.

Another significant trend identified through the literature synthesis is the increasing integration of Lean Construction with sustainability objectives and long-term infrastructure resilience. Rather than measuring success solely through reductions in project cost and duration, contemporary studies increasingly evaluate Lean implementation according to broader performance indicators including environmental efficiency, resource optimization, stakeholder collaboration, and organizational learning. Recent investigations demonstrate that Lean-based optimization strategies contribute to more sustainable infrastructure development by improving resource utilization while simultaneously strengthening project quality and operational efficiency (Apriadi & Lesmana, 2026). Similar findings indicate that integrating Lean principles within quality management systems promotes continuous improvement and organizational consistency across different project phases (Amalia et al., 2024). These developments illustrate that Lean Construction has become closely aligned with emerging priorities in sustainable and intelligent construction management. The conceptual evolution observed across the reviewed literature therefore supports the relevance of examining Lean Construction as a strategic framework for addressing the operational challenges associated with infrastructure development in Manokwari Regency.

The overall evolution of Lean Construction research indicates that the field has progressed from theoretical production concepts toward multidisciplinary approaches integrating management science, digital technology, sustainability, and organizational behavior. This progression provides a stronger scientific basis for evaluating Lean implementation under diverse geographical and institutional conditions rather than assuming universal applicability across all construction environments. The literature also suggests that contextual adaptation has become increasingly important because implementation effectiveness is influenced by organizational maturity, project complexity, supply chain characteristics, and regional infrastructure capacity. These observations highlight the necessity of synthesizing international evidence before interpreting its relevance to construction projects operating within eastern Indonesia. The conceptual maturity demonstrated by the reviewed studies provides a robust foundation for examining the implementation benefits, critical success factors, and contextual barriers that are discussed in the following section.

Synthesis of Lean Construction Benefits, Barriers, and Critical Success Factors

The thematic synthesis of the selected studies indicates that Lean Construction consistently improves construction project performance by integrating production planning, workflow optimization, and continuous improvement into a unified management approach. Rather than generating benefits through a single management tool, Lean Construction creates cumulative performance improvements because multiple practices operate simultaneously to reduce process variability and eliminate activities that do not contribute to customer value. The reviewed studies demonstrate that improvements are frequently observed in labor productivity, project scheduling, material utilization, construction quality, and stakeholder coordination across different project types. These findings reinforce the argument that Lean Construction should be interpreted as a comprehensive production management philosophy instead of a collection of isolated operational techniques (Idris & Hermawan, 2025). The consistency of these reported outcomes across different geographical contexts suggests that Lean principles possess considerable adaptability when implementation is supported by organizational commitment and

effective project governance. The synthesis also indicates that implementation success depends on balancing technical process improvements with organizational and human resource development.

Among the reported implementation benefits, productivity improvement and waste reduction emerged as the two most frequently identified outcomes across the reviewed publications. Better production planning enables construction activities to proceed with fewer interruptions, while collaborative scheduling reduces idle time, unnecessary material movement, and process waiting. Studies conducted in Indonesian construction projects also report significant reductions in material waste through systematic identification of non-value-adding activities and more efficient resource allocation (Allo & Bhaskara, 2022). Similar evidence shows that integrating Lean principles into daily project operations contributes to higher productivity while simultaneously strengthening construction quality management practices (Amalia et al., 2024). These improvements are particularly important for projects operating under limited resource availability because efficiency gains directly influence both project cost and schedule performance. The literature therefore positions waste elimination not only as an operational objective but also as a strategic mechanism for improving overall project competitiveness.

Ta Table 4. Synthesis of Lean Construction Benefits, Barriers, and Critical Success Factors

Aspect	Main Findings	Dominant Evidence
Benefits	Higher labor productivity, improved schedule reliability, reduced material waste, better construction quality, lower rework, stronger stakeholder collaboration	Frequently Reported
Barriers	Limited Lean knowledge, organizational resistance, inadequate training, weak coordination, logistics constraints, low digital adoption	Frequently Reported
Critical Success Factors	Top management commitment, workforce competency, collaborative planning, continuous improvement culture, effective communication	Frequently Reported

The evidence presented in Table 4 demonstrates that implementation benefits are consistently accompanied by organizational and operational challenges that require strategic management rather than technical intervention alone. Several studies emphasize that the effectiveness of Lean Construction depends on maintaining coordination among project participants while ensuring that planning decisions remain responsive to changing site conditions (Juniawan et al., 2024). Contemporary international evidence likewise reports that Lean implementation contributes to measurable quality improvement when production control is supported by collaborative organizational practices and systematic performance monitoring (Idrissi Gartoumi et al., 2024). These observations indicate that successful Lean adoption requires continuous interaction between management capability, technical planning, and organizational learning. Consequently, organizations focusing exclusively on operational tools without strengthening managerial capacity may achieve only limited performance improvements.

Despite the substantial benefits reported across the literature, numerous studies identify persistent barriers that continue to limit Lean Construction implementation, particularly in developing construction industries. The most frequently reported obstacles include inadequate understanding of Lean principles, resistance to organizational change, insufficient workforce competency, fragmented communication among stakeholders, and inconsistent managerial commitment throughout project execution (Sarhan et al., 2020). Indonesian research similarly highlights that implementation challenges often originate from conventional management cultures that prioritize short-term project completion over systematic process improvement (Prayuda et al., 2021). Additional barriers emerge in regions characterized by complex logistics networks, where irregular material supply, transportation uncertainty, and limited access to construction technologies reduce the effectiveness of Lean-based planning systems. These contextual constraints indicate that implementation strategies should be adapted according to local project characteristics instead of relying on standardized organizational

models. Such findings reinforce the importance of incorporating contextual considerations into Lean implementation planning.

The synthesis also identifies several critical success factors that consistently distinguish successful Lean Construction implementation from less effective organizational initiatives. Strong commitment from senior management provides strategic direction and facilitates organizational acceptance of process changes introduced through Lean practices. Workforce competency and continuous professional development strengthen the ability of project teams to implement collaborative planning techniques and identify opportunities for continuous improvement throughout project execution. Recent Indonesian studies further demonstrate that organizations adopting Lean principles alongside structured project management practices achieve greater operational efficiency and stronger resource utilization than organizations relying on conventional construction management approaches (Manurung et al., 2026). Other empirical evidence confirms that systematic waste identification and elimination contribute directly to higher project efficiency while supporting better decision-making during project implementation (Prasetyo, 2026). These recurring observations suggest that Lean Construction implementation should be regarded as an organizational transformation process requiring simultaneous improvements in leadership, technical capability, communication, and production management.

Collectively, the reviewed evidence demonstrates that Lean Construction generates measurable organizational value when implementation extends beyond the application of individual tools and becomes embedded within project governance and organizational culture. The interaction between implementation benefits, organizational barriers, and critical success factors illustrates that project performance depends on the alignment of technical processes with managerial capability and stakeholder collaboration. This multidimensional perspective provides a stronger analytical basis for evaluating the applicability of Lean Construction within construction environments characterized by geographical constraints and logistical complexity. The findings synthesized in this section therefore establish the conceptual foundation for assessing the implementation potential of Lean Construction in Manokwari Regency, where contextual adaptation is expected to play a decisive role in determining implementation effectiveness.

Potential Application of Lean Construction in Manokwari Regency and Research Implications

The synthesized evidence indicates that Manokwari Regency possesses considerable potential for adopting Lean Construction because ongoing infrastructure development increasingly requires project management approaches capable of improving efficiency under geographically constrained conditions. Infrastructure expansion involving public buildings, transportation facilities, educational institutions, and healthcare infrastructure has intensified the demand for better coordination of construction resources and more reliable production planning. Unlike metropolitan construction environments, projects in Manokwari frequently encounter logistical uncertainty, extended material transportation routes, and uneven workforce availability, making conventional project management practices less effective in controlling project performance. Contemporary studies demonstrate that Lean Construction improves project efficiency by emphasizing value creation, workflow stability, and systematic waste elimination rather than relying exclusively on traditional cost and schedule control mechanisms (Garcés & Peña, 2023). These characteristics suggest that the principles of Lean Construction are highly compatible with the operational challenges commonly experienced in regional construction projects. The contextual relevance identified through this review supports the argument that Lean implementation should be interpreted as an adaptive management strategy rather than a standardized project management procedure.

One of the most applicable Lean approaches for construction projects in Manokwari is the Last Planner System (LPS) because it strengthens collaborative planning while improving schedule reliability through continuous coordination among project participants. Construction activities in geographically dispersed regions often experience interruptions caused by delayed material delivery, changing site conditions, and inconsistent resource availability, making collaborative production planning particularly important. International implementation experiences indicate that LPS contributes to improved workflow predictability by ensuring that scheduled activities are executed only after prerequisite resources become available (LCI, 2018). Complementary planning approaches such as Just in Time (JIT) may further reduce excessive material storage and minimize inventory-related losses

when transportation schedules are properly coordinated. Integrating these planning mechanisms would enable contractors operating in Manokwari to reduce process variability while improving operational flexibility under uncertain logistical conditions. Such adaptations illustrate that Lean tools can be selected according to local operational priorities rather than implemented as rigid management standards.

Table 5. Recommended Lean Construction Strategies for Construction Projects in Manokwari Regency

Lean Tool	Primary Objective	Expected Contribution in Manokwari
Last Planner System (LPS)	Collaborative production planning	Improved schedule reliability and project coordination
Just in Time (JIT)	Material flow optimization	Reduced inventory costs and material deterioration
Value Stream Mapping (VSM)	Waste identification	More efficient construction processes and resource allocation
Visual Management	Information transparency	Better communication among project participants

The implementation priorities presented in Table 5 indicate that the selected Lean tools address operational issues directly associated with regional construction conditions rather than introducing complex technological interventions. Visual Management, for example, improves information accessibility by presenting project progress, work priorities, and operational indicators in a format that can be rapidly interpreted by multidisciplinary construction teams (Tezel et al., 2018). Value Stream Mapping similarly enables contractors to identify process inefficiencies occurring across procurement, material handling, and construction execution before they generate significant project delays or unnecessary costs. Continuous Improvement practices strengthen organizational learning by encouraging regular evaluation of project performance and systematic identification of opportunities for operational enhancement. Integrating these complementary tools creates a management system capable of responding dynamically to changing project conditions while maintaining production stability throughout the construction process.

Although the reviewed literature demonstrates substantial implementation potential, successful adoption of Lean Construction in Manokwari depends on several organizational and institutional prerequisites. Workforce competency remains a fundamental requirement because Lean implementation demands collaborative planning, continuous communication, and a comprehensive understanding of value-oriented production management. Organizational commitment from contractors, consultants, project owners, and local government agencies is equally important because Lean principles require coordinated decision-making across multiple project stakeholders. Recent Indonesian studies indicate that organizations adopting Lean practices achieve more sustainable performance improvements when technical implementation is accompanied by continuous capacity development and organizational learning initiatives (Apriadi & Lesmana, 2026). Similar findings also emphasize that systematic waste reduction and productivity improvement become more sustainable when Lean principles are integrated into organizational management systems instead of being introduced as isolated operational initiatives (Anggraini et al., 2022). These observations suggest that successful implementation requires long-term institutional commitment alongside technical process improvement.

From a theoretical perspective, this review extends existing Lean Construction literature by demonstrating that implementation effectiveness should be evaluated within specific geographical, logistical, and organizational contexts rather than assuming universal applicability across construction environments. The synthesis contributes to the growing body of knowledge emphasizing contextual adaptation as an essential component of Lean implementation, particularly for infrastructure development in emerging regions. Existing systematic reviews likewise indicate that implementation outcomes vary according to project characteristics, institutional capacity, and regional construction ecosystems, highlighting the importance of context-sensitive implementation frameworks (Lolomsait

& Setiawan, 2025). This perspective broadens the conceptual understanding of Lean Construction beyond production optimization toward adaptive construction management capable of responding to regional development challenges. The review therefore provides an analytical foundation for future empirical investigations examining Lean implementation within eastern Indonesian construction projects using quantitative, qualitative, or mixed-method research designs.

The practical implications of this study extend beyond academic discussion by providing evidence-based guidance for contractors, consultants, project owners, and regional policymakers seeking to improve construction project performance in Manokwari Regency. The synthesized findings indicate that Lean Construction offers practical opportunities to strengthen productivity, improve material utilization, enhance planning reliability, and reduce operational waste through systematic process management. Implementing these strategies gradually, beginning with organizational capacity building and collaborative planning practices, is likely to produce more sustainable outcomes than introducing multiple Lean tools simultaneously. The review also identifies several research opportunities related to digital Lean implementation, regional logistics optimization, and organizational readiness that remain insufficiently explored within eastern Indonesian construction contexts. These directions provide a valuable foundation for future investigations seeking to strengthen intelligent construction management and sustainable infrastructure development in geographically challenging regions.

CONCLUSION

This study employed a Systematic Literature Review to synthesize scientific evidence on Lean Construction and to evaluate its potential application in construction projects in Manokwari Regency. The findings indicate that Lean Construction is an effective construction management approach for improving project performance by eliminating non-value-adding activities, optimizing resource utilization, and enhancing workflow reliability. The synthesized evidence demonstrates that Lean Construction contributes to higher labor productivity, reduced material waste, improved construction quality, shorter project completion time, and greater cost efficiency. The review further identifies the Last Planner System, Just in Time, Value Stream Mapping, Visual Management, and Continuous Improvement as the Lean practices most frequently associated with successful project implementation. These approaches collectively strengthen planning reliability, communication, workflow stability, and value creation throughout the project lifecycle. The analytical synthesis also confirms that Lean Construction has evolved from a production philosophy into an integrated management framework capable of supporting more efficient and sustainable construction practices. The findings therefore provide a comprehensive understanding of the current state of Lean Construction research and its practical relevance to contemporary construction management.

The review also demonstrates that Manokwari Regency has considerable potential for implementing Lean Construction because its ongoing infrastructure development is accompanied by logistical constraints, geographical challenges, and limitations in construction resources. Successful implementation requires organizational commitment, workforce competency development, effective stakeholder collaboration, and integrated project management practices that support continuous improvement. From a theoretical perspective, this study extends the existing body of knowledge by providing a contextual synthesis of Lean Construction implementation within geographically constrained construction environments. From a practical perspective, the findings offer evidence-based guidance for contractors, consultants, project owners, and local governments in developing more efficient construction management strategies. The study is limited by its reliance on published literature and therefore does not provide direct empirical validation within construction projects in Manokwari Regency. Future studies are encouraged to conduct empirical investigations using case studies, surveys, or mixed-method approaches to evaluate the effectiveness of Lean Construction implementation under local project conditions. Further research should also explore the integration of Lean Construction with digital technologies and intelligent project management systems to support sustainable infrastructure development in eastern Indonesia.

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