Perera, H.V.D., Perera, B.A.K.S. and Mannapperuma, M.M.N., 2026. Barriers to use of leagile project management for stakeholder collaboration in green building constructions in Sri Lanka. In: Waidyasekara, K.G.A.S., Jayasena, H.S., Chandanie, H. and Tennakoon, G.A. (eds). *Proceedings of the 14th World Construction Symposium*, 10-11 July 2026, Sri Lanka. pp. 292-305. DOI: https://doi.org/10.31705/WCS.2026.22. Available from: https://ciobwcs.com/papers/

BARRIERS TO USE OF LEAGILE PROJECT MANAGEMENT FOR STAKEHOLDER COLLABORATION IN GREEN BUILDING CONSTRUCTIONS IN SRI LANKA

H.V.D. Perera[1], B.A.K.S. Perera[2] and M.M.N. Mannapperuma[3]

ABSTRACT

Leagile project management has been identified as a promising concept to address the dynamic complexities inherent in green building (GB) projects. However, stakeholder collaboration in green buildings received lack of consideration in traditional project management. Therefore, this study explores barriers to adopt 'Leagile Project Management' for improving stakeholder collaboration in GB projects. The research adapted interpretivism paradigm using qualitative research choice via a Delphi study to collect data. Manual content analysis was used to analyse data collected. The study identified 14 notable stakeholders collaborating challenges in green buildings with 16 key lean barriers and 16 key agile barriers that hinder the effective application of Leagile project management. Further, identified key Lean and Agile barriers were mapped related to each stakeholder collaboration challenges in green building constructions in Sri Lanka. The study identifies that stakeholder collaboration challenges in GB construction arise from a complex interplay of economic, organisational, and regulatory constraints. The combined Lean and Agile perspectives reveal common barriers, including resource limitations, insufficient leadership commitment, cultural resistance, and fragmented coordination among stakeholders. These factors collectively limit effective collaboration and hinder successful GB project delivery. The findings highlight the importance of identifying Leagile adoption barriers and their association with stakeholder collaboration challenges, emphasising the need for a more integrated and adaptive project management approach to address structural inefficiencies and behavioural issues, thereby enhancing stakeholder alignment, improving coordination, and supporting more effective and sustainable project outcomes.

Keywords: *Barriers; Leagile Project Management; Green Building Construction; Stakeholder Collaboration.*

[1] Undergraduate, Department of Building Economics, University of Moratuwa, Sri Lanka, pererahvd20@uom.lk
[2] Senior Professor, Department of Building Economics, University of Moratuwa, Sri Lanka, kanchana@uom.lk
[3] Lecturer, Department of Building Economics, University of Moratuwa, Sri Lanka, nawanjanam@uom.lk

1. INTRODUCTION

LeAgile project management is an integration of Lean and Agile methodologies designed to enhance efficiency and responsiveness in environments where traditional frameworks are less effective (Kashikar et al., 2016). Agile project management is characterised by its iterative and incremental processes, emphasizing flexibility, collaboration, and responsiveness to change (Demir et al., 2014). When combined with Lean principles which focus on reducing waste and optimizing supply chain performance, this hybrid approach, known as LeAgile project management, offers distinct advantages (Demir, 2013). By integrating Lean's waste minimization with Agile's iterative strategies, LeAgile enhances efficiency, accelerates delivery, and promotes stakeholder engagement (Demir, 2013). Accordingly, LeAgile strategies have been utilized to overcome limitations of traditional project management, leading to reduced costs, shorter lead times, and improved stakeholder collaboration (Spassova, 2023).

Green building (GB) is a sustainable approach aimed at reducing environmental, social, and economic impacts of constructions (Vijayan et al., 2023; Almakayeel et al., 2023). This is achieved through the use of energy-efficient materials, designs, and renewable energy sources (Almakayeel et al., 2023). Accordingly, effective inter-organisational collaboration among architects, engineers, contractors, clients, and regulatory bodies is essential for achieving certification standards and delivering high-performing GBs (Qiang et al., 2021). However, the adoption of GBs remains constrained by several challenges, including elevated initial costs, limited awareness of green technologies, and inadequate knowledge of sustainable practices (Agboola et al., 2024; Gou, 2020). Particularly, insufficient collaboration and communication among stakeholders emerges as a critical issue, often leading to misaligned objectives, delays in decision-making, and fragmented information flows (Alqadami et al., 2020; Larsson & Larsson, 2020).

In this context, the application of LeAgile strategies within construction supply chains is reflected in models such as Make-to-Stock (MTS), Assemble-to-Order (ATO), Design-to-Order (DTO), and Self Build-House (SBH) (Mostafa et al., 2016). These approaches highlight the potential for delivering cost-effective, customized, and sustainable outcomes when stakeholders operate as a unified team, particularly by optimising stakeholder collaboration (Oyombe et al., 2023; Stern, 2016). Indeed, LeAgile project management has been identified as a promising concept to address the dynamic complexities inherent in GBs (Demir et al., 2014), while Agile practices further enhance productivity by fostering cooperation, trust, and adaptability to evolving project needs (Stern, 2016). However, the adoption of Lean and Agile principles in GBs remains limited, particularly due to the under exploration of associated barriers that aggregated by stakeholder collaboration challenges, resulting in inefficiencies such as waiting, excess inventory, and defects in GB construction (Ekanayake et al., 2018). Therefore, this gap underscores the need for further investigation into the barriers of adopting LeAgile project management for enhancing stakeholder integration in GB construction (Ekanayake & Idar, 2022).

Accordingly, this research aimed to investigate barriers to integrate LeAgile project management with the stakeholder collaboration of GB constructions in Sri Lanka. The research has three objectives, 1) to investigate the notable stakeholder collaboration challenges in green building constructions in Sri Lanka, 2) to assess the key Lean barriers related to each notable stakeholder collaboration challenges in green building constructions in Sri Lanka, and 3) to assess the key Agile barriers related to each notable stakeholder collaboration challenges in green building constructions in Sri Lanka.

2. LITERATURE REVIEW

2.1 GREEN BUILDING CONSTRUCTION PROJECTS

GB encompasses environmentally responsible and resource-efficient practices throughout a building's life cycle, from initial planning and design to demolition (Berardi, 2013). The concept integrates principles of sustainable development and energy efficiency, addressing global warming concerns (Liu et al., 2022). Consequently, GBs contribute to resource efficiency, waste reduction, and improved indoor environments, while significantly reducing greenhouse gas emissions compared to conventional buildings (Meena et al., 2022; Liu et al., 2022; Zhao et al., 2023). Further, GBs offer notable economic and social advantages by reduce maintenance and lifecycle costs through energy savings and lower CO_2 emissions, while also enhancing job productivity (Addy et al., 2022; Meena et al., 2022; Liu et al., 2022). Compared to conventional buildings, GBs can achieve 20–30% water savings and 40–50% energy savings, alongside improved indoor air quality (Meena et al., 2022). Socially, they promote occupant health, wellbeing, and productivity, and support social equity by providing healthier living environments, particularly in urban areas (Fu et al., 2020; Singh & Gupta, 2021). However, despite these benefits, GB projects involve unique risks due to reliance on innovative materials and technologies, requiring proactive risk management, stakeholder engagement, and continuous monitoring to ensure successful project delivery (Kibert, 2022; Javed et al., 2019).

2.2 STAKEHOLDER COLLABORATION CHALLENGES IN GREEN BUILDING CONSTRUCTION PROJECTS

GB constructions are inherently collaborative, requiring effective engagement among diverse stakeholders such as architects, engineers, contractors, clients, and regulatory bodies to achieve sustainability objectives (Winanda, 2024; Li et al., 2022). However, despite this necessity, stakeholder collaboration in GBs is often hindered by multiple interrelated challenges (Li et al., 2022). Figure 1 illustrates key stakeholder collaboration challenges in GBs.

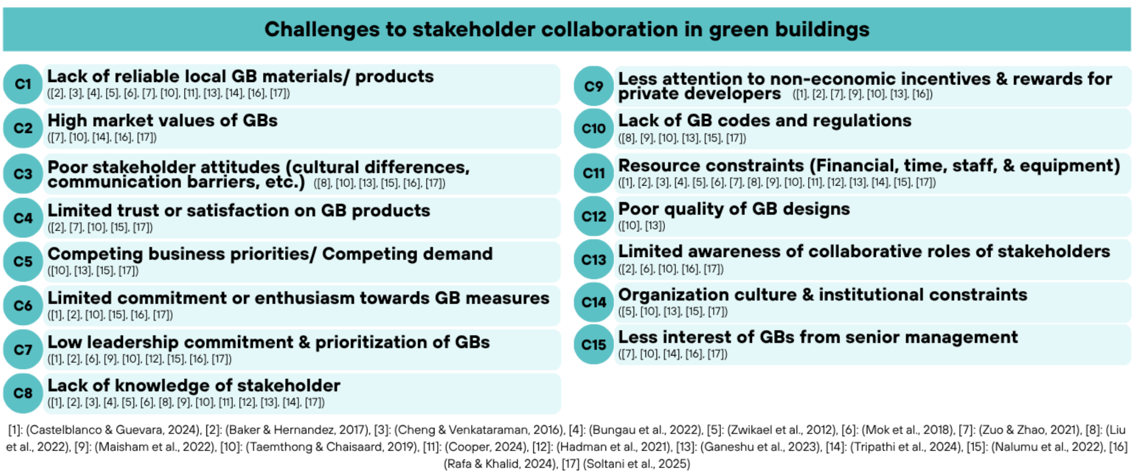

Figure 1: Challenges to stakeholder collaboration in green buildings

According to the Figure 1, a key issue lies in the lack of leadership commitment and limited interest from senior management towards GB initiatives, often resulting in low prioritisation of sustainability objectives (Castelblanco & Guevara, 2024). This is further exacerbated by insufficient stakeholder knowledge and limited awareness of collaborative roles, which restrict effective participation and coordination (Cooper, 2024; Zuo & Zhao, 2021). Additionally, organisational culture and institutional constraints, along with poor stakeholder attitudes and communication barriers, contribute to fragmented collaboration and reduced trust among project participants (Nalumu et al., 2022). Resource constraints, including financial, time, and technical limitations, as well as the high market value of GBs and lack of reliable local materials, further complicate stakeholder engagement (Baker & Hernandez, 2017). Moreover, the absence of adequate GB codes and regulations and limited attention to non-economic incentives for developers weaken motivation to collaborate (Cooper, 2024). Collectively, these challenges lead to inefficiencies, misalignment of objectives, and hinder the successful delivery of green building projects.

2.3 LEAGILE PROJECT MANAGEMENT

LeAgile project management combines the strengths of Agile and Lean approaches to improve construction project performance. Agile methods enhance client satisfaction, project transparency, risk management, and timely delivery, while maintaining flexibility to respond to changing requirements (Pinto, 2023). These characteristics align closely with the goals of sustainable construction, supporting more socially, economically, and environmentally responsible outcomes (Ershadi et al., 2021). In contrast, Lean project management focuses on improving efficiency by minimising waste and maximising value through continuous improvement practices such as Just-in-Time systems, quality management, and supplier coordination (Shah & Ward, 2003; Maradzano et al., 2019). It further emphasises collaboration, standardisation, and streamlined workflows to enhance overall project performance (Maradzano et al., 2019). Core practices including 5S, waste elimination, and teamwork contribute to consistent performance improvement (Shaqour, 2021; Tafazzoli et al., 2020). The integration of Agile and Lean is particularly effective when applied to incremental, process-level improvements in construction projects (Alavi & Aghakhani, 2021; Bhamra et al., 2020; Mostafa et al., 2016; Oyombe et al., 2023). Thus, the LeAgile approach provides a balanced framework to achieve both efficiency and adaptability in construction project delivery.

2.4 KEY LEAN BARRIERS AND AGILE BARRIERS OF LEAGILE PROJECT MANAGEMENT

Despite the growing adoption of LeAgile approaches in construction, a range of organisational, technical, and cultural barriers continue to hinder their effective implementation (Mostafa et al., 2016; Oyombe et al., 2023). Lean implementation is constrained by inadequate management commitment, lack of standardisation, and insufficient training programs (Rybkowski et al., 2017). Economic constraints, including high initial costs, also pose challenges (Sadeghi et al., 2022). Furthermore, poor stakeholder engagement, ineffective communication, and misalignment of incentives reduce efficiency, while limited focus on continuous improvement and inconsistent quality control hinder successful Lean application (Orsi et al., 2021; Stern, 2016). Key barriers to Agile implementation include cultural misalignment with Agile values, lack of leadership support, and insufficient training and understanding of Agile principles (Ng et al., 2023). Additionally, fragmented supply chains, diverse project teams, and ineffective communication hinder collaboration (Pinto, 2023). Challenges such as inflexible contracts, time constraints, and difficulties in scaling Agile practices further limit its effective adoption (Ng et al., 2023; Sadeghi et al., 2022). LeAgile aligns well with GB objectives by combining Lean's waste minimisation with Agile's flexibility and responsiveness to design changes and fluctuating demands, which are common in GB projects (Demir et al., 2014; Kibert, 2022). This integration facilitates real-time data sharing, reduces rework, and enhances efficiency in a context constrained by economic and technical barriers (Ekanayake et al., 2018). Moreover, LeAgile promotes early stakeholder involvement and iterative feedback, helping to overcome fragmented traditional practices and misaligned project goals (Wen & Qiang, 2022). Given the complexity and uncertainty of construction projects, this approach supports improved collaboration, adaptability, and resource optimisation. Consequently, integrating LeAgile with stakeholder collaboration is essential to enhance project delivery and align GB projects with Sri Lanka's broader sustainability objectives. Despite the growing adoption of LeAgile approaches in construction, a range of organisational, technical, and cultural barriers continue to hinder their effective implementation. In the context of Sri Lanka, these challenges are further intensified in green building projects due to limited stakeholder collaboration, high costs, and low awareness of sustainable practices, which collectively hinder efficient project delivery (Ekanayake & Idar, 2022). Therefore, integrating LeAgile project management with stakeholder collaboration becomes critical to address these issues.

3. METHODOLOGY

Qualitative research focuses on phenomena related to kind and quality which explore the reasons for human behaviours and discover motives through in-depth interviews (Kothari, 2004). Delphi technique engages experts systematically and iteratively (Brady & O'Connor, 2014). Accordingly, a Delphi technique was employed as it gathers expert opinions in various domains, facilitating consensus and more profound expertise of a specific phenomenon (Gu et al., 2025). The number of Delphi rounds was decided based on the point at which the interviewees reached a consensus (Barrios et al., 2021).

Table 1: Interviewees' profile

Expert	Designation	Compulsory Qualifications Experience in research /industry				Additional Qualifications (Respondents must possess at least 3 qualifications)					Delphi rounds	
		In the construction field > 10 years	In LeAgile project management > 03 years	In GBs > 05years	In project management > 05 years	B.Sc. in Built environment / related field	M.Sc. in Built Environment / related field	Professional Qualifications in Built environment / GBs	Indexed publications in LeAgile project management and GB > 02	Interest in GBs / LeAgile project management	R1	R2
E1	Project Manager	√	√	√	√	√	√	√	√	√	√	√

Expert	Designation	Compulsory Qualifications Experience in research /industry				Additional Qualifications (Respondents must possess at least 3 qualifications)					Delphi rounds	
		In the construction field > 10 years	In LeAgile project management > 03 years	In GBs > 05years	In project management > 05 years	B.Sc. in Built environment / related field	M.Sc. in Built Environment / related field	Professional Qualifications in Built environment / GBs	Indexed publications in LeAgile project management and GB > 02	Interest in GBs / LeAgile project management	R1	R2
E2	Engineer	√	√	√	√	√	√	√	-	√	√	√
E3	Project Manager	√	√	√	√	√	√	√	√	√	√	√
E4	Construction Manager	√	√	√	√	√	-	√	-	√	√	√
E5	Project Manager	√	√	√	√	√	√	√	-	√	√	√
E6	Project QS	√	√	√	√	√	√	√	-	√	√	√
E7	Construction Manager	√	√	√	√	√	√	√	√	√	√	√
E8	Cost Manager	√	√	√	√	√	√	√	-	√	√	√
E9	Project Manager	√	√	√	√	√	√	√	-	√	√	√
E10	Construction Manager	√	√	√	√	√	√	√	-	√	√	√
E11	Project Manager	√	√	√	√	√	√	√	-	√	√	√
E12	Project Manager	√	√	√	√	√	√	√	-	√	√	√
E13	Engineer	√	√	√	√	√	√	√	√	√	√	√

Delphi Rounds	R1P1	To identify stakeholder collaboration challenges in green building constructions in Sri Lanka
	R1P2	To identify Lean barriers related to each stakeholder collaboration
	R1P3	To identify Agile barriers related to each stakeholder collaboration
	R2P1	To assess the key Lean barriers related to each notable stakeholder collaboration challenges in green building constructions in Sri Lanka
	R2P2	To assess the key Agile barriers separately related to each notable stakeholder collaboration challenges in green building constructions in Sri Lanka

Consequently, two Delphi rounds were conducted through 13 semi-structured interviews to explore the alignment of LeAgile project management in fostering stakeholder collaboration in GBs, face to face, 60 - 75 minutes, based on interview guidelines. The experts were selected through purposive sampling, ensuring inclusion of individuals with specialized knowledge in project management, LeAgile project management, and GBs as identified in Table 1. Data saturation was achieved at the 11th interview. Two further interviews were conducted solely to validate saturation. Manual content analysis was applied, capturing context-specific information by systematically examining the content

(Linneberg & Korsgaard, 2021). Further, a 75% agreement threshold was adopted as the cutoff point following a similar study conducted by Alkaissy et al. (2022).

4. FINDINGS AND ANALYSIS

4.1 NOTABLE STAKEHOLDER COLLABORATION CHALLENGES IN GREEN BUILDING CONSTRUCTION PROJECTS IN SRI LANKA (R1Q1)

The findings from Round 1 Phase I are presented in this section. At the end of the literature review, fifteen stakeholder collaboration challenges in GBs were recognised. Consequently, validity of literature findings for the GBs and identification of notable stakeholder collaboration challenges were performed in Round 1 Phase 1. Literature findings were authenticated, and fourteen stakeholder collaboration challenges were derived at the end of Round 1 Phase I, meeting the 75% cutoff. Findings derived at the end of Round 1 Phase I are tabulated in Table 2.

Table 2: Notable stakeholder collaboration challenges in green buildings

	Notable stakeholder collaboration challenges in green buildings	R1P1 (> 75%)
C1	Lack of reliable local GB materials/ products	√
C2	High market values of GBs	√
C3	Poor stakeholder attitudes (cultural differences, communication barriers, etc.)	√
C4	Limited trust or satisfaction on GB products	√
C5	Competing business priorities/ Competing demand	√
C6	Limited commitment or enthusiasm towards GB measures	√
C7	Low leadership commitment & prioritization of GBs	√
C8	Lack of knowledge of stakeholder	X
C9	Less attention to non-economic incentives & rewards for private developers	√
C10	Lack of GB codes and regulations	√
C11	Resource constraints (Financial, time, staff, and equipment)	√
C12	Poor quality of GB designs	√
C13	Limited awareness of collaborative roles of stakeholders	√
C14	Organization culture & institutional constraints	√
C15	Less interest of GBs from senior management	√

As per the experts, material-related constraints emerge as a significant issue, particularly the lack of reliable local GB materials and products, which increases dependence on costly imports. This is closely linked with the high market value of GBs and broader resource constraints, including financial, time, and technical limitations, which collectively restrict stakeholder engagement. In addition, limited trust in GB products is evident, with concerns over quality and credibility, as reflected by E9, E11 who noted that such materials are often perceived as "inferior or experimental."

Cultural and organisational factors further influence collaboration dynamics as per experts. Poor stakeholder attitudes, including resistance to change, cultural differences, and communication barriers, hinder the adoption of GB practices. This is reinforced by organisational culture and institutional constraints, along with competing business priorities that reduce focus on sustainability objectives. A lack of commitment and enthusiasm towards GB measures is also observed by E1, E5, and E6, particularly at leadership level, where low prioritisation and limited interest from senior management affect decision-making processes. As E11 highlighted, "green practices are often viewed as unnecessary luxuries by clients," indicating underlying perception challenges. Regulatory and structural issues are also prominent. The lack of established GB codes and regulations, combined with limited awareness of collaborative stakeholder roles, contributes to fragmented project coordination. Although initially identified, the lack of stakeholder knowledge appears less critical compared to other systemic constraints. Furthermore, poor quality of GB designs and limited attention to non-economic incentives reduce motivation among developers, while weak collaboration practices persist, as stated by E2, "different parties in a project rarely collaborate on sustainability goals."

4.2 KEY LEAN BARRIERS RELATED TO EACH NOTABLE STAKEHOLDER COLLABORATION CHALLENGES IN GREEN BUILDING CONSTRUCTION PROJECTS IN SRI LANKA (R1Q2, R2Q1)

This section presents the findings derived from Round 1 Phase II, and Round 2 Phase I. The literature review revealed sixteen key Lean barriers to stakeholder collaboration in GBs. Subsequently, validation of literature findings for the stakeholder collaboration of GBs were fulfilled in Round 1 Phase II. In Round 2 Phase I, experts were requested to map the key Lean barriers to notable stakeholder collaboration challenges in GBs. Findings derived at the end of Round 2 Phase I are tabulated in Table 3.

Table 3: Key Lean barriers related to notable stakeholder collaboration challenges

Stakeholder collaboration challenges	Key Lean Barriers	R1P2 (> 75%)	R2P1 (> 75%)
C1	L3, L5, L13, L16	√	√
C2	L3, L4, L6, L7	√	√
C3	L2, L5, L7, L8, L11, L13, L16	√	√
C4	L5, L7, L11, L12, L13	√	√
C5	L2, L8, L9, L15	√	√
C6	L1, L10, L13, L1, L16	√	√
C7	L3, L4, L6, L7, L9, L14	√	√
C9	L2, L8, L15	√	√
C10	L2, L4, L5, L9	√	√
C11	L3, L7, L9, L12	√	√
C12	L2, L9, L13	√	√
C13	L11, L16	√	√
C14	L1, L2, L13, L14	√	√
C15	L1, L2, L7	√	√

L1 Complexity of Lean tools, L2 Lack of standardization, L3 Economic constraints, L4 Environmental regulations, L5 Fragmented industry structure, L6 High initial costs, L7 Inadequate management commitment, L8 Inadequate performance metrics, L9 Inadequate research and development, L10 Inconsistent quality control, L11 Ineffective communication, L12 Inefficient project delivery systems, L13 Insufficient training programs, L14 Limited focus on continuous improvement, L15 Misalignment of incentives, L16 Poor stakeholder engagement

As per the experts, several stakeholder collaboration challenges in GB projects are closely associated with Lean-related barriers. Economic constraints (L3), high initial costs (L6), and inadequate management commitment (L7) are consistently linked with issues such as high market values of GBs and low leadership prioritisation. Experts emphasised the financial burden, with E9 noting that "green buildings are perceived as expensive, which deters many stakeholders from investing," reflecting how cost-related barriers influence decision-making. Fragmented industry structure (L5), poor stakeholder engagement (L16), and ineffective communication (L11) are strongly connected to poor stakeholder attitudes, limited trust in GB products, and lack of awareness of collaborative roles. These findings highlight coordination difficulties across project participants.

Additionally, lack of standardisation (L2), misalignment of incentives (L15), and limited focus on continuous improvement (L14) are associated with organisational culture constraints and competing business priorities, indicating systemic inefficiencies. Insufficient training programs (L13) and inadequate research and development (L9) further relate to poor design quality and limited innovation in GB practices. Regulatory issues, particularly environmental regulations (L4), also align with the lack of GB codes and frameworks. As highlighted by E1, "the lack of data and independent verification of green products fuels distrust," reinforcing how quality control issues (L10) and weak institutional structures shape stakeholder perceptions and collaboration practices.

4.3 KEY AGILE BARRIERS RELATED TO EACH NOTABLE STAKEHOLDER COLLABORATION CHALLENGES IN GREEN BUILDING CONSTRUCTION PROJECTS IN SRI LANKA (R1Q3, R2Q2)

This section presents the findings derived from Round 1 Phase III, and Round 2 Phase II. The literature review revealed sixteen key Agile barriers to stakeholder collaboration in GBs. Subsequently, validation of literature findings for the stakeholder collaboration of GBs were fulfilled in Round 1 Phase III. In Round 2 Phase II, experts were requested to map the key Agile barriers to notable stakeholder collaboration challenges in GBs. Findings derived at the end of Round 2 Phase II are tabulated in Table 4.

Table 4: Key Agile barriers related to notable stakeholder collaboration challenges

Stakeholder collaboration challenges	Key Agile Barriers	R1P3 (> 75%)	R2P2 (> 75%)
C1	A1, A5, A9, A12, A15	√	√
C2	A5, A8, A12	√	√
C3	A1, A2, A6, A9, A13, A14	√	√
C4	A1, A4, A5, A6, A9	√	√
C5	A1, A3, A7, A11, A12, A14	√	√

Stakeholder collaboration challenges	Key Agile Barriers	R1P3 (> 75%)	R2P2 (> 75%)
C6	A1, A2, A12	√	√
C7	A3, A4, A6, A15, A16	√	√
C9	A7, A11, A14	√	√
C10	A3, A4, A9	√	√
C11	A4, A10, A15, A16	√	√
C12	A1, A2, A8	√	√
C13	A4, A6, A10	√	√
C14	A2, A6, A9	√	√
C15	A1, A6, A11, A12, A14	√	√

A1 Complexity and uncertainty in projects, A2 Cultural misalignment with Agile values, A3 Difficulty in scaling Agile practices, A4 Diverse project teams, A5 Fragmented supply chains, A6 Inadequate leadership support, A7 Inconsistent application of Agile practices, A8 Inflexibility in contracts, A9 Lack of empirical evidence, A10 Lack of training and understanding of Agile principles, A11 Performance measurement and accountability, A12 Quality assurance concerns, A13 Regulatory and compliance issues, A14 Short-term focus, A15 Technological barriers, A16 Time constraints

Experts reveal that complexity and uncertainty in projects (A1), cultural misalignment (A2), and inadequate leadership support (A6) are strongly linked with poor stakeholder attitudes, limited commitment, and low prioritisation of GB initiatives. Resistance to change and short-term focus (A14) further influence competing business priorities and reduced interest from senior management. As E4 noted, "many senior professionals do not see the value in changing long-standing procedures," reflecting cultural and behavioural barriers. Barriers such as fragmented supply chains (A5), diverse project teams (A4), and inconsistent application of Agile practices (A7) are associated with trust issues, lack of collaboration, and limited awareness of stakeholder roles. Inflexible contracts (A8) and regulatory constraints (A13) further connect with the absence of GB codes and regulations, restricting adaptability. Technological barriers (A15), lack of training (A10), and time constraints (A16) correspond with resource limitations and poor design quality, indicating gaps in implementation capacity. Additionally, lack of empirical evidence (A9) and quality assurance concerns (A12) contribute to distrust in GB products. As highlighted by E9, "the lack of data and independent verification… fuels distrust," demonstrating how uncertainty and limited validation mechanisms influence stakeholder confidence and engagement.

5. DISCUSSION

The findings collectively demonstrate that stakeholder collaboration challenges in GB construction are systemic and multi-dimensional, cutting across material, organisational, and regulatory domains (Castelblanco & Guevara, 2024; Cooper, 2024). From a combined LeAgile perspective, both Lean and Agile barriers reinforce similar constraints, particularly in terms of economic pressures, weak leadership commitment, and fragmented stakeholder engagement (Alavi & Aghakhani, 2021; Ali & Sameh, 2024; Sadeghi et al., 2024). Cost-related issues and resource limitations restrict the adoption of collaborative practices, while lack of standardisation, inconsistent processes, and limited training further weaken coordination mechanisms (Orsi et al., 2021; Lalmi et al., 2021). At the same time, Agile-related challenges such as cultural misalignment, resistance to change, and short-term orientation intensify these issues by reducing adaptability and responsiveness among stakeholders (Ng et al., 2023). Moreover, both perspectives converge on the importance of trust, communication, and institutional support (Rybkowski et al., 2018). Fragmented supply chains, ineffective communication, and absence of regulatory frameworks collectively hinder integration across project stakeholders (Chathuranga et al., 2023; Cooper, 2024). These overlapping barriers indicate that stakeholder collaboration in GBs is not constrained by a single factor, but rather by the interaction of structural inefficiencies, behavioural limitations, and implementation gaps within existing project management practices.

6. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the study identified that stakeholder collaboration challenges in GB construction are strongly influenced by interconnected economic, organisational, managerial, and regulatory barriers. The findings revealed that the most critical collaboration challenges include the lack of reliable local GB materials and products, high market values of GBs, poor stakeholder attitudes, limited trust in GB products, competing business priorities, weak leadership commitment, inadequate awareness of collaborative stakeholder roles, and resource constraints. These issues demonstrate that stakeholder collaboration in GB projects is not only a technical concern but also a behavioural and institutional challenge. The study further established that both Lean and Agile barriers significantly intensify these collaboration challenges. From the Lean perspective, barriers such as economic constraints, fragmented industry structures, inadequate management commitment, insufficient training programmes, ineffective communication, and poor stakeholder engagement were found to be highly influential. Similarly, the Agile perspective highlighted barriers including project complexity and uncertainty, fragmented supply chains, inadequate leadership support, technological barriers, diverse project teams, and quality assurance concerns as key contributors to ineffective collaboration in GB projects. The overlap between Lean and Agile barriers indicates that stakeholder collaboration problems are multidimensional and require integrated management approaches rather than isolated interventions.

The study contributes to existing knowledge by demonstrating how Lean and Agile barriers influence stakeholder collaboration challenges in GB projects. The findings highlight the need for stronger GB regulations, improved stakeholder training, better communication frameworks, greater leadership commitment, and incentive mechanisms to enhance collaboration and encourage GB adoption. Furthermore, organisations should adopt integrated LeAgile management approaches to improve coordination, trust, and project performance.

However, the study is limited by its context-specific scope and primarily based on qualitative research approach, which may affect the generalisability of the findings. In addition, reliance on stakeholder perceptions may introduce subjectivity. Future research could expand the sample scope, apply quantitative validation methods, and explore the implementation of integrated LeAgile approaches in different GB contexts.

Overall, the study highlights that effective stakeholder collaboration is critical to the successful delivery of GB projects and requires both organisational and regulatory improvements within the construction industry.

7. REFERENCES

Addy, M. N., Adinyira, E., Dadzoe, F., & Opoku, D. (2022). The market for green buildings in Sub-Saharan Africa: Experts perspective on the economic benefits in Ghana. *Journal of Construction in Developing Countries, 27*(1), 173–188. https://doi.org/10.21315/jcdc2022.27.1.10

Agboola, S. A., Idowu, F. A., Yusuf, F. M., & Musa, A. K. (2024). Challenges to sustainable green building practice in Nigeria. *FUDMA Journal of Sciences, 7*(6), 157–163. https://doi.org/10.33003/fjs 2023-0706-2114

Alkaissy, M., Arashpour, M., Li, H., Alaghmand, S. & Nezamian,A. (2022). Quantitative analysis of safety risks and relationship with delayed project completion times. *Risk Analysis, 42*(3), 580-591. https://doi.org/10.1111/risa.13778

Alavi, S., & Aghakhani, H. (2021). Identifying the effect of green human resource management practices on lean-agile (LEAGILE) and prioritizing its practices. *International Journal of Productivity and Performance Management, 72*(3), 599–624. https://doi.org/10.1108/ijppm-05-2020-0232

Ali, A., & Sameh, H. (2024). Developing a theoretical framework for enhancing green project approaches via Agile methodology. *Science Reports, 14*, 27786. https://doi.org/10.1038/s41598-024-78613-x

Alqadami, A. T., Zawawi, N. A. W. A., Rahmawati, Y., Alaloul, W., & Alshalif, A. F. (2020). Key success factors of implementing green procurement in public construction projects in Malaysia. In *The 5th International Conference on Civil and Environmental Engineering for Sustainability* (498, pp. 1-9). IOP Publishing Ltd. https://doi.org/10.1088/1755-1315/498/1/012098

Baker S, & Hernandez, M. (2017). Communicating with stakeholders when bad news is uncertain. *International Journal of Public Leadership, 13*(2), 85–97. https://doi.org/10.1108/IJPL-11-2016-0051

Barrios, M., Guilera, G., Nuno, L., & Gomez-Benito, J. (2021). Consensus in the delphi method: What makes a decision change?. *Technological Forecasting and Social Change, 163*, 120484. https://doi.org/10.1016/j.techfore.2020.120484

Berardi, U. (2013). Sustainable construction: Green building design and delivery. *Intelligent Buildings International 5*(1), 65–66. https://doi.org/10.1080/17508975.2012.756388

Bhamra, R., Nand, A., Yang, L., Albregard, P., Azevedo, G., Corraini, D., & Emiliasiq, M. (2020). Is leagile still relevant? A review and research opportunities. *Total Quality Management and Business Excellence, 32*(13–14), 1569–1593. https://doi.org/10.1080/14783363.2020.1750360

Brady, S. R. & O'Connor, M. K. (2014). Understanding how community organising leads to social change: The beginning development of formal practice theory. *Journal of Community Practice, 22*(1/2), 210-228. https://doi.org/10.1080/10705422.2014.901263

Castelblanco, G. & Guevara, J. (2024). Stakeholder dynamics: Rethinking roles and responsibilities in user-pay transport PPP projects. *Journal of Construction Engineering and Management, 150*(8), 05024009. https://doi.org/10.1061/JCEMD4.COENG-1447

Chathuranga, S., Jayasinghe, S., Antucheviciene, J., & Wickramarachchi, R. (2023). Practices driving the adoption of agile project management methodologies in the design stage of building construction projects, *Buildings, 13*(4), 1079. https://doi.org/10.3390/buildings13041079

Cooper, M. (2024 April 18). *Exploring the role of stakeholder collaboration in sustainable supply chain management*. Research Square. https://doi.org/10.21203/rs.3.rs-4286600/v1

Demir, S. T. (2013). *AgiLean PM: A unifiying strategic framework to manage construction projects,* [Doctoral thesis, Liverpool John Moores University]. LJMU Research Online. https://researchonline.ljmu.ac.uk/id/eprint/4509/1/157452_AgiLean_STD_2013_WithoutFigures.pdf

Demir, S. T., Bryde, D. J., & Sertyesilisik, B. (2014). Introducing AgiLean to construction project management. *Journal of Modern Project Management, 1*(3), 29-39. https://journalmodernpm.com/manuscript/index.php/jmpm/article/view/136

Ekanayake, H. (2019). Traditional project management approach, industry challenges and key attributes: A case study of construction project management in Sri Lanka. *Asia Pacific Journal of Advanced Business and Social Studies, 5*(1), 52-64. https://doi.org/10.25275/APJABSSV5I1BUS6

Ekanayake, H., & Idar, R. B. (2022). Innovative project management concepts and project performance: Construction project management in Sri Lanka. *American Journal of Multidisciplinary Research and Review (AJMRR), 1*(5), 29-37. https://www.ajmrr.com/wp-content/uploads/2022/11/D152937.pdf

Ershadi, M., Jefferies, M., Davis, P., & Mojtahedi, M. (2021). Incorporating environmental sustainability in project portfolio management by construction contractors. *International Journal of Structural and Civil Engineering Research, 10*(3) 123–127. https://doi.org/10.18178/ijscer.10.3.123-127

Fu, Y., Dong, N., Ge, Q., Xiong, F., & Gong, C. (2020). Driving-paths of green buildings industry (GBI) from stakeholders' green behavior based on the network analysis. *Journal of Cleaner Production, 273*, 122883. https://doi.org/10.1016/j.jclepro.2020.122883

Gou, Z. (2020). The shift of green building development in China from a voluntary to mandatory approach. In Z. Gou (Ed.), *Green Building in Developing Countries: Policy, Strategy and Technology* (pp. 1-21). Springer Cham. DOI: 10.1007/978-3-030-24650-1_1

Gu, C., Reefke, H., & Yates, N. (2025). Autonomous vehicle adoption and supply chain social sustainability: Delphi study and expert interviews. *International Journal of Physical Distribution & Logistics Management, 55*(3), 275-306. https://doi.org/10.1108/IJPDLM-01-2024-0027

Javed, N., Thaheem, M. J., Bakhtawar, B., Nasir, A. R., Khan, K. I. A., & Gabriel, H. F. (2019). Managing risk in green building projects: Toward a dedicated framework. *Smart and Sustainable Built Environment, 9*(2), 156–173. https://doi.org/10.1108/sasbe-11-2018-0060

Kashikar, A., Mehta, D., Motichandani, B., & Chaitanya, P. D. (2016). A case study on agile and lean project management in construction industry. *IOSR Journal of Mechanical and Civil Engineering, 13*(4), 31–39. https://doi.org/10.9790/1684-1304013139

Kibert, C. J. (2022). *Sustainable construction: GB design and delivery* (5th ed.). Wiley. https://content.e-bookshelf.de/media/reading/L-18059417-6ed6ba0f1d.pdf

Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International (Pvt) Ltd. Publishers. https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1285422

Lalmi, A., Fernandes, G., & Souad, S.B. (2021). Synergy between traditional, agile and lean management approaches in construction projects: Bibliometric analysis. *Procedia Computer Science, 196*, 732-739. https://doi.org/10.1016/j.procs.2021.12.070

Larsson, J., & Larsson, L. (2020). Integration, application and importance of collaboration in sustainable project management. *Sustainability, 12*(2), 585. https://doi.org/10.3390/su12020585

Li, Y., Li, M., Sang, P., Chen, P., & Li, C. (2022). Stakeholder studies of green buildings: A literature review. *Journal of Building Engineering, 54*, 104667. https://doi.org/10.1016/j.jobe.2022.104667

Linneberg, M.S. and Korsgaard, S. (2021). Coding intercultural fieldwork data: A hands-on approach. In D. S. A. Guttormsen, J. Lauring, and M. Chapman (Eds.) *Field Guide to Intercultural Research* (pp. 93-105). Edward Elgar Publishing. https://doi.org/10.4337/9781788970129.00015

Liu, T., Chen, L., Yang, M., Sandanayake, M., Miao, P., Shi, Y., & Yap, P. (2022). Sustainability considerations of GBs: A detailed overview on current advancements and future considerations. *Sustainability, 14*(21), 14393. https://doi.org/10.3390/su142114393

Maradzano, I., Matope, S., & Dondofema, R. A. (2019). Application of lean principles in the south African construction industry. *The South African Journal of Industrial Engineering, 30*(3), 210-223. https://doi.org/10.7166/30-3-2240

Meena, C. S., Kumar, A., Jain, S., Rehman, A. U., Mishra, S., Sharma, N. K., Bajaj, M., Shafiq, M., & Eldin, E. T. (2022). Innovation in green building sector for sustainable future. *Energies, 15*(18), 6631. https://doi.org/10.3390/en15186631

Mostafa, S., Chileshe, N., & Abdelhamid, T. (2016). Lean and agile integration within offsite construction using discrete-event simulation: A systematic literature review. *Construction Innovation, 16*(4), 483-525. *http://dx.doi.org/10.1108/CI-09-2014-0043*

Nalumu, D.J., Mensah, H., Amponsah, O., & Takyi, S.A. (2021). Stakeholder collaboration and irrigation practices in Ghana: Issues, challenges, and the way forward. *SN Applied Sciences, 3*(576), 1-16. https://doi.org/10.1007/s42452-021-04407-9

Ng, P.L., Maqsood, T., Khalfan, M., & Rahmani, F. (2023). AgiBuild: A Scaled agile framework for building adaptation projects. *Buildings, 13*(12), 3019. https://doi.org/10.3390/buildings13123019

Orsi, A., Abdelhamid, T. S., Pellicer, E., & GuillénGuillamón, I. (2021). Improving GB project management processes through the lean approach. *Lean Construction Journal, 19*, 156-179. https://doi.org/10.60164/d1g8c3e2f

Oyombe, G. G., Awino, Z. B., Ogutu, M., & Njihia, J. M. (2023). How leagile strategy and strategic partnership affect competitive advantage of construction supply chains. *Journal of Business Strategy, Finance and Management, 4*(2), 184–201. https://doi.org/10.12944/jbsfm.04.02.02

Pinto, H. W. (2023). Exploring the implementation of agile project management in the United States construction industry: Benefits, challenges, and success factors. *Journal of Entrepreneurship and Project Management, 7*(7), 11–23. https://doi.org/10.53819/81018102t4163

Qiang, G., Cao, D., Wu, G., Zhao, X., & Zuo, J. (2021). Dynamics of collaborative networks for GB projects: Case study of Shanghai. *Journal of Management in Engineering, 37*(3). https://doi.org/10.1061/(asce)me.1943-5479.0000892

Rybkowski, Z. K., Forbes, L. H., & Tsao, C. C. Y. (2018). The evolution of lean construction education (Part 1 of 2): At US-based universities. In V. AGonzález (Ed.) , *Proceedings of 26th Annual Conference of the International Group for Lean Construction* (pp. 1013-1023). IGLC26. https://doi.org/10.24928/2018/0447

Sadeghi, S., Akbarpour, A., & Abbasianjahromi, H. (2022). Provide a lean and agile strategy for an antifragile sustainable supply chain in the construction industry (residential complex). *Cleaner Logistics and Supply Chain, 5*(4), 100079. https://doi.org/10.1016/j.clscn.2022.100079

Singh, A., & Gupta, K. (2021). An overview of the green building construction in India. *International Journal of Engineering Applied Sciences and Technology, 6*(2), 144-150. https://doi.org/10.33564/ijeast.2021.v06i02.022

Shah, R., & Ward, P. T. (2003). Lean manufacturing: Context, practice bundles, and performance. *Journal of Operations Management, 21*(2), 129–149. https://doi.org/10.1016/s0272-6963(02)00108-0

Shaqour, E. (2021). The impact of adopting lean construction in Egypt: Level of knowledge, application, and benefits. *Ain Shams Engineering Journal, 13*(2), 101551. https://doi.org/10.1016/j.asej.2021.07.005

Spassova, A. (2023). *Innovative project management with FIDIC contracts* (1st ed). Taylor & Francis. https://doi.org/10.4324/9781003272892

Stern, T. V. (2016). *Lean and agile project management: How to make any project better, faster, and more cost effective* (2nd ed). Routledge. https://doi.org/10.4324/9780429343414

Tafazzoli, M., Mousavi, E., & Kermanshachi, S. (2020). Opportunities and challenges of green-lean: An integrated system for sustainable construction. *Sustainability, 12*(11), 4460. https://doi.org/10.3390/su12114460

Vijayan, D. S., Devarajan, P., Sivasuriyan, A., Stefańska, A., Koda, E., Jakimiuk, A., Vaverková, M. D., Winkler, J., Duarte, C. C., & Corticos, N. D. (2023). A state of review on instigating resources and technological sustainable approaches in green construction. *Sustainability, 15*(8), 6751. https://doi.org/10.3390/su15086751

Winanda, L. a. R., Yami, N., Kartika, D., Manaha, Y. P., & Ma'ruf, A. (2024). Achieving green construction rating in building projects with fuzzy system approach. In *The 4th Aceh International Symposium on Civil Engineering (AISCE 2023)* (Volume 476, 01024). E3S Web of Conferences. https://doi.org/10.1051/e3sconf/202447601024

Zhao, W., Peng, P., Guo, B., Deng, X., & Wu, W. (2023). Comprehensive social cultural and economic benefits of green buildings based on improved AHP FCE method. *Buildings, 13*(11), 311. https://doi.org/10.3390/buildings13020311

Zuo, J., & Zhao, Z. (2014). Green building research current status and future agenda: A review. *Renewable and Sustainable Energy Reviews, 30*, 271–281. https://doi.org/10.1016/j.rser.2013.10.021