



Analysis of Problems and Solutions in Stakeholder Management in Digital Technology-Based Sustainable Construction Projects

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ABSTRACT

Stakeholder management in sustainable construction projects has become increasingly complex due to conflicting stakeholder interests, digital technology adoption barriers, and governance coordination challenges. Previous studies have generally discussed stakeholder management, sustainability assessment, and digital technology implementation separately, resulting in limited integration between governance mechanisms and digital decision-support systems in construction project management. This study aims to develop an integrated stakeholder governance framework for sustainable construction projects by combining Multi-Criteria Decision Making (MCDM), collaborative governance principles, and digital technologies such as Artificial Intelligence (AI), blockchain, fuzzy logic, and BIM-LCA. This study employs a qualitative descriptive approach using a structured literature review and thematic analysis of recent studies related to stakeholder management, sustainable construction, and digital technology implementation. The findings identify nine major stakeholder management challenges related to stakeholder conflicts, BIM-LCA implementation barriers, digital governance limitations, stakeholder coordination complexity, and limited participation in technology adoption. The study demonstrates that effective stakeholder management requires the integration of digital technologies, participatory governance mechanisms, and adaptive coordination systems. The proposed framework contributes conceptually by integrating stakeholder analysis, sustainability assessment, collaborative governance, and digital decision-support mechanisms into a unified governance-oriented model for sustainable construction project management. Practically, the framework provides guidance for improving stakeholder coordination, transparency, sustainability-oriented decision-making, and collaborative project governance in sustainable construction projects.

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I. Introduction

Sustainable construction projects increasingly involve complex stakeholder interactions due to the integration of digital technologies, sustainability objectives, and collaborative governance requirements. In modern construction environments, stakeholders such as project owners, contractors, consultants, governments, local communities, and environmental experts often possess different priorities, levels of influence, and decision-making interests. These differences create challenges in project coordination, communication, transparency, and sustainability-oriented decision-making processes. Therefore, effective stakeholder management has become an essential component in improving project governance and sustainability performance.

According to the Project Management Body of Knowledge (PMBOK), stakeholder management includes the processes required to identify stakeholders, analyze their interests and influence, develop engagement strategies, and monitor stakeholder participation throughout the project lifecycle. However, the increasing adoption of digital technologies in sustainable construction projects has introduced additional governance complexities, particularly regarding decision synchronization, data integration, collaborative coordination, and transparency among stakeholders.

Previous studies have identified several critical challenges related to stakeholder management in sustainable construction projects. Wolf et al. reported that stakeholders frequently experience disagreements regarding sustainable retrofit strategies because of conflicting priorities related to energy performance, investment cost, and economic benefits [1]. Similarly, Zhang et al. emphasized that decision-making related to low-carbon construction strategies is often dominated by technical planners and developers, while the involvement of local governments, communities, and environmental experts remains limited [2]. In addition, Zhu et al. demonstrated that the diverse levels of stakeholder power and interest in off-site construction projects complicate stakeholder prioritization and coordination processes [3]. These findings indicate that stakeholder management remains a major governance challenge in achieving sustainability-oriented construction projects.

The implementation of digital technologies in construction projects also faces significant barriers. Parece et al. identified limitations in BIM-LCA implementation caused by low BIM model quality, insufficient environmental databases, limited interoperability, and the lack of real-time analytical support [4]. Another study by Parece et al. further revealed that the absence of shared understanding regarding BIM roles, responsibilities, and benefits contributes to the suboptimal integration of BIM-LCA throughout the project lifecycle [5]. Furthermore, Hwabamungu and Shepherd found that stakeholder involvement significantly influences the successful adoption of digital technologies in the construction industry [6]. These studies suggest that digital technology adoption in construction projects is not only a technical issue but also a governance and stakeholder coordination issue.

Although previous studies have discussed stakeholder management, digital technology adoption, sustainability assessment, and collaborative governance, these studies are generally fragmented and focus on individual dimensions separately. Existing research primarily examines either sustainability performance, stakeholder relationships, or digital technology implementation without integrating these aspects into a unified governance framework for sustainable construction projects [7], [8], [9]. In addition, previous studies have not sufficiently explained how digital technologies can operationally support stakeholder engagement, decision transparency, conflict resolution, and sustainability-oriented governance simultaneously.

In this study, sustainability performance refers to the integration of environmental, economic, social, and governance considerations within project decision-making and stakeholder coordination processes. Therefore, there is a need for an integrated governance approach capable of supporting collaborative stakeholder management while simultaneously improving sustainability performance in construction projects.

This study addresses the identified research gap by proposing an integrated stakeholder governance framework for sustainable construction projects. The framework combines Multi-Criteria Decision Making (MCDM) approaches with digital technologies such as Artificial Intelligence (AI), blockchain, fuzzy logic, and BIM-LCA to improve stakeholder coordination and decision-making processes. In this framework, AI is utilized to support stakeholder data analysis and decision prediction, blockchain enhances transparency and traceability of stakeholder interactions, fuzzy logic assists in handling uncertainty in stakeholder preferences,

and BIM-LCA supports sustainability assessment through environmental impact evaluation. In addition, the framework incorporates collaborative governance principles through the use of a Common Data Environment (CDE) and an Interactive Stakeholder Journey Map to facilitate communication, participation, and stakeholder coordination throughout the project lifecycle [10].

The novelty of this research lies in the development of an integrated digital stakeholder governance framework that systematically combines MCDM, collaborative governance mechanisms, and multiple digital technologies within the context of sustainable construction project management. Unlike previous studies that discuss these approaches separately, this study proposes a governance-oriented integration model that connects stakeholder analysis, sustainability assessment, digital collaboration, and decision-support mechanisms into a unified conceptual framework.

Based on this background, the objectives of this study are: (1) to identify the major stakeholder management challenges in sustainable construction projects, (2) to analyze the limitations of existing stakeholder governance approaches, and (3) to formulate an integrated conceptual framework based on MCDM and digital technologies to support collaborative and sustainability-oriented project governance. The findings of this study are expected to contribute theoretically to the development of stakeholder governance literature and practically to support decision-making, stakeholder coordination, and sustainability performance improvement in sustainable construction projects.

II. Research Method

This study employs a qualitative descriptive approach using a structured literature review and thematic analysis to identify stakeholder management challenges and formulate an integrated governance framework for sustainable construction projects. The study focuses on stakeholder management issues related to digital technology adoption, collaborative governance, and sustainability-oriented project management in the construction sector.

The literature review process was conducted systematically using scientific publications indexed in reputable international journals published between 2023 and 2025. The selected literature focused on stakeholder management, sustainable construction, digital technology implementation, Building Information Modeling-Life Cycle Assessment (BIM-LCA), collaborative governance, and decision-support systems in infrastructure projects. Literature sources were obtained through academic databases such as Scopus, ScienceDirect, and Google Scholar using keywords including “stakeholder management”, “sustainable construction”, “digital technology”, “BIM-LCA”, “collaborative governance”, “MCDM”, “AI in construction”, and “blockchain in project management”.

The literature selection process consisted of three stages: identification, screening, and eligibility assessment. In the identification stage, relevant publications were collected based on predefined keywords and publication years. During the screening stage, duplicate and irrelevant articles were excluded based on title and abstract evaluation. The eligibility stage involved selecting articles that specifically discussed stakeholder management challenges, sustainability performance, governance issues, and digital technology applications in construction projects. The final selected literature was analyzed to identify recurring issues, technological limitations, and stakeholder coordination challenges relevant to sustainable construction governance.

The analytical framework of this study was developed based on stakeholder management principles in PMBOK and categorized into three main issue groups. The first category focuses on stakeholder disagreements and decision-making barriers, including conflicting retrofit priorities, BIM-LCA implementation barriers, and limitations in digital governance mechanisms. The second category examines challenges in digital technology evaluation and implementation, including limited stakeholder participation in low-carbon planning, interoperability limitations, and weak coordination in digital collaboration systems. The third category analyzes stakeholder relationship and coordination issues, including stakeholder influence complexity, limited participation in technology adoption, and coordination challenges in sustainable construction management.

Data analysis was conducted using content analysis and thematic analysis techniques. Content analysis was used to extract key information, stakeholder issues, technology-related barriers, and governance challenges from the selected literature. Subsequently, thematic analysis was performed to classify recurring patterns, identify relationships between concepts, and synthesize integrated solution themes. The identified

themes were then mapped into a conceptual stakeholder governance framework that integrates Multi-Criteria Decision Making (MCDM), collaborative governance principles, and digital technologies such as Artificial Intelligence (AI), blockchain, fuzzy logic, and BIM-LCA.

To improve analytical consistency, this study utilized an analysis matrix consisting of problem categories, key stakeholder issues, root causes, technological barriers, proposed solutions, and governance strategies. The matrix was used to systematically compare findings across the selected studies and identify the most relevant approaches for stakeholder coordination and sustainability-oriented decision-making.

The credibility and reliability of the findings were strengthened through literature triangulation by comparing perspectives, findings, and solution approaches from multiple peer-reviewed scientific sources. Triangulation was conducted by cross-examining stakeholder management studies, digital technology implementation studies, and sustainability governance studies to ensure conceptual consistency and analytical validity.

The results of the analysis are presented in the form of a descriptive and conceptual narrative explaining stakeholder management challenges, governance limitations, digital technology integration mechanisms, and the proposed stakeholder governance framework for sustainable construction projects.

III. Result and Discussion

This study identifies nine key issues in stakeholder management in sustainable construction projects. Table 1 presents a summary of the issues and solutions analyzed in this study.

Key Issues	Solution 1	Solution 2	Source
Disagreement between the government and tenants on retrofit priorities	Multi-Criteria Decision Making (MCDM)	Digital technology (AI, big data, blockchain)	[1], [11]
Barriers to BIM-LCA implementation in the AEC industry	Improvement of data standards and interoperability	Adaptive project classification and stakeholder management	[4], [12]
Limitations of digital technology research for project management	Technology Acceptance Model (TAM)	Ordinal logistic regression model	[7], [13]
Incomprehensive evaluation of digital technology in urban regeneration	Multidimensional mixed-methods analysis	Inclusive collaborative governance	[8], [9]
Lack of involvement in low-carbon planning	BIM-based collaborative framework	Structured coordination mechanism	[2], [14]
Lack of understanding of coordination in BIM implementation	Quadruple Bottom Line (QBL)	Sustainable collaborative relationship management	[5], [15].
Complexity of stakeholder relationships in off-site projects	Fuzzy logic for stakeholder mapping	Fuzzy-based adaptive monitoring system	[3].
Lack of involvement in digital technology adoption	Value-oriented participatory mechanisms	Cross-functional consultative forum	[6]
Lack of coordination in construction waste management	Interactive Stakeholder Journey Map in Construction (ISJMC)	Cross-functional communication platform	[10]

Source: Researcher analysis from various literature sources (2023–2025)

Table 1 serves as the analytical basis for developing the integrated stakeholder governance framework proposed in this study. The findings indicate that stakeholder management challenges in sustainable construction projects are interconnected and cannot be addressed through isolated technical solutions alone. Across the nine identified issues, two major patterns emerged. First, technological barriers such as BIM-LCA interoperability limitations, unequal digital technology adoption, and weak real-time coordination systems significantly influence stakeholder participation and decision-making effectiveness. Second, governance-related barriers such as conflicting stakeholder priorities, fragmented communication mechanisms, and

limited collaborative coordination reduce the effectiveness of sustainability implementation in construction projects.

These findings demonstrate that stakeholder management in sustainable construction projects requires an integrated governance approach that combines technological capabilities with collaborative governance principles. In this study, digital technologies such as AI, blockchain, BIM-LCA, and fuzzy logic are positioned not merely as technical tools, but as enabling mechanisms that support transparency, adaptive stakeholder engagement, sustainability assessment, and evidence-based decision-making processes. Therefore, the proposed framework integrates technological, organizational, and governance dimensions into a unified stakeholder management model for sustainable construction projects.

A. Disagreement on Priorities in Sustainable Retrofit Solutions

The research results identified disagreement among stakeholders as a fundamental problem in sustainable building retrofit projects. This disagreement arose due to differences in priorities between the government and tenants regarding energy benefits, economic aspects, and investment costs. These differences in perspective are exacerbated by the limitations of dynamic, inclusive, and multi-criteria-based decision-making methods, making it difficult to reach agreement on optimal retrofit strategies. Obstacles such as a lack of financial incentives, limited access to green financing schemes, and weak coordination between government agencies also slow down the implementation of retrofit policies.

The first recommended solution is the application of a Multi-Criteria Decision Making (MCDM) approach that involves a systematic assessment of the attitudes and preferences of various stakeholders. This method allows for the identification of retrofit solutions that are more balanced, transparent, and adaptive to the project context. Wolf et al. showed that the MCDM approach provides insights into the optimal compromise among stakeholders so that the resulting decisions not only consider technical and economic aspects but also social acceptability and long-term sustainability [1].

The second alternative solution emphasizes the use of digital technologies such as AI, big data, and blockchain to support data-driven decision-making, increase transparency, and strengthen collaboration among stakeholders in sustainable projects. Tumpa and Naeni explained that the integration of these technologies enables real-time collection and analysis of project data, supports early detection of risks, and ensures accountability through transparent recording systems [7].

Overall, the findings indicate that stakeholder disagreements in sustainable retrofit projects cannot be resolved solely through technical optimization or economic evaluation. Effective governance requires the integration of participatory decision-making mechanisms, transparent digital systems, and adaptive stakeholder coordination processes capable of balancing sustainability, economic, and social considerations simultaneously.

Table 2. Comparison of the MCDM Approach and Digital Technology in Resolving Stakeholder Disagreements

Aspects	MCDM	Digital Technology
Key Focus	Systematic preference assessment	Data-driven decision making
Methods	Multi-criteria, optimal compromise	AI, big data, blockchain
Advantages	Balanced, transparent, adaptive	Real-time, transparent, accountable
Output	Optimal retrofit solutions	Early risk detection, decentralized record keeping
Support required	Financial incentives, public policy	Digital infrastructure, system integration

Source: [1], [7]

Table 2 demonstrates that the MCDM approach and digital technologies possess complementary characteristics in resolving stakeholder disagreements. MCDM provides a methodological framework for systematic preference assessment, while digital technologies provide infrastructure for real-time data-driven decision-making. The integration of both approaches enables more adaptive, transparent, and collaborative governance mechanisms in sustainable retrofit projects.

B. Barriers to BIM-LCA Implementation in the Construction Industry

The implementation of Building Information Modeling-Life Cycle Assessment (BIM-LCA) in the Architecture, Engineering, and Construction industry still faces major barriers that hinder the integration of

sustainability principles into construction decision-making. The primary obstacles include low BIM model quality, limited environmental databases, insufficient interoperability between software platforms, and lack of real-time analytical support. Manual and repetitive data input processes also reduce efficiency and increase the potential for analytical errors [4].

Parece et al. recommended improving interoperability and data standardization to strengthen BIM-LCA integration and improve information exchange efficiency between platforms [4]. In addition, automation and real-time analytical support are needed to accelerate environmental impact evaluation processes. Continuous training and capacity development programs are also essential to improve stakeholder understanding and operational competence related to BIM-LCA implementation.

Complementary approaches proposed by Martins et al. emphasized adaptive project classification, collaborative stakeholder management, and cross-functional coordination to improve transparency and project effectiveness [12]. These findings indicate that BIM-LCA implementation requires not only technical system integration but also collaborative governance mechanisms capable of supporting stakeholder communication and sustainability-oriented coordination processes.

Table 3. Obstacles and Solutions for BIM-LCA Implementation

Barriers	Impact	Solutions	Implementation
Low BIM model quality	Inaccurate analysis	Improved data standards	Format standardization, automatic validation
Lack of environmental data	Incomplete LCA evaluation	Comprehensive environmental database	Integrated database, open API
Limited interoperability	Inefficient data exchange	Enhanced interoperability	IFC format, ISO 19650 standard
Repetitive manual input	Slow, error-prone	Process automation	Automatic plugins, scripting
Non-real-time analysis	Delayed decisions	Real-time analysis tools	Interactive dashboard, cloud computing
Low professional competence	Slow adoption	Ongoing training	Workshops, certification, e-learning

Source: [4], [12]

The analysis demonstrates that BIM-LCA implementation barriers are not solely technological problems but also stakeholder coordination and governance challenges. Therefore, successful BIM-LCA adoption requires integrated data management, collaborative communication structures, and continuous stakeholder capacity development throughout the project lifecycle.

C. Limitations of Digital Technology Research for Project Governance

The limited research exploring the implications of digital technology in improving decision-making processes and stakeholder engagement at the infrastructure project governance level indicates a significant research gap. Most previous studies focus on organizational sustainability performance, while governance-related operational issues at the project level remain insufficiently explored [7].

Tumpa and Naeni proposed the use of digital technologies to improve transparency, collaboration, and stakeholder engagement in infrastructure governance [7]. Their study highlighted the role of the Technology Acceptance Model (TAM) in understanding how perceived usefulness and ease of use influence digital technology adoption by project professionals.

An alternative analytical approach developed by Huq and Puthuvayi utilized ordinal logistic regression analysis to assess stakeholder satisfaction and identify key performance determinants in project governance [13]. This model supports evidence-based decision-making processes by providing objective and measurable stakeholder evaluation mechanisms.

These findings suggest that digital technologies can significantly strengthen project governance when supported by transparent decision-making structures and active stakeholder participation mechanisms. The integration of digital governance and stakeholder engagement therefore becomes essential for improving sustainability-oriented project management.

D. Evaluation of Digital Technology Application in Urban Regeneration

The lack of comprehensive evaluation regarding digital technology implementation in urban regeneration projects remains a challenge for sustainability-oriented governance. Existing studies often examine technologies such as GIS, BIM, AI, and IoT separately without integrating project stages, implementation scale, and stakeholder participation dimensions [8].

Xiahou et al. recommended a multidimensional analytical approach integrating systematic review, bibliometric analysis, and stakeholder configuration assessment to identify technology implementation patterns [8]. Their findings revealed significant disparities in technology adoption, particularly regarding AI implementation, which remains substantially lower compared to GIS and BIM technologies.

Liao and Liu emphasized that successful urban regeneration requires collaborative governance mechanisms capable of balancing economic, environmental, and social interests among stakeholders [9]. Government institutions, communities, and private sectors must therefore collaborate within transparent governance systems to ensure sustainability-oriented urban regeneration outcomes.

The unequal distribution of digital technology adoption across project stages indicates that technology implementation strategies must be aligned with governance needs, stakeholder participation levels, and project-scale characteristics to ensure sustainable urban regeneration outcomes.

E. Lack of Involvement in Low-Carbon Planning

Limited stakeholder involvement in low-carbon planning remains a major challenge in sustainable construction governance. The planning process is frequently dominated by technical experts and developers, while local governments, environmental experts, and communities are insufficiently involved in collaborative decision-making processes [2].

Zhang et al. proposed the implementation of BIM-based collaborative frameworks integrated with carbon visualization systems to improve transparency in low-carbon planning [2]. This approach enables stakeholders to evaluate the environmental impacts of design alternatives objectively and collaboratively.

Mejía et al. further emphasized that transparent carbon visualization systems can function as shared communication mechanisms that reduce conflicts and improve evidence-based decision-making among stakeholders [14]. This transparency strengthens coordination processes and minimizes sustainability-related disagreements during project implementation.

These results demonstrate that transparent BIM-based collaboration mechanisms can improve stakeholder involvement in low-carbon planning and reduce conflicts during sustainability-oriented decision-making processes.

F. Lack of Coordination Understanding in BIM Implementation

Limited understanding regarding stakeholder roles, responsibilities, and coordination mechanisms in BIM implementation continues to reduce the effectiveness of BIM adoption throughout the building lifecycle [5]. Fragmented communication, inconsistent data sharing, and unclear responsibilities frequently hinder collaborative project implementation.

Parece et al. identified the importance of implementing a Quadruple Bottom Line (QBL) approach involving profit, people, planet, and process dimensions to improve BIM collaboration effectiveness [5]. In addition, Common Data Environment (CDE)-based information sharing systems and BIM coordination mechanisms can significantly improve collaborative integration among stakeholders.

Yang et al. further explained that successful stakeholder relationships in construction projects depend on transparent communication, mutual trust, and collaborative organizational culture [15]. Therefore, BIM implementation should not be viewed solely as a technical process but also as a governance and stakeholder management process.

The findings emphasize that BIM implementation effectiveness depends not only on technical integration but also on shared understanding, collaborative culture, and coordinated stakeholder engagement throughout the building lifecycle.

G. The Complexity of Stakeholder Relationships in Off-Site Projects

Stakeholder relationships in off-site construction projects involve complex interactions characterized by different levels of power, interests, and influence [3]. Static stakeholder mapping approaches are often insufficient to capture dynamic stakeholder changes during project implementation.

Zhu et al. developed fuzzy logic-based stakeholder mapping approaches capable of providing adaptive and representative stakeholder analysis [3]. The use of linguistic scales and membership functions enables more flexible evaluation of stakeholder influence and project interests.

The implementation of fuzzy logic systems supported by analytical platforms such as MATLAB, Python, and AI-assisted project management systems enables dynamic stakeholder monitoring and adaptive governance strategies. Continuous stakeholder mapping updates also improve responsiveness toward changing project environments and stakeholder expectations.

The use of fuzzy logic enables more adaptive and representative stakeholder analysis, particularly in dynamic project environments where stakeholder influence and interests continuously evolve throughout project implementation.

H. Lack of Involvement in Digital Technology Adoption

The lack of effective stakeholder involvement in digital technology adoption frequently contributes to implementation failure in construction projects [6]. Weak communication, limited collaboration, and insufficient participation during planning stages often reduce technology relevance and organizational acceptance.

Hwabamungu and Shepherd demonstrated that active stakeholder participation significantly improves technology adoption effectiveness because stakeholders can directly contribute to identifying operational needs and implementation challenges [6]. Cross-functional consultation forums and participatory engagement mechanisms therefore become important governance instruments for supporting successful technology implementation.

These findings confirm that stakeholder participation is a critical factor in successful digital technology adoption, as collaborative engagement improves technology relevance, organizational acceptance, and implementation effectiveness.

I. Lack of Coordination in Construction Waste Management

Weak coordination among stakeholders in construction waste management remains a major barrier to circular economy implementation in sustainable construction projects [10]. Developers, contractors, suppliers, regulators, and waste management actors often operate separately without integrated communication and governance systems.

Gondak et al. developed the Interactive Stakeholder Journey Map in Construction (ISJMC), which functions as an interactive stakeholder mapping and communication platform throughout the construction project lifecycle [10]. This system improves role clarity, communication transparency, and collaborative coordination among stakeholders involved in circular economy implementation.

The implementation of interactive stakeholder mapping systems strengthens communication transparency, role clarity, and collaborative coordination, which are essential for supporting circular economy principles and sustainable construction waste management.

J. Proposed Integrated Stakeholder Governance Framework

The synthesis of the identified stakeholder management challenges and solution approaches resulted in the development of an integrated stakeholder governance framework for sustainable construction projects. The framework combines three main dimensions: stakeholder coordination, digital technology integration, and collaborative governance mechanisms.

At the stakeholder management level, the framework addresses issues related to stakeholder conflicts, communication gaps, participation limitations, and coordination complexity through adaptive stakeholder mapping, participatory decision-making, and collaborative engagement mechanisms. At the technology integration level, AI, BIM-LCA, blockchain, and fuzzy logic function as enabling technologies that support data-driven decision-making, sustainability assessment, transparency, and adaptive monitoring systems. Meanwhile, collaborative governance mechanisms such as Common Data Environment (CDE), cross-functional consultation forums, and Interactive Stakeholder Journey Maps strengthen communication transparency and inter-organizational coordination.

The proposed framework positions sustainability performance as the primary outcome of integrated governance implementation. In this study, sustainability performance includes environmental, economic, social, and governance dimensions supported through transparent decision-making, stakeholder collaboration, and digital technology integration. The framework therefore contributes conceptually by connecting stakeholder management, sustainability governance, and digital technologies into a unified governance-oriented model for sustainable construction projects.

IV. Conclusion

This study identified nine major stakeholder management challenges in sustainable construction projects related to stakeholder conflicts, digital technology implementation barriers, governance limitations, and coordination complexity. The findings demonstrate that stakeholder management challenges in sustainable construction projects are highly interconnected and cannot be effectively addressed through isolated technical or managerial approaches alone.

The study highlights that sustainable construction governance requires the integration of collaborative stakeholder engagement, digital decision-support mechanisms, and adaptive coordination systems. Technologies such as Artificial Intelligence (AI), blockchain, BIM-LCA, and fuzzy logic can strengthen transparency, sustainability assessment, stakeholder mapping, and evidence-based decision-making processes when supported by collaborative governance mechanisms. In addition, participatory coordination approaches such as Common Data Environment (CDE), consultative stakeholder forums, and Interactive Stakeholder Journey Maps contribute to improving communication transparency and stakeholder collaboration throughout the project lifecycle.

The main contribution of this study lies in the development of an integrated stakeholder governance framework that combines Multi-Criteria Decision Making (MCDM), collaborative governance principles, and digital technologies within a unified conceptual model for sustainable construction project management. Unlike previous studies that primarily discuss stakeholder management, sustainability assessment, and digital technology implementation separately, this study conceptually integrates these dimensions into a governance-oriented framework that supports sustainability-oriented project decision-making.

The theoretical contribution of this research strengthens the literature on stakeholder governance and digital transformation in sustainable construction management. Practically, the proposed framework provides guidance for construction stakeholders in improving project transparency, stakeholder coordination, sustainability assessment, and collaborative decision-making processes through digital governance mechanisms.

This study is limited by its literature-based conceptual approach and therefore requires further empirical validation in real construction project environments. Future studies are recommended to evaluate the implementation of the proposed framework through case studies, comparative project analysis, and longitudinal assessment in different sustainable construction contexts. Further research may also explore the effectiveness of emerging digital technologies in supporting adaptive stakeholder governance and sustainability-oriented project management.

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