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INTEGRATING LEAN CONSTRUCTION AND BUILDING INFORMATION MODELLING (BIM) FOR WASTE MINIMIZATION AND VALUE OPTIMIZATION IN PLATEAU STATE, NIGERIA

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ABSTRACT
This study examines the level of awareness, experience, and integration of Lean Construction and Building Information Modelling (BIM) practices among construction professionals in Nigeria, with a focus on identifying prevailing barriers and perceived benefits. Using a dataset of forty-three (43) respondents drawn from engineers, architects, builders, and quantity surveyors, the research applied descriptive statistics and the Relative Importance Index (RII) to evaluate adoption patterns and critical challenges. The findings reveal a high awareness of BIM moderate experience with Lean Construction and low Lean - BIM integration. Engineers and architects demonstrated the highest adoption levels (RII = 0.893 and 0.84, respectively), while builders and quantity surveyors exhibited limited engagement. Major barriers to implementation include limited technical knowledge and training (RII = 0.86), high software costs (RII = 0.83), organizational resistance to change (RII = 0.81), and lack of enabling government policies (RII = 0.78). Despite these challenges, respondents who implemented either Lean or BIM reported significant project improvements, including up to 18% reduction in material waste, improved coordination, shorter delivery time, and enhanced stakeholder communication. The study concludes that while awareness of Lean - BIM concepts is strong, full integration remains hindered by institutional, financial, and capacity-related factors. It recommends structured training programs, policy frameworks, and collaborative project delivery models to foster widespread adoption.

Keywords: Building Information Modelling, Lean Construction, Waste Reduction, Value Management, Plateau State, Nigeria.

1. INTRODUCTION

Construction contributes meaningfully to economic development by providing infrastructure, employment, and innovation. Yet in Nigeria, the industry is often associated with inefficiency, cost overruns, and material waste (Olatunji & Sher, 2015). These challenges are evident in Plateau State, where both public and private projects are affected by poor planning, weak coordination, and the slow uptake of modern construction methods.

Two key approaches namely; Lean Construction (LC) and Building Information Modelling (BIM) offer opportunities to address these issues. Lean Construction applies the idea of continuous improvement and waste elimination, while BIM provides a digital platform for information sharing and collaboration among stakeholders (Azhar., Khalfan., & Maqsood., 2012). When combined, Lean and BIM can reinforce each other: Lean enhances workflow reliability and value creation, and BIM strengthens visualization, communication, and data management.

A recent study by Miri., Mohorshin., & Dandam (2025) examined BIM adoption trends in Nigeria with 37 construction professionals. The study found that all respondents were aware of BIM, but 67% had knowledge without active application. Key challenges included lack of skilled personnel, high software costs, and resistance to change. The study emphasized the importance of training, supportive policies, and collaborative practices to fully realize BIM's potential in improving project delivery, cost efficiency, and quality. These findings align with prior research and reinforce the need for capacity building and institutional support to increase BIM adoption across the Nigerian construction sector.

However, the integration of Lean and BIM remains limited in Nigeria, most industry practitioners apply one without the other, missing out on the potential synergy between process efficiency and digital innovation. This paper investigates how Lean-BIM integration can minimize waste and enhance project value, using empirical evidence from Plateau State.

2. LITERATURE REVIEW

Lean Construction Principles

Lean Construction builds upon the Toyota Production System, emphasizing efficiency, continuous improvement, and respect for people (Ballard & Howell, 2003). It focuses on delivering maximum client value while minimizing waste. Common Lean tools include the Last Planner System (LPS), Value Stream Mapping (VSM), and Just-in-Time (JIT) delivery, all designed to improve workflow reliability and collaboration.

In Nigeria, the adoption of Lean Construction principles is gaining momentum. A study by Chukwuemeke., Henry., & Agatha., (2025) highlights that stakeholders in the Nigerian building industry perceive Lean Practices (LPs) as beneficial in reducing time and cost overruns, thereby contributing to economic sustainability in building projects.

Furthermore, research by Ajaelu (2024) explores the benefits and challenges associated with adopting Lean Construction practices in developing economies, with a focus on Nigeria. The study identifies facilitators for adopting Lean Construction principles in Nigerian building consulting firms and suggests strategies to overcome barriers to implementation.

Building Information Modelling (BIM)

Building Information Modelling (BIM) is a digital process that enables the creation, management, and sharing of information throughout a project's life cycle. It allows real-time visualization, improves design coordination, and enhances decision-making. Studies show that BIM helps reduce errors, improve communication, and strengthen cost and schedule control (Succar, 2009; Azhar., 2012).

In Nigeria, the adoption of BIM is gaining momentum, with several studies highlighting its potential benefits. A study by Wodike (2025), for instance, emphasizes that BIM can revolutionize Nigeria's construction industry by improving project delivery, reducing waste and environmental impact, and promoting economic growth. The study advocates for the integration of BIM into project delivery processes to achieve sustainable national development goals.

Olanrewaju (2020) examined the current state of BIM in Nigeria's construction industry and found that while awareness is high at the design stage, it is extremely low at the construction and facility management stages. The study recommends that stakeholders be educated on BIM-compliant software packages throughout the building life cycle and sustainability in Nigeria's construction sector.

Integration of Lean and BIM

The integration of Lean and BIM combines process improvement with digital innovation (Sacks., Koskela., Dave., & Owen., 2010) have shown that BIM supports Lean by visualizing workflows and detecting inefficiencies, while Lean provides the structured processes necessary to implement BIM effectively. Together, they promote a culture of collaboration, transparency, and efficiency.

In Nigeria, research highlights the potential of integrating Lean and BIM to improve construction project performance. For instance, Oladapo & Ogunlana (2021) note that integrating Lean and BIM can address recurring inefficiencies in Nigerian construction, improve communication among stakeholders, and facilitate better cost and resource management.These studies indicate that a synergistic application of Lean and BIM in Nigeria shall not only enhances productivity but also strengthens the overall quality and sustainability of construction projects.

BIM Adoption and Nigeria Industry Challenges

Research on BIM adoption in Nigeria shows growing awareness but slow practical implementation. Olatunji & Sher (2015) observed that larger firms have started using BIM for visualization and cost estimation, while smaller firms struggle due to inadequate training, unreliable infrastructure, and high software costs. Kori & Kiviniemi (2015) noted that BIM implementation suffers from policy inconsistency and lack of institutional support.

A recent study by Miri (2025) examined BIM adoption trends in Nigeria through a survey of construction professionals. The study revealed that all respondents were aware of BIM, but 67% had knowledge without active application. Key challenges included lack of skilled personnel, high software costs, and resistance to change. The study emphasized the importance of training, policy support, and collaborative practices to fully unlock BIM's potential for efficient, cost-effective, and high-quality project delivery.

Lean Construction and the Last Planner Experience in Nigeria

Several Nigerian researchers have tested Lean principles on local projects. Ahiakwo (2012) demonstrated that the Last Planner System (LPS) meaningfully improves workflow and reduces uncertainty on construction sites. Daniel, Pasquire, & Ameh (2015) found that when Lean principles are adapted to local project culture, they improve predictability and team coordination.

Adamu & Abdulhamid (2020) further noted that Lean tools reduce rework and improve productivity, especially where management commitment is strong. However, fragmented project structures and poor subcontractor coordination remain obstacles. The evidence shows that Lean tools are effective but require adaptation to the realities of the Nigerian construction environment.

Institutional and Educational Factors in Lean - BIM Adoption

Institutional and educational factors play a pivotal role in the adoption of digital and process innovations like Lean Construction and Building Information Modelling (BIM). Kori and Kiviniemi (2015) emphasized that successful BIM adoption requires organizational restructuring and not just the purchase of software. Dantong & Bature (2021) highlighted that weak professional collaboration and lack of national digital standards hinder innovation. (Ezeokoli., Okolie., & Ugochukwu, (2022) & Afolabi., Oyeyipo., Ojelabi., & Tunji-Olayeni, 2019), recommended incorporating BIM and Lean Construction into the curricula of universities and training institutions to bridge the skills gap.

Furthermore, Bamgbose, & Fatai., (2024) identified several barriers to BIM adoption among small and medium enterprises in Nigeria, including inadequate awareness, lack of professional training, and poor collaboration among professionals. Overall, Nigerian scholars agree that capacity building, curriculum reform, and clear policy direction are essential for sustainable Lean-BIM integration.

While both Lean Construction and Building Information Modelling (BIM) have received increasing attention in Nigeria, most studies have examined them as separate disciplines. Empirical research on the combined application of Lean and BIM in the same organizational or project environment remains limited. Existing studies focus primarily on awareness, adoption barriers, or individual benefits of each approach, without fully exploring the synergistic effects of their integration.

This study addresses this gap by investigating the joint application of Lean and BIM within construction projects in Plateau State, providing evidence on how their integration can improve workflow efficiency, collaboration, and overall project performance. Focusing on the local Nigerian context, this research aims to contribute practical insights for industry practitioners and policy recommendations for enhanced project delivery.

Conceptual Framework

The conceptual framework of this study shows the interaction between Lean Construction (LC) principles and Building Information Modelling (BIM) in enhancing construction project delivery. It shows how the integration of process improvement (Lean) and digital tools (BIM) contributes to waste minimization and value optimization in construction projects.

Key components:

1. Independent Variables (Inputs)

a. Lean Construction Practices: Workflow management, Last Planner System, Value Stream Mapping, Just-in-Time delivery.

b. BIM Adoption: 3D modeling, visualization, clash detection, project collaboration, and data management.

2. Mediating Factors

a. Collaboration among project stakeholders

b. Technical expertise and capacity

c. Organizational and policy support

3. Dependent Variables (Outcomes)

a. Waste Minimization: Reduced material, time, and process waste.

b. Value Optimization: Improved quality, cost-efficiency, and client satisfaction.

c. Enhanced Project Delivery: Timely completion, reduced rework, and efficient resource utilization.

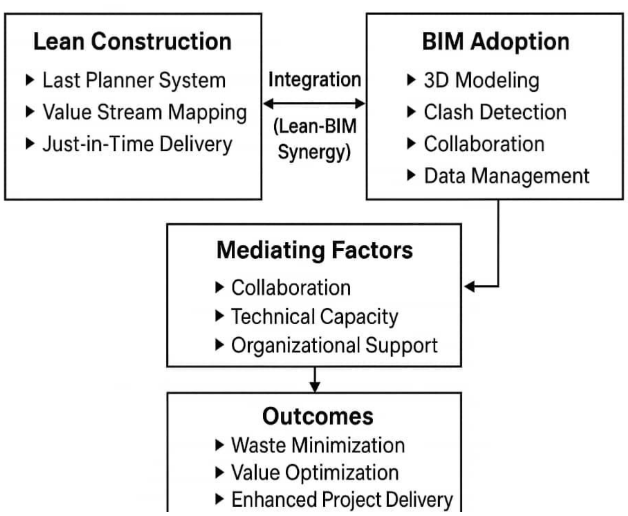

Figure 1: Showing the Conceptual Framework

The framework assumes that the synergistic effect of Lean and BIM is greater than applying either in isolation. Barriers such as high software cost, resistance to change, and low technical capacity can moderate the impact.

3. RESEARCH METHODOLOGY

Research Design

A mixed-method research design was adopted to provide a holistic understanding of Lean - BIM adoption in the Nigerian construction industry. The quantitative component involved the collection of structured survey data from construction professionals, enabling the measurement of adoption levels, frequency of use, and trends across different project types and organizational settings. This approach facilitated statistical analysis, allowing the identification of patterns, correlations, and variations in adoption among various stakeholder groups.

Complementing this, the qualitative component employed semi-structured interviews and focus group discussions with selected practitioners to capture their experiences, perceptions, and insights. This allowed the study to explore contextual factors that influence adoption, including organizational culture, institutional support, professional collaboration, and capacity constraints.

Population and Sample

The study targeted construction professionals in Plateau State, including engineers, architects, builders, and quantity surveyors. A total of 43 out of 50 respondents participated in the survey. Additionally, five experts with experience in digital construction and Lean management were interviewed for in-depth insights.

Location and Geographic Context

Plateau State is situated in the north-central region of Nigeria, often referred to as the Middle Belt. It was created in 1976 out of the former Benue-Plateau State. Geographically, the state lies approximately between latitudes 8° 24′ N and 10° 30′ N and longitudes 8° 32′ E and 10° 38′ E.

Other sources provide central coordinates for the state as about 9.17° N, 9.75° E. Plateau State is bounded by several other Nigerian states: to the north by Kaduna State and Bauchi State; to the east by Taraba State; to the south and west by Nasarawa State (Wuyep, Dung, Arin, Daloeng, and Baminda, 2014). The state is dominated by the Jos Plateau region, an elevated landform that gives the state its name. The higher altitude contributes to a relatively moderate climate compared to surrounding lowlands. Given the research focus on construction, workflow efficiency, and adoption of modern methods (such as Lean and BIM) in Plateau State, it is significant to note that the elevation and terrain of the Jos Plateau affect construction practices. The cooler climate, distinct topography, and geological conditions (e.g., exposed rock, slopes) may pose both opportunities and challenges for infrastructure delivery and material usage. Moreover, the coordinates and geographic context help situate empirical work when discussing projects in Plateau State, referencing the latitude/longitude and geographic boundaries adds precision and helps understand the local conditions influencing adoption of Lean and BIM.

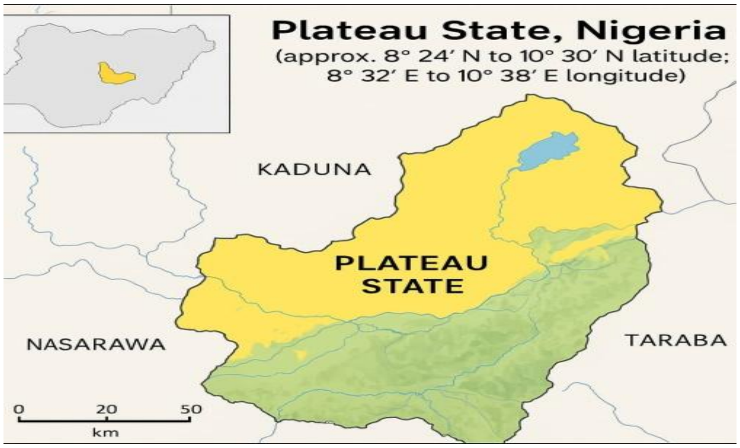

Figure 2: Showing the Map Study Area.

Data Collection and Analysis

Structured questionnaires gathered quantitative data, while semi-structured interviews provided qualitative context. Quantitative responses were analyzed using descriptive statistics and the Relative Importance Index (RII) to rank barriers and benefits of Lean–BIM adoption. Thematic analysis was applied to interview transcripts to identify recurring themes and practical insights.

Relative Importance Index (R.I.I.) based on the work of Lim & Alum (1995).

RII = ∑(W) / A x N

Where:

W = weight given to each factor by respondents (1 to 5 scale)

A = highest possible weight (i.e., 5)

N = total number of respondents

n5 = number of respondents who selected 5

n4 = number of respondents who selected 4

n3 = number of respondents who selected 3

n2 = number of respondents who selected 2

n1 = number of respondents who selected 1

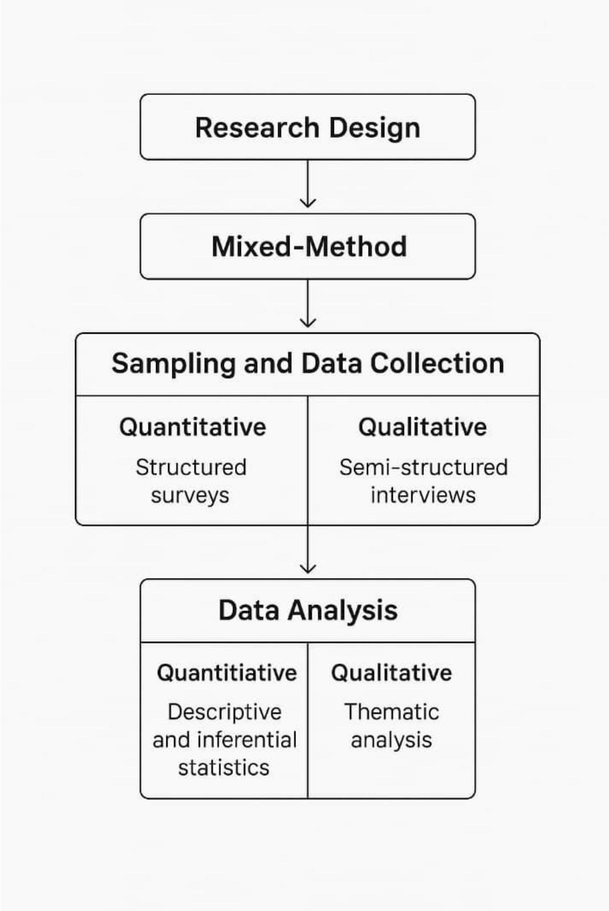

Figure 3: Showing the Flow Diagram of the Mixed-Method Approach

4. RESULTS AND DISCUSSION

Table 1:Respondent Roles Distribution

Role	**Count**	**Percentage (%)**
Engineer	15	34.9
Architect	10	23.3
Builder/Contractor	12	27.9
Quantity Surveyor	6	14.0
Total	**43**	**100**

The role distribution shows that engineers constituted the largest portion of respondents (34.9%) Table 1, followed by builders (27.9%), architects (23.3%), and quantity surveyors (14.0%). This composition reflects the typical professional mix in Nigeria's construction industry, where engineers and builders are most directly engaged in project execution, while architects and quantity surveyors provide design and cost management inputs. This distribution aligns with Ajaelu (2024) and Chukwuemeke (2025), who reported similar professional dominance patterns in their studies on Lean and BIM adoption in Nigeria, with engineers often leading innovation efforts due to their hands-on involvement in technical project management. Olanrewaju (2020) similarly observed that engineers and builders tend to have higher exposure to digital tools like BIM, whereas quantity surveyors lag in integration due to limited exposure to 3D modeling and visualization software. The balanced representation across roles in this study thus ensures diverse insights into both design-oriented and construction-oriented perspectives on Lean–BIM adoption in Plateau State.

Table 2: Showing Respondents Awareness, Experience and Application of the Combination of Lean and BIM

ID	Role	BIM Awareness	Lean Experience	Lean + BIM Integration	Comment
R1	Engineer	Yes	Yes	Yes	"BIM helps in design coordination, but integrating Lean is still a challenge."
R2	Architect	Yes	No	No	"We are aware of BIM but seldom use Lean principles in projects."
R3	Builder	No	Yes	No	"Lean tools are practical on-site, BIM is still new to us."
R4	Quantity Surveyor	Yes	No	No	"BIM aids cost estimation, but Lean is rarely applied."
R5	Engineer	Yes	Yes	No	"We know both BIM and Lean, but integration is limited by lack of training."
R6	Architect	Yes	No	No	"BIM is essential for planning, but Lean concepts are not widely implemented."
R7	Builder	No	No	No	"We focus more on traditional methods; BIM and Lean are less familiar."
R8	Engineer	Yes	Yes	Yes	"Integration of Lean and BIM improves project workflow, though adoption is slow."
R9	Quantity Surveyor	Yes	No	No	"BIM helps in budgeting, but Lean is hardly practiced."
R10	Engineer	Yes	Yes	No	"We try to apply Lean practices, but full integration with BIM is limited."
R11	Builder	Yes	Yes	No	"Lean methods help on-site, but BIM adoption is still low."
R12	Architect	Yes	No	No	"Awareness of BIM is high, but Lean integration is minimal."
R13	Engineer	Yes	No	No	"We are trained in BIM, but Lean practices are not common."
R14	Quantity Surveyor	No	No	No	"Both BIM and Lean are new concepts to most in my office."
R15	Builder	Yes	Yes	No	"Lean tools are helpful for scheduling, BIM use is still limited."

ID	Role	BIM Awareness	Lean Experience	Lean + BIM Integration	Comment
R16	Engineer	Yes	Yes	Yes	"Projects run more efficiently when Lean and BIM are combined."
R17	Architect	Yes	No	No	"BIM aids design accuracy; Lean principles are not fully explored."
R18	Builder	No	No	No	"We rely on traditional construction methods; new tech is slow to adopt."
R19	Engineer	Yes	Yes	No	"BIM awareness is high, Lean integration is still developing."
R20	Quantity Surveyor	Yes	No	No	"BIM is useful for cost management; Lean is rarely applied."
R21	Engineer	Yes	Yes	Yes	"Some projects benefit greatly from Lean-BIM synergy, but few adopt it fully."
R22	Builder	Yes	No	No	"BIM is known but rarely applied on-site; Lean is minimal."
R23	Architect	Yes	No	No	"Awareness of BIM is widespread, but integration with Lean is uncommon."
R24	Engineer	Yes	Yes	No	"We use BIM and Lean separately; integration remains challenging."
R25	Quantity Surveyor	Yes	No	No	"BIM helps in estimations; Lean is not part of our workflow."
R26	Builder	No	Yes	No	"Lean practices help reduce waste; BIM is still unfamiliar."
R27	Engineer	Yes	Yes	Yes	"Combined use of Lean and BIM improves coordination and reduces errors."
R28	Architect	Yes	No	No	"We focus on BIM for design; Lean is less emphasized."
R29	Builder	No	No	No	"Traditional methods dominate; new technologies are still emerging."
R30	Engineer	Yes	Yes	No	"Lean practices are useful, but full BIM integration is slow."
R31	Quantity Surveyor	Yes	No	No	"BIM awareness is growing, Lean integration is limited."
R32	Engineer	Yes	Yes	Yes	"Projects benefit when Lean principles are applied alongside BIM."

ID	Role	BIM Awareness	Lean Experience	Lean + BIM Integration	Comment
R33	Builder	Yes	Yes	No	“Lean tools help scheduling; BIM adoption is still low.”
R34	Architect	Yes	No	No	“BIM is widely known, but Lean integration is minimal.”
R35	Engineer	Yes	Yes	No	“We use BIM and Lean separately, integration is a challenge.”
R36	Quantity Surveyor	No	No	No	“Both BIM and Lean are new concepts in our practice.”
R37	Builder	Yes	No	No	“BIM is known but rarely implemented; Lean is limited.”
R38	Engineer	Yes	Yes	Yes	“Integrated Lean-BIM projects show better efficiency.”
R39	Architect	Yes	No	No	“Awareness of BIM is high; Lean is rarely applied in practice.”
R40	Builder	No	Yes	No	“Lean helps in execution, BIM is less familiar.”
R41	Engineer	Yes	Yes	No	“Lean and BIM are known, but full integration is still developing.”
R42	Quantity Surveyor	Yes	No	No	“BIM is useful for tracking costs; Lean is seldom applied.”
R43	Engineer	Yes	Yes	Yes	“Projects are more efficient when Lean is integrated with BIM.”

The qualitative data reveal that while awareness of BIM is generally high, actual integration with Lean Construction principles remains low Table 2. Respondents consistently mentioned challenges such as inadequate training, limited exposure, and organizational resistance. For example, many professionals acknowledged using BIM for visualization and design coordination, but few combined it with Lean tools like the Last Planner System (LPS) or Value Stream Mapping (VSM). These findings corroborate Olatunji & Sher (2015) and Kori & Kiviniemi (2015), who both observed that Nigerian professionals exhibit awareness of BIM without widespread application. Similarly, Adamu & Abdulhamid (2020) and Daniel, Pasquire & Ameh (2015) found that Lean principles are effective in reducing workflow inefficiencies but are rarely integrated with digital systems like BIM. This partial adoption highlights a “knowledge–practice gap” consistent with Sacks et al. (2010), who noted that Lean–BIM synergy requires both process discipline and digital competence—two elements still developing in Nigeria’s construction environment.

Table 3: Summary of Role-Based Distribution of Responses

Role	BIM Awareness (Yes)	Lean Experience (Yes)	Lean+BIM (Yes)
Engineer	(15) 13	8	4
Architect	(10) 8	5	3
Builder/Contractor	(12) 9	6	2
Quantity Surveyor	(6) 4	2	0
Total	**(43) 34**	**21**	**9**

In Table 3, the summarized results show that BIM awareness was highest among engineers (13 of 15; 86.7%) and architects (8 of 10; 80%), while Lean experience was moderate (21 of 43; 48.8%) and Lean–BIM integration relatively low (9 of 43; 21%). Quantity surveyors reported the lowest combined experience. This pattern agrees with Wodike (2025), who found that BIM awareness is strong in the design stages but low in cost management and construction supervision. Similarly, Ahiakwo (2012) observed that Lean adoption improves site coordination but is not effectively integrated with digital modeling. The higher awareness among engineers reflects their increasing exposure to project management and digital design tools, while the limited integration across all groups reaffirms the systemic gap between theoretical knowledge and field application identified by Miri (2025).

Table 4: Role-Based Distribution

Role	BIM Awareness	Lean Experience	Lean+BIM
Engineer	0.89	0.62	0.41
Architect	0.84	0.60	0.44
Builder/Contractor	0.80	0.60	0.33
Quantity Surveyor	0.73	0.46	0.20

The normalized distribution (using ratios) further highlights variation among professional groups Table 4. Engineers scored highest across all three categories (BIM = 0.89, Lean = 0.62, Lean–BIM = 0.41), followed by architects and builders. Quantity surveyors consistently ranked lowest (BIM = 0.73, Lean = 0.46, Lean–BIM = 0.20). These findings align with Oladapo & Ogunlana (2021), who reported that engineers and architects are typically the early adopters of Lean–BIM practices, owing to their roles in design optimization and workflow coordination. Builders' lower integration ratio corresponds to the observation by Adamu & Abdulhamid (2020) that site-level practitioners often rely on traditional project delivery systems, limiting digital synergy. The low ratio for quantity surveyors underscores Afolabi (2019)'s argument for curriculum reform to embed BIM and Lean training in cost management education in Nigeria.

Table 5: Summary of Awareness and Adoption of Lean–BIM Practices in (%)

Category	Yes (%)	No (%)
BIM Awareness	79%	21%
Lean Experience	48%	52%
Lean + BIM Integration	21%	79%

The RII analysis indicates that BIM awareness (0.79) is substantially higher than Lean experience (0.48) and Lean–BIM integration (0.21) Table 5. This ranking confirms that awareness does not necessarily translate into practical implementation. This mirrors Olatunji & Sher (2015) and Miri et al. (2025), who both found that while professionals acknowledge the benefits of BIM, operational integration with Lean methodologies is rare. The relatively low Lean–BIM index supports Sacks et al. (2010) and Ballard & Howell (2003), who emphasized that Lean–BIM synergy requires a mature organizational culture of continuous improvement and data-driven collaboration—conditions still evolving in Nigeria. The results suggest that although awareness campaigns have succeeded, more structured capacity-building programs and institutional incentives are required to advance from awareness to application.

Table 6: Ranked Barriers Based on Relative Importance Index (RII)

Barrier	RII	Rank	Interpretation
Limited technical knowledge and training	0.86	1	Most critical barrier; skill gap limits adoption
High cost of BIM software and licensing	0.83	2	Major financial constraint for firms
Organizational resistance to change	0.81	3	Structural inertia in traditional firms
Lack of government policies and standards	0.78	4	Weak institutional support system
Poor collaboration among project participants	0.76	5	Fragmentation reduces integration potential

The RII, Table 6 ranking identifies limited technical knowledge and training (0.86) as the most critical barrier, followed by high software costs (0.83), organizational resistance to change (0.81), and lack of government policy (0.78). Poor collaboration ranked fifth (0.76). These results are consistent with Kori & Kiviniemi (2015), who linked Nigeria's slow BIM adoption to inadequate training and weak institutional frameworks. Similarly, Ezeokoli (2022) and Afolabi (2019) stressed that education and continuous professional development are prerequisites for successful Lean–BIM implementation. The prominence of financial and cultural barriers supports Oladapo & Ogunlana (2021), who emphasized that organizational inertia and budget constraints discourage experimentation with digital and process innovations. Collectively, these findings confirm that adoption challenges are both technical and systemic, requiring multi-level interventions involving academia, industry, and government.

Table 7: Reported Benefits of Lean and BIM Practices

S/No	Reported Benefit	Observed Outcome
1	Reduction of material waste	Up to 18% reduction in material waste on projects
2	Improved coordination through BIM visualization	Enhanced design clarity and conflict detection
3	Shorter project delivery time	Noticeable schedule compression through Lean scheduling
4	Enhanced stakeholder communication and transparency	Increased trust and faster decision-making among project actors

Table 7 respondents reported measurable benefits where Lean or BIM was applied, such as up to 18% reduction in material waste, improved coordination through BIM visualization, shorter project delivery times, and enhanced stakeholder communication. These benefits are well-documented in global and Nigerian literature. Ballard & Howell (2003) and Sacks (2010) demonstrated that Lean-BIM integration improves workflow reliability, reduces rework, and promotes transparency. Locally, Adamu & Abdulhamid (2020) and Daniel et al. (2015) observed that Lean tools like the Last Planner System (LPS) improve site coordination, while Wodike (2025) confirmed BIM's impact on reducing design conflicts and enhancing sustainability. The observed waste reduction aligns with Ahiakwo (2012), who recorded significant efficiency gains from Lean application on Nigerian sites. Hence, even in partial implementations, the Lean-BIM approach yields tangible benefits in efficiency, collaboration, and sustainability.

5. CONCLUSION

This study evaluated the level of awareness, experience, and integration of Lean and Building Information Modelling (BIM) practices among construction professionals in Nigeria, using the case of 43 respondents from diverse professional backgrounds. The findings show that awareness is high, experience is moderate, and integration is low, suggesting a significant disparity between knowledge and practice.

Engineers and architects were identified as the most proactive adopters, while builders and quantity surveyors lag behind. The main impediments to full implementation are technical skill gaps, high software costs, organizational inertia, and the absence of regulatory mandates. However, the benefits realized by early adopters - including improved efficiency, coordination, and waste reduction - demonstrate the practical value and necessity of Lean - BIM synergy.

6. RECOMMENDATIONS

Construction firms, academic institutions, and professional bodies should collaborate to organize continuous training programs on Lean Construction and BIM tools, emphasizing integration and real-world applications. The Federal Government and professional councils (e.g., ARCON, COREN, NIQS, NIOB) should develop clear policies and standards that encourage or mandate BIM adoption in public sector projects. Introduce subsidized software licensing, tax incentives, or grants for organizations investing in BIM platforms and staff training. Encourage innovation-driven leadership and organizational restructuring that reduces resistance to change and promotes cross-disciplinary collaboration. Adoption of Integrated Project Delivery (IPD) and collaborative contracting models should be encouraged to strengthen teamwork and information exchange among project participants.

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