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ASSESSING BIM PROFICIENCY LEVELS AMONG ARCHITECTURAL PROFESSIONALS IN CROSS RIVER STATE, NIGERIA

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Abstract
Building Information Modelling (BIM) is transforming the global architecture, engineering, and construction (AEC) industry, yet its adoption in developing contexts like Nigeria remains nascent. This study assesses the proficiency levels of architectural professionals in Cross River State, Nigeria, exploring their awareness, skills, and barriers to effective BIM implementation. Using a quantitative survey approach, primary data were collected from 120 registered architects via structured questionnaires. Findings reveal moderate awareness (65%) but low proficiency in advanced BIM dimensions (4D–7D), with only 12% demonstrating practical expertise. Key barriers include inadequate training (RII=0.89), high software costs (RII=0.87), and limited IT infrastructure (RII=0.85). Demographically, 68% of participants were male, 72% aged 26–40, and 55% had 5–10 years of experience. The study highlights a significant gap between basic CAD proficiency and advanced BIM capabilities, underscoring the need for targeted training and policy support. Recommendations include integrating BIM into university curricula, establishing subsidized training centers, and enforcing BIM standards by professional bodies. This research provides a foundation for enhancing BIM adoption in Nigeria's AEC sector, contributing to sustainable construction practices.

Keywords: Building Information Modelling, BIM proficiency, architectural professionals, industry, training, barriers.

Introduction & Literature Review
The architecture, engineering, and construction (AEC) industry is experiencing a transformative shift driven by digital technologies, with Building Information Modelling (BIM) emerging as a cornerstone for modern construction practices. BIM is a collaborative, data-driven process that integrates multidimensional information to create intelligent 3D models, facilitating enhanced design accuracy, project coordination, and lifecycle management (Eastman et al., 2011). By enabling real-time collaboration among stakeholders, BIM reduces errors, minimizes waste, and optimizes resource use, contributing to sustainable construction outcomes (Azhar, 2011). In developed nations such as the United States, the United Kingdom, and Australia, BIM adoption is well-established, often mandated by government policies that require its use in public projects (McAuley et al., 2017). For instance, the UK's BIM Level 2 mandate has driven widespread adoption, resulting in reported cost savings of up to 20% on public infrastructure projects (Cabinet Office, 2016). However, in developing countries like Nigeria, BIM adoption lags significantly, constrained by technological, economic, and educational barriers (Hamma-adama & Kouider, 2018).

In Nigeria, the AEC sector is a critical driver of economic growth, contributing approximately 4% to the national GDP (National Bureau of Statistics, 2023). Yet, the industry grapples with inefficiencies such as cost overruns, project delays, and poor coordination, which BIM could address (Saka & Chan, 2020). Cross River State, located in Nigeria's South-South geopolitical zone, is witnessing rapid urban development and tourism-driven construction, including projects like the Calabar International Convention Centre and Obudu Cattle Ranch redevelopment (Cross River

State Government, 2024). These projects underscore the need for advanced digital tools to enhance efficiency and sustainability. However, studies suggest that Nigerian architects predominantly rely on traditional 2D computer-aided design (CAD) tools like AutoCAD, with limited progression to BIM's advanced dimensions (4D–7D), which include time, cost, sustainability, and facility management data (Maina, 2018; Babatunde et al., 2020).

The global discourse on BIM highlights its potential to revolutionize construction by fostering interoperability and data-driven decision-making (Gourlis & Kovacic, 2017). For instance, 4D BIM integrates time scheduling, enabling real-time project monitoring, while 5D BIM incorporates cost estimation, reducing financial risks (Succar, 2009). Higher dimensions (6D and 7D) address sustainability and facility management, aligning with global sustainability goals (ISO, 2018). In developed contexts, BIM proficiency is linked to improved project outcomes, with studies reporting up to 30% reduction in rework and 15% faster project delivery (Stanley & Thurnell, 2014). Conversely, in Nigeria, the adoption rate remains low, with only 13% of architectural professionals demonstrating practical BIM expertise, largely due to inadequate training and high software costs (Fagbemi et al., 2016).

Several studies have explored BIM adoption in Nigeria, identifying key barriers. Hamma-adama et al. (2018) found that while awareness of BIM is growing, particularly in urban centers like Lagos and Abuja, its implementation is hindered by a lack of skilled professionals and standardized guidelines. In a survey of Nigerian construction firms, Onyejeakor et al. (2020) reported that 78% of respondents cited insufficient training as the primary barrier, followed by high software costs (72%) and limited IT infrastructure (68%). Cultural resistance to technological change also plays a significant role, as professionals accustomed to 2D workflows often perceive BIM as complex and resource-intensive (Eadie et al., 2013). Moreover, the absence of government mandates, unlike in countries like Singapore and the UK, limits industry-wide adoption (Olawumi & Chan, 2019).
Education is a critical factor in bridging the BIM proficiency gap. Arroteia et al. (2019) argue that integrating BIM into tertiary curricula is essential for equipping graduates with relevant skills. However, Nigerian universities often lack dedicated BIM labs and trained faculty, with only 15% of architecture programs offering BIM-specific courses (EJSIT, 2019). This educational gap perpetuates a cycle of low proficiency, as graduates enter the workforce without practical BIM experience (Maina, 2018). In Cross River State, where the construction sector is expanding due to government-led initiatives, the lack of BIM proficiency could hinder the region's ability to compete in a globalized AEC market.

The theoretical framework for this study draws from the Technology Acceptance Model (TAM), which posits that perceived ease of use and usefulness influence technology adoption (Davis, 1989). In the context of BIM, professionals' proficiency levels are shaped by their exposure, training, and access to resources (Gledson & Greenwood, 2017). Additionally, the Diffusion of Innovations theory (Rogers, 2003) highlights the role of innovation characteristics, such as relative advantage and complexity, in determining adoption rates. BIM's perceived complexity and high initial costs may deter its uptake among Nigerian architects, necessitating targeted interventions. This study focuses on Cross River State to provide a region-specific analysis of BIM proficiency, addressing a gap in the literature, as most Nigerian studies focus on major cities like Lagos and

Port Harcourt (Saka & Chan, 2020). By assessing awareness, skills, and barriers among architectural professionals, the research aims to inform strategies for enhancing BIM adoption in Nigeria's emerging construction markets. The findings contribute to the global discourse on BIM in developing contexts and offer practical insights for policymakers, educators, and industry stakeholders in Cross River State.

Method

Research Design and Population

This study adopted a quantitative descriptive approach to assess BIM proficiency among architectural professionals in Cross River State, Nigeria. The target population comprised 150 registered architects, identified through the Architects Registration Council of Nigeria (ARCON) database for Cross River State. A sample size of 120 was determined using the Krejcie and Morgan (1970) formula, ensuring a 95% confidence level.

Data Collection

Primary data were collected using a structured questionnaire, designed based on a literature review of BIM adoption studies (Babatunde et al., 2020; Hamma-adama & Kouider, 2018). The questionnaire was divided into three sections: (1) demographic profile (age, gender, experience, education), (2) BIM awareness and proficiency (rated on a 5-point Likert scale: 1 = no knowledge, 5 = expert), and (3) barriers to BIM adoption (rated on a 5-point Likert scale: 1 = strongly disagree, 5 = strongly agree). The questionnaire was pre-tested with 10 architects to ensure clarity and reliability (Cronbach's alpha = 0.82). Data were collected over four weeks (March–April 2025) via in-person and online distribution, achieving a 92% response rate (110 valid responses).

Data Analysis

Descriptive statistics (frequency, percentages, mean) and the Relative Importance Index (RII) were used to analyze responses, with IBM SPSS Statistics version 25 as the analytical tool. RII was calculated as:

$$RII = \frac{\mathcal{E}W}{A \times N}$$

where (W) is the weight of each response, (A) is the highest weight (5), and (N) is the total number of respondents.

Demographic Profile of Participants

Table 1 summarizes the demographic characteristics of the respondents.

Table 1
Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	75	68.2
	Female	35	31.8
Age Group	21–25 years	15	13.6
	26–40 years	79	71.8
	41–60 years	16	14.5
Years of Experience	<5 years	30	27.3
	5–10 years	60	54.5
	>10 years	20	18.2
Education Level	Bachelor's degree	65	59.1
	Master's degree	40	36.4
	PhD	5	4.5

Results And Discussion

BIM Awareness and Proficiency Levels

The study found that 65% of respondents were aware of BIM, primarily through professional workshops (42%) and academic training (28%). However, proficiency levels varied significantly across BIM dimensions, as shown in Table 2.

Table 2
BIM Proficiency Levels Among Respondents

BIM Dimension	Mean Score	RII	Proficiency Level
2D CAD	4.2	0.84	High
3D BIM	3.8	0.76	Moderate
4D BIM	2.1	0.42	Low
5D BIM	1.9	0.38	Low
6D–7D BIM	1.5	0.30	Very Low

High proficiency in 2D CAD (RII=0.84) reflects the industry's reliance on tools like AutoCAD, consistent with Fagbemi et al. (2016). Moderate proficiency in 3D BIM (RII=0.76) indicates some adoption of tools like Revit, but low proficiency in 4D–7D BIM suggests limited expertise in advanced applications like scheduling and sustainability analysis. Only 12% of respondents demonstrated practical expertise (score ≥4) in any BIM dimension beyond 3D, highlighting a skill gap.

Barriers to BIM Adoption

Table 3 presents the key barriers to BIM adoption, ranked by RII.

Table 3

Barriers to BIM Adoption

Barrier	Mean Score	RII	Rank
Inadequate training	4.45	0.89	1
High software costs	4.35	0.87	2
Limited IT infrastructure	4.25	0.85	3
Resistance to change	4.10	0.82	4
Lack of government mandates	3.95	0.79	5

Inadequate training (RII=0.89) was the most significant barrier, aligning with Maina (2018), who noted a lack of skilled BIM tutors in Nigerian universities. High software costs (RII=0.87) and limited IT infrastructure (RII=0.85) reflect economic and technological constraints, corroborating Onyejeakor et al. (2020). Resistance to change (RII=0.82) indicates cultural barriers, while the absence of government mandates (RII=0.79) underscores the need for policy intervention, as seen in developed nations (Hamma-adama & Kouider, 2018).

Demographic Influences

Cross-tabulation analysis revealed that professionals aged 26–40 and those with 5–10 years of experience reported higher BIM awareness (70%) and proficiency (RII=0.80 for 3D BIM) compared to older or less experienced counterparts. This suggests that younger, mid-career architects are more exposed to BIM through modern education and professional networks. Gender and education level showed no significant correlation with proficiency.

Conclusion

This study reveals moderate BIM awareness among architectural professionals in Cross River State, Nigeria, but a significant gap in advanced BIM proficiency, particularly beyond 3D modeling. The reliance on 2D CAD tools and limited expertise in 4D–7D BIM highlight a disconnect between industry demands and professional capabilities. Key barriers insufficient training, high costs, and inadequate infrastructure mirror challenges across developing nations. These findings underscore the urgent need to enhance BIM education and infrastructure to align with global AEC standards.

Recommendations

- Curriculum Integration: Universities in Cross River State should integrate BIM into architectural curricula, focusing on practical training in tools like Revit and Navisworks, as suggested by Arroteia et al. (2019).

- Subsidized Training Centers: Government and professional bodies like ARCON should establish subsidized BIM training centers to enhance accessibility.
- Policy Mandates: Enforcing BIM standards for public projects, as seen in the UK, could drive adoption (Hamma-adama & Kouider, 2018).
- Industry-Academia Collaboration: Partnerships between firms and universities can facilitate real-world BIM projects, bridging the skill gap.
- Funding for Infrastructure: Investments in IT infrastructure, including high-spec computers and software licenses, are critical to overcoming technical barriers.

Future research should explore BIM adoption in other Nigerian states and assess the impact of training interventions on proficiency levels.

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