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BARRIERS TO BUILDING INFORMATION MODELLING (BIM) ADOPTION AMONG ARCHITECTURE, ENGINEERING AND CONSTRUCTION (AEC) SMALL AND MEDIUM-SIZED ENTERPRISES IN JOS METROPOLIS, NIGERIA

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ABSTRACT

Building Information Modelling (BIM) is widely credited with improving productivity and coordination in construction, yet its adoption among architecture, engineering and construction (AEC) small and medium-sized enterprises (SMEs) in Nigeria remains concentrated in Lagos and Abuja, leaving other regions poorly understood. This study surveyed AEC professionals practising in Jos Metropolis, Plateau State, in Nigeria's North-Central geopolitical zone, to establish current BIM awareness, rank adoption barriers, and identify enablement strategies. After geographic screening, 89 of 109 received responses were retained and analysed using descriptive statistics and the Relative Importance Index (RII). Results show that 87.6% of respondents had heard of BIM, but only 20.2% had received formal training and only 23.6% of firms reported a specific adoption plan. Weak client demand (RII = 0.703) and the absence of a government mandate (RII = 0.695) were ranked the most severe barriers, ahead of unproven local return on investment, software/hardware cost, and lack of affordable training; technical complexity and workload pressure were rated least severe. Respondents rated university curriculum integration (RII = 0.846) and a shared BIM Hub facility (RII = 0.798) as more important enablement strategies than a public-project mandate (RII = 0.727), even though mandate absence was the second most severe rated barrier. The findings suggest that demand-side and capability-building interventions are likely to be more effective in this market than regulation or cost subsidy alone, and provide, to the authors' knowledge, among the first empirical evidence on AEC SME BIM adoption specific to Jos Metropolis and Nigeria's North-Central zone.

Keywords: building information modelling; BIM adoption barriers; construction SMEs; Jos Metropolis, Nigeria; Relative Importance Index

1. INTRODUCTION

Building Information Modelling (BIM) is widely presented in the international literature as a transformative process technology for the architecture, engineering and construction (AEC) sector, with documented benefits for productivity, error reduction and, where applied to later project stages, sustainability performance (Succar, 2009; Eastman, Teicholz, Sacks, & Liston, 2018). Global uptake has nonetheless been uneven: adoption in Sub-Saharan Africa continues to lag high-income regions, and systematic reviews of the African BIM literature describe adoption as nascent and unevenly documented across countries (Saka & Chan, 2019). Nigeria is the largest construction market in Sub-Saharan Africa, yet BIM uptake among its AEC firms, the majority of which are small and medium-sized enterprises (SMEs), remains limited (Saka & Chan, 2020).

The existing Nigerian BIM literature is concentrated in Lagos and Abuja. Published studies from these two cities include national and Abuja-focused adoption assessments (Saka & Chan, 2020; Saka, Chan, & Siu, 2020; Chigemezu, Jovita, & Elamah, 2024), a study of BIM use in quantity surveying consultancy (Okereke, Ihekweme, & Awodele, 2021), and accounts of BIM-enabled collaboration among Lagos consultants (Onungwa & Uduma-Olugu, 2017; Onungwa, Uduma-Olugu, & Igwe, 2017). A related study applying the Relative Importance Index to BIM's role in sustainable material use was likewise conducted in Lagos (Albert, Nathaniel, & Olonilebi, 2025). A recent systematic review of the Nigerian BIM literature confirms this geographic concentration, finding that most research to date has focused on Lagos and Abuja and has neglected other regions (Alabi, et al., 2026). Jos Metropolis, the capital of Plateau State in Nigeria's North-Central geopolitical zone, has a construction market profile that differs from these southern and federal-capital contexts: it is dominated by small firms and sole practitioners, and its economic history includes a period of intercommunal violence between 2001 and the early 2010s that disrupted commercial activity in the city (International Crisis Group, 2012), alongside infrastructure constraints that are distinctive relative to Lagos or Abuja.

This geographic imbalance in the evidence base has practical consequences. Enablement strategies, professional continuing-development programmes, and university curricula for the North-Central region are currently designed, if at all, without a local evidence base; strategies validated in Lagos or Abuja cannot simply be transplanted to Jos without empirical verification, given the differences in firm scale, client demand structures and infrastructure reliability between these markets. To the authors' knowledge, no published study has empirically examined BIM adoption barriers among AEC SMEs specifically in Jos Metropolis or the North-Central geopolitical zone of Nigeria.

This paper addresses that gap. It aims to establish current levels of BIM awareness and usage among AEC professionals in Jos Metropolis, to rank the severity of the barriers they face, and to identify which enablement strategies practitioners themselves regard as most likely to be effective. The remainder of the paper is structured as follows: Section 2 reviews the relevant literature and presents the study's conceptual framework; Section 3 describes the materials and method; Section 4 presents the results and discusses them in relation to the literature, including their practical implications; and Section 5 draws conclusions and identifies directions for future research.

2. LITERATURE REVIEW

2.1 BIM: Definition, Dimensions and Benefits

BIM is best understood not as a software product but as a collaborative process for generating and managing digital representations of the physical and functional characteristics of a facility throughout its lifecycle (Succar, 2009; Eastman, Teicholz, Sacks, & Liston, 2018). Maturity in BIM use is often described along a dimensional continuum: 3D geometric modelling, 4D scheduling, 5D cost integration, and 6D/7D applications extending to sustainability performance and asset/facility management. The evidence base for BIM's benefits; reduced design errors, cost and time savings, and improved coordination is now substantial in high-income construction markets (Eastman et al., 2018). In developing-country contexts, however, adoption where it occurs is typically confined to 3D visualisation and documentation; the higher dimensions remain largely aspirational (Saka & Chan, 2019).

2.2 BIM Adoption in Developing Countries

A systematic literature review and comparative analysis of BIM innovation across six developing countries on three continents found that drivers, barriers and enablers of adoption cluster around consistent themes; cost, skills availability, client demand, and regulatory support despite substantial contextual variation between countries (Ariono, Wasesa, & Dhewanto, 2022). In Malaysia, exploratory factor analysis of BIM barriers among small construction projects identified five underlying categories: technical adoption, behavioural, implementation, management and digital-education barriers (Waqar, Qureshi, & Alaloul, 2023), while a related Malaysian study of sustainable housing projects proposed BIM strategies addressing cost, policy and capacity constraints specifically (Rahim, Ismail, Subramaniam, Abdullah Habib, & Durdyev, 2023). A partial least squares structural equation modelling (PLS-SEM) study across several developing countries found that BIM activities account for approximately 30% of variance in overall project sustainability outcomes, underscoring the practical stakes of adoption barriers beyond productivity alone (Abdel-Tawab, Kineber, Chileshe, Abanda, Ali, & Almukhtar, 2023). Scientometric and bibliometric reviews of the developing-country BIM literature more broadly confirm that research volume remains concentrated in a small number of countries and that most available studies are cross-sectional, survey-based accounts similar in design to the present study (Adekunle, Ejohwomu, & Aigbavboa, 2021; Ametepey, Aigbavboa, Addy, & Thwala, 2024). Comparable single-country accounts exist for Kenya, where BIM's influence on engineering contract management was examined in Nairobi (Mosse et al., 2020), and for Algeria, where architects' perspectives on BIM adoption were surveyed (Tehami & Seddiki, 2023); both studies report barrier profiles broadly consistent with the cost, skills and demand-side themes identified elsewhere in the developing-country literature.

2.3 BIM Adoption in Nigeria

Studies of BIM adoption in the Nigerian AEC sector converge on a recurring set of barriers: high software and hardware costs, skills shortages, the absence of government mandates, weak client demand, and limited professional body support (Saka & Chan, 2020). Saka & Chan (2020) applied interpretive structural modelling to barriers facing Nigerian construction SMEs and found that barriers operate within a socio-technical system in which SMEs' internal environment, rather than external mandate alone, substantially shapes adoption behaviour; a companion study identified the drivers of sustainable BIM adoption specifically among Nigerian SMEs (Saka, Chan, & Siu, 2020). Chigemezu, Jovita, & Elamah (2024), surveyed 127 construction professionals in the Federal Capital Territory and reported comparatively high stakeholder awareness alongside slower translation of that awareness into firm-level readiness. Okereke, Ihekweme, & Awodele (2021), examined BIM use specifically within quantity surveying consultancy practice and found quantity surveyors trailing other disciplines in BIM usage. Two related Lagos-based studies examined BIM-enabled collaboration: one found that inadequate infrastructure, a shortage of skilled personnel, and low awareness were the principal constraints on realising BIM's collaborative potential in schematic and post-contract design stages (Onungwa & Uduma-Olugu, 2017), while a companion paper positioned BIM more broadly as an underused construction management tool in the Nigerian industry (Onungwa, Uduma-Olugu, & Igwe, 2017). Using the same Relative Importance Index technique adopted in the present study, Albert, Nathaniel, & Olonilebi (2025) ranked BIM's contribution to material optimisation and waste reduction among Lagos construction professionals, providing a useful methodological precedent for RII-based barrier and benefit ranking in the Nigerian BIM literature. A national macro-BIM maturity assessment situated Nigeria at an early diffusion stage relative to international benchmarks (Hamma-adama & Kouider, 2020; Alabi, et al., 2026). Most recently, a systematic review of the Nigerian BIM literature confirmed that research has concentrated heavily in Lagos and Abuja and identified regional evidence gaps, including the North-Central zone, as a priority for future research the gap this paper addresses.

2.4 Conceptual Framework

This study is informed by the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer, 1990), which explains innovation adoption as jointly shaped by the characteristics of the technology itself, the adopting organisation's internal readiness, and the external environment within which the organisation operates. Because the Nigerian BIM literature consistently identifies skills and training availability as a distinct and recurring constraint (Saka & Chan, 2020; Okereke, Ihekweme, & Awodele, 2021), the framework used here treats human capital; the availability of affordable, locally accessible training as an analytically distinct concern that sits alongside, rather than fully inside, the organisational dimension of TOE. This framing is used descriptively, to organise and interpret the barrier items measured in this study; it is not tested statistically here, and the discussion in Section 4.6 treats the boundary between organisational and human-capital constraints as an open empirical question rather than a settled one.

Diffusion of Innovations theory (Rogers, 2003) is drawn on to interpret the gap this study finds between BIM awareness and actual adoption intention (see Section 4.3): awareness of an innovation and the decision to adopt it are analytically distinct stages, and a population can show high awareness while remaining early in the decision process. Institutional theory (DiMaggio & Powell, 1983) is used in Section 4 to interpret the balance of coercive (mandate), normative (professional body) and mimetic (market/peer) pressures in the Jos context.

3. MATERIALS AND METHOD

3.1 Research Design

The study adopts a post-positivist, quantitative cross-sectional survey design. A structured questionnaire was the primary data collection instrument, distributed to AEC professionals practising in Jos Metropolis. This design is appropriate for establishing the prevalence and relative severity of adoption barriers across a defined population, which was the study's primary objective.

3.2 Study Area

Jos Metropolis is the administrative capital of Plateau State, in Nigeria's North-Central geopolitical zone. Its AEC sector is dominated by sole practitioners and small/medium firms, and the market has been shaped by a period of intercommunal conflict between the early 2000s and the early 2010s (International Crisis Group, 2012) and by infrastructure constraints, including irregular electricity supply and inconsistent internet connectivity, that are less severe in Lagos or Abuja. These characteristics motivate treating Jos as a context requiring independent empirical study rather than one to which findings from southern Nigerian cities can be directly generalised.

3.3 Population, Sampling and Response

The target population comprised AEC professionals and firm principals practising in Jos Metropolis, including architects, builders, structural and civil engineers, MEP engineers, quantity surveyors and allied disciplines, recruited through professional networks and body chapters; Nigerian Institute Of Architects (NIA), Nigerian Institute Of Builders (NIOB), Nigerian Society of Engineers (NSE), Nigerian Institute of Quantity Surveyors (NIQS). The questionnaire was distributed as an online form. A total of 109 responses were received; 89 respondents (81.7%) confirmed their primary practice location as Jos Metropolis and were retained for analysis. The remaining 20 responses (12 practising elsewhere in Plateau State, seven in other Nigerian states, and one who did not specify a location) were excluded on geographic eligibility grounds. Table 1 summarises the screening process.

Table 1: Data Screening and Sample Derivation

Step	Criterion	n retained
1	Total responses received	109
2	Retained: primary practice location confirmed as Jos Metropolis	89
3	Excluded: practice located elsewhere in Plateau State	−12
4	Excluded: practice located in another Nigerian state	−7
5	Excluded: location not specified	−1
	Final analytical sample	**89**

No duplicate records were identified in the retained sample. Item non-response within the 89 retained records ranged from 0% (professional experience, registration body, BIM awareness and current-usage items) to a maximum of 21.3% (the firm BIM-adoption-plan item, C5, left blank by 19 respondents, plausibly by those whose firms do not currently use BIM in any form); the seven barrier items and three enablement items each had 85–88 valid responses. All records were used as submitted; no values were reconstructed or imputed.

3.4 Research Instrument

The questionnaire comprised: a respondent and firm profile section; a BIM awareness and current-usage section (Yes/No and categorical items); seven barrier statements rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), covering cost, technical complexity, client demand, return on investment, workload, government mandate, and training availability; a training-preference section; two infrastructure items (office electricity supply, internet quality); and three enablement-strategy items rated on a five-point importance scale (1 = Not at all important to 5 = Extremely important).

The analytical plan originally specified for this study also included Exploratory Factor Analysis (EFA) across an expanded barrier battery and a multiple regression model of adoption intention, comparable in scope to the five-category EFA structure identified by Waqar et al. (2023) for

Malaysian small construction projects. The instrument actually administered seven undifferentiated barrier items and three enablement items, which does not provide sufficient indicators per construct to support EFA, nor a validated composite adoption-intention variable to regress. Rather than proceed with an underpowered version of these analyses, the analytical plan was revised prior to write-up to descriptive statistics and RII ranking only; this is disclosed here for transparency rather than left as an implicit limitation.

3.5 Data Analysis

Descriptive statistics (frequencies, percentages, means and standard deviations) were computed for all profile, awareness and usage items. The Relative Importance Index; the same technique used by Albert, Nathaniel, & Olonilebi (2025) to rank BIM-related items among Lagos construction professionals was computed for each barrier and enablement item as $RII = \Sigma W / (A \times N)$, where W is the weighting given to each response category (1–5), A is the highest possible weight (5), and N is the number of valid responses for that item; items were then ranked in descending order of RII. Analysis was performed in Python (pandas).

Table 2: Data Analysis Plan by Research Objective

Objective	Data type	Analytical technique
Establish response profile and screen data	Categorical / nominal	Frequency counts, geographic and completeness screening
Describe respondent and firm characteristics	Categorical / nominal	Descriptive statistics (frequencies, percentages)
Assess BIM awareness and current usage	Categorical / nominal	Descriptive statistics (frequencies, percentages)
Rank severity of adoption barriers	5-point Likert	Relative Importance Index (RII); mean, SD
Rank importance of enablement strategies	5-point Likert	Relative Importance Index (RII); mean, SD

4. RESULTS AND DISCUSSION

4.1 Data Screening

As reported in Section 3.3, 89 of 109 received responses (81.7%) met the geographic eligibility criterion and form the analytical sample for this paper. All retained records were used as submitted; none required reconstruction. Item non-response ranged from 0% (professional experience, registration body, and the three BIM awareness/usage items C1–C3, each with a full 89 valid responses) to a maximum of 21.3% (the firm BIM-adoption-plan item, C5, left blank by 19 respondents, plausibly by those whose firms do not currently use BIM in any form). The seven barrier items and three enablement items each attracted 85–88 valid responses (95.5–98.9% completeness).

4.2 Respondent and Firm Characteristics

Architects were the largest discipline group (41 respondents, 46.6% of the 88 respondents who specified a discipline), followed by builders/contractors (19, 21.6%), quantity surveyors (8, 9.1%), MEP engineers (7, 8.0%), civil/infrastructure engineers (7, 8.0%), structural engineers (4, 4.5%), and BIM coordinators/land surveyors (2, 2.3%). Most respondents were experienced: 40 (44.9%) reported 6–15 years in practice and 37 (41.6%) reported 16 or more years; only 12 (13.5%) had five years' experience or less. Registration was concentrated in NIA (32, 36.0%), NIOB (19, 21.3%) and NSE (15, 16.9%), with 9 respondents (10.1%) not yet registered with any body and 7 (7.9%) registered with other bodies, Architects Registration Council Of Nigeria (ARCON), Nigerian Association of Technologists in Engineering (NATE), or the Nigerian Institution of Surveyors (NIS). By firm type, 35 respondents (40.2% of the 87 who specified) worked in small/medium firms, 28 (32.2%) were sole practitioners, and 24 (27.6%) worked in public/government agencies, confirming the SME- and sole-practitioner-dominated character of the Jos AEC market described in Section 3.2.

Table 3: Profile of Respondents and Firms (n = 89)

Variable	Category	n	%
Discipline	Architect / Architectural Designer	41	46.6
	Builder/Contractor	19	21.6
	Quantity Surveyor / Cost Estimator	8	9.1
	Structural Engineer / Detailer	4	4.5
	Civil / Infrastructure Engineer	7	8.0
	MEP Engineer	7	8.0
	BIM Coordinator / Land Surveyor	2	2.3
Experience	6-15 years	40	44.9
	16+ years	37	41.6
	0-5 years	12	13.5
Registration body	NIA	32	36.0
	NIOB	19	21.3
	NSE	15	16.9

Variable	Category	n	%
	None / not yet registered	9	10.1
	NIQS	7	7.9
	Other (NATE, ARCON, NIS)	7	7.9
Firm type	Small/Medium (2-250 staff)	35	40.2
	Sole Practitioner	28	32.2
	Public/Government Agency	24	27.6

Note. Discipline percentages are of 88 valid responses (1 missing); firm-type percentages are of 87 valid responses (2 missing); experience and registration are of the full n = 89.

4.3 BIM Awareness and Current Usage

Awareness of BIM is high: 78 of 89 respondents (87.6%) had heard of BIM before completing the survey, and 70 (78.7%) reported being able to explain the concept to a colleague or client. This awareness has not, however, translated into formal capability: only 18 respondents (20.2%) had received any formal BIM training. Adoption intention is mixed; of the 70 respondents who answered the adoption-plan item, 40 (57.1% of valid responses; 44.9% of the full sample) intend to adopt or increase BIM use but have no specific plan, 21 (30.0% of valid responses; 23.6% of the full sample) reported a specific adoption plan, 7 were unsure, and 2 reported no intention to adopt. Use of open (IFC) standards for cross-disciplinary model exchange remains limited: of the 86 respondents who answered, only 21 (24.4%) reported using IFC even occasionally, while 32 (37.2%) use native file formats exclusively and 33 (38.4%) were unsure. This pattern; high stated awareness, low formal training, and a majority sitting at the 'intend to but no plan' stage rather than either committed adoption or outright rejection is consistent with Diffusion of Innovations theory's distinction between awareness and the adoption decision (Rogers, 2003).

The co-occurrence of high stated awareness with low formal training and a majority of firms sitting at the 'intend to but no specific plan' stage is consistent with Rogers (2003) distinction between knowledge and the later stages of the innovation-decision process: a population can be broadly aware of an innovation while remaining, in aggregate, at an early point in the decision to adopt it. This pattern echoes the Abuja findings of Chigemezu, Jovita, & Elamah (2024), who similarly reported high stakeholder awareness of BIM alongside slower translation into firm-level implementation, suggesting the awareness-adoption gap is not unique to Jos but may be a more general feature of the current Nigerian BIM diffusion trajectory outside the most BIM-active Lagos firms.

4.4 Barriers to BIM Adoption

Table 4 and Figure 1(a) present the RII rankings for the seven barrier items. Weak client demand was ranked the most severe barrier (RII = 0.703, mean = 3.52, SD = 1.29), narrowly ahead of the absence of an official government mandate for BIM use (RII = 0.695, mean = 3.48). Unproven local return on investment (RII = 0.665), the cost of software and hardware (RII = 0.664) and the lack of affordable local training (RII = 0.655) formed a closely clustered middle tier. Technical complexity (RII = 0.525) and workload/time pressure (RII = 0.524) were rated the least severe of the seven barriers, both with mean scores close to the survey's neutral midpoint. The two highest-ranked barriers; client demand and government mandate are both external, environmental-level constraints in TOE terms (Tornatzky & Fleischer, 1990) rather than internal organisational or technological constraints, a pattern discussed below.

Table 4: Relative Importance Index (RII) Rankings of BIM Adoption Barriers (n = 85-87)

Rank	Barrier	N	Mean	SD	RII
1	No official state mandate for BIM use	86	3.48	1.35	0.695
2	Clients in Jos do not ask for BIM deliverables	87	3.52	1.29	0.703
3	No affordable BIM courses available in Jos	87	3.28	1.20	0.655
4	Financial return (ROI) for BIM unproven locally	86	3.33	1.09	0.665
5	Software and hardware too expensive for budget	87	3.32	1.22	0.664
6	BIM too technically difficult for daily work	85	2.62	1.01	0.525
7	No time to learn new workflows due to deadlines	87	2.62	1.06	0.524

Infrastructure conditions relevant to BIM use were also captured directly. Just over half of respondents (48, 53.9%) reported eight hours or fewer of stable daily office electricity, and a further 7 (7.9%) rely entirely on generators or inverters; only 12 (13.5%) reported 16 or more hours of stable supply. Office internet was rated unreliable or slow by 39 respondents (43.8%) and as having no connection at all by 14 (15.7%), against 36 (40.4%) rating it reliable. These figures are reported descriptively rather than folded into the barrier RII ranking, since they were not asked in Likert form; they are discussed as contextual evidence below.

The two most severely rated barriers in this study; weak client demand and the absence of a government mandate are both environmental-level constraints in TOE terms (Tornatzky & Fleischer, 1990), external to the firm and outside its direct control. By contrast, technical complexity and workload pressure, which speak most directly to the technology and organisational-capacity dimensions, were rated least severe. This ordering is a meaningful finding in its own right: it suggests that Jos AEC professionals do not, in the main, regard BIM as too difficult to learn or as competing unmanageably with existing workloads; rather, they perceive limited reason to invest, given that neither client expectation nor regulation currently

compels it. This is broadly consistent with the institutional reading offered by Onungwa & Uduma-Olugu (2017) and with the socio-technical, SME-internal-environment emphasis of Saka & Chan's (2020) interpretive structural model of Nigerian SME barriers, though the close, narrowly-ranked pairing of demand and mandate at the top of the ranking found here has not, to the authors' knowledge, been directly reported for a North-Central Nigerian sample elsewhere in the literature.
The infrastructure figures reported above; over half of respondents with eight or fewer hours of stable daily electricity, and 59.6% rating their internet unreliable, slow, or absent were not asked as Likert barrier items and so cannot be RII-ranked alongside Table 4. They nonetheless provide direct contextual evidence for why any Jos-specific enablement strategy needs to account for physical infrastructure constraints that are less binding in Lagos or Abuja office environments, and are treated here as a contextual finding rather than an additional ranked barrier.

4.5 Enablement Strategies
Table 5 and Figure 1(b) present the importance ratings for the three enablement strategies asked about directly. Universities integrating BIM into AEC degree curricula was rated the most important strategy (RII = 0.846, mean = 4.23), followed by a shared 'BIM Hub' facility for SMEs in Jos (RII = 0.798, mean = 3.99). A regulatory mandate for BIM on public projects in Plateau State, despite mandate absence being the second most severely rated barrier in Table 4, was rated the least important of the three enablement strategies (RII = 0.727, mean = 3.64); still a high absolute rating, but noticeably behind the other two. Separately, of the 87 respondents who answered, 86 (98.9%) indicated they would invest in BIM training if it were delivered locally and subsidised, and a majority (47, 54.0%) preferred a short intensive workshop format (1–5 days) over professional-body CPD sessions (23, 26.4%) or fully online courses (17, 19.5%).

Table 5: Importance Ratings of Enablement Strategies (n = 87-88)

Rank	Strategy	N	Mean	SD	RII
1	Universities integrating BIM into AEC degree curricula	87	4.23	1.03	0.846
2	Shared "BIM Hub" facility for SMEs in Jos	87	3.99	1.12	0.798
3	Mandating BIM for public projects in Plateau State	88	3.64	1.18	0.727

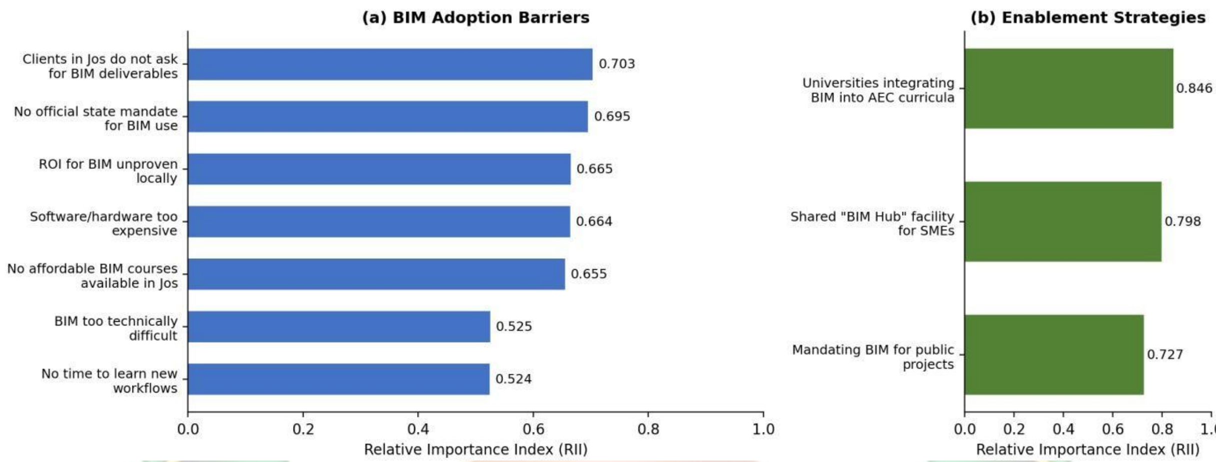

Figure 1: RII Rankings of (a) BIM Adoption Barriers and (b) Enablement Strategies, Jos Metropolis AEC SMEs (n = 89)

A striking feature of the results is that respondents rated a government mandate as the least important of the three enablement strategies tested (Table 5), even though the absence of a mandate was rated the second most severe barrier, immediately behind weak client demand (Table 4). Universities integrating BIM into curricula and a shared BIM Hub facility were both rated more important. Read together, these findings suggest that, in the Jos context, practitioners do not see regulation alone as sufficient, or perhaps as the most trusted lever, and instead place more confidence in interventions that directly build capability and reduce the cost of entry (a shared facility, curriculum reform) than in top-down mandate. This nuance would not have been visible from the barrier ranking alone, and illustrates the value of asking about enablement strategies as a distinct question rather than assuming that a top-ranked barrier automatically implies the top-priority intervention.

4.6 Human Capital as an Organisational, not Purely Technical, Constraint

Training availability was rated the least severe of the environmental/cost-cluster barriers (RII = 0.655, rank 5 of 7), yet 98.9% of respondents who answered indicated willingness to invest in training if delivered locally and subsidised, with a clear preference for short intensive workshops over online or CPD-session formats. This combination; near-universal demand for training paired with only moderate barrier severity relative to client demand, mandate absence and ROI uncertainty is consistent with the view, discussed in Section 2.4 following Saka and Chan (2020), that skills and human-capital constraints in the Nigerian SME context are experienced as bound up with organisational and market constraints rather than as a separable, purely technical deficit. Waqar, Qureshi, & Alaloul's (2023) five-category EFA structure for Malaysian small construction projects, which separates a distinct 'digital education' barrier from technical-adoption, behavioural, implementation and management barriers, illustrates that this distinction is, in principle, empirically testable with a sufficiently large item battery; the present study's seven-item instrument cannot adjudicate the question statistically (Section 3.4), but the pattern observed here is consistent enough with the qualitative tenor of prior Nigerian BIM barrier studies (Onungwa & Uduma-Olugu, 2017; Okereke, Ihekweme, & Awodele, 2021) to warrant treating it as a plausible interpretation rather than a confirmed factor structure.

4.7 Practical Implications

The findings point to differentiated priorities for the actors with a stake in BIM adoption in Jos. For the Plateau State Ministry of Works and other public procuring authorities, the results suggest that a phased BIM requirement for public projects above a threshold value would address a barrier respondents rate as severe, but should not be pursued as a stand-alone measure: respondents rated it the least important of the three enablement strategies, behind capability-building interventions. Similarly, efforts to stimulate client demand through awareness campaigns and demonstration projects would directly address the second most severe barrier; weak client demand for BIM deliverables. For NIA, NIOB, NSE and NIQS Plateau State chapters, the near-universal willingness to invest in locally delivered, subsidised training (98.9%), together with the clear preference for short intensive workshops over online courses, points towards CPD programming built around concentrated, in-person short courses rather than self-paced online modules. For Plateau State University and the University of Jos, curriculum integration of BIM was the single highest-rated enablement strategy in this study (RII = 0.846) and represents the most strongly endorsed single intervention available to any actor in this study. For software vendors, the combination of high perceived cost barriers (RII = 0.664) and severe infrastructure constraints (Section 4.4) suggests that affordable, low-connectivity-tolerant tools are likely to find more traction in this market than premium cloud-first products designed for reliable-power, high-bandwidth contexts. For firms themselves, the gap between broad awareness (87.6%) and firm-level planning (23.6% with a specific plan) suggests that the binding constraint for many firms is not information but a first concrete step, for which a shared BIM Hub facility (the second-highest-rated enablement strategy, RII = 0.798) could plausibly lower the barrier to a first pilot use.

5. CONCLUSIONS

This study surveyed 89 AEC professionals in Jos Metropolis, Nigeria, and found that while BIM awareness is high (87.6%), formal training and firm-level adoption planning lag well behind. Weak client demand and the absence of a government mandate were rated the most severe adoption barriers, ahead of unproven local return on investment, software/hardware cost, and training availability; technical complexity and workload pressure were rated comparatively minor concerns. Practitioners rated university curriculum reform and a shared BIM Hub facility as more important enablement strategies than a public-project mandate, despite mandate absence being the second most severely rated barrier.

The study's contribution is primarily empirical: it provides what is, to the authors' knowledge, among the first systematic evidence on AEC SME BIM adoption barriers specific to Jos Metropolis and the North-Central geopolitical zone, a region absent from the concentrated Lagos/Abuja Nigerian BIM literature (Alabi, Alabi, Fadeyi, Okon, Oke, Oloye, & Arayela, 2026). Its findings, particularly the ordering of environmental barriers above technical ones, and the ranking of enablement strategies above mandate offer testable propositions for future work rather than a validated causal or factor-analytic model.

Several limitations should be noted. The cross-sectional design cannot establish causation among the barriers and outcomes measured. The seven-item barrier battery, while sufficient for descriptive ranking, is not amenable to factor-analytic validation of an underlying dimensional structure, and the analytical plan was revised during the study to reflect this rather than to force an unsupported multivariate analysis (Section 3.4); a future study using an expanded, dimension-specific Likert battery (minimum 5–10 items per hypothesised construct, following the five-category structure identified by Waqar, Qureshi, & Alaloul (2023) would be needed to test the TOE-plus-human-capital framework outlined in Section 2.4 empirically. The sample is drawn from the formal and semi-formal AEC sector and does not capture the informal construction market, which is substantial in Jos. Findings are not generalisable beyond Jos without replication. Three directions for future research follow: (1) longitudinal follow-up tracking adoption change after any enablement interventions are implemented; (2) replication with an expanded, EFA-capable instrument in other North-Central cities (e.g. Kaduna, Lafia, Bauchi) to build a regional evidence base and test the conceptual framework statistically; and (3) a qualitative study of the informal construction sector's engagement with digital construction tools in Jos.

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