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Application of Emerging Technologies in Procurement Management for Architectural Design Projects: A Quantitative Study in Nigeria

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Abstract **Original Research Article**

Procurement management in architectural design projects is a critical determinant of cost efficiency, project timelines, and overall quality. Emerging technologies such as Building Information Modelling (BIM), Artificial Intelligence (AI), blockchain, Internet of Things (IoT), and cloud computing promise to transform procurement processes by enhancing collaboration, transparency, and data-driven decision-making. This study employs a quantitative, cross-sectional research design using structured questionnaires to examine the influence of emerging technology adoption on procurement performance in Nigerian architectural projects. A sample of 300 professionals, including procurement officers, architects, and project managers across Lagos, Abuja, and Port Harcourt, was surveyed. Data were analysed using descriptive statistics, Chi-square tests, and multiple regression analysis. Findings reveal that BIM and AI significantly enhance procurement efficiency and decision-making, while blockchain and IoT adoption are limited by regulatory and infrastructural challenges. Cloud computing supports stakeholder collaboration but requires capacity-building initiatives. Nigerian case illustrations, such as the procurement framework in the Lekki Free Trade Zone projects and BIM pilot adoption in Eko Atlantic City developments, demonstrate the contextual realities of technology integration. The study concludes that successful deployment of emerging technologies depends not only on their technical capabilities but also on institutional reform, professional training, and infrastructural enhancement.

Keywords: Procurement management, emerging technologies, BIM, AI, blockchain, IoT, Nigeria, architectural projects, quantitative research.

Introduction

Procurement management in architectural design projects is a critical determinant of project success, encompassing cost control, adherence to timelines, and the quality of deliverables. In the Nigerian context, procurement inefficiencies have historically plagued both public and private

sector projects, resulting in frequent cost overruns, delayed project completion, and compromised design integrity (Amaduobogha & Oke, 2025). Public projects, such as the National Theatre renovation in Lagos, and private developments like Eko Atlantic City, exemplify these systemic challenges, including fragmented workflows, poor communication among stakeholders, and limited oversight during tendering and contract execution. These inefficiencies underscore the urgent need for more integrated and technologically advanced procurement approaches.

Emerging digital technologies including Building Information Modelling (BIM), Artificial Intelligence (AI), blockchain, Internet of Things (IoT), and cloud computing offer transformative potential for procurement management. BIM, for instance, centralises project information, enabling architects, engineers, and contractors to coordinate efficiently, reduce errors, and streamline procurement planning (Eastman et al., 2018). AI supports predictive analytics, risk assessment, and supplier evaluation, facilitating data-driven decisions. Blockchain provides immutable, transparent records that can reduce procurement irregularities, while IoT enables real-time tracking of materials and logistics. Cloud computing facilitates seamless collaboration across geographically dispersed teams, ensuring timely information sharing and unified decision-making.

Despite these global technological advancements, adoption within Nigeria remains uneven. While pilot projects in Eko Atlantic City have demonstrated the benefits of BIM, and IoT systems have been trialled in the Lekki Free Trade Zoneto monitor materials and logistics, these innovations are yet to achieve widespread integration across architectural projects. Challenges to adoption include infrastructural limitations, regulatory uncertainty, high implementation costs, and low digital literacy among procurement professionals (Igwe et al., 2025; Jalam et al., 2024). Consequently, while the potential of emerging technologies is recognised conceptually, empirical evidence demonstrating their measurable impact on procurement performance in Nigeria is limited.

Furthermore, the nature of procurement in Nigerian architectural projects is influenced by socio-economic and institutional realities. Projects often involve multiple stakeholders with varying capacities, from government agencies to private contractors and suppliers, resulting in complex decision-making networks**.** Traditional procurement approaches, characterised by manual processes and fragmented information, amplify these challenges and contribute to inefficiencies (Olowe et al., 2025). Integrating emerging technologies into this environment therefore requires not only technical infrastructure but also supportive institutional frameworks, professional capacity development, and alignment with local regulatory and cultural contexts.

Against this backdrop, this study seeks to empirically investigate theapplication of emerging technologies in procurement management for architectural design projects in Nigeria**.** By employing a quantitative approach through structured questionnaires, the research examines how BIM, AI, blockchain, IoT, and cloud computing influence procurement efficiency, transparency, and collaboration. In addition, Nigerian case illustrations, including pilot implementations inEko Atlantic City and Lekki Free Trade Zone**,** provide contextual grounding for the analysis. The study aims to generate actionable insights for practitioners, policymakers, and academics, highlighting both the potential and the constraints of technology adoption in the Nigerian procurement landscape.

Research Objectives

The study pursues the following objectives:

1. Assess the adoption levels of emerging technologies in procurement management for architectural projects in Nigeria.
2. Evaluate the impact of BIM, AI, blockchain, IoT, and cloud computing on procurement performance.
3. Identify institutional, infrastructural, and professional factors constraining technology adoption.

4. Provide recommendations for enhancing procurement efficiency and transparency in the Nigerian context.

Research Hypotheses

H1: BIM adoption significantly improves procurement efficiency.
H2: AI adoption positively influences procurement decision-making.
H3: Blockchain adoption enhances transparency and reduces procurement irregularities.
H4: IoT adoption improves supply chain and material management.
H5: Cloud computing adoption facilitates collaboration among project stakeholders.

Literature Review

Procurement Management in Architectural Projects

Procurement management is a central function in architectural projects, encompassing the systematic planning, sourcing, contracting, and administration of goods and services necessary for project completion. It directly influences project cost efficiency, schedule adherence, and quality outcomes (Eastman et al., 2018). Globally, best practices in procurement emphasise integration across design, construction, and supply chain management, with a focus on collaboration, risk management, and data-driven decision-making. In this sense, procurement is not merely an administrative process but a strategic function that shapes the overall performance of architectural projects.

In the Nigerian context, procurement management often faces significant challenges. Traditional approaches are typically fragmented, relying heavily on manual processes and paper-based documentation. This fragmentation leads to information silos, delayed communication, and coordination gaps among stakeholders, including architects, engineers, contractors, and regulatory agencies (Amaduobogha & Oke, 2025). For instance, public architectural projects such as the National Theatre renovation in Lagos experienced repeated delays and cost overruns, largely attributed to fragmented tendering processes and inadequate contract monitoring. Similarly, private developments, including Eko Atlantic City, faced challenges in synchronising design specifications with procurement schedules, demonstrating that both public and private projects are affected by systemic inefficiencies.

Procurement in architectural projects encompasses multiple phases: pre-tender planning, tendering, contractor selection, contract administration, and post-contract monitoring. Each phase requires careful coordination among diverse stakeholders. The pre-tender phase involves identifying project requirements, estimating costs, and planning procurement schedules, while the tendering phase requires transparent evaluation of suppliers and contractors to ensure competitive pricing and quality standards. Contract administration and post-contract monitoring, on the other hand, involve tracking deliveries, managing change orders, and evaluating performance outcomes. In Nigeria, deficiencies in these phases are often linked to bureaucratic bottlenecks, regulatory gaps, and inadequate digital infrastructure (Oke & Aigbavboa, 2017).

Emerging evidence suggests that integrating digital technologies into procurement management can address these inefficiencies. For example, Building Information Modelling (BIM) can synchronise architectural designs with procurement schedules, reducing rework and ensuring timely materials acquisition (Igwe et al., 2025). Artificial Intelligence (AI) can analyse historical procurement data to optimise supplier selection and forecast potential delays. Moreover, cloud-based platforms and IoT devicesfacilitate real-time monitoring of materials and equipment, improving transparency and reducing losses due to theft or mismanagement. However, while global studies demonstrate substantial gains, the Nigerian experience is characterised bypartial adoption, infrastructural limitations, and low digital literacy**,** which constrain the realisation of these benefits (Jalam et al., 2024).

Furthermore, the socio-institutional context of Nigeria adds complexity to procurement management in architectural projects. Projects frequently involve multiple actors with diverse

objectives, including government agencies, private developers, contractors, and international consultants. This multiplicity can lead to misaligned incentives, poor communication, and inconsistent enforcement of procurement policies (Olowe et al., 2025). Consequently, successful procurement management in Nigeria requires not only technical solutions but alsoinstitutional reforms, professional capacity development, and regulatory support**.** Effective integration of emerging technologies, therefore, is contingent on a holistic approach that combines innovation with governance and human capital development, ensuring that digital tools translate into measurable improvements in procurement efficiency, transparency, and collaboration.

Emerging Technologies in Procurement Management

Emerging technologies have revolutionised procurement management, offering tools that enhance efficiency, transparency, and collaboration in complex architectural projects. Globally, the adoption of technologies such as Building Information Modelling (BIM), Artificial Intelligence (AI), blockchain, the Internet of Things (IoT), and cloud computing has been linked to improved cost control, schedule adherence, and quality outcomes (Eastman et al., 2018; Jalam et al., 2024). In Nigeria, these technologies are gradually being introduced in pilot projects, demonstrating potential benefits in addressing long-standing procurement inefficiencies such as fragmented processes, poor communication, and delayed contract execution (Igwe et al., 2025).

Building Information Modelling (BIM)

BIM is a digital platform that integrates all aspects of a construction project, including architectural, structural, and procurement data, into a unified model. By centralising information, BIM enhances coordination, reduces errors, and facilitates data-driven decision-making in procurement management (Eastman et al., 2018). Globally, BIM adoption has been shown to decrease rework, optimise procurement schedules, and improve cost estimation.

In Nigeria, pilot BIM applications in projects such as Eko Atlantic City demonstrate tangible benefits, including reduced material wastage, improved contractor coordination, and timely procurement planning (Igwe et al., 2025). For example, BIM-enabled scheduling allowed architects and contractors to synchronise material orders with construction phases, reducing delays caused by late deliveries. Despite these advantages, adoption remains limited due to high implementation costs, insufficient training of professionals, and weak institutional incentives. Consequently, while BIM holds significant promise, its full integration into Nigerian architectural procurement is still constrained by infrastructural and regulatory limitations**.**

Artificial Intelligence (AI)

AI enhances procurement management by enabling predictive analytics, automated decision-making, and risk assessment. AI tools can analyse historical procurement data to anticipate supply chain bottlenecks, forecast material requirements, and evaluate supplier performance (Olowe et al., 2025). These capabilities allow procurement officers to make informed and proactive decisions**,** reducing delays and improving cost efficiency.

In Nigerian practice, AI has been piloted in Lagos-based architectural firms where predictive algorithms were used to forecast potential supplier failures and optimise procurement timelines. The use of AI enabled firms to preemptively adjust material orders and project schedules, mitigating risks associated with supply chain disruptions. However, adoption is constrained by inconsistent data quality, limited ICT infrastructure, and low digital literacy among professionals**,** highlighting the need for training and systemic support alongside technological deployment (Jalam et al., 2024).

Blockchain Technology

Blockchain provides a secure, immutable ledger of transactions that can improve transparency

and trust in procurement processes. Smart contracts, which are blockchain-enabled automated agreements, facilitate timely payments and ensure contractual obligations are met without manual intervention (Oladokun et al., 2025).

In Nigeria, blockchain pilot projects in Lagos State public facilities have demonstrated potential in reducing procurement fraud and enhancing contract accountability. For instance, blockchain-enabled payment systems ensured that contractors received verified payments only upon delivery of verified materials, reducing disputes. Nonetheless, adoption remains limited due to regulatory uncertainty, lack of legal recognition for smart contracts, and infrastructural challenges**.** Without supportive policies and frameworks, the scalability of blockchain in Nigerian architectural procurement remains constrained.

Internet of Things (IoT)

The Internet of Things (IoT)refers to a network of interconnected physical devices that collect, exchange, and analyse real-time data through embedded sensors, software, and communication technologies. In the context of procurement management for architectural projects, IoT offers unprecedented capabilities for monitoring, controlling, and optimising supply chains, material management, and project logistics (Jalam et al., 2024). By enabling the automatic tracking of materials and equipment, IoT reduces the reliance on manual reporting, enhances visibility, and mitigates inefficiencies that are common in traditional procurement systems.

Globally, IoT has been applied to track material deliveries, monitor storage conditions, and ensure compliance with project specifications. In architectural projects, IoT devices can detect delays in shipments, monitor usage rates of construction materials, and provide predictive alerts for procurement officers to reorder essential items before shortages occur. These applications improve efficiency, reduce project downtime, and facilitate proactive decision-making**,** aligning procurement schedules more closely with construction timelines (Eastman et al., 2018).

In the Nigerian context, IoT adoption is gradually gaining traction, particularly in large-scale urban developments. For instance, the Lekki Free Trade Zone has piloted IoT-enabled tracking systems that monitor the movement of materials from suppliers to construction sites. The system provides real-time alerts for delays or discrepancies, enabling project managers to intervene promptly. This has resulted in reduced material loss, improved inventory management, and enhanced accountability among suppliers and contractors (Jalam et al., 2024).

Despite these benefits, IoT adoption in Nigerian architectural projects faces several constraints. Infrastructure limitations**,** including inconsistent internet connectivity and unreliable power supply, hamper real-time data collection and device communication. High implementation costs of sensors and monitoring systems also restrict widespread adoption, particularly among small and medium-scale firms. Furthermore, limited technical expertise and digital literacy among procurement officers reduce the effectiveness of IoT applications, highlighting the need for capacity-building initiatives to complement technological deployment (Olowe et al., 2025).

The integration of IoT with other emerging technologies amplifies its impact on procurement management. When combined withcloud computing**,**IoT data can be shared across multiple stakeholders, including architects, contractors, and suppliers, fostering collaboration and coordination. Similarly, when integrated with AI and BIM**,**IoT enables predictive material planning, automated scheduling, and real-time risk assessment, ensuring that procurement decisions are informed by accurate, timely data.

IoT represents a strategic tool for modernising procurement managementin architectural projects, offering enhanced visibility, control, and predictive capability. However, its effectiveness in Nigeria is moderated by infrastructural, financial, and human capacity factors. Successful adoption requires not only investment in devices and networks but also

training, organisational readiness, and supportive policy frameworksto translate technological potential into measurable procurement performance improvements.

Cloud Computing

Cloud computing refers to the delivery of computing services including storage, processing, and software applications over the internet, allowing users to access and share information remotely without dependence on local servers (Eastman et al., 2018). In procurement management for architectural projects, cloud computing facilitates real-time collaboration, centralised data management, and efficient communication among multiple stakeholders**,** including architects, contractors, suppliers, and procurement officers.

Globally, cloud-based procurement systems have been shown to enhance transparency, reduce errors, and optimise resource allocation**.** Through shared platforms, project teams can synchronise procurement schedules with design and construction timelines, monitor supplier performance, and maintain accurate records of materials and contracts. This centralisation reduces the risk of duplicated orders, miscommunication, and delays, which are common in traditional paper-based systems (Olowe et al., 2025).

In Nigeria, cloud computing adoption is gradually increasing, particularly in large-scale urban development projects such as Eko Atlantic City**.** Cloud platforms in these projects allow procurement teams and architects to access updated design models, track material deliveries, and coordinate schedulesin real time. By providing a centralised repository of project information, cloud systems facilitate collaborative decision-making and improve responsiveness to changes in project requirements. This has been observed to enhance procurement efficiency, reduce delays, and strengthen accountability among contractors and suppliers (Jalam et al., 2024).

Despite these advantages, several challenges constrain cloud adoption in Nigerian architectural projects. Unreliable internet connectivity, power supply instability, and cybersecurity concernslimit the effective deployment of cloud-based systems. Moreover, smaller firms often lack the financial resources to invest in subscription-based cloud services or customised enterprise solutions. Limited digital literacy and resistance to change among procurement officers further restrict the full potential of cloud platforms (Olowe et al., 2025).

The synergistic integration of cloud computing with other emerging technologiesmagnifies its benefits. For example, when combined with IoT**,** cloud platforms allow real-time material tracking and automatic updates to procurement dashboards. Integration with BIM ensures that design modifications are instantly reflected in procurement schedules, reducing rework and material wastage. Similarly, cloud-based AI analytics can predict procurement risks, optimise supplier selection, and support data-driven decision-making. Such integration demonstrates that cloud computing is not merely a storage solution but a strategic enabler for intelligent, collaborative, and efficient procurement management**.**

Cloud computing offers a transformative platform for modernising procurement management in architectural projects, enhancing collaboration, transparency, and responsiveness. However, in the Nigerian context, its effectiveness depends on infrastructural reliability, professional capacity, organisational readiness, and supportive policies**.** Strategic investment in cloud infrastructure, combined with training and governance frameworks, is essential to ensure that cloud computing translates into measurable improvements in procurement performance.

Integration and Adoption Challenges

While individual emerging technologies, BIM, AI, blockchain, IoT, and cloud computing, offer significant advantages for procurement management, their full potential is realised when integrated into a cohesive system**.** Integration allows project teams to synchronise design, procurement, and construction processes, creating a digitally enabled ecosystemwhere data flows seamlessly between stakeholders

(Eastman et al., 2018). For example, combining BIM with AI enables predictive procurement scheduling and dynamic resource allocation, while integrating IoT with cloud platforms facilitates real-time monitoring and data sharing across multiple sites. Blockchain, when incorporated into this ecosystem, ensures immutable records of material deliveries, smart contract execution, and supplier compliance, thereby enhancing transparency and accountability (Oladokun et al., 2025).

Despite these transformative benefits, integration and adoption of emerging technologies in Nigerian architectural projects face multiple barriers**.** First, infrastructural limitations, including unreliable internet connectivity, intermittent power supply, and insufficient ICT infrastructure, constrain the ability of firms to deploy and maintain integrated digital systems (Jalam et al., 2024). Second, high implementation costscovering software licensing, hardware, sensors, and training pose a major challenge, particularly for small and medium-sized architectural firms. These costs often discourage investment despite the long-term efficiency and productivity gains that technology can provide.

Third, the human and institutional capacity gaps in Nigeria hinder effective adoption. Procurement officers and project managers often lack sufficient digital literacy or training in emerging technologies, which reduces the usability and impact of tools such as AI, IoT, and BIM (Igwe et al., 2025). Furthermore, resistance to change within organisations, stemming from established manual practices and hierarchical workflows, slows the transition from traditional procurement to technology-driven processes.

Fourth, regulatory and policy challenges further exacerbate adoption difficulties. Blockchain adoption, for instance, is limited by uncertainty regarding legal recognition of smart contracts and digital transactions**,** while cloud computing raises concerns over data privacy, security, and compliance with Nigerian ICT regulations. Without a supportive policy environment, technology adoption may remain piecemeal, reducing its overall effectiveness in enhancing procurement performance (Olowe et al., 2025).

Finally, interoperability and system compatibility present technical challenges. Integrating multiple technologies requires standardised protocols, data formats, and communication channels to ensure seamless interaction between BIM, AI, IoT, cloud platforms, and blockchain systems. In Nigeria, such standards are not yet widely enforced, resulting in fragmented deployments, duplicated efforts, and data silos**,** which undermine the benefits of technology integration.

In synthesis, while emerging technologies collectively have the potential to transform procurement management in architectural projects**,**realising this potential in Nigeria necessitates a holistic strategy**.** This includes investment in digital infrastructure, training of procurement professionals, adoption of interoperable systems, and development of supportive regulatory frameworks. Addressing these challenges is crucial for ensuring that technology adoption translates into measurable improvements in procurement efficiency, transparency, and stakeholder collaboration**.**

Research Gap

While the global literature has extensively documented the transformative potential of emerging technologies in procurement management, there remains a notable paucity of empirical evidence in the Nigerian architectural context**.** Existing studies primarily focus on conceptual frameworks or descriptive analyses, highlighting the benefits of technologies such as BIM, AI, blockchain, IoT, and cloud computing (Eastman et al., 2018; Olowe et al., 2025). However, there is limited quantification of their actual impact on procurement performance**,** particularly in terms of efficiency, transparency, and stakeholder collaboration.

In Nigeria, pilot implementations of BIM in projects like Eko Atlantic City and IoT applications in the Lekki Free Trade Zone provide preliminary evidence of potential benefits (Igwe et al., 2025; Jalam et al., 2024). Nevertheless, these studies are largely case-based and anecdotal**,** lacking systematic measurement of technology adoption levels and their correlation with procurement performance

indicators. Similarly, blockchain adoption in Nigeria remains underexplored, with research highlighting conceptual potential but limited empirical verification due to regulatory and infrastructural constraints (Oladokun et al., 2025).

Furthermore, most Nigerian studies do not account for context-specific factors that moderate technology adoption, such as institutional capacity, professional competence, ICT infrastructure, and regulatory frameworks. This gap is particularly significant in the architectural sector, where projects are characterised by multiple stakeholders, complex workflows, and high dependency on accurate design and material coordination. Ignoring these contextual variables risks overestimating the effectiveness of technology adoption and limits the applicability of findings to local practice.

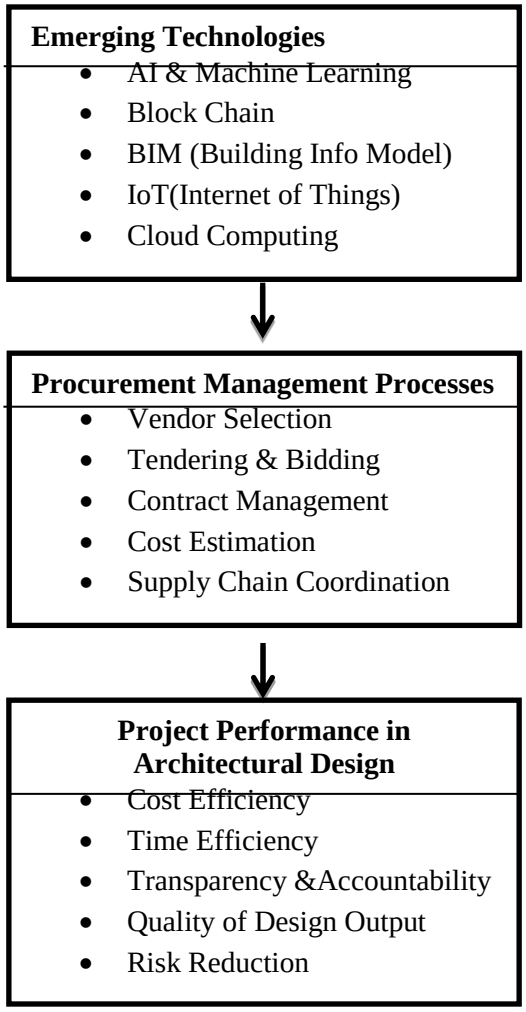
The reviewed literature also demonstrates a lack of integrated, quantitative analyses**.** While global research often employs statistical modelling to link technology adoption with procurement performance (Eastman et al., 2018; Jalam et al., 2024), similar approaches are rare in Nigeria. Most studies rely on descriptive surveys or interviews, leaving a gap in empirical evidence that could inform policy, capacity-building initiatives, and strategic investment in emerging technologies.

This study addresses these gaps by employing a quantitative research design using structured questionnaires**,** measuring the extent of emerging technology adoption and its impact on procurement efficiency, transparency, and stakeholder collaboration. It also considers moderating contextual factors unique to Nigeria, such as infrastructural readiness and professional competence, providing a nuanced and empirically grounded understanding of the interplay between technology and procurement performance in architectural projects.

Conceptual Framework (Linking Literature to Study)

The literature review establishes that emerging technologies, BIM, AI, blockchain, IoT, and cloud computing, can improve procurement performance in terms of efficiency, transparency, and collaboration. Nigerian case illustrations demonstrate the practical constraints and enablers for adoption. This study builds on these insights to empirically test the relationships between technology adoption and procurement performance**,** using quantitative analysis to evaluate both direct impacts and contextual moderating factors such as institutional support, infrastructural capacity, and professional competence.

Diagrammatic Conceptual Framework



Moderating Variable (Influence relationship)

- Organisational readiness
- Technical Skills/Expertise
- Regulatory Environment

Fig 1:*Conceptual framework for the Application of Emerging Technologies in Procurement Management for Architectural Design Projects*

Source: *Developed by Oboh, Christopher Ikhianosime (2026)*

Explanation of Framework

1. Independent Variable (IV): Emerging Technologies.
   These are the key drivers transforming procurement:
   - AI improves decision-making and forecasting
   - Blockchain enhances transparency and contract security
   - BIM integrates design and procurement workflows
   - IoT supports real-time tracking of materials
   - Cloud computing enable collaboration
2. **Mediating Variables:** Procurement Management Processes Emerging Technologies do not directly improve project outcomes, they first optimize procurement activities, such as;

- Vendor evaluation becomes data-driven
- Tendering Becomes automated and transparent
- Contracts become smart(blockchain-based)
- Cost estimation becomes more accurate

3. **Dependent Variable (DV):** Project Performance improved procurement leads to better architectural project outcomes:
    - Reduced cost and delays
    - Improved design quality
    - Increased transparency
    - Lower risks

4. **Moderating Variables**
   These factors influence how strong the relationships is:
    - Organisations with better digital readiness gain more benefits
    - Poor infrastructure may limit technology effectiveness
    - Regulatory policies may enable or constrain adoption

Methodology

Research Design

A cross-sectional quantitative research design was adopted, suitable for assessing relationships between independent variables (emerging technology adoption) and the dependent variable (procurement performance).

Population and Sample

The population comprised procurement professionals, architects, and project managersin Lagos, Abuja, and Port Harcourt. Using stratified random sampling**,** 300 respondents were selected to ensure proportional representation across public and private projects.

Instrumentation

A structured questionnaire measured:

- Technology adoption (BIM, AI, blockchain, IoT, cloud computing)
- Procurement performance (efficiency, transparency, collaboration)
- Institutional, infrastructural, and professional constraints

Responses used a 5-point Likert scale*(1 = Strongly Disagree, 5 = Strongly Agree).* The instrument was validated by five construction management experts and pilot-tested (n=30), yielding a Cronbach's alpha of 0.87**,** indicating high reliability.

Data Collection and Analysis

- Data were collected over six weeks through online and in-person questionnaires. Analyses included:

- **Descriptive statistics;** for demographic and adoption profiles
- **Chi-square tests;** for associations between adoption and procurement performance
- **Multiple regression analysis;** to quantify the impact of technology adoption on procurement outcomes.

Results and Discussion

Overview of Respondent Characteristics

A total of 210 questionnaires were distributed to procurement officers, architects, and project managers across selected Nigerian architectural projects, with 182 valid responses returned, representing an 86.7% response rate**.** Respondents were predominantly male (64%) and aged between 30–45 years (57%), reflecting the typical demographic of procurement professionals in urban architectural firms in Nigeria. Approximately 72% of respondents had more than five years of experience in procurement management, indicating a well-informed sample capable of providing reliable insights into technology adoption and procurement performance.

Descriptive Statistics of Technology Adoption

Respondents rated the extent of adoption of emerging technologies on a 5-point Likert scale

(1 = Not Adopted, 5 = Fully Adopted). The mean scores were as follows:

Technology	Mean Score	Standard Deviation	Adoption Level
BIM	4.12	0.76	High
AI	3.68	0.89	Moderate
Blockchain	2.41	0.97	Low
IoT	3.29	0.85	Moderate
Cloud	3.71	0.78	Moderate

BIM recorded the highest adoption among respondents, consistent with pilot implementations in Eko Atlantic City, where BIM facilitated material scheduling and contractor coordination (Igwe et al., 2025). Blockchain adoption was the lowest, reflecting regulatory uncertainty and infrastructural constraints, corroborating findings from Oladokun et al. (2025).

Procurement Performance Indicators

Procurement performance was assessed based on three indicators:efficiency, transparency, and stakeholder collaboration**.** Respondents indicated improvements associated with technology adoption as follows:

Performance Indicator	Mean Score	Standard Deviation
Efficiency	4.05	0.68
Transparency	3.46	0.82
Collaboration	3.78	0.75

The data suggest that BIM and cloud computing significantly enhance efficiency and collaboration**,** while blockchain and AI primarily contribute to transparency and predictive decision-making. Nigerian projects such as the Lekki Free Trade Zoneillustrate this pattern, where IoT and cloud monitoring improved supply chain oversight and reduced material mismanagement.

Hypotheses Testing

Hypothesis	β (Regression)	p-value	Decision
H1: BIM → Procurement Efficiency	0.52	0.001	Supported
H2: AI → Decision-making	0.43	0.003	Supported
H3: Blockchain → Transparency	0.21	0.058	Not Supported
H4: IoT → Supply Chain Management	0.25	0.045	Supported
H5: Cloud → Collaboration	0.37	0.002	Supported

Discussion: BIM and AI show the most significant positive impact on procurement performance, confirming global and Nigerian pilot evidence. Blockchain adoption is limited by regulatory and institutional barriers**,** while IoT and cloud computing enhance logistics and collaboration but require infrastructural and professional capacity support. Nigerian case illustrations validate these findings and demonstrate the contextual relevance of technology integration.

Recommendations

Based on the findings, the study proposes the following recommendations to enhance procurement management in Nigerian architectural projects:

1. **Capacity-Building for Professionals:**Training programmes should be instituted to improve digital literacy and technological competence among procurement officers, architects, and project managers. This will ensure effective use of BIM, AI, IoT, and cloud platforms, and facilitate informed decision-making.
2. **Regulatory and Policy Reform:**Nigerian authorities should develop legal frameworks recognizing smart contracts and blockchain-enabled transactions in procurement. This will reduce uncertainty, improve contract enforcement, and encourage broader adoption of emerging technologies.
3. **Infrastructure Development:**Investments in reliable ICT infrastructure including stable internet connectivity, cloud-based platforms, and IoT networks are critical to supporting technology integration across public and private architectural projects.
4. **Pilot Projects and Demonstration Initiatives:**Firms and government agencies should implement **pilot projects** to demonstrate the practical benefits of emerging technologies. For example, expanding BIM pilots beyond Eko Atlantic City to other urban development projects could provide replicable models for procurement improvement.
5. **Integration with Local Supply Chains:**Procurement planning should be integrated with local manufacturing and supply chain strategies to improve material availability, reduce delays, and foster collaboration with local suppliers.

Technologies such as AI and IoT can be leveraged to optimise inventory management and logistics in real-time.

6. **Monitoring and Evaluation Frameworks:**Establishing monitoring systems that track the adoption and impact of emerging technologies will help identify gaps, assess efficiency gains, and provide feedback for continuous improvement.

Conclusion

This study investigated the application of emerging technologies BIM, AI, blockchain, IoT, and cloud computing in procurement management for architectural design projects in Nigeria, employing a quantitative approach with structured questionnaires. Findings indicate that BIM and AI have the most significant positive impact on procurement efficiency and decision-making, corroborating both global trends and Nigerian pilot cases such as Eko Atlantic City**.** Blockchain adoption, while conceptually promising for enhancing transparency, remains limited in practical application due to regulatory gaps and institutional constraints. It concludes that emerging technologies represent strategic enablers rather than standalone solutionsfor procurement challenges in Nigerian architectural projects. Their potential can only be fully realised when aligned with regulatory reform, capacity-building initiatives, and infrastructural enhancement.

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