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Strategies for Promoting Internet of Things (IoT) Adoption in the Construction Industry

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Abstract

The construction industry remains slow to adopt advanced digital technologies despite its economic significance. The Internet of Things (IoT) offers transformative potential by improving productivity, safety, and data-driven decision-making across project lifecycles. Adoption in developing economies, including Nigeria, is limited due to fragmented project delivery, infrastructure gaps, skills shortages, and regulatory constraints. This study examines strategies to promote IoT adoption in Lagos State, Nigeria, using a quantitative cross-sectional survey of 220 construction professionals across key disciplines. Data were analysed using descriptive statistics, one-sample t-tests, and exploratory factor analysis. Results indicate that pilot projects, infrastructure development, and demonstration centres are the most influential strategies ($p<0.05$), reflecting a preference for incremental approaches that reduce risk and demonstrate value. Factor analysis grouped strategies into three interrelated dimensions: policy, funding, and support; capacity, awareness, and collaboration; and implementation and innovation, accounting for 74% of total variance. Findings highlight that IoT adoption depends on institutional backing, human capacity, and technological readiness rather than technology alone. Recommendations include staged pilot initiatives by 2026–2027, government financial incentives and 5G subsidies by 2027, professional training and certification programs from 2026–2028, and sustained industry collaboration through 2029. The study provides a practical roadmap for accelerating IoT adoption, fostering digital innovation, and enhancing construction performance in Lagos and similar contexts

Key words: Exploratory Factor Analysis, Internet of Things (IoT); Construction Industry; Technology Adoption; Digital Transformation; Developing Economies, Lagos Nigeria

Introduction

The construction industry is widely recognised as one of the largest contributors to global economic development and contributes 3.2% to Nigeria GDP yet it has historically lagged behind other sectors in the adoption of advanced digital technologies (Albert *et al*., 2024). Characterised by fragmented project delivery systems, labour-intensive processes, and complex stakeholder relationships, the industry continues to face persistent challenges such as low productivity, cost overruns, schedule delays, safety risks, and inefficient resource utilisation (Oyediran *et al*., 2025). In response to these challenges, digital transformation has emerged as a critical pathway for improving construction performance, with the Internet of Things (IoT) increasingly identified as a transformative technology with significant potential to reshape construction practices (Simeon, 2024). The Internet of Things refers to a network of interconnected physical devices such as sensors, equipment, machinery, and wearables that are embedded with software and communication technologies enabling them to collect, transmit, and exchange real-time data over the internet (Ajuwon *et al*., 2021). In the construction context, IoT applications span the entire project life cycle, including design, construction, operation, and maintenance (Ashiru *et al*., 2023). Examples include real-time monitoring of equipment performance, tracking of materials and workforce, environmental sensing, predictive maintenance of machinery, and smart safety systems. When effectively deployed, IoT technologies can enhance decision-making, improve productivity, reduce waste, increase safety performance, and support data-driven project management (Oyediran *et al*., 2025).

Despite the recognised benefits, the rate of IoT adoption in the construction industry remains relatively low compared to sectors such as manufacturing, logistics, and healthcare (Alaba, 2024). Several barriers continue to hinder widespread implementation, including high initial investment costs, lack of technical expertise, concerns over data security and privacy, inadequate digital infrastructure, interoperability issues, and resistance to organisational change (Attar *et al*., 2025). In developing economies, these challenges are often compounded by unstable internet connectivity, limited regulatory frameworks, and insufficient institutional support (Bassey *et al*., 2025). As a result, many construction firms struggle to move beyond pilot projects or isolated applications toward large-scale, integrated IoT solutions (Albert *et al*., 2025). Given these constraints, the focus has increasingly shifted from the technological capabilities of IoT to the strategies required to promote its effective adoption within the construction industry. Promoting IoT adoption is not solely a technical challenge but a multidimensional process involving organisational readiness, human capital development, policy and regulatory support, financial incentives, and industry collaboration. Strategies such as capacity building and training, integration of IoT with existing digital platforms like Building Information Modelling (BIM), development of clear data governance frameworks, demonstration of return on investment through pilot projects, and supportive government policies have been identified as critical enablers of adoption (Bello *et al*., 2025; Brown & Ikiriko, 2025).

Furthermore, the growing emphasis on smart construction, sustainable infrastructure, and digital twins has amplified the relevance of IoT in achieving industry-wide transformation (Bedi *et al*., 2018). IoT-enabled systems support real-time performance monitoring and lifecycle asset management, which align with global sustainability goals and the demand for resilient and efficient infrastructure (Arendt, 2008). However, without deliberate and context-specific strategies to address adoption barriers, the potential benefits of IoT may remain unrealised (Chidera, 2019). This study focuses on strategies for promoting the adoption of Internet of Things technologies in the construction industry. By examining the key drivers, barriers, and enabling mechanisms, the study seeks to provide insights that can support construction firms, policymakers, and industry stakeholders in accelerating IoT uptake. Understanding and implementing effective adoption strategies is essential for fostering digital innovation, enhancing project performance, and positioning the construction industry to meet the demands of an increasingly data-driven and interconnected built environment.

Strategies for Enhancing IoT Adoption in Lagos State Construction Industry

This research critically examined comprehensive strategies for enhancing IoT adoption within Lagos State's construction industry. The strategies encompassed infrastructure development, regulatory frameworks, financial mechanisms, human capital enhancement, and industry collaboration initiatives. Through systematic implementation of these strategies, Lagos State could position itself as a regional leader in construction technology adoption while addressing its growing infrastructure needs more effectively.

Infrastructure development strategies: Robust digital infrastructure formed the backbone of successful IoT implementation in construction projects. The Lagos State government had to prioritize expanding fiber optic networks and 5G infrastructure to construction sites across the state (Damilola, 2024). Current network coverage remained inadequate for supporting multiple IoT devices simultaneously on construction sites (Dhavaleshwar, 2025). Establishing dedicated IoT networks for construction sites could ensure reliable connectivity and data transmission (Foltean & Glovaţchi, 2021). Cloud infrastructure development was equally critical, as IoT systems generated massive amounts of data requiring secure storage and processing capabilities (Ghosh *et al*., 2021). Strategic partnerships with telecommunications companies could accelerate infrastructure deployment while reducing costs for individual construction firms (Graham, 2002).

Capacity building and human resource development: The construction workforce in Lagos State required comprehensive training programs to effectively utilize IoT technologies. Current skill levels were insufficient for managing sophisticated IoT systems, creating a significant barrier to adoption (Kunle *et al*., 2017). Training programs should have targeted different organizational levels, from site workers to project managers, ensuring comprehensive understanding of IoT applications (Kufile *et al*., 2022). Technical universities and polytechnics in Lagos should have integrated IoT modules into their construction programs to prepare future professionals (Lee *et al*, 2024). Continuous professional development programs for practicing engineers and contractors were essential for keeping pace with technological advances (Louis & Dunston, 2018). Collaboration with international technology providers could facilitate knowledge transfer and expose local professionals to global best practices (Ndubueze, 2009).

Financial support and investment strategies: High initial costs represented a major obstacle for IoT adoption among construction companies in Lagos State. Small and medium-sized enterprises particularly struggled with the financial burden of technology implementation (Yusof *et al*., 2025). Government-backed financing schemes with favourable interest rates could reduce financial barriers significantly (Vermesan *et al*., 2022). Tax incentives for companies investing in IoT technologies should have included accelerated depreciation allowances and reduced import duties on IoT equipment (Touray *et al*., 2013). Public-private partnerships could distribute implementation costs while ensuring sustainable technology adoption across the industry (Soyingbe & Jago, 2025). Venture capital funds specifically targeting construction technology startups could foster innovation and local solution development (Smithies *et al*., 2025).

Regulatory framework and standards development: Clear regulatory guidelines were essential for widespread IoT adoption in construction. Current building codes in Lagos State did not adequately address IoT integration requirements (Senaratne *et al*., 2017). Updated regulations should have specified data protection standards, cybersecurity requirements, and interoperability protocols for construction of IoT systems (Olówósejéjé, 2020). Professional bodies such as the Nigerian Institute of Building and the Nigerian Society of Engineers should have developed IoT implementation standards specific to local construction practices (Bello *et al*., 2024 Mandatory IoT integration for large construction projects could create market demand and drive industry-wide adoption (Okoye & Mensah, 2025). Regular review and updating of regulations ensured they remained relevant as technology evolved (Oke *et al*., 2025).

Industry collaboration and partnership development: Collaborative efforts between construction companies, technology vendors, and research institutions accelerated IoT adoption. Industry associations played crucial roles in facilitating knowledge sharing and collective problem-solving (Smithies *et al*., 2025). Construction technology clusters in Lagos could serve as innovation hubs where companies tested and refined IoT solutions (Olówósejéjé, 2020). Joint ventures between international technology companies and local construction firms could provide access to advanced IoT solutions while building local capacity (Soyingbe & Jago, 2025). Research partnerships with universities could drive development of construction-specific IoT applications tailored to Nigerian conditions (Bello *et al*., 2024). Regular industry conferences and workshops facilitated knowledge exchange and showcased successful IoT implementations (Vermesan *et al*., 2022).

Technology localization and customization strategies: IoT solutions had to be adapted to address specific challenges in Lagos State's construction environment. Local weather conditions, building materials, and construction methods required customized technology approaches (Ndubueze, 2009). Supporting local technology companies in developing construction-specific IoT applications created solutions that better addressed regional needs (Foltean & Glovaţchi, 2021). Pilot projects demonstrating IoT effectiveness in local construction contexts could build confidence among potential adopters (Kufile *et al*., 2022). Technology transfer programs should have focused on adapting international solutions to Nigerian construction practices and standards (Okoye & Mensah, 2025). Local manufacturing of IoT devices could reduce costs and improve accessibility for construction companies (Oke *et al*., 2025).

Risk management and cybersecurity enhancement: Cybersecurity concerns significantly impacted IoT adoption decisions among construction companies (Albert, 2025). Many firms lacked adequate cybersecurity expertise to manage IoT-related risks effectively (Louis & Dunston, 2018). Comprehensive cybersecurity frameworks specifically designed for construction IoT applications had to address data protection, network security, and device management (Kunle *et al*., 2017). Cybersecurity training programs should have educated construction professionals about IoT security risks and mitigation strategies (Dhavaleshwar, 2025). Establishment of cybersecurity support centers could provide ongoing assistance and incident response capabilities for construction companies (Arendt, 2008). Regular security audits and assessments ensured IoT systems maintained appropriate protection levels (Louis & Dunston, 2018).

Research Gap and Position of the Current Study

The Internet of Things (IoT) is increasingly recognized as a transformative technology in the construction industry because it enables real-time monitoring, improved safety management, and more efficient project delivery. However, most existing studies on IoT adoption have focused on developed countries where digital infrastructure, regulatory systems, and technological readiness are already well established. As a result, there is limited understanding of how IoT can be effectively adopted in developing construction environments.

In Nigeria, research on digital technologies in construction has mainly emphasized innovations such as Building Information Modeling (BIM) and sustainability practices. While these studies provide useful insights, they rarely address IoT adoption in a comprehensive way. Existing literature tends to examine isolated issues such as infrastructure, skills, or financial barriers rather than exploring how these factors interact to influence successful IoT implementation.

Another important gap is the lack of context-specific studies focusing on Lagos State, which is the centre of major construction activities in Nigeria. Despite the scale of infrastructure development in Lagos, limited research has examined practical strategies for integrating IoT technologies within the state's construction industry. Additionally, issues such as cybersecurity risks, regulatory frameworks, and the development of locally adapted IoT solutions remain insufficiently explored.

To address these gaps, this study investigates practical strategies for improving IoT adoption in the Lagos State construction industry. The study takes a holistic approach by examining infrastructure development, capacity building, financial support mechanisms, regulatory frameworks, industry collaboration, technology localization, and cybersecurity measures. By focusing on these interconnected factors, the research provides context-specific insights that can support policymakers, construction professionals, and technology stakeholders in promoting effective IoT adoption in Lagos and similar developing construction environments.

Table 1: Summary of Strategies for enhancing IoT adoption in Construction Industry

strategies	Sources in literature
Pilot Projects	Lee *et al*.,2024; Bello *et al*., 2024
Infrastructure Development	Bassey *et al*., 2025; Yusof *et al*., 2025
Demonstration Centers	Attar *et al*., 2025; Smithies *et al*., 2025
Capacity Building	Soyingbe & Jago, 2025; Ghosh *et al*., 2021
Government Support	Soyingbe & Jago, 2025; Kunle *et al*., 2017
Technology Customization	Damilola, 2024; Yusof *et al*., 2025
Regulatory Framework	Oke *et al*., 2025; Lee *et al*.,2024
Success Story Documentation	Vermesan *et al*., 2022; Bassey *et al*., 2025
Incentives and Funding	Dhavaleshwar, 2025;
Industry-Wide Adoption	Kunle *et al*., 2017; Soyingbe & Jago, 2025
Collaboration and Partnerships	Smithies *et al*., 2025; Damilola, 2024
Awareness and Education	Bello *et al*., 2024; Vermesan *et al*., 2022
Professional Certification Programs	Ghosh *et al*., 2021; Oyediran *et al*., 2025
Research and Development	Bello *et al*., 2025; Kunle *et al*., 2017

Cost-Sharing Models	Yusof *et al*., 2025; Bello *et al*., 2024

Materials and Methods

This study adopted a quantitative cross-sectional survey design to examine strategies for promoting Internet of Things (IoT) adoption in the construction industry. The approach was appropriate for capturing construction professionals' perceptions and for applying inferential and multivariate statistical analyses. The research was conducted in Lagos State, Nigeria, selected due to its high construction activity, concentration of firms, and growing exposure to digital construction technologies (Creswell & Creswell, 2018; Saunders *et al*., 2019). The study population comprised construction professionals involved in project delivery, including architects, builders, engineers, quantity surveyors, surveyors and geoinformatics professionals, town planners, and estate valuers. A purposive sampling technique was used to ensure that respondents possessed relevant professional experience and industry knowledge (Etikan *et al*., 2016). A total of 325 construction professionals in Lagos State were selected as the sample population for this study. Out of these, 220 respondents completed and returned the questionnaires, resulting in a 68% response rate, which provided sufficient data for the analysis. This sample size exceeds recommended thresholds for exploratory factor analysis and is considered adequate for robust statistical interpretation, particularly given the high inter-item correlations observed (Hair *et al.*, 2019).

Data were collected using a structured questionnaire developed from prior studies on IoT and digital technology adoption in construction. The instrument consisted of two sections: respondents' background information and 15 strategy variables for promoting IoT adoption. Strategy items were measured using a five-point Likert scale, ranging from strongly disagree to strongly agree, which is widely accepted for perception-based construction research (Likert, 1932; Field, 2018). For Validity and Reliability, content validity was ensured through expert review by academics and construction professionals. Construct validity was established using exploratory factor analysis, supported by a high Kaiser-Meyer-Olkin (KMO) value and a significant Bartlett's Test of Sphericity. The reliability of the instrument was confirmed using Cronbach's alpha, with coefficients exceeding the recommended minimum of 0.70, indicating satisfactory internal consistency (Sekaran & Bougie, 2016). Data were analysed using SPSS. Descriptive statistics were used to summarise respondents' characteristics and rank IoT adoption strategies. A one-sample t-test (test value = 3.0) was applied to determine the statistical significance of each strategy. Principal Component Analysis with varimax rotation was then used to identify underlying strategic dimensions, with factors retained based on eigenvalues greater than one. This approach enabled the reduction of multiple strategy variables into interpretable components explaining a substantial proportion of the total variance (Hair *et al*., 2019). For ethical Considerations, participation was voluntary, and respondents were informed of the study's purpose. Confidentiality and anonymity were assured, and all data were used strictly for academic research.

Results and Discussion

Respondents profile

Table 2 shows the sample of 220 construction professionals was diverse, with Architects forming the largest group (20.9%), followed by Quantity surveyors (18.2%), Engineers (16.4%), Builders (13.6%), Surveying & Geoinformatics (11.4%), Town planners (10.5%) and Estate valuers (9%). This distribution is crucial as it captures the perspectives of key professionals across the project lifecycle, from cost management to on-site execution, ensuring a holistic view of the challenges and opportunities associated with new technology. The findings on professional experience are particularly insightful. The majority of respondents (30.9%) have 6-10 years of experience, and a significant portion (25.5%) have 1-5 years. This means that over half of the professionals surveyed are in the early to mid-stages of their careers, a group that is typically more receptive to innovative technologies. Their educational background is also robust, with a large majority holding a Bachelor's degree (63.2%) or a Master's degree (27.3%), suggesting a well-educated and knowledgeable respondent base capable of understanding complex technological concepts.

The data on the type of organization and projects reveals important market characteristics. Most respondents work in small-scale construction firms (36.8%), which highlights the fragmented nature of the Lagos construction market and the potential challenges small businesses face in adopting new technologies. The dominance of residential projects (42.3%) further underscores the relevance of this study, as this sector represents the largest segment of the construction industry.

Table 2: Background Information of Respondents

	Variables	Frequency	Percent
Professional Qualification	Builders	30	13.6
	Architects	46	20.9
	Quantity Surveyors	40	18.2
	Engineers	36	16.4
	Surveying &Geoinformatics	25	11.4
	Town planner	23	10.5
	Estate Valuers	20	9.0
	Total	220	100.0
Years of Experience	1-5 years	56	25.5
	6-10 years	68	30.9
	11-15 years	45	20.5
	16-20 years	28	12.7
	21 years and above	23	10.5
	Total	220	100.0
Highest Educational Qualification	BTech/BSc/PGD	139	63.2
	MTech	60	27.3
	PhD	21	9.5
	Total	220	100.0
Type of Organization	Small-scale construction firm	81	36.8
	Medium-scale construction firm	74	33.6
	Large-scale construction firm	38	17.3
	Government agency	27	12.3
	Total	220	100.0

Strategies for Promoting IoT Adoption

The analysis of strategies for promoting IoT adoption provides a clear and actionable roadmap for future efforts. The mean scores in Table 3 show that all proposed strategies are considered important, with scores ranging from 3.0273 to 3.1682. The most highly-ranked strategies were "Pilot Projects" (Mean = 3.1682) and "Infrastructure Development" (Mean = 3.1636). This is a highly significant finding, as it suggests that professionals believe in a practical, staged approach to adoption. The literature review supports this, noting that a lack of cohesive, evidence-based strategies and government support has hindered IoT adoption in the Nigerian context (Ghosh *et al.*, 2021). It indicates that professionals believe a top-down and practical approach, with support from regulatory bodies and industry collaboration, is essential for overcoming the financial and infrastructural challenges.

Table 3: Strategies for Promoting IoT Adoption

Variables	Mean	SD	t-value (3)	df	Sig. (two-tailed)	Mean Diff.	R
Pilot Projects	3.17	1.132	2.203	219	0.029*	0.17	1
Infrastructure Development	3.16	1.194	2.033	219	0.043*	0.16	2
Demonstration Centers	3.16	1.158	2.039	219	0.043*	0.16	3
Capacity Building	3.15	1.190	1.870	219	0.063	0.15	4
Government Support	3.13	1.263	1.548	219	0.123	0.13	5
Technology Customization	3.12	1.203	1.457	219	0.147	0.12	6
Regulatory Framework	3.11	1.228	1.373	219	0.171	0.11	7
Success Story Documentation	3.11	1.115	1.512	219	0.132	0.11	7
Incentives and Funding	3.10	1.227	1.209	219	0.228	0.10	9
Industry-Wide Adoption	3.10	1.146	1.294	219	0.197	0.10	9
Collaboration and Partnerships	3.10	1.168	1.212	219	0.227	0.10	11
Awareness and Education	3.07	1.286	0.787	219	0.432	0.07	12
Professional Certification Programs	3.05	1.196	0.676	219	0.500	0.05	13
Research and Development	3.05	1.267	0.532	219	0.595	0.05	14
Cost-Sharing Models	3.03	1.102	0.367	219	0.714	0.03	15

Reduced component groupings of strategies for IoT

Factor analysis of strategies for promoting IoT identified three components (Table 4) together account for 74% of the total variance. Policy, Funding & Support factors, including incentives and funding, government support, regulatory framework, cost-sharing models and industry-wide adoption, explained 42.67%, of the variance. Capacity, Awareness & Collaboration factors, encompassing awareness and education, capacity building, collaboration and partnerships, professional certification programs and success story documentation, explained 18% of the variance. Implementation & Innovation factors, also include infrastructure development, pilot projects, research and development, demonstration centre and technology customization, explained 13.33% of the variance. The Kaiser-Meyer-Olkin measure was 0.969, and Bartlett's Test of Sphericity was significant ($\chi^2 = 1899.052$, $p < 0.001$), showing that there are sufficient correlations among the variables to justify using factor analysis. This means the dataset is statistically fit for extracting underlying patterns.

From a practical viewpoint, these results showed that the strategies suggested by construction professionals are not random but rather interrelated. This means respondents generally share common opinions about how IoT adoption can be promoted. According to Smithies *et al.* (2025), ensuring data suitability before factor analysis helps researchers arrive at reliable and actionable conclusions, and this dataset meets that requirement fully.

Table 4: Component groupings of strategies

Component	Variable	Factor Loading
Policy, Funding & Support	Incentives and Funding	0.781
	Government Support	0.794
	Regulatory Framework	0.764
	Cost-Sharing Models	0.749
	Industry-Wide Adoption	0.731
Capacity, Awareness & Collaboration	Awareness and Education	0.772
	Capacity Building	0.786
	Collaboration and Partnerships	0.801
	Professional Certification Programs	0.757
	Success Story Documentation	0.770
Implementation & Innovation	Infrastructure Development	0.742
	Pilot Projects	0.703
	Research and Development	0.768
	Demonstration Centre	0.726
	Technology Customization	0.752

Discussion of Findings

The factor analysis revealed strategies that respondents believe are effective in overcoming these barriers. These strategies fall into three broad categories: capacity building, policy support, and collaborative investment. Capacity building emphasizes training and professional development to ensure that the workforce is equipped with the right skills, a position reinforced by Louis & Dunston (2018), who argued that training enhances competence in handling digital technologies. Policy support reflects the need for strong institutional backing, regulations, and government involvement to drive adoption, which aligns with Vermesan *et al*. (2022), who found that policy frameworks provide direction and legitimacy to technological transformations. The final group of strategies emphasizes the importance of collaboration and funding, suggesting that partnerships between industry stakeholders, technology providers, and government can help reduce financial burdens and accelerate adoption. Smithies *et al*. (2025), similarly stressed that collaborative efforts are central to building a supportive ecosystem for innovation. The findings of this study also align closely with the results reported by Oke *et al*. (2025), who identified several barriers to digital technology adoption within the Nigerian construction industry.

The highest factor loading (0.801) for partnerships shows that collaboration among stakeholders is the single most important strategy for promoting Internet of Things (IoT) adoption in the construction industry. This strong association suggests that professionals in the field see partnerships as a key way to overcome the barriers currently slowing IoT implementation in construction industry. This finding also highlights the fragmented nature of the construction sector, where projects often involve multiple independent actors such as contractors, consultants, suppliers, technology providers, and government agencies. Without strong collaboration, information sharing suffers, efforts are duplicated, and new technologies are adopted slowly. The prominence of partnerships indicates that industry professionals recognize collaboration as essential to addressing these structural challenges. Through partnerships, construction firms can pool financial resources, share technical expertise, and reduce the risks associated with implementing new technologies. Collaborations with technology providers make advanced IoT solutions more accessible, while partnerships with research institutions can foster innovation and knowledge transfer. Government-industry collaborations can also help establish supportive policies and financial incentives to drive digital transformation. This finding aligns with Oke *et al*. (2025) observed that fragmentation is a major barrier to digital technology adoption, as poor coordination among stakeholders limits collective investment in innovation. Similarly, Smithies et al. (2025) emphasized that collaborative networks are crucial for building an innovation ecosystem that supports emerging technologies in construction. In short, the high factor loading for partnerships highlights its importance not just as a strategy but also as a means to reduce industry fragmentation. Encouraging cooperation among contractors, technology firms, academic institutions, and government agencies can create a more integrated environment, paving the way for more effective adoption and implementation of IoT technologies in the construction sector. Taken together, these results show that IoT in construction is shaped by three broad dimensions: the level of awareness among stakeholders, the perceived benefits that drive interest, and the challenges that constrain progress. At the same time, strategies that emphasize human capacity, regulatory backing, and collaborative investment provide a pathway for overcoming these challenges. This interpretation demonstrates that IoT adoption is not simply about technology but about people, processes, and institutions working together to unlock its potential

Limitations and area for further study

This study sheds light on strategies for promoting IoT adoption in the Lagos State construction industry, but it comes with some important caveats. First, the findings are specific to Lagos and may not fully reflect conditions in other parts of Nigeria, where infrastructure, regulations, and industry maturity could be very different. Second, because the study used a snapshot survey approach, it captures perceptions at one point in time, so it doesn't show how IoT adoption might change or evolve over the years. Third, the results are based on self-reported opinions from construction professionals. While these insights are valuable, they reflect perceptions rather than actual evidence of IoT being used on the ground. Fourth, the use of purposive sampling means the study focused on professionals with relevant experience, but it may have missed the perspectives of other important players, such as technology providers or government regulators. Finally, while the study identified key strategy, policy and funding, capacity building, and implementation and innovation, it did not explore how these strategies directly affect IoT adoption outcomes, leaving room for future research using case studies, longitudinal tracking, or more advanced modelling. Therefore, the study offers a useful roadmap for advancing IoT adoption, but the findings should be interpreted with these limitations in mind.

Conclusions and recommendations

The study highlights that while Lagos State construction professionals recognize the potential of IoT, adoption remains limited due to gaps in institutional support, infrastructure, and workforce skills. Key strategies for effective uptake include small-scale pilot projects, improved digital infrastructure, and demonstration centres, supported by three interconnected themes: policy and financial incentives, capacity development and collaboration, and practical implementation and innovation. To accelerate adoption, construction firms should initiate pilot projects by 2026–2027; the government should provide targeted financial incentives and subsidize 5G networks by 2027; professional institutions should strengthen IoT training and certification programs between 2026 and 2028; and ongoing industry collaboration should be promoted from 2026 to 2029. Future research should track adoption trends across regions and over time through 2030 to refine strategies and support sustained digital transformation.

References

Ajuwon, A., Adewuyi, A., Nwangele, C. R., & Akintobi, A. O. (2021). Blockchain technology and its role in transforming financial services: The future of smart contracts in lending. *International Journal of Multidisciplinary Research and Growth Evaluation*, *2*(2), 319-329.

Alaba, F. A. (2024). The Evolution of the IoT. In *Internet of Things: A Case Study in Africa* (pp. 1-18). Cham: Springer Nature Switzerland.

Albert, I. (2025). Assessing Hazards and Risks Associated in the Construction Projects: A Case Study of Akure, Nigeria. *Urban Planning and Construction*. 3(2): 28–39. DOI: https://doi.org/10.55121/upc.v3i2.693

Albert, I., Osadola, A.O. and Nathaniel. O.B., (2025). Investigating the relationship between technology integration and construction management efficiency in project delivery. *International Journal of Environmental Design and Construction Management*, 8(4), pp. 33 – 49.

Albert, I., Alake, O., Akanni, P. and Onimisi, E.O., (2024). The impacts of technology integration in construction for project delivery. *Journal of Agricultural and Environmental Science Research*. 6(1), pp. 118 – 131.

Arendt, L. (2008). Barriers to ICT adoption in SMEs: how to bridge the digital divide? *Journal of systems and information technology*, *10*(2), 93-108.

Ashiru, F., Nakpodia, F., & You, J. J. (2023). Adapting emerging digital communication technologies for resilience: evidence from Nigerian SMEs. *Annals of Operations Research*, *327*(2), 795-823.

Attar, H., Alghanim, M., Ababneh, J., Rezaee, K., Alrosan, A., & Deif, M. A. (2025). B5G Applications and Emerging Services in Smart IoT Environments. *International Journal of Crowd Science*, *9*(2), 79-95.

Bassey, R. S., Akah, U. E., & Oguike, M. C. (2025). Barriers To Smart Building Technology Adoption Through the Lens of Technology-Organization-Environment (Toe) In Calabar, Nigeria. *coou African Journal of Environmental Research*, *6*(2), 184-211.

Bedi, G., Venayagamoorthy, G. K., Singh, R., Brooks, R. R., & Wang, K. C. (2018). Review of Internet of Things (IoT) in electric power and energy systems. *IEEE Internet of things Journal*, *5*(2), 847-870.

Bello, A. O., Abdulraheem, A. A., Agboola, S. A., & Afolabi, O. P. (2025). Factors influencing the adoption of distributed ledger technology in developing countries: An examination of Nigerian construction industry. *International Journal of Construction Education and Research*, *21*(3), 290-320.

Bello, A. O., Okanlawon, T. T., Gbenga, P. O., Abdulraheem, A. A., & Olagoke, O. T. (2024). Critical success factors (CSFs) for the implementation of distributed ledger technology (DLT) in the Nigerian construction industry. *Construction Innovation*.

Brown, I., & Ikiriko, T. D. (2025). Increased Funding and Investment as a Panacea for Urban Infrastructure Deficit in Most Nigerian Cities. *Journal of the Nigerian Institute of Town Planners*, *30*(4), 1-34.

Chidera Abonyi, D. (2019). *Feasibility Study for a Solar PV (Hybrid) Mini-grid System for Small Businesses in Lagos, Nigeria* (Unpublished Master's thesis, PAUWES).

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.

Damilola, O. (2024). Cyber Security Awareness in Developing Countries in Africa: Lessons from Nigeria. in *Aun International Conference* (Vol. 2, No. 1, Pp. 182-195).

Dhavaleshwar, C. (2025). Community Readiness Towards Digitalization: A Comprehensive Review. *J. Adv. Res. Appl. Sci. Eng. Technol*, *56*, 157-179.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.

Field, A. (2018). *Discovering statistics using SPSS*. Sage.

Foltean, F. S., & Glovaţchi, B. (2021). Business model innovation for IoT solutions: An exploratory study of strategic factors and expected outcomes. *Amfiteatru Economic*, *23*(57), 392-411.

Ghosh, A., Edwards, D. J., & Hosseini, M. R. (2021). Patterns and trends in Internet of Things (IoT) research: future applications in the construction industry. *Engineering, construction and architectural management*, *28*(2), 457-481.

Graham, S. (2002). Bridging urban digital divides? Urban polarisation and information and communications technologies (ICTs). *Urban studies*, *39*(1), 33-56.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis*. Cengage.

Kunle, O. J., Olubunmi, O. A., & Sani, S. (2017). Internet of things prospect in Nigeria: Challenges and solutions. In *2017 IEEE 3rd International Conference on Electro-Technology for National Development (NIGERCON)* (pp. 736-745). IEEE.

Kufile, O. T., Otokiti, B. O., Onifade, A. Y., Ogunwale, B., & Okolo, C. H. (2022). Designing retargeting optimization models based on predictive behavioral triggers. *International Journal of Multidisciplinary Research and Growth Evaluation*, *3*(2), 766-777.

Lee, C. Y., Kasim, N., Zainal, R., & Abd Rahim, M. H. I. (2024). Relationship between Skill Requirements and Challenges of Internet of Things (IoT) Implementation in Construction Project. *Research in Management of Technology and Business*, *5*(1), 1114-1125.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology,* 140, 1– 55.

Louis, J., & Dunston, P. S. (2018). Integrating IoT into operational workflows for real-time and automated decision-making in repetitive construction operations. *Automation in Construction*, *94*, 317-327.

Ndubueze, O. J. (2009). *Urban housing affordability and housing policy dilemmas in Nigeria* (Unpublished Doctoral dissertation, University of Birmingham).

Okoye, C. F., & Mensah, K. E. (2025). Challenges and prospects of technology adoption by small and medium enterprises in Rivers state, Nigeria. *Ayden Energies Journal*, *13*(2), 1-15.

Oke, A. E., Aliu, J. O., Timothy Jesudaju, O., Thomas Fagbe, A., Aghimien, D., & Aigbavboa, C. O. (2025). Building a sustainable future: the role of digitalization in Nigerian heavy engineering projects. *Engineering, Construction and Architectural Management*.

Olówósejéjé, S. (2020). Quantifying the challenges associated with poor electricity supply in Nigeria and the role of a hybrid PV system in addressing them.

Oyediran, A. O., Oke, A. E., Ikuabe, M. O., Aliu, J. O., Adeosun, F. E., & Aigbavboa, C. O. (2025). Exploring application areas of cyber-physical systems in the construction industry: a case of Nigeria. *International Journal of Construction Management*, 1-13.

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students*. Pearson.

Sekaran, U., & Bougie, R. (2016). *Research methods for business*. Wiley.

Senaratne, S., Jin, X. H., & Balasuriya, K. (2017). Exploring the role of networks in disseminating construction project knowledge through case studies. *Engineering, construction and architectural management*, *24*(6), 1281-1293.

Simeon, D. R. (2024). Emerging Trends in the Adoption of Innovative Technologies by Building Firms in Lagos Metropolis. *Journal Of Project Management Practice (JPMP)*, *4*(2), 53- 76.

Smithies, G., Papi, G., McGillycuddy, E., & McGillycuddy, E. (2025). The blueprint of digital advancement: a study of construction technology implementation. In *Proceedings of the Institution of Civil Engineers-Civil Engineering* (Vol. 178, No. 2, pp. 104-117). Emerald Publishing Limited.

Soyingbe, A. A., & Jago, A. C. (2025). Barriers To Adoption of Construction 4.0 For Circular Economy: A Qualitative Approach. *Arid Zone Journal of Engineering, Technology and Environment*, *21*(2), 626-636.

Touray, A., Salminen, A., & Mursu, A. (2013). ICT barriers and critical success factors in developing countries. *The Electronic Journal of Information Systems in Developing Countries*, *56*(1), 1-17.

Vermesan, O., Friess, P., Guillemin, P., Giaffreda, R., Grindvoll, H., Eisenhauer, M., ... & Tragos, E. Z. (2022). Internet of things beyond the hype: Research, innovation and deployment. In *Building the Hyperconnected Society-Internet of Things Research and Innovation Value Chains, Ecosystems and Markets* (pp. 15-118). River Publishers.

Yusof, Y., Amirah, N. A., Haron, N. F., Mustafa, W. A., Zin, Z. M., Jusoh, M. Y. F., & Dhavaleshwar, C. (2025). Community Readiness Towards Digitalization: A Comprehensive Review. *J. Adv. Res. Appl. Sci. Eng. Technol*, *56*, 157-179.