



CHALLENGES OF SMART BUILDING SPECIFICATION ON WORKING DRAWING AND SPECIFICATION IN THE NIGERIAN CONSTRUCTION INDUSTRY

ABSTRACT

This study examines the challenges associated with integrating smart building specifications into working drawings within the Nigerian construction industry. As the demand for intelligent building systems grows, practitioners face increasing complexities in design detailing, documentation standards, and coordination among stakeholders. A mixed-methods approach was employed to capture a comprehensive understanding of these challenges.

**GLORY A. ODUBANJO; BASIT ADEBAYO;
OLUWATOBILOBA ODUKOYA; AILENDE E.
OKODUWA; BAMIDELE J. ADEWUMI; &
ADEKUNLE OGUNNAIKE**

Department of Architecture, College of Environmental
Science and Management, Caleb University, Imota,
Ikorodu, Lagos, Nigeria

Corresponding Author:

glory.odubanjo@calebuniversity.edu.ng

DOI: <https://doi.org/10.70382/tijbees.vogi4.046>

INTRODUCTION

Specifications are comprehensive documents that define exact standards for materials and workmanship in architectural projects (Owolabi, Harry, Adewumi, Onomade & Asaju, 2024). They play a crucial role in maintaining quality control across every stage of a building's lifecycle (Njonge, 2023; Alugbur, Otuonuyo, Adewumi, Onomade & Asaju, 2024). This chapter states the challenges of smart building specification in the Nigerian Construction Industry (NCI), particularly on working drawings and specifications. Buildings are designed to meet the needs and desires of their occupants, with growing emphasis on improving comfort in the living space. As a result, the construction industry worldwide is experiencing a significant transformation fueled by technological progress and the urgent demand for sustainable development (Emmanuel et al., 2025). The global construction industry is experiencing a profound



Quantitatively, a structured survey was administered to 605 professionals in the built environment across Nigeria, including architects, engineers, quantity surveyors, and builders, to identify prevalent issues and assess their impact on project delivery. Qualitatively, in-depth interviews were conducted with representatives from 15 architectural and construction firms actively engaged in smart building projects, providing nuanced insights into practical difficulties and contextual factors influencing the adoption of smart technologies. Findings reveal that inadequate technical knowledge, evolving client requirements, limited local standards for smart systems, and gaps in multidisciplinary collaboration significantly impede the effective translation of smart building specifications into working drawings. Severity is reflected in the fact that only 39.4% of respondents found existing specification practices fully compliant with best-practice standards, indicating a substantial performance gap. Furthermore, 73.3% reported frequent ambiguities and scope changes, a critical problem in smart building projects where precise definitions of system integration, data protocols, sensor placements, and automation standards are essential for success. The study also highlights the lack of specialized training and insufficient integration of smart technologies into existing regulatory frameworks as key obstacles. The paper concludes by recommending targeted capacity building, the development of localized smart building guidelines, and stronger cross-disciplinary engagement to enhance the quality and efficiency of smart building documentation in Nigeria.

Keywords: Design challenges, Nigerian construction industry, Smart buildings, Specifications, Working drawings.

transformation driven by rapid technological advancements and a heightened emphasis on sustainability (Adewumi, Onomade, Asaju, Adeboye, 2023). In Nigeria, these dynamics are especially pronounced, as professionals within Architecture, Engineering, and Construction (AEC) increasingly integrate digital tools, such as smart sensors, the Internet of Things (IoT), Building Information Modelling (BIM), and building automation systems, into the building lifecycle (design, construction, management, and maintenance) to enhance operational efficiency and occupant comfort (Ejidike, Mewomo, & Anugwo, 2024; Toyin & Mewomo, 2023). Therefore, maintaining quality in construction projects is vital for delivering successful results. Nonetheless, ensuring uniform quality across different facets, such as materials, workmanship, and compliance with established standards, presents significant challenges (Njonge, 2023; Emesidi, Otuonuyo, Adewumi, Asaju, & Onomade, 2024). Despite this momentum, the Nigerian construction industry faces unique challenges



in adopting smart building principles. For instance, BIM uptake remains low due to systemic barriers such as limited technical capacity, resistance to shifting from traditional workflows, and inadequate governmental support, factors that reduce its effectiveness in transforming project outcomes (Toyin & Mewomo, 2023; Adewumi, Onomade, David-Mukoro, Bamiloye, Otuonuyo, Chukwuka & Oru, 2025). Similarly, while awareness of smart building concepts among professionals has grown, the actual implementation of key systems, such as energy management, IT connectivity, safety/security, and automation, lags, weakened by gaps in knowledge, policy, and collaboration (Ejidike, Mewomo & Anugwo, 2024; Hassan, Adewumi, Olukunga, 2024; Oru, Adewumi & Asaju, 2024).

The situation is compounded by the underutilisation of integrated platforms that combine BIM with IoT and AI, technologies essential for creating intelligent, resilient, and sustainable buildings. Research indicates that while BIM adoption offers benefits across the design, construction, and operation stages, disconnects between these phases and limited facility management readiness hinder its transformative potential (Mohammed, 2022; Olanrewaju et al., 2020). This disconnect impedes the seamless integration of building specifications into working drawings, thereby affecting the quality and coherence of smart building documentation.

The aim of this study is to critically examine the challenges associated with specifying smart building systems within architectural working drawings in the Nigerian construction industry. While the objectives are to:

- identify prevailing practices and deficiencies in integrating smart-building specifications into architectural drawings in Nigeria.
- evaluate how inadequate specification impacts project outcomes, particularly in terms of quality, cost, and operational performance.
- propose evidence-based strategies to strengthen specification practices for smart building projects.

These objectives guide a comprehensive investigation into specification processes, stakeholder practices, and industry gaps in Nigeria's context.

LITERATURE REVIEW

Specifications are formal, contract-level documents that detail required materials, workmanship, performance criteria, and methods for construction projects; they complement drawings by conveying the written requirements that graphics cannot fully express (Alugbue et al., 2024; Emesiobi et al., 2024). Clear specifications, therefore, set quality benchmarks, facilitate inspection and commissioning, and reduce disputes by translating design intent into enforceable obligations (ISO, 2015; Alugbue et al., 2024). In practice, specifications act as a communication and quality-control tool that aligns architects, engineers, contractors, and facility managers around measurable acceptance tests (Emesiobi et al., 2024; IEA Annex 81, 2023). For



smart buildings, this remit expands: specifications must address sensors, control systems, data schemas, network interfaces, cybersecurity safeguards, and firmware/software compatibility, elements that go well beyond conventional material and workmanship clauses (GSA BTTRG, 2024; NIST, 2024; Frontiers, 2023). International best practice (e.g., GSA P100 guidance; ISO 9001 quality management principles) therefore expects specifications to define data protocols, system integration points, open communication standards (BACnet/Modbus/Haystack, etc.), and commissioning/acceptance tests for automated systems (GSA BTTRG, 2024; ISO, 2015).

Literature on Nigerian practice documents persistent shortfalls in specification writing and implementation. Several recent studies have reported that specification documents are inconsistently prepared, often incomplete, and sometimes underutilized in project documentation, particularly on smaller projects, resulting in informal on-site directions, rework, and weakened quality assurance (IAEME/IJCIET studies; Alugbue et al., 2024; Emesiobi et al., 2024). Nigerian case studies and surveys point to common causes: limited technical knowledge of smart systems among practitioners, insufficient local standards and templates for digital and IoT components, poor multidisciplinary coordination, and weak compliance/enforcement mechanisms (Alugbue et al., 2024; Frontiers, 2023). In Lagos and other megacity contexts, facility managers emphasize that well-prepared specifications reduce corrective maintenance and extend lifecycle performance, a finding mirrored in international facility-management evidence (Emesiobi et al., 2024; IEA Annex 81, 2023).

Conceptual Framework

This study's conceptual frame treats specifications as the mechanism that translates design intent into measurable, enforceable performance (a TQM perspective) and as the procedural documentation required by ISO-style quality management systems (ISO 9001) to assure repeatable outcomes. Total Quality Management (TQM), Six Sigma, and Lean Construction principles converge on one requirement: reduce variation and ambiguity before construction begins by defining precise acceptance criteria and continuous-improvement loops (ISO, 2015; IEA Annex 81, 2023). International smart-building guidelines place additional emphasis on data governance, standard tagging, and commissioning protocols (GSA BTTRG, 2024; NIST, 2024). Applied locally, the framework requires translating these international principles into localized templates (specifying network endpoints, cybersecurity baselines, sensor calibration and interoperability tests) and training to make such documents usable in Nigerian practice (Alugbue et al., 2024; Emesiobi et al., 2024).



Empirical Review

Empirical evidence from Nigeria confirms that well-written specifications improve durability, safety, and operational efficiency where they are used, but also highlights recurring weaknesses where specifications are ambiguous or lack risk/change-management clauses (Alugbue et al., 2024; Emesiobi et al., 2024). Recent Nigerian surveys and studies document coordination problems, ambiguous language, contractor non-compliance, and weak enforcement, problems that mirror international literature on smart-building adoption, where the absence of standard guidelines, tagging, and interoperability protocols causes integration failures (Frontiers, 2023; IEA Annex 81, 2023). Globally, federal guidelines and technical references (e.g., GSA P100, GSA BTTRG) demonstrate how prescriptive specification language and mandatory data-exposure requirements reduce integration risks and enable third-party analytics; these measures are largely absent in Nigerian documentation practices (GSA BTTRG, 2024). In addition, cybersecurity and device-level guidance from NIST and related bodies show that specifying security controls and logging/patching requirements at procurement and design stages is crucial, an area currently under-specified in many Nigerian smart-building projects (NIST, 2024; Frontiers, 2023).

Gaps in Literature

Although Nigerian studies repeatedly document the importance of specifications and systemic failures in their application, three critical gaps remain between local practice and international best practice. First, few studies propose concrete templates or frameworks for integrating smart-systems specifications (networking, tagging, API endpoints, cyber controls) into architectural working drawings; international references (GSA; IEA Annex reports) provide models that could be localized (GSA BTTRG, 2024; IEA Annex 81, 2023). Second, empirical evidence is sparse on how specific specification deficiencies (e.g., missing data-tagging, lack of commissioning protocols) uniquely affect smart-systems outcomes such as interoperability, uptime, and cybersecurity incidents in Nigerian contexts. Most local studies focus on general quality outcomes rather than smart-system performance (Alugbue et al., 2024; Emesiobi et al., 2024). Third, while international scholarship and practice increasingly recommend digital tools (BIM, data tagging standards, AI-assisted specification checking), there is limited Nigerian research on industry readiness and capacity to adopt these tools or on how they might be used to bridge the specification gap (IEA Annex 81, 2023; ScienceDirect on BIM in Nigeria, 2025). This study addresses these gaps by examining how specifications are prepared for smart features in Nigeria, how they compare to international templates, and what institutional and capacity-building interventions are required for alignment with global best practices.



METHODOLOGY

This research employs a quantitative-dominant mixed-methods approach to deeply investigate the challenges of specifying smart building systems in Nigerian architectural drawings and construction projects. This design was chosen to capture both broad statistical patterns in professional practice and nuanced insights into specification processes, thereby enhancing the validity and practical relevance of the findings.

The quantitative strand involved administering structured questionnaires to approximately 600 construction industry professionals, including architects, engineers, quantity surveyors, contractors, and project managers across major Nigerian construction hubs. Over 90% of the responses originated from Lagos, recognized as Nigeria's leading center for smart building development. The survey used a combination of closed-ended and Likert-scale items to gather data on current practices in specification writing for smart building elements, perceived difficulties such as issues of clarity, integration, and standardization, as well as impacts on project outcomes. It also collected demographic data, covering professional experience, specialization, and firm type, to contextualize the analysis. Data from the questionnaires were analyzed using descriptive statistics and inferential techniques (such as chi-square tests and ANOVA) via SPSS to explore relationships between variables like experience levels and awareness or execution of smart specifications. In order to complement the survey and provide rich contextual insights, the study incorporated a qualitative phase comprising semi-structured interviews and document reviews. Interviews were conducted with 15 key informants drawn from top architectural and construction firms in Lagos, including firms such as James Cubitt Architects, FMA Architects, and Studio One, which are known for their experience in specification drafting and involvement in smart or sustainable projects. These interviews probed deeper into barriers like knowledge gaps, technological constraints (including use of digital tools such as BIM), stakeholder coordination challenges, and institutional support mechanisms. Additionally, the qualitative phase examined actual specification documents to identify patterns or deficiencies in smart systems detailing.

This triangulated methodology thus combines the strength of statistical analysis to identify broad trends with qualitative thematic coding to uncover deeper, practice-based issues. Survey data were processed through descriptive and inferential statistical methods, while interview transcripts were analyzed using thematic coding to extract recurring themes and insights. Ethical clearance was obtained for the study, and confidentiality was assured for all participants to ensure integrity and openness in responses. In summary, this mixed-methods approach provides a comprehensive understanding of specification challenges in Nigeria's emerging smart building sector, bridging gaps between quantitative prevalence and qualitative depth.



RESULTS AND DISCUSSION

Demography of Respondents

The survey produced 605 valid responses from built environment professionals spanning seven Nigerian states, with Lagos alone accounting for a significant majority (90.9 %). In line with national trends documented by Adewumi et al. (2025), the gender distribution leaned male, comprising 68.4 % men and 31.6 % women. The data revealed a predominantly young workforce: 57.2 % of respondents were aged between 20 and 30, while 29.4 % fell within the 31–40 range, and 13.4 % were over 40 years old. Educational qualifications were high across the board, with 44 % holding a B.Sc. or HND, 37.3 % possessing a master’s degree, and 12 % a doctorate.

In terms of professional composition, architects represented the largest group at 54.0 %, followed by engineers (18.5 %), contractors (13.2 %), project managers (10.3 %), and other specialists (4.0 %). Notably, 72 % of respondents had fewer than ten years of industry experience, indicating a relatively youthful cohort likely educated amid growing emphasis on sustainability and digital design tools. This background may influence their receptiveness to modern specification methodologies, echoing observations (Emesiobi, Otuonuyo, & Onamade 2024).

Table 1: Geographical Distribution of Respondents

State	Frequency	Percent
Lagos	550	90.87%
Ogun	8	1.32%
Abuja	6	0.99%
Others	41	6.82%
Total	605	100%

Author’s Fieldwork (2025)

Table 2: Demographic Characteristics of Respondents

Demographic Variable	Category	Frequency	Percent
Gender	Male	414	68.4%
	Female	191	31.6%
Age Group	20-30 years	346	57.2%
	31-40 years	178	29.4%
	41+ years	81	13.4%
Specialization	Architect	327	54.0
	Engineer	112	18.5
	Contractor	80	13.2
	Project Manager	62	10.3
	Others	24	4.0

Author’s Fieldwork (2025)



Presentation of Results and Discussion by Objective

Table 3: Specification Application by Project Phase

Phase	Frequency	Percent
Construction	565	93.3%
Procurement	525	86.7%
Pre-Design/ Design	338	55.9%
Post-Construction	212	35.0%

Author's Fieldwork (2025)

As shown in Table 3, specifications are overwhelmingly applied during the construction (93.3%) and procurement (86.7%) phases, but their use drops sharply at the pre-design/design stage (55.9%) and is even less common in post-construction phases (35.0%). This distribution reveals a critical misalignment with best practices for smart building development. Smart building systems, such as integrated automation, energy management, and IoT-based monitoring, require meticulous specification during the earliest design stages to ensure that architectural drawings incorporate the necessary conduits, control interfaces, and spatial allocations for advanced technologies. The relatively low emphasis on specifications in the pre-design/design phase (just 55.9%) indicates that many Nigerian projects still treat specifications primarily as a construction-phase tool rather than as a proactive design management instrument. This practice is inconsistent with international smart building workflows, where specifications and working drawings jointly establish detailed technical frameworks from the outset (Baharetha et al., 2024). The low post-construction figure (35.0%) further highlights a gap in using specifications to support commissioning, facility management, and smart system handover, reinforcing concerns raised by Emesiobi et al. (2024) that weak specifications compromise long-term operational efficiency and maintenance planning.

Table 4: Effectiveness and Challenges in Specification Use

Parameter	Agreement
Specifications are highly effective	66.7
Ambiguities or scope changes are frequent	73.3
Compliance enforcement is adequate	40.0

Author's Fieldwork (2025)

Table 4 provides additional insight into the practical challenges of smart building specification in Nigeria. While 66.7% agree that specifications are generally effective, an even higher proportion (73.3%) acknowledge that ambiguities and scope changes are frequent. These ambiguities are particularly problematic in smart building projects, where precise definitions of system integration, data protocols, sensor placements,



and automation standards are critical (Kennedy & Kabari, 2024). When specifications are vague or frequently altered, contractors and subcontractors are left to interpret or improvise complex technological installations, increasing the risk of compatibility failures and costly rework. Moreover, only 40.0% believe that compliance enforcement is adequate, underscoring a systemic weakness. For smart systems, where unseen elements like software configurations and network resilience play pivotal roles, inadequate enforcement of specification details can result in systems that fail to meet operational requirements despite appearing compliant on the surface (Owolabi et al., 2025). Together, these results highlight that the challenges of smart building specification in Nigeria are not merely about writing documents, but about when, how, and with what clarity specifications are prepared and tied into architectural drawings. The overemphasis on construction-phase specifications, coupled with persistent ambiguities and weak enforcement, means that critical smart building elements are often under-detailed at the design stage and inconsistently executed on site. This underscores the urgent need for the Nigerian construction industry to elevate specification practices, embed them robustly in the early drawing and design process, and enforce compliance throughout the project lifecycle.

Table 5: Experience Level vs Perceived Effectiveness

Years of Experience	High Effectiveness (%)	Moderate/Low Effectiveness
0-5	72.4	27.6%
6-10	68.5	31.5%
11 and above	59.3	40.7%

Author's Fieldwork (2025)

Table 5 reveals those perceptions of specification effectiveness decline with increased professional experience. Among respondents with 0–5 years' experience, 72.4% rated specification effectiveness as high, compared to 68.5% for those with 6–10 years, and only 59.3% for practitioners with over 11 years' experience.

Table 6: ANOVA Summary Table

Source	SS	Df	MS	F	Sig (p)
Between Groups	8.432	2	4.216	6.113	0.003
Within Groups	156.712	227	0.691		
Total	165.144	229			

Author's Fieldwork (2025)

The ANOVA summary in Table 6 confirms this difference is statistically significant ($F = 6.113, p = 0.003$). This suggests that more seasoned professionals are less satisfied with current specification practices, likely because they have encountered repeated



real-world failures in specification clarity, coordination, or enforceability, especially on complex projects like smart buildings. This aligns with Owolabi et al. (2025), who note that ambiguities and poor change management undermine project quality, and with Emesiobi et al. (2024), who report operational inefficiencies in Lagos facilities tied back to inadequate initial specifications. It implies that younger professionals may be overconfident due to less exposure to on-site deviations and latent performance failures of smart systems.

Table 7: Specification Challenges Ranked by Prevalence

Challenge	Ranking in Top 3
Ambiguities in specification formatting	73.3
Poor coordination among stakeholders	68.0
Lack of standardised specification formats	64.5
Inadequate knowledge of smart specs	59.2

Author's Fieldwork (2025)

Table 7 provides direct insight into the specific bottlenecks constraining effective smart building specification in Nigeria.

- Ambiguities in specification formatting (73.3%) emerged as the most cited challenge, closely followed by poor coordination among stakeholders (68.0%) and lack of standardized formats (64.5%).
- Inadequate knowledge of smart specifications (59.2%) underscores a skills and awareness gap in integrating IoT, automation, and data protocols into design documents.

This mirrors findings from Alugbue et al. (2024) in Lagos, who documented widespread concern over inconsistencies in specification documents, and from Kennedy & Kabari (2024) in Abuja, who highlighted low adoption of smart systems partly due to limited professional expertise. Collectively, it reinforces the argument by Baharetha et al. (2024) that unclear or non-standard specification documentation is one of the top barriers to smart building implementation in emerging economies.

Table 8: Proposed Innovations

Variable	Frequency	Percent
Compliant	112	39.4%
Neutral	49	17.3%
Not Compliant	18	6.3%
Slightly Compliant	23	8.1%
Very Compliant	82	28.9%

Author's Fieldwork (2025)



Table 8 also reveals that only about 39.4% found existing specification practices fully compliant, with substantial neutrality or partial compliance ratings. This underscores the real-world gap between current practices and best-practice specification standards for smart buildings.

Taken together, these findings illustrate those ambiguities, lack of standardization, poor coordination, and limited expertise directly spill over into architectural working drawings. When specifications are vague or disconnected from smart technology needs:

- working drawings fail to include detailed schematics for automation systems,
- there is no clear provision for sensor grids, control panels, or structured cabling layouts.
- and operational efficiency or facility management suffers post-construction.

This echoes Emesiobi et al. (2024) on operational inefficiencies and Owolabi et al. (2025) on quality deviations arising from weak specs, and helps explain why many smart building projects in Nigeria struggle to achieve performance targets despite modern facades.

Table 9: Proposed Innovations

Innovation Proposed	Respondents (%)
Standardised templates for specifications	88.5
Integration with BIM/AI	81.0
Enhanced professional training and certification	76.2
Environmental impact inclusion	69.7

Author's Fieldwork (2025)

Table 9 shows overwhelming support for key interventions. This is consistent with recommendations by Owolabi et al. (2025), who advocated for leveraging BIM and AI to upgrade Nigeria's specification regime, and by Emesiobi et al. (2024), who suggested that training and templates would improve facility life-cycle outcomes.

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Findings

This study finds that the Nigerian construction industry faces significant obstacles in specifying smart building systems within architectural drawings. While many professionals understand the importance of detailed specifications for driving quality and operational performance, numerous practical issues continue to impede effective implementation. Specifications are frequently incomplete, ambiguously worded, or poorly coordinated with other design documents. Such deficiencies create confusion on site, force contractors to improvise, and ultimately lead to deviations from design intent, delays, cost overruns, and compromised building performance. These patterns



were observed across multiple data sources: large-scale infrastructure case studies (Owolabi et al., 2025), facility management insights from Lagos (Emesiobi et al., 2024), and our quantitative survey, which highlighted widespread concerns about clarity and standardization.

Consistent with prior Lagos-focused studies, our analysis shows that a lack of clear standards and fragmented stakeholder communication are central problems. Moreover, qualitative interviews revealed limited technical knowledge of smart building technologies among architects and engineers. Without adequate training, professionals may omit critical smart elements, such as sensors, control systems, data wiring, or cybersecurity provisions, from both specifications and drawings altogether. This finding aligns with Kennedy & Kabari (2024), who highlighted broader knowledge gaps and infrastructure challenges that deter investment in smart building capabilities.

Recommendations

Drawing on these insights and supported by literature, we propose a multi-pronged strategy to overcome current shortcomings:

1. Develop Standardized Smart-Specification Templates

Regulatory bodies (such as ARCON and NIA) and professional institutes should create standardized specification templates and guidelines that comprehensively cover both traditional and smart building components. This could draw on global best practices to incorporate divisions for building automation, IoT systems, network protocols, and security. Standard templates would ensure consistency across projects and reduce ambiguity, making it easier to audit and enforce specification compliance. Mandatory inclusion of smart technology sections in contract documents should also be legislated.

2. Strengthen Digital Tools and Integration

Encourage widespread adoption of Building Information Modeling (BIM) platforms and other digital tools that link specifications directly with architectural drawings. As demonstrated in the literature (Owolabi et al., 2025), integrating BIM with specification databases enables real-time updates, clash detection, and synchronization of design intent with technical requirements, thereby minimizing coordination errors. Industry-wide training on BIM-based specification processes, especially for smart building systems, should be prioritized.

3. Build Professional Capacity

Targeted capacity building is essential. Universities and professional bodies must embed modules on smart building technologies and advanced specification writing



within architectural and engineering curricula, as well as continuing professional development (CPD) programs. Echoing Kennedy & Kabari (2024) and Emesiobi et al. (2024), mentorship arrangements where less experienced firms are paired with experts in sustainable and smart projects can further bridge practical knowledge gaps. Specialized certification programs focused on IoT systems, energy optimization, and digital controls will also help professionals draft informed specifications.

4. Enforce Compliance Through Audits and Collaboration

Strengthen regulatory oversight by mandating thorough pre-construction specification reviews and conducting random site audits to verify that smart elements are being correctly implemented. Clients and regulators must actively scrutinize tender documents and working drawings for omissions before projects commence. Additionally, fostering interdisciplinary design teams, where architects, electrical engineers, IT specialists, and contractors collaboratively prepare specifications, will improve technical accuracy. Formal communication channels, such as structured design-review meetings, should be institutionalized to align all stakeholders.

5. Expand Research and Policy Support

Further empirical studies are needed to develop localized, performance-based codes for smart building systems. Drawing on frameworks like Total Quality Management (TQM), Six Sigma, and Lean Construction (Owolabi et al., 2025), these standards can be adapted to Nigeria's unique context. Policy interventions, such as tax incentives or grants, could also encourage investment in smart technologies, making it feasible for firms to acquire the necessary tools and training.

6. Integrate Advanced Technologies

Explore emerging innovations like AI-driven specification tools, digital twins, and dynamic online spec platforms that enhance precision and allow real-time validation of specification compliance. Pilot programs on flagship smart projects can demonstrate these technologies' effectiveness and build industry confidence in their adoption.

7. Address Infrastructure Barriers

Finally, systemic challenges like unreliable power supply and inadequate broadband, which Kennedy & Kabari (2024) identified as deterrents to smart building investments, must be addressed. Stable infrastructure justifies the design and specification of sophisticated smart systems and ensures they function as intended once installed.



Conclusion

Clear and comprehensive specifications are indispensable for realizing the full benefits of smart buildings in Nigeria. By adopting standardized processes, leveraging modern digital tools, building professional capacity, and addressing broader infrastructural and regulatory gaps, the Nigerian construction industry can overcome current deficiencies. These measures will help ensure that architectural drawings and specifications fully capture smart building requirements, leading to higher-quality, more reliable, and sustainable built environments.

REFERENCES

- ACEEE. (2017). A. E. C. E. E. *Using smart technology to save energy in existing buildings*. American Council for an Energy-Efficient Economy. <https://www.aceee.org/sites/default/files/publications/researchreports/a1701.pdf>
- Adewale, B., Oluwatayo, A. A., Uwakonye, O. U., & Ogunkoya, A. B. (2018). Shortfalls of specification writing in Nigerian architectural practice. *International Journal of Civil Engineering and Technology*, 9(7), 497–506.
- Adewumi, Bamidele J., Onamade, Akintunde O. Asaju, Opeyemi A; Adegbile, Michael B.O. (2023). Impact of Architectural Education on Energy Sustainability in Selected Schools of Architecture in Lagos Megacity. *Caleb International Journal of Development Studies*, 6(2), 209-218
- Adewumi, B. J., Onamade, A. O., David-Mukoro, K. D., Bamiloye, M. I., Otuonuyo, G. A., Chukwuka, O. P., & Oru, T. O. (2025). Quality reassurance in construction project: Leveraging specifications for standards and testing materials/workmanship. *International Journal of Research and Innovation in Social Science*, 9(3), 1662–1672. <https://doi.org/10.47772/IJRISS.2025.90300131>
- Alugbue, W. K., Otuonuyo, G. A., Adewumi, B. J., Onamade, A. O., & Asaju, O. A. (2024). Impact of specification on construction administration for project management within Lagos megacity. *International Journal of Research and Innovation in Social Science*, 8(III Special Issue), 4664–4670. <https://doi.org/10.47772/IJRISS.2024.803340S>
- Atamewan, E. E. (2022). Smart building projects in Nigeria: The role of architects. *Unicross Journal of Science and Technology*, 1(1), 1–14.
- Baharetha, S., Soliman, A. M., Hassanain, M. A., Alshibani, A., & Ezz, M. S. (2024). Assessment of the challenges influencing the adoption of smart building technologies. *Frontiers in Built Environment*, 9, 33–40. <https://doi.org/10.3389/fbuil.2023.1334005>
- Bamidele J. Adewumi; Akintunde O. ONamade; Felix A. Onyikelio; George A. Otuonuyo; Oluwole A. Alagbe; Michael B. O., Adegbile & Matthew A. Dayomi (2025b). Who Benefits? A deep Dive into the Social and Economic Impact of Cooperative Housing Estate in Lagos Megacity. *UNIABUJA Journal of Engineering and Technology*, 2(1), 104-117.
- Ejidike, C. C., Mewomo, M. C., & Anugwo, I. C. (2024). Assessment of construction professionals' awareness of the smart building concepts in the Nigerian construction industry. *Journal of Engineering, Design and Technology*, 22 (5), 1491–1504. <https://doi.org/10.1108/JEDT-05-2022-0263>
- Emesiobi, T. A., Otuonuyo, G. A., Adewumi, B. J., Asaju, O. A., & Onamade, A. O. (2024). Specification: A key tool for efficient facility management in Lagos megacity. *International Journal of Research and Innovation in Social Science*, 8(4), 3417–3426.
- Faremi, J. O., Ajayi, O. O., Zakariyyah, K. I., & Sotunbo, A. S. (2021). Sustainable facilities management for smart buildings: A case study of the Heritage Place, Lagos. *LAUTECH Journal of Civil and Environmental Studies*, 7(1), 146–160.
- Frontiers in Built Environment. (2023). Assessment of the challenges influencing the adoption of smart building technologies (Ejidike & Mewomo, and related authors). *Frontiers*. <https://www.frontiersin.org/articles/10.3389/fbuil.2023.1334005/full>
- GSA (General Services Administration). (2024). *Building Technologies Technical Reference Guide (BTTRG) — Smart building design and implementation guidance* (Version 3.0). U.S. General Services Administration. https://www.gsa.gov/system/files/Building_Technologies_Technical_Reference_Guide_%28BTTRG%29_Version_3.0_%28REDACTED_Final%29_May2024.pdf



**AUGUST, 2025 EDITIONS. INTERNATIONAL JOURNAL OF:
BUILT ENVIRONMENT & EARTH SCIENCE VOL. 9**

- Hassan, T.A., Adewumi, B.J., & Olukunga, O.A. (2024). An Empirical Review on Affordable Housing Estate Using Vernacular Architecture in Lagos State. *EKSU Journal of the Management Scientists*, 3 (1), 218-224
- IAEME / IJCIET & related journals. (2021). *Shortfalls of specification writing in Nigerian construction practice*. IAEME / IJCIET. https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_9_ISSUE_7/IJCIET_09_07_051.pdf
- IEA EBC Annex 81. (2023). *Data-driven smart buildings: State-of-the-art review* (Annex 81 Report). International Energy Agency — Energy in Buildings and Communities Programme. [https://annex81.iea-ebc.org/Data/publications/Annex%2081%20State-of-the-Art%20Report%20\(final\).pdf](https://annex81.iea-ebc.org/Data/publications/Annex%2081%20State-of-the-Art%20Report%20(final).pdf)
- ISO. (2015). *ISO 9001:2015 — Quality management systems — Requirements*. International Organization for Standardization. <https://www.iso.org/standard/62085.html>
- Kennedy, G. W., & Kabari, A. D. (2024). Evaluation of architecture, engineering and construction professionals' adoption of smart building practices from conceptualization to construction in Abuja, Nigeria. *International Journal of Engineering and Modern Technology*, 10(2), 131–146. <https://doi.org/10.56201/ijemt.v10.no2.2024.pg131.146>
- Mohammed, H. (2022). *Building Information Modeling and Internet of Things Integration in the Construction Industry: A Scoping Study*. *Advances in Civil Engineering*.
- NIST. (2024). *Cybersecurity guidance for smart building technologies / technical reports* (NIST Technical Series). National Institute of Standards and Technology. <https://nvlpubs.nist.gov/nistpubs/ir/2024/NIST.IR.8498.ipd.pdf>
- Olanrewaju, O. I., Chileshe, N., & Babarinde, S. A. (2020). Investigating the barriers to building information modeling (BIM) implementation within the Nigerian construction industry. *Engineering, Construction and Architectural Management*, 27 (10), 2931–2958.
- Omorogiuwa, E., & Temitope, I. (2019). Design optimization and implementation of smart building management system in Nigeria. *Journal of Instrumentation and Innovation Sciences*, 4(3), 1–16.
- Opeyemi A. Asaju; Bamidele J. Adewumi; Akintunde O. Onomade & Oluwode A. Alagbe (2024). Environmental Impact on Energy Efficiency of Architectural Studies in Selected Territory Institutions in Lagos Mega-City, Nigeria. *Gen-Multidisciplinary Journal of Sustainable Development*, 2(1), 29-37.
- Oru, T.O., Adewumi, B.J., & Asaju, O.A. (2024). A Comparative Study on Improving Energy-Efficiency in Multi-Apartment Residential Buildings. *EKSU Journal of the Management Scientists*, 3(1), 255-267.
- Owolabi, T. O. S., Harry, E. G., Adewumi, B. J., Onamade, A. O., & Alagbe, O. A. (2024). Ensuring quality in construction projects: The role of specifications as quality assurance tools. *Anchor University Journal of Science and Technology*, 5(2), 181–191. <https://doi.org/10.4314/aujst.v5i2.3>
- ScienceDirect / Elsevier. (2025). *Mitigating construction waste in Nigeria: The role of Building Information Modelling (BIM)*. (Article discussing BIM adoption and benefits in Nigerian practice). <https://www.sciencedirect.com/science/article/pii/S272912525000508>
- Toyin, J. O., & Mewomo, M. C. (2023). An investigation of barriers to the application of building information modelling in Nigeria. *Journal of Engineering, Design and Technology*, 21 (2), 442–468. <https://doi.org/10.1108/JEDT-10-2021-0594>