IJAAR PUBLISHING®

African Journal of Environment and Sustainable Development | ISSN: 3027-2718
Vol. 3, Issue 3 (2025) | www.ijaar.org

ASSESSMENT OF ARCHITECTS' KNOWLEDGE AND ACCEPTABILITY OF SMART BUILDING CONCEPTS IN LAGOS STATE, NIGERIA

O. D. ODEBIYI[1], C. T. ODEFADEHAN[2], W. U. DANJUMA[3], D. A. OLOFU[4].

[1,2,3,4] Department of Architecture, College of Postgraduate Studies,
Caleb University, Imota, Lagos State, Nigeria

Corresponding Author's Email: debbythewriter02@gmail.com

Other author's email:
christian.odefadehan@calebuniversity.edu.ng

ABSTRACT

Smart buildings are reshaping the design and operation of structures, with benefits in energy efficiency, occupant comfort, and safety. However, the uptake of smart building concepts among Nigerian architects remains limited, potentially affecting the nation's sustainable building goals. This study assesses the knowledge and acceptance of smart building concepts among architects in Nigeria. Using a mixed-methods approach, the research combines a survey and semi-structured interviews with practicing architects. The survey evaluates architects' familiarity with smart technologies, such as automation systems, sensors, and data analytics, while exploring their perceptions of its benefits and challenges, and providing deeper insights into architects' experiences and views on integrating smart technologies into building design. The study's findings will offer a clearer picture of smart building practices in Nigeria and propose strategies to boost its adoption in the construction industry. It will also highlight knowledge gaps and obstacles hindering the adoption of smart concepts. These outcomes aim to inform policymakers and stakeholders in developing initiatives to support smart building integration in the country's construction sector.

Keywords: Smart Building Concept, Architect, Knowledge, Acceptability, Energy Efficiency.

O. D. Odebiyi, C. T. Odefadehan, W. U. Danjuma & D. A. Olofu. (2025). Assessment of Architects' Knowledge and Acceptability of Smart Building Concepts in Lagos State, Nigeria. *African Journal of Environment and Sustainable Development. 3*(3), 58-74. DOI: https://doi.org/10.5281/zenodo.17053142

1.0 INTRODUCTION

Smart buildings have emerged as a transformative concept in the design and construction of structures, utilizing advanced technologies to optimize energy consumption, enhance occupant comfort and safety, and reduce operational costs (Cyril et al., 2022). These buildings integrate various smart technologies, including building automation systems, sensors, and data analytics, contributing significantly to sustainable and resilient building practices (Mewomo et al., 2022). Despite their potential, the knowledge and acceptability of smart building concepts among architects in Nigeria remain limited, which poses a challenge to achieving sustainable development in the country's construction sector.

Recent studies conducted globally have examined the adoption of smart building technologies among architects. For instance, Mewomo, Ogunbiyi, and Dahunsi (2022) explored awareness and perceptions of smart building concepts among construction professionals in Nigeria, revealing a general awareness but limited understanding of specific technologies. The study highlighted that architects exhibited a relatively higher level of awareness compared to other construction professionals, indicating the necessity for targeted education and training initiatives to enhance understanding and utilization of these technologies.

The challenges associated with incorporating smart technologies in building design and construction are multifaceted. Key obstacles include high implementation costs, inadequate awareness among construction professionals, lack of interoperability among systems, insufficient technical expertise, and concerns regarding data privacy and security (Mewomo et al., 2022). Additionally, integrating diverse systems and retrofitting existing buildings with smart technologies presents further complexities. To overcome these challenges, a collaborative approach involving stakeholders in the construction industry is essential. This collaboration should focus on raising awareness, providing education on smart building concepts, establishing interoperability standards, and investing in research and development (Mewomo et al., 2022).

Despite these obstacles, significant opportunities for adopting smart building technologies exist. Improved energy efficiency through advanced controls, predictive analytics, and real-time monitoring can lead to substantial cost savings and environmental benefits (Cyril et al., 2022). Moreover, smart technologies can enhance occupant comfort and productivity by providing features like automated climate control and lighting optimization, which create more pleasant living and working environments. Additionally, real-time monitoring systems contribute to safety by enabling prompt responses to emergencies and detecting potential hazards (Amaral et al., 2013).

Aligning with sustainable development goals, the integration of smart building technologies can significantly reduce carbon emissions and optimize resource use. The potential for energy management systems (EMS) and renewable energy technologies, such as solar photovoltaic systems, can lead to considerable energy savings while promoting environmental sustainability. The adoption of these technologies can enhance the overall value of buildings, extending the lifespan of assets and reducing operational costs.

In Nigeria, research on the knowledge and acceptability of smart building concepts among architects is still limited (Mewomo et al., 2022). Surveys in Lagos indicate that only a small percentage of architects are familiar with smart building technologies, underscoring the urgent need for education and training. Addressing these gaps is critical for promoting the adoption of smart building technologies, ultimately leading to improved energy efficiency and sustainability in the Nigerian construction industry.

In conclusion, this study will provide insights into architects' knowledge and acceptance of smart building concepts in Nigeria, highlighting barriers and opportunities for integration. It aims to contribute to the global discourse on smart building technologies and identify strategies for fostering their adoption within the Nigerian context.

2.0 LITERATURE REVIEW

The integration of smart building technologies into urban architecture is crucial for enhancing sustainability and efficiency in modern designs. Smart buildings leverage advanced systems to optimize energy use, improve occupant comfort, and reduce environmental impacts. This literature review explores the definitions, components, characteristics, benefits, history, and recent developments in smart buildings, particularly focusing on their applications in Nigeria. Smart Buildings are technologically advanced and highly connected structures that leverage integration, automation, and connectivity to optimize building performance, enhance occupant comfort, and improve operational efficiency. These buildings utilize a network of sensors, devices, and systems to collect and analyze data in real time, enabling intelligent decision-making and responsive actions (Mardacany, 2014).

Smart buildings consist of interconnected components, such as sensors, control systems, and communication networks, that work together to enhance building performance.

Key Objectives:

1. Energy Optimization: Smart buildings monitor and analyze data in real time to adjust heating, cooling, and lighting systems, optimizing energy usage while maintaining occupant comfort.
2. Occupant Comfort: They provide personalized controls for temperature and lighting, automated shading, and air quality monitoring, tailoring the environment to individual preferences for a more comfortable experience.
3. Functionality Integration: Smart buildings integrate various systems, including security (access control, video surveillance, and emergency response) and smart appliances, ensuring seamless connectivity and convenience.

The interconnectivity of these components allows for data exchange, enabling informed decision-making and operational optimization, leading to improved energy efficiency, enhanced comfort, streamlined functionality, and increased sustainability (Ruiz *et al.*, 2023).

These components can be categorized into the following:

Sensors and Actuators

Sensors and actuators are essential components of smart buildings that play a crucial role in collecting data and enabling automated control.

Sensors are devices that measure physical phenomena such as temperature, humidity, light, motion, and occupancy in buildings. They convert these measurements into electrical signals for monitoring and adjusting building systems in real time.

Actuators, in contrast, respond to signals from sensors or control systems to perform physical actions. They control various systems, including HVAC, lighting, shading, and security. For example, motorized blinds can adjust natural light levels, and smart thermostats can regulate temperature based on occupancy. (Alsafery *et al.*, 2023)

By integrating sensors and actuators, smart buildings can gather data on environmental conditions and occupant behavior, enabling automatic adjustments that enhance energy efficiency, comfort, and safety.

Building Automation Systems (BAS)

Building Automation Systems (BAS) are essential for smart buildings, offering centralized control, monitoring, and optimization of various systems. They integrate data from sensors, devices, and subsystems to manage various functions. Utilizing advanced software, hardware, and communication protocols, BAS facilitates seamless integration and coordination of building systems. They provide operators with a centralized interface to monitor and control building performance. By analyzing data from sensors and other sources, BAS can optimize system operations for greater efficiency. (Vijayan *et al.*, 2020)

The automation capabilities of BAS include scheduling HVAC based on occupancy patterns, adjusting lighting based on daylight availability, and optimizing energy use through demand response strategies. They also support fault detection and diagnostics, alerting operators to any abnormalities or inefficiencies.

Internet of Things (IoT) Connectivity

The Internet of Things (IoT) is defined as a network of interconnected physical devices, objects, and sensors that can collect, exchange, and share data over the Internet, according to a study by Havard, McGrath, Flanagan, and MacNamee (2018). These devices are embedded with sensors, actuators, and communication capabilities, allowing them to interact with their environment and perform tasks autonomously or with minimal human intervention.

In smart buildings, Internet of Things (IoT) technology enables the integration and connectivity of various systems, such as HVAC, lighting, security, and energy management. These interconnected devices communicate with each other, gather real-time data, and respond intelligently to optimize energy use, enhance operational efficiency, and improve occupant comfort.

IoT facilitates centralized monitoring and control of building systems, allowing for the collection and analysis of data related to energy usage, occupancy patterns, and environmental conditions. This data-driven approach enables informed decision-making and the implementation of energy-saving strategies.

IoT connectivity serves as the backbone of smart buildings, allowing devices like environmental sensors, smart thermostats, and lighting controls to work together. This integration supports remote management, advanced analytics, and machine learning, leading to better building performance.

Overall, IoT transforms smart buildings into intelligent systems that enhance efficiency, functionality, and sustainability through automation and data insights. (Shah *et al.*, 2022)

2.1 Conceptual Review

Smart buildings represent a significant advancement in building design, focusing on energy efficiency, occupant comfort, and security through the integration of advanced technologies. In the context of Nigeria, where the adoption of intelligent building systems is still in its infancy, understanding the conceptual frameworks and factors influencing the acceptance of smart building concepts is crucial.

Key Concepts

AUTOMATED LIGHTING AND TEMPERATURE CONTROL SYSTEMS:

a. These systems utilize sensors and actuators to monitor and adjust environmental conditions, ensuring optimal energy usage and comfort.
b. By responding to real-time data on occupancy and environmental changes, they can significantly reduce energy waste while enhancing the occupant experience. (Gunarathne *et al.,* 2019)

ENERGY-EFFICIENT APPLIANCES AND FIXTURES:

a. The integration of energy-efficient technologies in buildings can substantially lower operational costs and energy consumption.
b. This aligns with Nigeria's broader goals for sustainability and energy conservation, addressing the pressing need for efficient energy use amidst growing demand. (Chel & Kaushik, 2018)

INTEGRATED SECURITY SYSTEMS:

a. Smart buildings incorporate integrated security solutions, including surveillance, access control, and alarm systems, enhancing safety for occupants.
b. Given the security challenges in Nigeria, these systems are essential for fostering safer living and working environments. (Metallidou *et al.,* 2020)

ADVANCED DATA ANALYTICS TOOLS:

a. Utilizing data analytics platforms enables facility managers to gain insights into building performance.
b. By analyzing data collected from various building systems, these tools help identify inefficiencies, optimize maintenance, and support informed decision-making. (Yang & Bayapu, 2020)

The adoption of smart building concepts in Nigeria can be understood through various theoretical frameworks that address the factors influencing architects' knowledge and acceptance of these technologies.

Technology Acceptance Model (TAM):

This model suggests that perceived ease of use and perceived usefulness significantly influence individuals' decisions to accept and use technology.

In the context of smart buildings, architects' perceptions of the benefits and usability of intelligent systems will likely impact their willingness to incorporate such technologies in their designs (Natasia *et al.* 2022).

Diffusion of Innovations Theory:

This theory posits that the adoption of new technologies occurs through a social process influenced by communication channels, the perceived advantages of innovations, and the adoption rate within social systems. It offers a framework for understanding the interplay between innovations, individuals, and the broader social context in driving change and improving the fit between products or behaviors and the needs of individuals and groups

(Wani & Ali, 2015). Understanding how smart building concepts can diffuse within the Nigerian context will be essential for increasing awareness and promoting adoption.

2.2 Theoretical Review

This study employs several theoretical frameworks to explore the knowledge and acceptance of smart building concepts among architects in Nigeria. The frameworks include:

Social Constructionism

Social constructionism posits that our understanding of reality is shaped by language, culture, and societal influences rather than being fixed or objective. This framework suggests that architects' perceptions of smart building concepts are constructed through social interactions, professional networks, and cultural norms. By examining these dynamics, the research aims to understand how architects' knowledge of sustainability and energy efficiency is influenced by the prevailing discourses within their professional community (Burr & Dick, 2017; Andrews, 2012).

Architectural Determinism

Architectural determinism suggests that the design and layout of buildings directly influence human behavior and interactions. This perspective asserts that while the built environment significantly impacts occupants' experiences, it is only one factor among many that shapes behavior. The research acknowledges that social, cultural, and psychological factors also play crucial roles in determining how individuals respond to their physical surroundings (Broady, 2017).

Technological Determinism

Technological determinism views technology as a primary driver of social change. This framework highlights how technological advancements shape societal structures and behaviors. However, it also acknowledges that social and cultural factors interact with technology, shaping its development and implementation. By adopting this nuanced perspective, the study seeks to explore the complex interplay between technology and society, recognizing that both influence each other (Wyatt, 2008; Dafoe, 2015).

2.3 Empirical Review

Architects play a crucial role in the design and development of intelligent buildings. They are responsible for translating the vision and requirements of clients into functional and aesthetically pleasing building designs. In the context of smart buildings, architects have the unique opportunity to integrate advanced technologies and innovative solutions into their designs, creating buildings that are not only visually appealing but also highly functional, sustainable, and energy-efficient.

The knowledge and acceptability of smart building concepts among architects are of utmost importance. Architects need to have a deep understanding of the principles, technologies, and benefits associated with smart buildings. This includes familiarity with concepts such as automation systems, IoT, data analytics, renewable energy integration, and sustainable design practices. They should also keep up with the latest advancements and trends in smart building technologies to stay at the forefront of the field. (Bali *et al.*, 2019)

By embracing smart building concepts, architects can contribute to the creation of buildings that meet the evolving needs of society. Intelligent buildings are designed to adapt to changing user requirements, optimize energy consumption, enhance occupant comfort and well-being, and minimize environmental impact. Architects who are knowledgeable and

accepting of smart building concepts can bring these benefits to their projects, creating spaces that are not only visually stunning but also technologically advanced and sustainable.

Additionally, architects have a role in advocating for smart building concepts and promoting their importance to clients, stakeholders, and the industry as a whole. By educating clients about the potential benefits and long-term cost savings of smart buildings, architects can drive the adoption of these concepts and influence decision-making processes. They can also collaborate with other professionals, such as engineers, contractors, and facility managers, to ensure the successful implementation and operation of intelligent building systems. (Jia *et al.*, 2019)

Architects play a crucial role in creating intelligent buildings by integrating advanced technologies and sustainable design principles into their projects. Their knowledge and acceptability of smart building concepts are essential to leverage the full potential of these technologies and create buildings that are efficient, sustainable, and responsive to user needs.

Emphasizing the importance of smart building concepts among architects is vital for advancing the field and realizing the benefits of intelligent buildings in our built environment.

There is a need for architects to have enhanced education and experience to play a leading role in the development of intelligent buildings, particularly in Nigeria. Some reasons are:

Enhanced Education: The implementation of intelligent buildings requires specialized knowledge and skills beyond traditional architectural training. Architects need to be educated about the latest technologies, building automation systems, energy-efficient design principles, and data analytics. This knowledge equips them to understand the complexities of integrating intelligent systems into building designs and to effectively collaborate with other stakeholders involved in the procurement process. (Almusaed *et al*., 2023)

Experience: Experience plays a vital role in successfully delivering intelligent buildings.

Architects with prior experience in designing and implementing smart building projects have a better understanding of the challenges, best practices, and emerging trends in this field. They can draw from their past experiences to navigate complexities, mitigate risks, and make informed decisions throughout the project lifecycle. (Kim *et al*., 2022)

Taking the Lead: Architects are often the primary designers and coordinators of building projects. By taking the lead in the procurement of intelligent buildings, architects can ensure that smart building concepts are integrated seamlessly into the design and construction process. Their expertise can guide the selection of appropriate technologies, consideration of sustainability factors, coordination with other disciplines, and adherence to relevant standards and regulations. (Baduge *et al*., 2022)

Nigerian Context: The specific mention of Nigeria highlights the need for architects in the country to take a proactive role in the procurement of intelligent buildings. Nigeria is experiencing rapid urbanization and a growing demand for sustainable infrastructure. Architects, being at the forefront of building design and construction, are well-positioned to drive the adoption of intelligent building concepts and technologies in the Nigerian context. By acquiring the necessary knowledge, skills, and practical experience, architects can effectively incorporate intelligent systems into building designs, contribute to sustainable development, and shape the future of building construction in Nigeria. (Eseosa & Temitope, 2019)

2.4 Summary and Research Gap

While there is a growing body of research globally on smart buildings and their benefits, there is limited research that specifically examines the perspectives and experiences of architects in Nigeria regarding smart building concepts. Hence, the research gap identified in this study is the lack of comprehensive research specifically focused on assessing the knowledge and acceptability of smart building concepts among architects in Nigeria.

Furthermore, the existing studies do not fully address the unique challenges and contextual factors present in Nigeria that could influence architects' understanding and acceptance of smart building concepts. These factors could include limited access to resources, technological infrastructure, and training opportunities; or the relevance of smart building concepts to local, environmental, cultural, and regulatory contexts. (Ejidike, 2022)

By addressing this research gap, this study aims to provide a deeper understanding of the current level of awareness and acceptance of smart building concepts among architects in Nigeria and ultimately contribute to the existing body of knowledge by providing valuable insights into the perspectives of architects in Nigeria and identifying areas that require attention or targeted interventions to promote the adoption and implementation of smart building concepts in the Nigerian architectural industry.

3.0 METHODOLOGY

This study utilizes a descriptive research design to examine architects' knowledge and acceptance of smart building concepts in Nigeria. A quantitative research approach was adopted to collect and analyze numerical data regarding the architects' familiarity with, and openness to, these concepts. Data were gathered through a structured online questionnaire, distributed via Google Forms, which included closed-ended questions aimed at assessing levels of knowledge and acceptance among a representative sample of architects in Lagos, Nigeria.

3.1 Research Design and Philosophy

The research employs a pragmatist philosophy, emphasizing practical, actionable insights into architects’ awareness and receptivity toward smart buildings. This approach is well-suited for generating practical recommendations to enhance understanding and acceptance of smart building concepts. The quantitative design allows for objective, measurable data collection, suitable for statistical analysis to identify patterns and trends.

3.2 Population and Sample

The population for this study comprises architects practicing in Lagos, Nigeria, with a total population size of 1,279, based on prior studies, and a desired sample size estimated at 140. Due to logistical constraints, the representative sample was selected using random sampling techniques to ensure diverse perspectives. This sample size provides a reliable basis for generalizing findings across the architectural community in Lagos, Nigeria.

3.3 Data Collection Method

Data was collected through an online questionnaire administered via Google Forms, allowing efficient and broad-reaching data gathering. The structured questionnaire, designed for clarity and relevance, assessed architects' knowledge and opinions on smart building concepts. Participants could conveniently access the questionnaire link and respond electronically, ensuring a secure and manageable data collection process.

3.4 Data Analysis

Upon collection, responses were analyzed using statistical methods, including frequency, percentage, and correlation analyses, to summarize and interpret the data. This quantitative analysis provided insights into the relationship between architects' knowledge and their acceptance levels of smart building concepts in Nigeria, offering an evidence-based understanding of current trends.

4.0 FINDINGS AND DISCUSSION

This research was carried out to assess the knowledge and acceptability of architects on the topic of smart building concepts in Lagos State, Nigeria. It also served to assess the level of awareness of smart building concepts among architects in Lagos, as well as what factors could influence architects' perceptions of these concepts.

4.1 Demographic Information

4.1.1 Gender

The gender distribution among respondents showed a slight male majority, with 58.8% male and 41.2% female participants. This distribution provides a balanced perspective for analyzing gender-specific insights, particularly in how male and female architects in Lagos might differ in their understanding and adoption of smart building concepts.

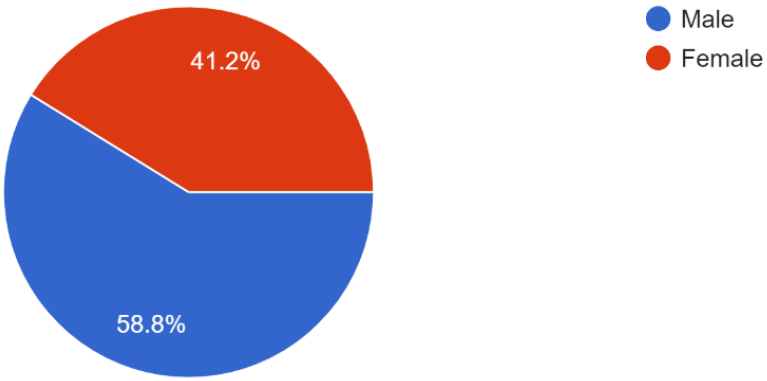


Fig 1. Gender distribution of respondents

4.1.2 Age Distribution

The age distribution of respondents was skewed towards younger professionals, with 36.5% between 0-25 years and 34.5% between 26-35 years. This means over 70% of respondents were under 36, highlighting a predominantly youthful demographic. This concentration among younger architects may indicate a potentially greater openness to new technology, such as smart building concepts. Meanwhile, a smaller portion, 29% of respondents, were aged 36 and above, providing additional perspectives that could reflect more traditional practices and possible resistance or cautious adoption of newer technologies in architectural design.

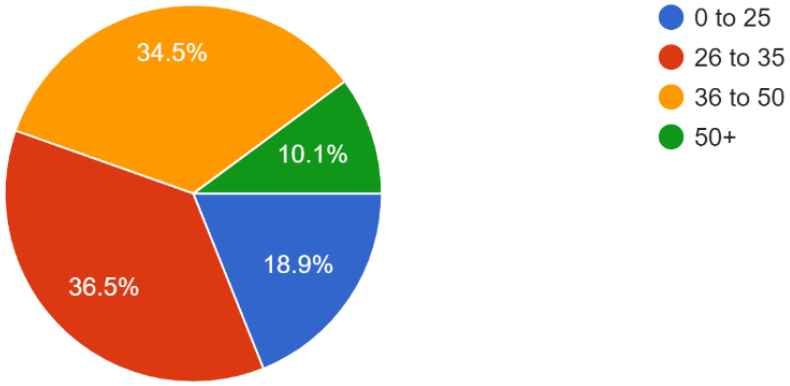


Fig 2. Distribution of respondents by age

4.1.3 Professional Designation Distribution

The designation distribution shows a higher proportion of Junior Architects at 38.5%, followed by Senior Architects at 27%. Freelance Architects comprised 18.2% of respondents, while Principal Architects represented 16.2%. This distribution indicates that a substantial portion of the survey population is early in their career, likely bringing fresh perspectives and a willingness to adopt new trends, including smart building technologies. However, the presence of more experienced professionals, such as Senior and Principal Architects, suggests a balanced range of perspectives, from innovative approaches to more established, conventional practices.

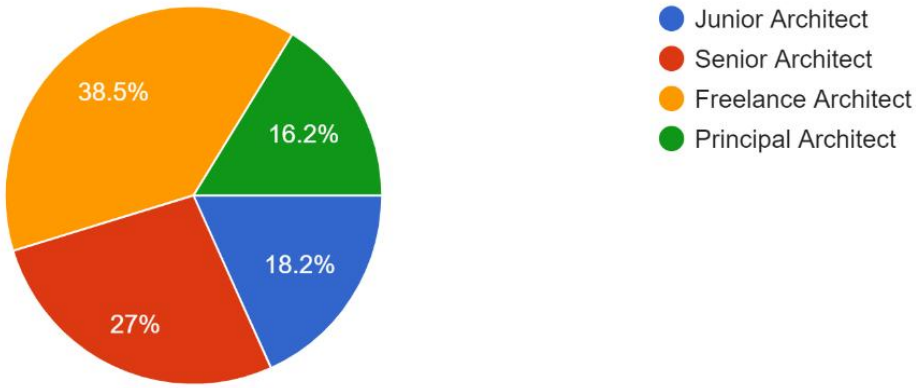


Fig 3. Distribution of respondents by professional designation

4.1.4 Educational Qualification Distribution

The educational qualifications of respondents show that a majority hold a Master's degree (62.8%), with a smaller proportion holding an HND or Bachelor's degree (23%), and an even smaller percentage having a PhD (14.2%). This indicates that most of the respondents possess advanced knowledge and skills in architecture, which may correlate with a stronger understanding and openness toward complex concepts like smart building technologies. The high number of Master's degree holders suggests a well-educated group, potentially more inclined to explore and integrate innovative design solutions.

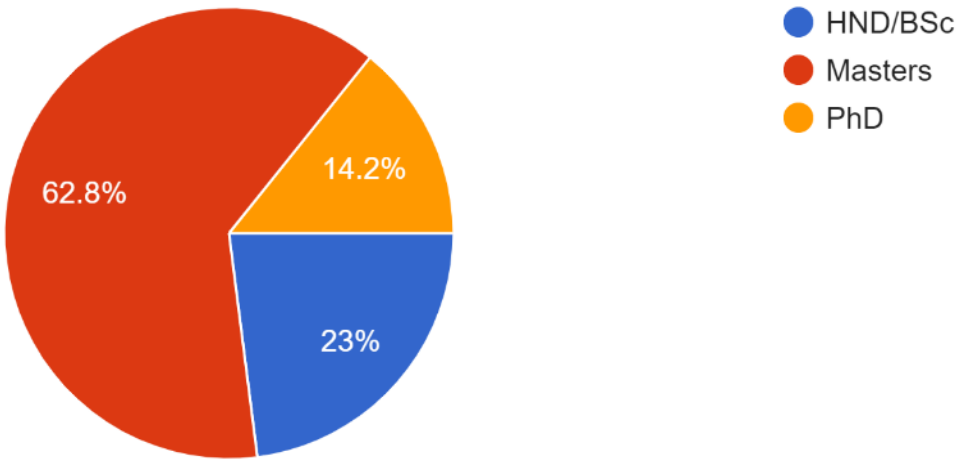


Fig 4. Distribution of respondents by educational qualification

4.2 Awareness and Understanding of Smart Building Concepts

Architects showed a moderate to high level of knowledge about smart buildings, with 50% rating their familiarity as moderate. Most viewed knowledge in this area as important, with 62.8% rating it as very or extremely important. Efficiency (80.4%), security (77%), and energy savings (73%) were the most appealing functionalities of smart buildings. While 29.1% of respondents were willing to pursue further training on smart technologies, 47.3% were open to it depending on circumstances, indicating a general interest in enhancing expertise in this field.

4.3 Factors Influencing Architects' Attitudes and Perceptions toward Smart Building Concepts

Most architects (56.1%) reported involvement in smart building projects, indicating active engagement in the field. However, significant barriers were identified in adopting smart building concepts. Cost considerations (75.7%) and lack of awareness and education (73%) were the most frequently cited challenges, followed by insufficient client demand (66.2%) and lack of supportive facilities (40.5%). Additionally, 31.8% noted industry resistance to change as a limiting factor. These insights suggest that while interest and involvement exist, several external factors hinder the wider adoption of smart building concepts in architecture.

4.3 State of Smart Building Technology Adoption in the Nigerian Construction Industry

The adoption of smart building concepts (SBCs) in architecture shows varied levels across building types and technologies. A majority of architects (56.1%) actively promote SBCs, with high adoption in office/business and educational buildings. Key technologies like video surveillance, HVAC systems, and security doors are widely integrated, especially in new, purpose-built structures (42.6%). However, adoption in the Nigerian construction industry remains moderate to low overall, with interest tempered by cost and other challenges.

4.4 Summary of Key Findings

This research aimed to assess architects' knowledge and acceptability of smart building concepts (SBCs) in Lagos State, Nigeria, as well as the factors influencing their perceptions. The findings reveal that 50% of architects have a moderate understanding of SBCs, and while many (35.8%) recognize the importance of SBC knowledge, nearly half (47.3%) are

uncertain about undergoing further training. Cost considerations were identified as a major influencing factor (75.7%) in the adoption of SBCs. Adoption is higher in residential, educational, and office buildings, compared to industrial and institutional structures. Additionally, architects extensively incorporate technologies like video surveillance and integrity perimeter doors into their projects.

Overall, these findings suggest that while architects in Lagos are moderately knowledgeable about smart building concepts, challenges related to cost, client demand, and education continue to influence adoption. This research provides valuable insights that can help shape future policies and training programs to foster the integration of smart building technologies in the Nigerian construction industry.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This research has assessed the knowledge and acceptability of smart building concepts among architects in Lagos State, highlighting the importance of architects' perspectives in shaping the adoption of these technologies within the Nigerian construction industry. As leaders of construction teams, architects significantly influence the integration of design and technological advancements.

The findings reveal that architects' perceptions of smart building concepts directly impact the rate of adoption of these technologies in the construction sector. The study indicates that these advancements are not only beneficial for the built environment and construction professionals but also enhance the experiences of building occupants.

Through an online survey, participants rated their understanding of smart building concepts and expressed opinions on the significance of this knowledge in the industry. The evaluation identified various factors influencing architects' attitudes toward smart building concepts, revealing that residential, educational, and commercial buildings were most commonly associated with the integration of smart technologies.

5.2 Recommendations

Based on the findings of this research, the following recommendations are made for architects and other construction professionals in Lagos State and Nigeria as a whole, concerning the adoption and integration of smart building concepts:

1. Further Research on Perceptions and Adoption: It is essential to understand the perceptions of architects and construction professionals towards emerging technologies like smart building concepts. Ongoing research is recommended to explore how these concepts can be further integrated into Nigeria's construction industry.
2. Advancement of Technology: The level of technological infrastructure in Nigeria plays a critical role in the effective adoption of smart building concepts. As technology continues to evolve, further studies should be conducted to adapt smart building solutions to the latest advancements, ensuring that current systems remain relevant as innovations emerge.
3. Addressing Cost Barriers: Cost remains the primary factor hindering the adoption of smart building concepts. Given the high initial investment required, stakeholders must explore financial support mechanisms to facilitate the seamless integration of these technologies into projects, particularly in the early stages.

4. Ongoing Studies and Solutions: Future research should focus on identifying barriers to the widespread adoption of smart building concepts and developing strategies to overcome these challenges. Continuous examination of emerging trends and solutions will help shape a more sustainable and efficient adoption process.

REFERENCES

Adejimi, A. (2022). Intelligent Buildings and the Role of Architects in the New Millennium. Congress Seminar Paper.

Alsafery, W., Rana, O., & Perera, C. (2023). Sensing within smart buildings: A survey. ACM Computing Surveys, 55(13s), 1-35.

Amaral, J., Reis, C., & Brandão, R. M. (2013). Energy management systems. In 2013 48th International Universities' Power Engineering Conference (UPEC) (pp. 1-6). IEEE.

Andrews, T. (2012). What is social constructionism? *Grounded theory review*, *11*(1).

Baduge, S. K., Thilakarathna, S., Perera, J. S., Arashpour, M., Sharafi, P., Teodosio, B., ... & Mendis, P. (2022). Artificial intelligence and smart vision for building and construction 4.0: Machine and deep learning methods and applications. Automation in Construction, 141, 104440.

Bali, M., Half, D. A., Polle, D., & Spitz, J. (2019). Smart building design: conception, planning, realization, and operation. Birkhäuser.

Bang, H., Shu, S., & Weber, E. (2020). The role of perceived effectiveness on the acceptability of choice architecture. Behavioural Public Policy, 4(1), 50-70. https://doi.org/10.1017/bpp.2018.1

Benavente-Peces, C. (2019). On the energy efficiency in the next generation of smart buildings—Supporting technologies and techniques. Energies, 12(22), 4399. https://doi.org/10.3390/en12224399

Broady, M. (2017). Social theory in architectural design. In P. Brown & S. Gulliver (Eds.), People and buildings (pp. 170-188). Routledge.

Burr, V., & Dick, P. (2017). Social constructionism (pp. 59-80). In P. Harper (Ed.), Handbook of qualitative research methods in psychology (Vol. 1). Palgrave Macmillan UK.

Chel, A., & Kaushik, G. (2018). Renewable energy technologies for sustainable development of energy efficient building. Alexandria engineering journal, 57(2), 655-669.

Cyril, C. E., Modupe, C. M., & Iruka, C. A. (2022). Assessment of construction professionals' awareness of the smart building concepts in the Nigerian construction industry. Emerald Publishing. Retrieved from https://www.emerald.com/insight/1726-0531.html

Dafoe, A. (2015). On technological determinism: A typology, scope conditions, and a mechanism. Science, Technology, & Human Values, 40(6), 1047-1076. https://doi.org/10.1177/0162243915589015

Davenport, T. H. (2018). From analytics to artificial intelligence. Journal of Business Analytics, 1(2), 73-80. https://doi.org/10.1080/2573234X.2018.1543535

Davis, F. D., Granić, A., & Marangunić, N. (2024). The technology acceptance model: 30 years of TAM. Switzerland: Springer International Publishing AG.

Domingues, P., Carreira, P., Vieira, R., & Kastner, W. (2016). Building automation systems: Concepts and technology review. Computer Standards & Interfaces, 45, 1-12. https://doi.org/10.1016/j.csi.2015.11.005

Ejidike, C. C. (2022). An assessment of the adoption of smart building concept in the Nigerian construction industry (Doctoral dissertation).

Elsevier Ltd. (2022). Editorial: AI and IoT Applications of Smart Buildings and Smart Environment Design, Construction and Maintenance [Journal pre-proof]. Building and Environment. Advance online publication. https://doi.org/10.1016/j.buildenv.2022.109968

Fântână, G. I., & Oae, S. A. (2013). Evolution of Smart Buildings. In International Conference on Environment, Energy, Ecosystems and Development (pp. 223-225).

Froufe, M. M., Chinelli, C. K., Guedes, A. L. A., Haddad, A. N., Hammad, A. W. A., & Soares, C. A. P. (2020). Smart Buildings: Systems and Drivers. Buildings, 10(9), 153. https://doi.org/10.3390/buildings10090153

Ghansah, F. A., Owusu-Manu, D.-G., Ayarkwa, J., Darko, A., & Edwards, D. J. (2022). Underlying indicators for measuring smartness of buildings in the construction industry. Smart and Sustainable Built Environment, 11(1), 126-142. https://doi.org/10.1108/SASBE-05-2020-0061

Ghansah, F. A., Owusu-Manu, D.-G., Ayarkwa, J., Edwards, D. J., & Hosseini, M. R. (2021). Exploration of latent barriers inhibiting project management processes in adopting smart building technologies (SBTs) in the developing countries. Construction Innovation, 21(4), 685-707. https://doi.org/10.1108/CI-07-2020-0116

Gunarathne, S. B. M. S. S., & Kalingamudali, S. R. D. (2019, February). Smart automation system for controlling various appliances using a mobile device. In 2019 IEEE international conference on industrial technology (ICIT) (pp. 1585-1590). IEEE.

Haenlein, M., Kaplan, A., Tan, C.-W., & Zhang, P. (2019). Artificial intelligence (AI) and management analytics. Journal of Management Analytics, 6(4), 341-343. doi:10.1080/23270012.2019.1699876.

Havard, N., McGrath, S., Flanagan, C., & MacNamee, C. (2018). Smart Building Based on Internet of Things Technology. In 2018 12th International Conference on Sensing Technology (ICST) (pp. 278-281). Limerick, Ireland. doi: 10.1109/ICSensT.2018.8603575.

Jia, M., Komeily, A., Wang, Y., & Srinivasan, R. S. (2019). Adopting Internet of Things for the development of smart buildings: A review of enabling technologies and applications. Automation in construction, 101, 111-126.

Julius Berger Nigeria. (n.d.). Construction of a high quality mixed-use tower according to Green Building Standards. Retrieved April 26, 2023, from https://www.julius-berger.com/references/nestoil-tower-lagos

Kim, D., Yoon, Y., Lee, J., Mago, P. J., Lee, K., & Cho, H. (2022). Design and implementation of smart buildings: A review of current research trend. Energies, 15(12), 4278.

Kruss, G., McGrath, S., Petersen, I.-H., & Gastrow, M. (2015). Higher education and economic development: The importance of building technological capabilities. International Journal of Educational Development, 43, 22-31. https://doi.org/10.1016/j.ijedudev.2015.04.011

Lawrence, T. M., Boudreau, M.-C., Helsen, L., Henze, G., Mohammadpour, J., Noonan, D., Patteeuw, D., Pless, S., & Watson, R. T. (2016). Ten questions concerning integrating smart buildings into the smart grid. Building and Environment, 108, 273-283. ISSN 0360-1323. https://doi.org/10.1016/j.buildenv.2016.08.022.

Maghsoodlou, F., Masiello, R., & Ray, T. (2004). Energy management systems. IEEE Power and Energy Magazine, 2(5), 49-57. https://doi.org/10.1109/MPAE.2004.1338122.

Marangunić, N., & Granić, A. (2015). Technology acceptance model: a literature review from 1986 to 2013. Universal access in the information society, 14, 81-95.

Mardacany, E. (2014). Smart cities characteristics: Importance of built environment components.

Metallidou, C. K., Psannis, K. E., & Egyptiadou, E. A. (2020). Energy efficiency in smart buildings: IoT approaches. IEEE access, 8, 63679-63699.

Mewomo, M.C., Ogunbiyi, O.O., & Dahunsi, O.S. (2022). Adoption of smart building concepts [Page 13]. Journal of Engineering, Design and Technology. Emerald Publishing Limited. DOI: 10.1108/JEDT-05-2022-0263.

Marić, I., Pucar, M., & Kovačević, B. (2016). Reducing the impact of climate change by applying information technologies and measures for improving energy efficiency in urban planning. Energy and Buildings, 115, 102-111.

Marmot, A. (2002). Architectural determinism. Does design change behaviour?. The British Journal of General Practice, 52(476), 252.

Meijer, A., & Thaens, M. (2018). Urban Technological Innovation: Developing and Testing a Sociotechnical Framework for Studying Smart City Projects. Urban Affairs Review, 54(2), 363–387. https://doi.org/10.1177/1078087416670274

Mihovska, A., & Sarkar, M. (2018). Smart Connectivity for Internet of Things (IoT) Applications. In R. Yager & J. Pascual Espada (Eds.), New Advances in the Internet of Things (pp. 69-81). Studies in Computational Intelligence, vol 715. Springer. https://doi.org/10.1007/978-3-319-58190-3_7

Minoli, D., Sohraby, K., & Occhiogrosso, B. (2017). IoT Considerations, Requirements, and Architectures for Smart Buildings—Energy Optimization and Next-Generation Building Management Systems. IEEE Internet of Things Journal, 4(1), 269-283. doi: 10.1109/JIOT.2017.2647881.

Natasia, S. R., Wiranti, Y. T., & Parastika, A. (2022). Acceptance analysis of NUADU as e-learning platform using the Technology Acceptance Model (TAM) approach. Procedia Computer Science, 197, 512-520.

Nguyen, T. A., & Aiello, M. (2013). Energy intelligent buildings based on user activity: A survey. Energy and Buildings, 56, 244-257. https://doi.org/10.1016/j.enbuild.2012.09.005

Nozharov, S., Yankov, I., Nozharova, D., & Miteva, E. (2021). Enhancing Sustainability and Energy Efficiency of Buildings: The Role of Intelligent Systems. InTechOpen. https://doi.org/10.5772/intechopen.95104

Olanrewaju, O. I., Chileshe, N., Babarinde, S. A., & Sandanayake, M. (2020). Investigating the barriers to building information modeling (BIM) implementation within the Nigerian construction industry. Engineering, Construction and Architectural Management, 27(10), 2931-2958. https://doi.org/10.1108/ECAM-01-2020-0042

Olanrewaju, O. I., Kineber, A. F., Chileshe, N., & Edwards, D. J. (2022). Modelling the relationship between Building Information Modelling (BIM) implementation barriers, usage and awareness on building project lifecycle. Building and Environment, 207(Part B), 108556. https://doi.org/10.1016/j.buildenv.2021.108556

Omar, O. (2018). Intelligent building, definitions, factors and evaluation criteria of selection. Alexandria Engineering Journal, 57(4), 2903-2910.

Paroutis, S., Bennett, M., & Heracleous, L. (2014). A strategic view on smart city technology: The case of IBM Smarter Cities during a recession. Technological Forecasting and Social Change, 89, 262-272. https://doi.org/10.1016/j.techfore.2013.08.041

Penner, R. R., & Steinmetz, E. S. (2002). Model-based automation of the design of user interfaces to digital control systems. IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, 32(1), 41-49. https://doi.org/10.1109/3468.995528

Ruiz, D. P., Vasquez, R. A. D., & Jadan, B. V. (2023). Predictive Energy Management in Internet of Things: Optimization of Smart Buildings for Energy Efficiency. Journal of Intelligent Systems & Internet of Things, 10(2).

Serrat, O. (2017). Social network analysis. In Knowledge solutions: Tools, methods, and approaches to drive organizational performance (pp. 39-43).

Shah, S. F. A., Iqbal, M., Aziz, Z., Rana, T. A., Khalid, A., Cheah, Y. N., & Arif, M. (2022). The role of machine learning and the internet of things in smart buildings for energy efficiency. Applied Sciences, 12(15), 7882.

Siemens. (2018). The future of smart building.

Sinopoli, J. (2010). Smart Buildings Systems for Architects, Owners and Builders.

Vijayan, D. S., Rose, A. L., Arvindan, S., Revathy, J., & Amuthadevi, C. (2020). Automation systems in smart buildings: a review. Journal of Ambient Intelligence and Humanized Computing, 1-13.

Wani, T. A., & Ali, S. W. (2015). Innovation diffusion theory. Journal of General Management Research, 3(2), 101-118.

Wyatt, S. (2008). Technological determinism is dead; long live technological determinism. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), The handbook of science and technology studies (pp. 165-180). MIT Press.

Yang, A., Han, M., Zeng, Q., & Sun, Y. (2021). Adopting Building Information Modeling (BIM) for the Development of Smart Buildings: A Review of Enabling Applications and Challenges. Advances in Civil Engineering, 2021, Article ID 8811476, 26 pages. https://doi.org/10.1155/2021/8811476

Yang, E., & Bayapu, I. (2020). Big Data analytics and facilities management: a case study. Facilities, 38(3/4), 268-281.

Yusuf, A. O., Opawole, A., Olojede, B. O., & Oshin, F. (2022). Assessment of the level of awareness of intelligent buildings in Lagos State, Nigeria. Acta Structilia, 29(2), 116-149. https://doi.org/10.18820/24150487/as29i2.5

Zhou, Y. (2022). Artificial intelligence in renewable systems for transformation towards intelligent buildings. Energy and AI, 10, 100182. https://doi.org/10.1016/j.egyai.2022.100182.