Assessment of Benefits and Challenges of Internet of Things (IoT) in Real Estate Practice

Mayowa M. Salami[1] & Adedamola O. Oluwunmi[1]
[1]Department of Estate Management, Faculty of Environmental Science,
University of Lagos, Akoka, Lagos State, Nigeria
*Corresponding Author's email: mayowasalami78@gmail.com

Abstract

Purpose: *The Internet of Things (IoT) is a groundbreaking development that has a big impact on many industries, including real estate. In the past, traditional methods and manual procedures have been the main drivers of property management, building, and urban planning. However, the emergence of IoT technology has led to a shift in the way real estate is constructed, maintained, and managed, particularly in developed nations. This paper, therefore, examined the perspectives of estate surveyors and valuers (ESVs) in Lagos State on the benefits and challenges of adopting IoT in the real estate profession.*

Design: *A quantitative survey was conducted using structured questionnaires administered to 184 estate surveyors and valuers (ESVs) in Lagos State, Nigeria. Percentages, mean, relative importance index (RII), and factor analysis were used to analyse the data.*

Research limitations and implications: *This study is limited to ESVs in Lagos State, Nigeria. Future research could explore the views of other built-environment professionals in Lagos State or ESVs across different regions.*

Findings: *The study found the benefits of IoT in real estate practice to be data-driven decision-making, efficient property management, and condition monitoring for preventive maintenance. Some of the challenges identified were the high cost of implementing IoT infrastructure, concerns about data security and privacy, and a lack of technical expertise among real estate professionals.*

Conclusion, Practical and Theoretical Implications: *The study offers practical implications for policymakers, real estate professionals, and academia by identifying key benefits and challenges to the adoption of IoT in the real estate industry. These insights are especially relevant for sustainable real estate development.*

Keywords: Decision-making, Industry, Internet of Things, Professionals, Real Estate

Introduction

Globally, the adoption of the Internet of Things (IoT) is expanding rapidly (Alenizi & Al-Karawi, 2023; Sivowaku, 2024). IoT is a groundbreaking development that has a significant impact on many industries, including real estate (Mistry, 2022; Bitton, 2023). It is transforming the real estate sector by leveraging smart technology to connect homes, buildings, and devices (Sapra, 2024a; Raji, 2024; Sivowaku, 2024). Real-time data gathering and automation are made possible

by IoT, which lowers operating costs and improves user experience and efficiency (Akindele, Ogundile, & Ogunniyi, 2021). As internet connectivity continues to grow worldwide, the real estate industry is poised for a transformation, with IoT at the forefront (Sivowaku, 2024).

Although the real estate sector has historically been slow to adopt technological innovations, it has always been a key cornerstone of economic expansion (Tanrivermis, Salami, & Tanrivermis, 2024; Sapra, 2024a). In the past, traditional methods and manual procedures have been the main drivers of property management, building, and urban planning. But the emergence of the Internet of Things (IoT) technology has caused a change in the way real estate is constructed, maintained, and managed, especially in developed nations (Sapra, 2024a). According to Alabi et al. (2020), Akinwamide, Hahn (2021), & Ojekunle (2023) in Nigeria, the real estate industry's lack of adoption of this innovative technology has been ascribed to a lack of knowledge among real estate professionals of its benefits despite the expanding corpus of research on IoT applications in the real estate industry globally (Alabi et al., 2020; Akindele et al., 2021; Raji, 2024; Mohammed et al., 2024; Norouzzadeh et al, 2025).

The majority of the previous research efforts in Nigeria have predominantly been extensive literature reviews on the subject matter (Alabi et al., 2020; Mohammed et al., 2024; Olajide-Ajire, Osalusi & Oduroye, 2024), while others that are empirical sampled the opinions of estate surveyors and valuers (ESVs) in Ondo (Akindele et al., 2021; Raji, 2024) and Edo States (Akinwamide & Hahn, 2021). It is opined that only few scholarly efforts in Nigeria have sought the views of ESVs in Lagos State, which is the economic nerve centre and the most populous city in Nigeria. These studies (Adedoyin, 2023; Jolayemi, 2024; Odebode, Ogunbayo & Obayomi, 2025) dealt with proptech generally but paid little attention to IoT in particular. This study, therefore, examined the perspectives of ESVs on the benefits and challenges of the adoption of IoT in the real estate profession. This is with a view to encouraging a broader adoption of IoT in the real estate industry, which will create smarter and environmentally friendly buildings. To achieve this aim, the specific objectives are to ascertain the benefits of the adoption of IoT; and investigate the challenges in real estate practice in the study area.

This study is expected to provide an opportunity for policymakers, real estate professionals, and other relevant stakeholders to be enlightened and educated on the benefits and challenges of the adoption of IoT. These insights are particularly pertinent to the creation of sustainable real estate. Furthermore, this study will contribute to the achievement of Sustainable Development Goal (SDG) 9 of the United Nations (Industry, Innovation, and Infrastructure). This is essential because our infrastructure and industry need to be improved to meet future challenges. Promoting cutting-edge sustainable technologies is necessary for this. Also, this study will establish strategies to enhance the adoption of IoT in the real estate profession. This is expected to serve as a framework on which other studies can be based. Additionally, it is anticipated that this research will contribute to closing a gap and add to the body of knowledge by examining how informed ESVs are about this emerging

technology option (which can facilitate efficient property management, improve security, and provide detailed insights into building performance and occupancy rates), and why they have not considered adopting it.

Literature Review

Concept of IoT

The Internet of Things (IoT) has become a game-changing technology that is changing the way many industries function by connecting systems, devices, and services. IoT is a wide term that describes a network of physical items that are equipped with sensors, software, and other technologies so they can gather and share data online (Lee & Lee, 2020). Four essential elements make up IoT, namely data analytics, communication networks, devices/sensors, and a graphical user interface (Gillis & Yasar, 2025). Data from the environment is collected by sensor-equipped devices and sent to a centralised system via communication networks. Making educated decisions is enabled by the actionable insights that are produced by processing and analysing this data (Bayoumi & McCaslin, 2016; Gillis & Yasar, 2025). Through automated monitoring and control systems, for example, smart buildings using IoT technology can optimise energy use, resulting in cost savings and a lessened environmental effect (Yashoda, 2023). Additionally, IoT uses predictive analytics to improve preventive maintenance procedures (Bayoumi & McCaslin, 2016).

IoT in Real Estate Practice

The real estate industry has seen constant and rapid innovation in recent years. This is due to the deployment of new technologies that have the ability to improve and influence the real estate sector. One such technology is the Internet of Things. IoT is becoming essential as the demand for tech-enabled, sustainable homes and workplaces rises; developers, investors, and property managers may use it to their advantage (Ademowo, 2025a). As the rate of urbanisation increases and the need for better living spaces increases, technology is changing how real estate is purchased, sold, planned, and managed. New technologies, such as the Internet of Things (IoT), are opening up possibilities for improved experiences, more efficiency, and more environmentally friendly practices in the real estate industry (Alameri, 2025).

The integration of IoT into real estate goes beyond simple technological advancements; it is about improving tenant experiences and changing the way buildings are managed. Through the utilisation of data-driven insights and linked devices, real estate professionals may unlock opportunities for increased sustainability, convenience, and efficiency. The real estate industry's future seems brighter than ever as we continue to adopt IoT technologies. Not only will properties become safer and smarter, but they will also become more sensitive to the needs of owners and tenants. It is an ambitious yet very human-centered vision that seeks to make environments more hospitable and adaptable (Bledowski, 2024).

Benefits of the Adoption of IoT in Real Estate Practice

Though IoT started out as a specialised technology idea, it has quickly spread throughout various industries and applications as a source of ongoing innovation. As the need for tech-enabled, safe, and sustainable places increases, more developers, property managers, and investors are depending on IoT developments to keep real estate competitive and relevant in the market (Kaushal, 2025). Several researchers

have attested to the fact that there are a lot of benefits that IoT can bring to the real estate industry. For example, IoT can help with materials tracking in real estate projects (Sapra, 2024a), improved security (Sivowaku, 2024; Kaushal, 2025), workplace and space optimisation (Mistry, 2022; Sapra, 2024a), condition monitoring for preventive maintenance (Sapra, 2024a), enhanced lighting efficiency (Sapra, 2024a), data-driven decision-making, and provision of detailed insights into building performance and occupancy rates (Sivowaku, 2024). Other benefits identified by scholars are: efficient property management through energy savings and maintenance cost reduction (Mohammed et al., 2024), more satisfactory housing search outcomes (Mistry, 2022), air quality monitoring and improved HVAC efficiency, and elimination of bottlenecks in real estate transactions (Sapra, 2024a). Despite the numerous benefits of IoT in real estate practice identified from the literature, challenges related to its adoption persist.

Challenges to the Adoption of IoT in Real Estate Practice

Numerous researchers have identified the challenges linked to the adoption of IoT in real estate practice. From the existing literature, some of the prominent challenges are summarised in Table 1.

TABLE 1. *Challenges to the Adoption of IoT in Real Estate Practice*

S/N	Challenges	Source(s)
1	High cost of implementing IoT infrastructure	Sapra (2024b); Sivowaku (2024); Ademowo (2025b), Oladoja, Akanbi, Adedotun, & Raji (2025a); Oladoja, Akanbi, Adedotun, & Raji (2025b)
2	Concerns about data security and privacy	Alenizi & Al-Karawi (2023); Mohammed et al. (2024); Olajide-Ajire et al. (2024); Sapra (2024b); Sivowaku (2024); Ademowo (2025b); Oladoja et al. (2025a); Oladoja et al. (2025b)
3	A lack of technical expertise among real estate professionals	Sivowaku (2024); Ademowo (2025b)
4	A lack of awareness	Sivowaku (2024)
5	Interoperability issues i.e. compatibility between different IoT devices and systems can be difficult to achieve.	Alenizi & Al-Karawi (2023); Raji (2024); Sapra (2024b); Norouzzadeh et al. (2025); Ademowo (2025b); Oladoja et al. (2025b)
6	Regulatory compliance	Olajide-Ajire et al. (2024); Sapra (2024b)
7	Scalability and maintenance challenges	Alenizi & Al-Karawi (2023); Oladoja et al. (2025a); Oladoja et al. (2025b)
8	User apathy and resistance to change	Bitton (2023)

Source: Authors' Compilation (2025)

Specifically, the systematic review conducted by Mohammed, Saidu, & Ibrahim (2024) identified sensor durability, data quality, wireless reliability, energy constraints, and system interoperability as the major challenges to the adoption of IoT. According to Olajide-Ajire, Osalusi, & Oduroye (2024), cybersecurity threats and data privacy concerns are the primary challenges while Oladoja et al. (2025a) stated that initial setup costs, security concerns, the need for ongoing system maintenance, and scalability issues are the barriers to IoT implementation.

Additionally, the main obstacles identified by Oladoja et al. (2025b) are scalability constraints, security and privacy concerns, high implementation and maintenance costs, and interoperability problems resulting from disparate IoT communication protocols that impede smooth system integration and connectivity. Ademowo (2025) stressed that the challenges of IoT adoption are high initial costs, data privacy and cybersecurity risks, lack of a skilled workforce, and integration complexities. Although implementing and scaling IoT deployments can present the above challenges, the benefits greatly exceed the costs. The secret is to take a strategic approach, recognise the challenges, make appropriate decisions, and never lose sight of the rewards (Burak, 2024).

Research Method

According to the 2025 Directory of firms on the Nigerian Institution of Estate Surveyors and Valuers (NIESV) Website, there are 458 Estate Surveying and Valuation Firms in Lagos State, Nigeria. The researchers sampled one Estate Surveyor and Valuer (ESV) per firm across 40% of the total number of firms, yielding a sample size of 184 ESVs in Lagos State. This is in line with the recommendation of Nwana (1981), who adjudged that 40% of a study population is adequate as a sample size. The research design used was a quantitative survey involving 184 ESVs in Lagos State, Nigeria. The data gathering instrument was a structured questionnaire. The questionnaire consisted of four sections: A, B, C, and D. Section A contained questions about participants' profiles. Section B focused on their general knowledge of IoT, while Section C included questions about their perceptions of the benefits of IoT in real estate practice. Section D of the questionnaire helped the researchers to collect data on the challenges to the adoption of IoT in the real estate practice.

To measure the benefits and challenges of the adoption of IoT in real estate practice, 11 benefits and 8 challenges identified from the literature were presented to the participants. The scale of measurement used was a 5-point Likert-type scale. Out of the 184 questionnaires administered, 122 (66%) were returned and found useful. The data from the 122 participants were subjected to descriptive and inferential statistics tools, specifically percentages, mean score, and factor analysis. The data obtained from sections A, B, and D were analysed using percentages and mean, while for section C, the mean and factor analysis were used. The results of the analyses are displayed using charts, tables, and a graph.

Findings and Discussion

Participants' Background Information and General Knowledge of IoT

This section shows preliminary information on the participants and their general knowledge of IoT. The results are detailed in Figures 1 to 7.

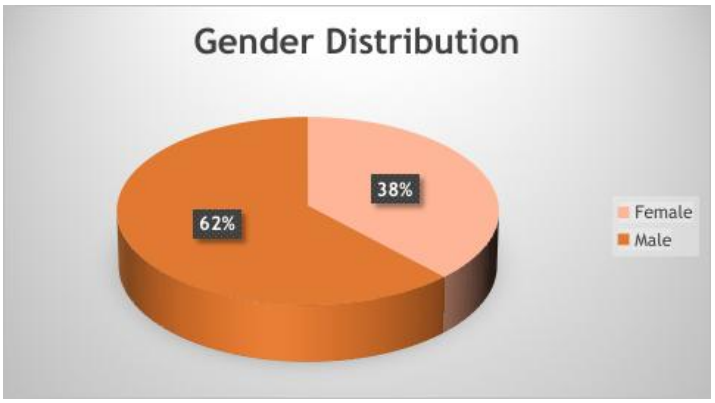

Figure 1. Gender of Participants

Figure 1 shows that out of the 122 respondents, 62% were males and 38% were females. Given that the profession is dominated by men, this may be expected. In addition, 46% of them are 41 years and above, 32% are between 31 and 40 years old, while the remaining 22% are between 20 and 30 years old (see Figure 2). This implies that all the respondents are adults and legally qualified to partake in this research.

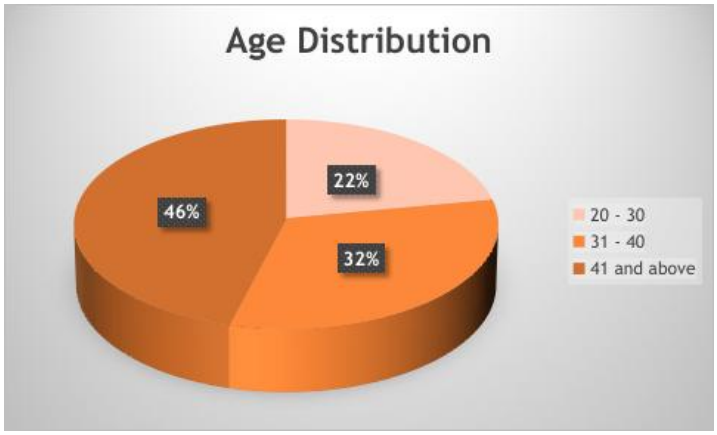

Figure 2. Age of Participants

With respect to the academic qualifications of the respondents (see Figure 3), most of them are B.Sc (41.0%) and M.Sc (37.7%) holders. This suggests that they possess the academic knowledge necessary to accurately answer the questions on IoT.

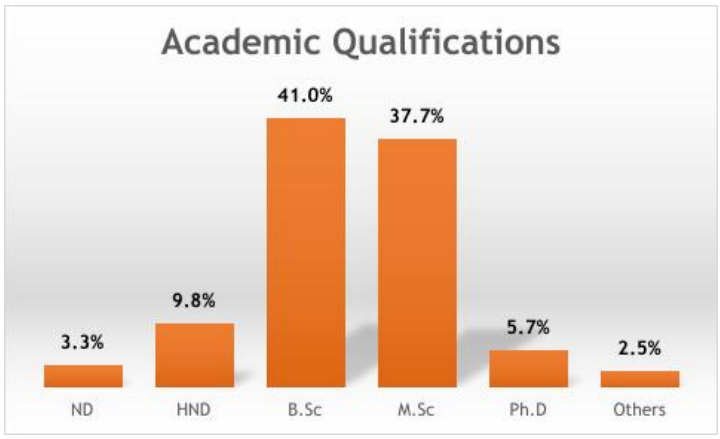

Figure 3. Academic Qualification

Figure 4 shows the professional qualifications of the respondents. According to the figure, 45% are associate members of the Nigerian Institution of Estate Surveyors and Valuers (NIESV), 24% are probationer members, 14% are fellows and 17% are graduate members. Hence, it can be concluded that a greater percentage (69%) are probationers or associate members of NIESV.

Figure 4. Professional Qualifications

The analysis in Figure 5 reveals the years of work experience of respondents. 30.4% had 5 years or less of working experience, 26.2% had 6-10 years of work experience, 16,4% had 11-15 years of work experience and 27.0% said they had more than 16 years of work experience. This implies that 70% of the respondents have more than 5 years of work experience, which may be regarded as sufficient experience to provide critical information.

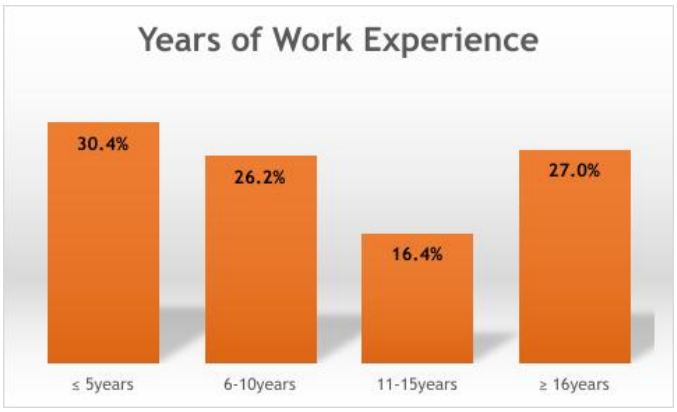

Figure 5. Years of Work Experience

An analysis of the level of awareness of IoT among respondents (see Figure 6) indicates that the majority (84%) of ESVs in the study area are aware of the term. This shows that there is a high level of awareness and familiarity with the concept among the survey participants. This is not surprising considering that a significant portion of the NIESV's Continuous Professional Development programmes have centred on integrating contemporary technologies into their range of services in order to improve real estate practice.

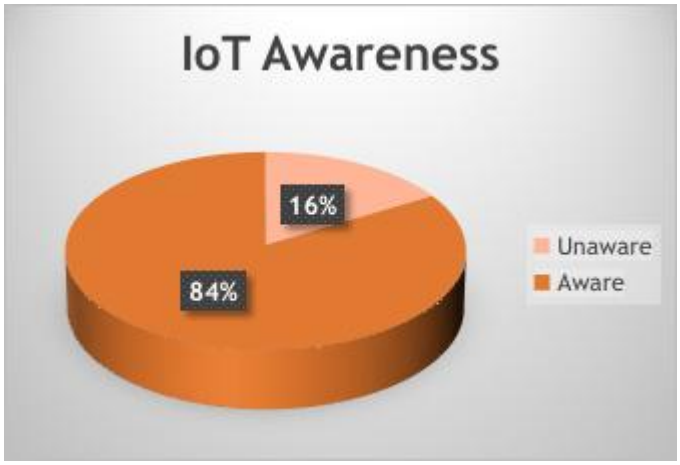

Figure 6. IoT Awareness

Figure 7 represents the opinions of 122 respondents when asked if they would encourage the adoption of IoT in real estate practice. A significant majority, amounting to 96%, expressed their support for its adoption, suggesting that they either see its benefits or are open to the idea of exploring this new technology. Conversely, a minority of respondents, 4%, indicated that they would not encourage its adoption. When the researchers probed further into why they were not in support, their reasons were the high cost of implementation and

maintenance, and the possibility that it may result in loss of employment.

Overall, the overwhelming positive response suggests that there is a strong interest and acceptance of the adoption of IoT in real estate practice among the participants. If the broader populace shares these sentiments, it could pave the way for more exploration and - potentially - adoption of IoT.

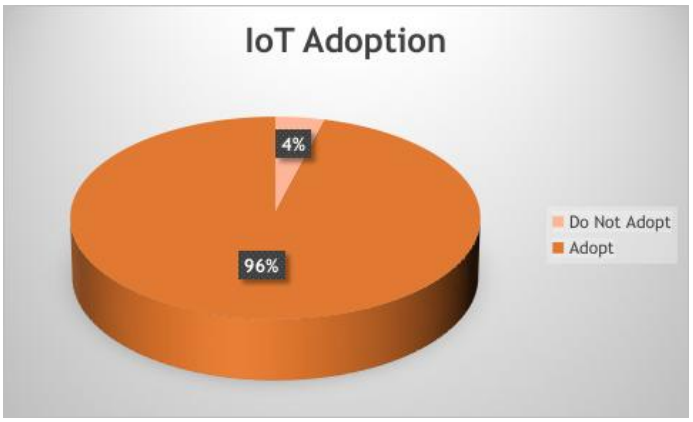

Figure 7. Encouragement of IoT Adoption

Benefits of the Adoption of IoT in Real Estate Practice

This section analyses the benefits of the adoption of IoT in real estate practice from the perceptions of ESVs in Lagos State. To get the mean and factor analysis, the researcher assigned 5 to "Strongly Agree," 4 to "Agree," 3 to "Somewhat Agree," 2 to "Disagree," and to "Strongly Disagree". Tables 2 to 3 and Graph 1 display the outcomes of the analyses

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Table 2. Benefits of the Adoption of IoT in Real Estate Practice

Benefits	Mean	Std. D	Rank
Data-driven decision-making	4.60	0.612	1
Efficient property management (energy savings, maintenance cost reduction, property management efficiency etc)	4.54	0.670	2
Condition monitoring for preventive maintenance	4.38	0.720	3
Provision of detailed insights into building performance and occupancy rates.	4.36	0.761	4
Enhanced lighting efficiency	4.35	0.760	5
Workplace and space optimisation	4.32	0.785	6
Air quality monitoring and improved HVAC efficiency	4.31	0.772	7
More satisfactory housing search outcomes	4.27	0.793	8
Elimination of bottlenecks in real estate transactions	4.23	0.811	9

Improved security	4.20	0.833	10
Materials tracking in real estate projects	4.20	0.781	10

The results in Table 2 revealed that the major benefit of the adoption of IoT in real estate practice is data-driven decision-making (with a mean of 4.60), this was followed by efficient property management (mean=4.54), condition monitoring for preventive maintenance (mean=4.38), provision of detailed insights into building performance and occupancy rates (mean=4.36), and enhanced lighting efficiency (mean=4.35). These outcomes are in agreement with those of Sapra (2024a), Sivowaku (2024), and Mohammed et al. (2024).

The analysis further revealed that workplace and space optimisation, air quality monitoring and improved HVAC efficiency, more satisfactory housing search outcomes, and elimination of bottlenecks in real estate transactions ranked 6th, 7th, 8th and 9th, respectively. Improved security and materials tracking in real estate projects were the least ranked benefits, with a mean of 4.20.

To ascertain the major benefit(s) of IoT in real estate practice, the researchers adopted factor analysis, principal component analysis in particular. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test and Bartlett's Test of Sphericity were used to determine whether the 11 benefits were suitable for factor analysis before this method of analysis was applied. If the K.M.O. value is more than 0.5, the sampling is deemed sufficient (Field, 2000; Hadia et al., 2016). Bartlett's Test of Sphericity was significant ($p < .05$), and the KMO was 0.8, higher than the suggested 0.5. As a result, factor analysis was deemed appropriate for the survey data.

Table 3. Factor Analysis of Benefits of the Adoption of IoT in Real Estate Practice

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Data-driven decision-making	6.663	60.57	60.6	6.663	60.57	60.6
Efficient property management	0.919	8.35	68.9			
More satisfactory housing search outcomes	0.764	6.95	75.9			
Improved security	0.510	4.63	80.5			
Provision of detailed insights into building performance and occupancy rates	0.473	4.30	84.8			

Elimination of bottlenecks in real estate transactions	0.433	3.94	88.7
Condition monitoring for preventive maintenance	0.347	3.16	91.9
Air quality monitoring and improved HVAC efficiency	0.321	2.92	94.8
Materials tracking in real estate projects	0.244	2.21	97.0
Workplace and space optimisation	0.200	1.82	98.8
Enhanced lighting efficiency	0.127	1.15	100.0

Table 3 shows the initial eigenvalues and rotation sums of squared loadings. The eigenvalues greater than 1 were extracted and this showed that only the first principal component (data-driven decision-making) shapes the extracted solution, making up for 60.6% of the overall variability, within the unique 11 additives (variables), so that the complexity of the statistics set may be drastically reduced with the use of the extracted additives.

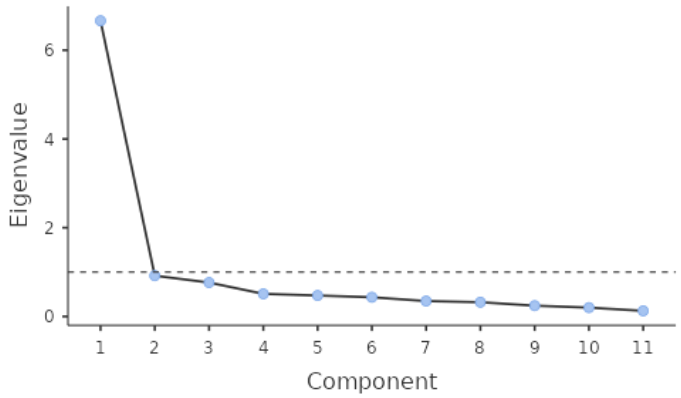

Figure 8. Scree plot

Figure 1 shows the Scree plot of the 11 items included in the factor analysis. An inspection of the Scree plot reveals that a departure from linearity coincides with a 1-factor result, indicating that, according to the ESVs in the study area, only 1 of the items is the prominent benefit.

TABLE 4. Component Matrix

Component	Component 1	Uniqueness
Data-driven decision-making	0.739	0.22517
Efficient property management	0.675	0.37477
Materials tracking in real estate projects	0.652	0.38031
More satisfying housing search outcomes	0.507	0.44677
Improved security	0.436	0.23254
Enhanced lighting efficiency	0.248	0.21136
Condition monitoring for preventive maintenance	0.260	0.00500
Air quality monitoring and improved HVAC efficiency	0.234	0.17087
Workplace and space optimisation	0.363	0.29417
Elimination of bottlenecks in real estate transactions	0.323	0.33966
Provide detailed insights into building performance and occupancy rates	0.325	0.00500

With respect to key benefits of IoT adoption in real estate practice, the positive loading of 0.739 indicates that data-driven decision-making is a crucial benefit. Moreover, the positive loading of 0.675 is significant, emphasising that efficient property management is vital. Furthermore, the positive loading of 0.652 indicates that materials tracking in real estate projects is an essential benefit of the adoption of IoT. Similarly, factor loading of 0.507 implies that more satisfying housing search outcomes is a vital benefit.

Challenges to the Adoption of IoT in Real Estate Practice

The respondents were asked to state the challenges to the adoption of IoT in real estate practice identified earlier from the literature. To arrive at the result, the mean was calculated using a 5-point Likert scale, where 5 was assigned to extremely severe, 4 to very severe, 3 to severe, 2 to slightly severe, and 1 to not severe. The outcomes of the analysis is presented in Table 5.

Table 5. Challenges to the Adoption of IoT in Real Estate Practice

Challenges	Mean	Std. D	Rank
High cost of implementing IoT infrastructure	4.47	0.763	1
Concerns about data security and privacy	4.37	0.795	2
A lack of technical expertise among real estate professionals	4.35	0.738	3
Interoperability issues i.e. compatibility between different IoT devices and systems, can be difficult to achieve.	4.30	0.757	4
Scalability and maintenance challenges	4.30	0.724	4
User apathy and resistance to change	4.24	0.882	6
A lack of awareness	4.07	0.854	7
Regulatory compliance	4.07	0.835	7

Table 5 displays the challenges to the adoption of IoT in real estate practice. The major challenges are the high cost of implementing IoT infrastructure (mean=4.47), concerns about data security and privacy (mean=4.37), a lack of technical expertise among real estate professionals (mean=4.35), interoperability issues (mean=4.30), and scalability and maintenance challenges (mean=4.30), which ranked 1st to 5th. Closely following is the user apathy and resistance to change, with a mean value of 4.24. This suggests that ESVs may be hesitant to transition to this technology. A lack of awareness and regulatory compliance both ranked least, with a mean value of 4.07.

In essence, while there are several benefits to the adoption of IoT in real estate practice, concerns range from the high cost of implementing IoT infrastructure, concerns about data security and privacy, and a lack of technical expertise among real estate professionals, to concerns about interoperability issues, scalability and maintenance challenges, user apathy, and resistance to change. This result is consistent with the outcomes of the studies of Alenizi and Al-Karawi (2023), Mohammed et al. (2024), Olajide-Ajire et al. (2024), and Norouzzadeh et al. (2025).

Conclusions and Recommendations

This study on leveraging the internet of things (IoT) in real estate practice has established that there are several benefits for the real estate industry, and it will serve as a worthy addition to the toolset of real estate practitioners; hence, its adoption should be encouraged. However, the challenges to its adoption cannot be overlooked. Therefore, for ESVs to exploit the potential of IoT, the following recommendations are pertinent:

1. The managing partners of estate surveying and valuation firms interested in adopting IoT should consider hiring IoT specialists or consultants, who can leverage open-source tools (OpenHAB, Node-RED, Macchina.io, and Zetta, among others) to reduce the high cost of implementing IoT infrastructure to a manageable budget.

2. Also, it is recommended that estate surveying and valuation firms use cybersecurity professionals to conduct routine security checks and consider data encryption and access control to curb concerns about data security and privacy.

3. However, to curtail the concerns about a lack of technical expertise among real estate professionals, ESVs should consider outsourcing the areas where IoT may enhance their services to information technology consultants.

4. Furthermore, to address the problem of interoperability, ESVs might consider deploying industry-standard application programming interfaces (APIs) to facilitate effective communication between various IoT platforms. Other solutions that facilitate interoperability include using Internet of Things gateways to act as middlemen, converting data between incompatible protocols, and putting security best practices like end-to-end encryption, authentication, and frequent security upgrades.

5. Additionally, the researchers suggest the formulation of a clear long-term strategy and continuous upgrade of IoT tools to surmount the scalability and

maintenance challenges of IoT adoption.

Limitations of the Study and Opportunity for Further Research

As with the majority of studies, the focus of this study is subject to limitations. First, this research was carried out by administering questionnaires to ESVs in Lagos State. Thus, there is a possibility that the results of the study may be different if other ESVs in other regions are included in a new study. Second, the focus was only on the perception of ESVs on the benefits and challenges to the adoption of IoT in real estate practice. Further studies may examine the extent of adoption of IoT in Lagos State or consider establishing the level of efficiency of IoT in Lagos State. Additionally, other researchers may consider conducting a comparative analysis of IoT adoption in Lagos State with other regions.

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