

**THE IMPACT OF THE ADOPTION OF INTERNET OF THINGS ON  
RESIDENTIAL PROPERTY MANAGEMENT: A CASE STUDY OF  
ABUJA METROPOLIS**



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**BENIN CITY**

**NOVEMBER, 2025**

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**BEING A PROJECT DISSERTATION SUBMITTED TO THE DEPARTMENT  
OF ESTATE MANAGEMENT, FACULTY OF ENVIRONMENTAL SCIENCE,  
UNIVERSITY OF BENIN, IN PARTIAL FULFILLMENT OF THE  
REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.)  
DEGREE IN ESTATE MANAGEMENT**

**NOVEMBER, 2025**

## **DECLARATION**

I, **Ochanya Ella Sunday**, do hereby declare that this project is undertaken by me in the Department of Estate management, Faculty of Environmental Sciences, University of Benin, Benin city, Edo state under the supervision of Dr. Mrs. Osasu Edionwe. The work embodied in this project has not been submitted by any candidate for the award of degree and is not concurrently being submitted for any other degree elsewhere.

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**DATE**

## CERTIFICATION

We certify that this project titled **THE IMPACT OF THE ADOPTION OF INTERNET OF THINGS ON RESIDENTIAL PROPERTY MANAGEMENT: A CASE STUDY OF ABUJA METROPOLIS**, was written and submitted by **OCHANYA ELLA SUNDAY** with **Matriculation Number ENV2002760** to the Department of Estate management, Faculty of Environmental Sciences, University of Benin, Benin City. In partial fulfillment of the requirement for the award of Bachelor of Science (B.Sc.) in Estate Management.

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(External Examiner)

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**DATE**

## **DEDICATION**

This research project is dedicated to Almighty God, whose divine guidance, wisdom, and grace have been my constant source of strength and inspiration throughout the course of this work. To Him be all the glory and honor.

## ACKNOWLEDGEMENTS

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## TABLE OF CONTENTS

<b>Title Page</b>	- - - - -	ii
<b>Declaration</b>	- - - - -	iii
<b>Certification</b>	- - - - -	iv
<b>Dedication</b>	- - - - -	v
<b>Acknowledgements</b>	- - - - -	vi
<b>Table of Contents</b>	- - - - -	vii
<b>List of Figures</b>	- - - - -	xi
<b>List of Tables</b>	- - - - -	xii
<b>Abstract</b>	- - - - -	xiv

### CHAPTER ONE: INTRODUCTION

1.1	Background of Study	1
1.2	Statement of the Research Problem	4
1.3	Research Questions	5
1.4	Aim of the Study	6
1.5	Objectives of the Study	6
1.6	Justification of the Study	6
1.7	Scope of the Study	7
1.8	Study Area: Abuja Metropolis	8
1.9	Definition of Terms	12

### CHAPTER TWO: LITERATURE REVIEW

2.1	Introduction	17
2.2	Conceptual Review	17
2.2.1	Concept of the Internet of Things (IoT)	17
2.2.2.	IoT in Residential Property Management	18
2.2.3.	Adoption of IoT in Residential Property Management in Nigeria	19

2.2.4	Factors Influencing IoT Adoption in Residential Property Management								20
2.2.5	IoT Adoption in Abuja’s Residential Property Market	-	-						20
2.2.6.	Challenges of IoT Adoption in Residential Property Management	-							20
2.3	Empirical Review	-	-	-	-	-	-	-	22
2.3.1	Extent of Application of IoT in Residential Property Management in Abuja	-	-	-	-	-	-	-	22
2.3.2	Economic Impact of IoT in the Study Area	-	-	-	-				24
2.3.3	Challenges Associated with IoT Adoption in Residential Property Management in	-	-	-	-	-	-	-	26
2.4	Literature on the Topic and Identified Gaps	-	-	-	-	-	-	-	28
2.5	Gaps in Existing Literature	-	-	-	-	-	-	-	29
2.6	Justification	-	-	-	-	-	-	-	30

### **CHAPTER THREE: RESEARCH METHODOLOGY**

3.1	Preamble	-	-	-	-	-	-	-	31
3.2	Research Design	-	-	-	-	-	-	-	31
3.2.1	Descriptive Research Design			-	-	-	-	-	31
3.2.2	Exploratory Research Design	-		-	-	-	-	-	31
3.2.3	Explanatory (Causal) Research Design			-	-	-	-	-	31
3.2.4	Experimental Research Design			-	-	-	-	-	32
3.2.5	Correlational Research Design			-	-	-	-	-	32
3.2.6	Diagnostic Research Design	-		-	-	-	-	-	32
3.2.7	Mixed-Methods Research Design	-		-	-	-	-	-	32
3.2.7.1	Quantitative Approach	-		-	-	-	-	-	32
3.2.7.2	Qualitative Approach	-		-	-	-	-	-	33
3.3	Research Area	-		-	-	-	-	-	33
3.4	Population of Study	-		-	-	-	-	-	33

3.5	Data Types and Sources	-	-	-	-	-	-	33
3.6	Sample Size	-	-	-	-	-	-	34
3.7	Instruments of Data Collection	-	-	-	-	-	-	34
3.8	Method of Data Collection	-	-	-	-	-	-	35
3.9	Method of Data Analysis	-	-	-	-	-	-	35

#### **CHAPTER FOUR: DATA PRESENTATION, ANALYSIS, AND INTERPRETATION**

4.1	Introduction	-	-	-	-	-	-	37
4.2	Questionnaire Response Rate	-	-	-	-	-	-	37
4.3	Characteristics of the Respondents	-	-	-	-	-	-	38
4.4	The Extent of the Application of IOT in Residential Property Management in Abuja	-	-	-	-	-	-	40
4.4.1	Awareness of IoT technology in residential buildings	-	-	-	-	-	-	40
4.4.2	IoT features available in the residential estate.	-	-	-	-	-	-	41
4.4.3	Frequency of IoT feature usage among respondents	-	-	-	-	-	-	42
4.4.4	Ease of use of IoT technology in respondents' residences.	-	-	-	-	-	-	42
4.5	Economic Impacts experienced from IoT in the residence	-	-	-	-	-	-	43
4.5.1	Improvement in residential experience through IoT usage.	-	-	-	-	-	-	43
4.5.2	Influence of IoT on Respondents decision to remain in their estate	-	-	-	-	-	-	44
4.5.3	Perceived reduction in utility bills since the introduction of IoT	-	-	-	-	-	-	45
4.5.4	Perception of rent value for IoT-enabled buildings compared to traditional ones	-	-	-	-	-	-	45
4.6	Challenges associated with the adoption of IoT in residential Property management in Abuja	-	-	-	-	-	-	46
4.6.1	Respondent's willingness to pay extra for an advanced IoT-enabled apartment	-	-	-	-	-	-	47
4.6.2	Impact of IoT on communication between tenants and property managers/landlords	-	-	-	-	-	-	47
4.6.3	Respondents' willingness to recommend IoT-enabled properties to others	-	-	-	-	-	-	48

4.6.4	Respondent’s opinion on the future standardization of IoT in Abuja’s residential properties - - - - -	48
4.7	Characteristics of respondents (Estate Surveyor & Valuers) - -	49
4.8	Respondent’s level of familiarity with IoT applications in residential property management - - - - -	50
4.8.1	IoT features integrated into the estates managed by respondents -	51
4.8.2	Motivating factors behind the adoption of IoT in estate management	51
4.8.3	Challenges encountered in adopting IoT in estate management -	52
4.8.4	Observation of cost savings in property management since IoT integration	53
4.8.5	Effect of IoT integration on tenant satisfaction in managed properties	54
4.8.6	Aspects of property management that have improved due to IoT adoption	54
4.8.7	Tenants’ willingness to embrace smart technology in IoT-enabled estates	55
4.8.8	Impact of IoT adoption on property value and profitability - -	56
4.8.9	Perception of IoT becoming a standard feature in property - -	56
4.9	Discussion of Findings - - - - -	57
4.9.1	The extent of the Application of IoT in residential property management in Abuja - - - - -	57
4.9.2	Economic Impacts of the adoption of IoT in the study area - -	58
4.9.3	Challenges associated with the adoption of IoT in the study area -	60
4.9.4	General Opinions from Estate Surveyors & Valuers, and Tenants -	61
<b>CHAPTER FIVE: SUMMARY, RECOMMENDATION AND CONCLUSION</b>		
5.1	Introduction - - - - -	63
5.2	Summary of Findings and Implications - - - - -	63
5.3	Conclusion - - - - -	64
5.4	Recommendations - - - - -	64
<b>REFERENCES</b> - - - - -		67
<b>APPENDIX</b> - - - - -		74

## LIST OF FIGURES

<b>Fig 1:</b> The Districts in Abuja	9
<b>Fig 2:</b> Abuja municipal area (Federal Capital City of Nigeria)	10
<b>Fig 3:</b> Map of Abuja, Nigeria Global 1000 Atlas	11

## LIST OF TABLES

<b>Table 4.1:</b>	Questionnaire Response Rate	-	-	-	-	38
<b>Table 4.2:</b>	General Characteristics of the Respondents	-	-			38
<b>Table 4.3:</b>	Are you aware that your residence uses Internet of Things (IoT) technology?	-	-	-	-	40
<b>Table 4.4:</b>	Which IoT features are available in your residential estate?	-				41
<b>Table 4.5:</b>	How often do you use these IoT features?	-	-	-		42
<b>Table 4.6:</b>	How easy is it to use the IoT technology in your residence?					42
<b>Table 4.7:</b>	What are the main impacts you have experienced from IoT in your residence?	-	-	-	-	43
<b>Table 4.8:</b>	Has IoT improved your overall residential experience?	-				44
<b>Table 4.9:</b>	Has IoT affected your decision to continue living in this estate?					44
<b>Table 4.10:</b>	Have you noticed a reduction in utility bills (electricity, water) since IoT was introduced?	-	-	-	-	45
<b>Table 4.11:</b>	Do you think smart buildings with IoT should cost higher rent than traditional buildings?	-	-	-	-	45
<b>Table 4.12:</b>	Which IoT-related challenges have you experienced in your residence?	-	-	-	-	46
<b>Table 4.13:</b>	Would you be willing to pay extra for an advanced IoT-enabled apartment	-	-	-	-	47
<b>Table 4.14:</b>	How has IoT impacted communication with property managers/landlords?	-	-	-	-	47
<b>Table 4.15:</b>	would you recommend IoT-enabled properties to others?	-				48
<b>Table 4.16:</b>	Do you think IoT will become a standard feature in residential properties in Abuja in the next 5–10 years?	-	-	-		48
<b>Table 4.17:</b>	Characteristics of respondents	-	-	-	-	49
<b>Table 4.18:</b>	How familiar are you with IoT applications in residential property management?	-	-	-	-	50
<b>Table 4.19:</b>	Which IoT features are integrated into the estates you manage?					51

<b>Table 4.20:</b>	What motivated the adoption of IoT in your estate(s)?	-	52
<b>Table 4.21:</b>	What challenges did you encounter in adopting IoT in your estate management?	- - - - -	52
<b>Table 4.22:</b>	Have you observed any cost savings in property management since integrating IoT?	- - - - -	53
<b>Table 4.23:</b>	Has the integration of IoT improved tenant satisfaction in your managed properties?	- - - - -	54
<b>Table 4.24:</b>	What aspects of property management have	- - -	55
<b>Table 4.25:</b>	Do tenants in IoT-enabled estates willingly embrace smart technology?	- - - - -	55
<b>Table 4.26:</b>	In your opinion, how has IoT affected the value and profitability of smart residential properties?	- - - -	56
<b>Table 4.27:</b>	Do you think IoT will become a standard feature in property management across Abuja in the next 5–10 years?	- -	57

## ABSTRACT

This study investigates the impact of the adoption of Internet of Things (IoT) on residential property management in Abuja Metropolis. The aim was to examine the extent of IoT adoption, evaluate its benefits in enhancing property management efficiency, and identify the challenges hindering widespread implementation.

A survey research design was employed. Structured questionnaires were administered to 52 out of 184 real estate firms operating in Abuja and 25 out of 125 smart home users. The responses were analyzed using descriptive and inferential statistical tools to assess patterns of adoption, perceptions, and outcomes of IoT utilization in residential property management.

Findings revealed that IoT adoption significantly improved security, energy efficiency, remote monitoring of facilities, communication between managers and tenants, and overall tenant satisfaction. Real estate firms acknowledged IoT as a tool for reducing operational costs and ensuring proactive maintenance. However, challenges such as high installation and maintenance costs, inadequate digital literacy among users, poor awareness, and unstable internet connectivity were identified as major barriers to full-scale adoption.

The study concludes that while IoT adoption in Abuja's residential property management is still at an early stage, its benefits are already evident in enhancing efficiency and tenant satisfaction. It recommends that property managers and real estate firms invest in capacity building and digital training, while government and private stakeholders should provide incentives and infrastructure support to lower the cost of IoT adoption. Strengthening internet connectivity and creating awareness campaigns among landlords and tenants will further encourage wider acceptance and integration of IoT in residential property management across Abuja Metropolis.

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background of Study

The use of Internet of Things (IoT) in managing residential properties can transform the way properties are handled (Afolabi, Ojelabi & Onuh, 2020). However, Nigeria's property sector, especially in Abuja, faces challenges with data management and technology infrastructure (Afolabi et al., 2020). Poor data management can lead to inefficiencies, inaccuracies, and corruption, ultimately affecting the overall quality of life for residents. Abuja's rapid growth has put pressure on its administrative capabilities, and the need for effective property management systems has become increasingly important. Current property management systems are often fragmented, with different stakeholders keeping separate records, leading to duplication of efforts and potential errors. IoT technology can provide a centralized platform for property data management, enabling real-time monitoring and improving decision-making (Gubbi, Buyya, Marusic & Palaniswami, 2013).

The adoption of IoT in residential property management can bring numerous benefits, including improved efficiency, reduced costs, and enhanced resident satisfaction. For instance, IoT sensors can be used to monitor and control various aspects of property management, such as energy consumption, waste management, and security (Kumar, Lokesh, & Varadarajan, 2019). However, despite these potential benefits, there are several challenges that need to be addressed. These include lack of infrastructure, high costs, and resistance to change from stakeholders (Kumar et al., 2019). Ensuring compliance with existing laws and policies is also crucial (Roman, Zhou, & Lopez, 2013). Security and privacy concerns associated with IoT technology must be resolved to protect property data (Roman et al., 2013).

This study aims to investigate the impact of IoT adoption in residential property management in Abuja, exploring its benefits and challenges. The findings of this study will contribute to the existing body of knowledge on IoT adoption in property management and provide insights for policymakers, property managers, and residents.

The integration of smart technologies into residential infrastructure aligns with global trends toward digital transformation in urban living, offering the potential to revolutionize traditional property management practices (Atzori, Iera, & Morabito, 2010). Smart property systems enabled by IoT can automate routine tasks such as meter reading, access control, and maintenance scheduling, thus reducing human error and operational overhead (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014). Moreover, IoT devices can generate actionable data that help property managers anticipate maintenance needs and optimize resource allocation, which can significantly improve tenant retention rates (Balta-Ozkan, Boteler, & Amerighi, 2014). In developing regions, the implementation of IoT in housing estates may also support government efforts toward sustainable urbanization and smart city development (Al-Fuqaha Guizani, Mohammadi, Aledhar, & Ayyash, 2015). Nevertheless, stakeholders must navigate limitations related to digital literacy, technology acceptance, and the affordability of IoT-enabled systems among property owners and tenants (Madakam, Ramaswamy, & Tripathi, 2015).

The lack of standardized IoT protocols and interoperability across devices further complicates integration efforts in residential contexts (Bandyopadhyay & Sen, 2011). As urban populations grow, the need for smart solutions in property management becomes more urgent to ensure sustainable living conditions and efficient resource utilization (Gubbi et al., 2013). IoT applications in residential settings are increasingly recognized for their role in enhancing real-time responsiveness, allowing for immediate detection of faults such as water leaks or electrical failures before they escalate (Swan, 2012). The

digital transformation of residential property management through IoT also supports the creation of data-driven governance, where policies and operational decisions are informed by accurate and up-to-date information (Hashem, Chang, Anura, Adewole, Yaqoob, Gani, Ahmed, & Chiroma, 2016).

In regions like Abuja where housing estates are expanding rapidly, adopting IoT can help create a more transparent and accountable system for rent collection, facility usage, and maintenance reporting (Whitmore, Agarwal, & Da Xu, 2015). Furthermore, IoT-enabled platforms can facilitate communication between property managers and tenants, strengthening service delivery and trust (Lee & Lee, 2015). Despite its advantages, the digital divide and limited public awareness about the role of IoT in housing management remain significant barriers to adoption in Nigeria (Gao & Bai, 2014). Concerns about cyber threats and unauthorized access to smart systems also contribute to skepticism among residents, especially in environments where data protection laws are not well enforced (Weber, 2010).

The management of residential properties in Abuja Metropolis faces increasing pressure to improve service delivery, particularly in areas such as maintenance response, energy efficiency, and security. Traditional manual systems often result in delays, tenant dissatisfaction, and operational inefficiencies. With the rise of smart technologies, the adoption of Internet of Things (IoT) in property management offers an opportunity to automate key functions, enhance tenant experience, and optimize management practices. This study is motivated by the need to assess how IoT is being adopted in residential property management, the extent of its effectiveness, and the challenges limiting its implementation. The research aims to provide insights that can guide property managers,

developers, and policymakers in leveraging IoT to enhance residential property management in Abuja.

Further research revealed that while IoT is transforming property management in advanced cities through devices that enable smart monitoring, predictive maintenance, energy efficiency, and improved tenant engagement (Zhang, Li, & Wang, 2020; Agyeman, Boateng, & Oppong, 2022), its application in Nigeria remains limited. Specifically, it was discovered that although Lagos is gradually adopting smart property technologies, there is a noticeable absence of empirical studies examining the use and impact of IoT in residential property management within Abuja Metropolis.

Abuja, being the capital city and a rapidly growing urban center with an increasing number of high-end residential developments, presents a strategic location for investigating how IoT technologies can be leveraged for more effective housing management. Previous studies have emphasized the potential of IoT to enhance building performance and tenant satisfaction (Ghosh & Nair, 2019; Adeleke, 2023), but without localized research in Abuja, stakeholders lack the data needed to make informed, context-specific decisions. This study is therefore motivated by both practical experience and a desire to fill a knowledge gap by assessing the current level of IoT adoption, the challenges faced, and its potential impact on residential property management in Abuja.

## **1.2 Statement of the Research Problem**

The integration of Internet of Things (IoT) technology in residential property management is a relatively new area of study, especially in developing nations like Nigeria (Afolabi et al., 2020). While research has shown the potential advantages of IoT in property management, such as increased efficiency, cost savings, and sustainability (Gubbi et al., 2013), there is still a notable lack of empirical data on its current use and

scope in residential settings (Atzori et al., 2010). Nigeria's unique challenges, including infrastructure limitations and rapid urbanization, require context-specific research.

Moreover, the economic benefits of IoT adoption in property management are not well understood in developing countries (Afolabi et al., 2020). Although IoT has driven significant economic value in industries like manufacturing and healthcare (Manyika, Chui, Bisson, Woetzel, & Stolyar, 2017), research on its economic benefits in residential property management is limited (Kumar et al., 2019). Existing studies suggest IoT can lead to cost savings, improved efficiency, and new revenue streams in property management (Gubbi et al., 2013), but specific evidence for Nigeria is scarce.

Furthermore, despite growing interest in IoT adoption, there is a lack of research on the challenges associated with its implementation in property management, particularly in the study area (Afolabi et al., 2020). Existing literature highlights technical, organizational, and financial barriers, including security concerns (Roman et al., 2013), interoperability issues (Al-Fuqaha et al., 2015), and high costs (Kumar et al., 2019). The study area's unique context may present additional challenges. This study aims to address these gaps by investigating IoT adoption, economic benefits, and associated problems in residential property management.

### **1.3 Research Questions**

1. To what extent is IOT applied on residential property management in Abuja?
2. What are the economic impacts of the adoption of IOT on residential property management in the study area?
3. What are the challenges associated with the adoption of IOT on residential property management in the study area?

#### **1.4 Aim of the Study**

The aim of this study is to evaluate the effectiveness and implications of integrating Internet of Things (IoT) technology on residential property management in Abuja Metropolis, with a view to providing information that could enhance awareness of IoT application among professionals in the built environment and real estate investors.

#### **1.5 Objectives of the Study**

1. To assess the extent of the application of Internet of Things on residential property management in Abuja.
2. To identify the economic impacts of IOT in the study area.
3. To examine the challenges associated with IoT adoption in property management in the study area.

#### **1.6 Justification of the Study**

The adoption of the Internet of Things (IoT) on residential property management has the potential to transform real estate operations, improve efficiency, and enhance economic outcomes (Akindele 2024). By analyzing the impact of IoT adoption in residential property management, this study provides valuable insights for real estate developers, property managers, and investors. It highlights how smart technologies can improve property value, reduce operational costs, and enhance tenant experience.

The study assesses the impact of IoT adoption, including its influence on employment opportunities in property management. It will help policymakers and industry stakeholders understand whether IoT leads to job displacement or creates new job opportunities in technology-driven property management services.

The findings of this research can inform policymakers on the need for appropriate regulations, data privacy laws, and infrastructure development to support IoT adoption in

residential property management in Abuja. It will serve as a basis for drafting policies that balance technological advancement with consumer protection and security concerns. There is limited research on the application of IoT in residential property management in Nigeria, particularly in Abuja. This study will provide empirical data on the benefits, challenges, and future prospects of IoT adoption, serving as a reference for future research and academic discourse.

For property owners and facility managers, this study will offer practical recommendations on how to integrate IoT into property management efficiently. It will highlight cost-effective ways to implement smart home technologies, optimize energy use, and improve security systems in residential estates. The study will promote awareness and encourage the adoption of digital innovations in Nigeria's real estate sector. By demonstrating the economic and operational benefits of IoT, it will influence stakeholders to embrace smart property management solutions that align with global best practices.

### **1.7 Scope of the Study**

This study focuses on the impact of the adoption of the Internet of Things (IoT) on residential property management, using Abuja Metropolis as a case study. The study is limited to Abuja Metropolis, covering major residential areas such as Maitama, Wuse, Gwarinpa, Jabi, Lokogoma, Lugbe, and other key urban districts where IoT adoption in property management may be emerging. This ensures a focused analysis of IoT implementation in a rapidly developing urban environment. The study also examines; the level of awareness and adoption of IoT in residential property management, the economic implications, including cost savings, property value appreciation, and job creation or displacement, the social impact, such as tenant satisfaction, security improvements, and lifestyle changes, the challenges and barriers to IoT adoption, including financial,

regulatory, and technical constraints, potential policy recommendations for better integration of IoT in residential property management.

The study considers IoT applications in residential property management, including; Smart home automation (e.g., smart lighting, heating, and air conditioning systems), Security systems (e.g., smart locks, CCTV with remote monitoring, and motion sensors), Energy efficiency solutions (e.g., smart meters and water leak detectors), Property maintenance systems (e.g., automated scheduling of repairs and predictive maintenance). Also, the study will analyze recent trends in IoT adoption, focusing on developments in the past 5–10 years while also considering future projections.

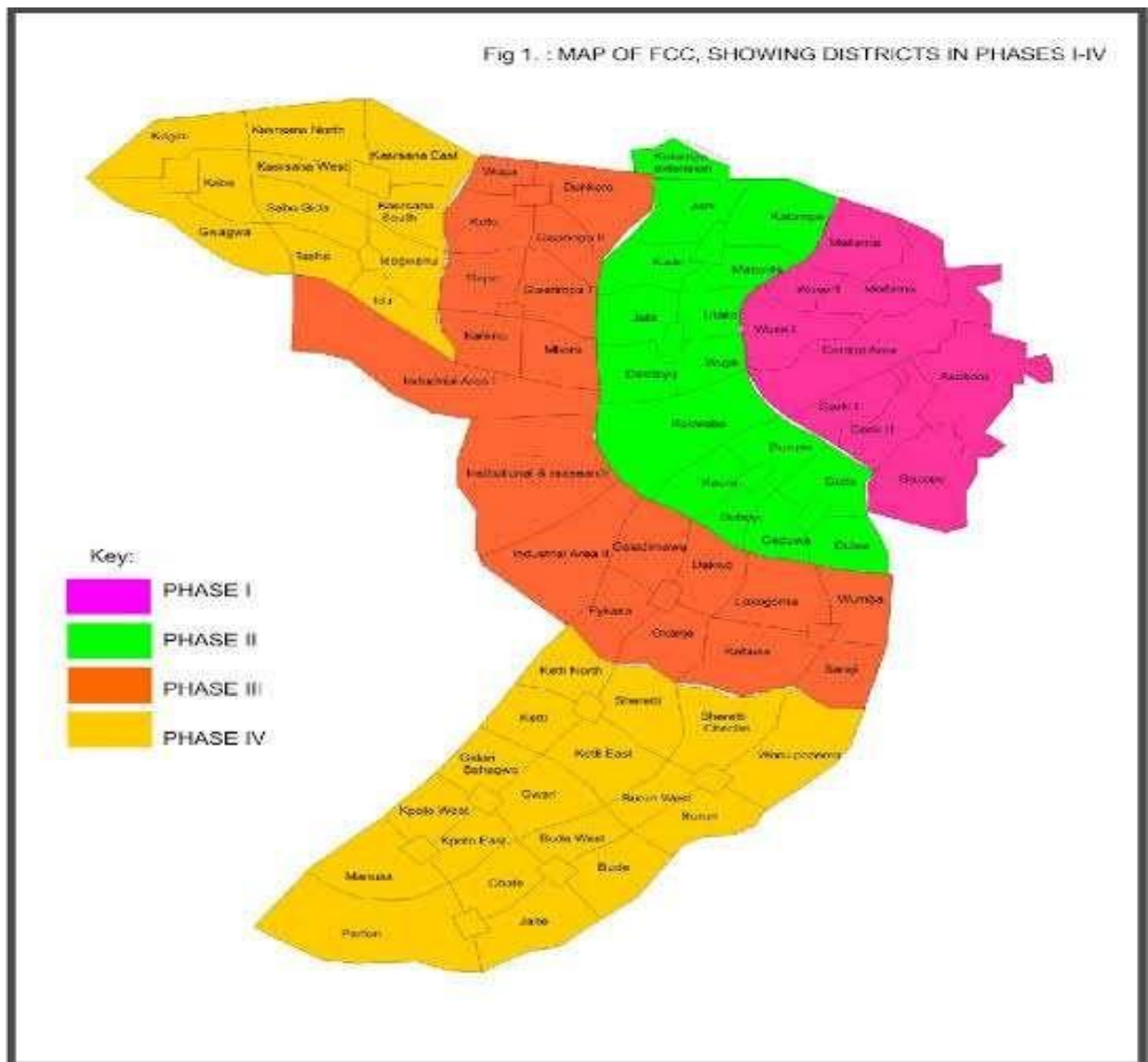
The research will target key stakeholders, including; Real estate developers and property managers in Abuja, Homeowners and tenants in IoT-enabled residential properties, Technology providers offering IoT solutions for real estate, Government agencies and policymakers involved in housing and urban development. With respect to some limitations, the study population will only consist real estate developers and property managers in Abuja, and homeowners & tenants in IoT-enabled residential properties.

### **1.8 Study Area: Abuja Metropolis**

Abuja, the capital city of Nigeria, is a rapidly developing urban center with a growing real estate market. The city is known for its well-planned infrastructure, high-end residential estates, and increasing adoption of smart technologies. As Nigeria's political and administrative hub, Abuja attracts a diverse population of government officials, business executives, expatriates, and middle-to-high-income earners.

Over the past decade, Abuja has witnessed a boom in gated communities and luxury residential estates, particularly in high-brow areas and fast-growing suburbs. Many of

these estates are integrating smart technologies to enhance security, energy efficiency, and overall convenience.



**Fig. 1:** The Districts in Abuja

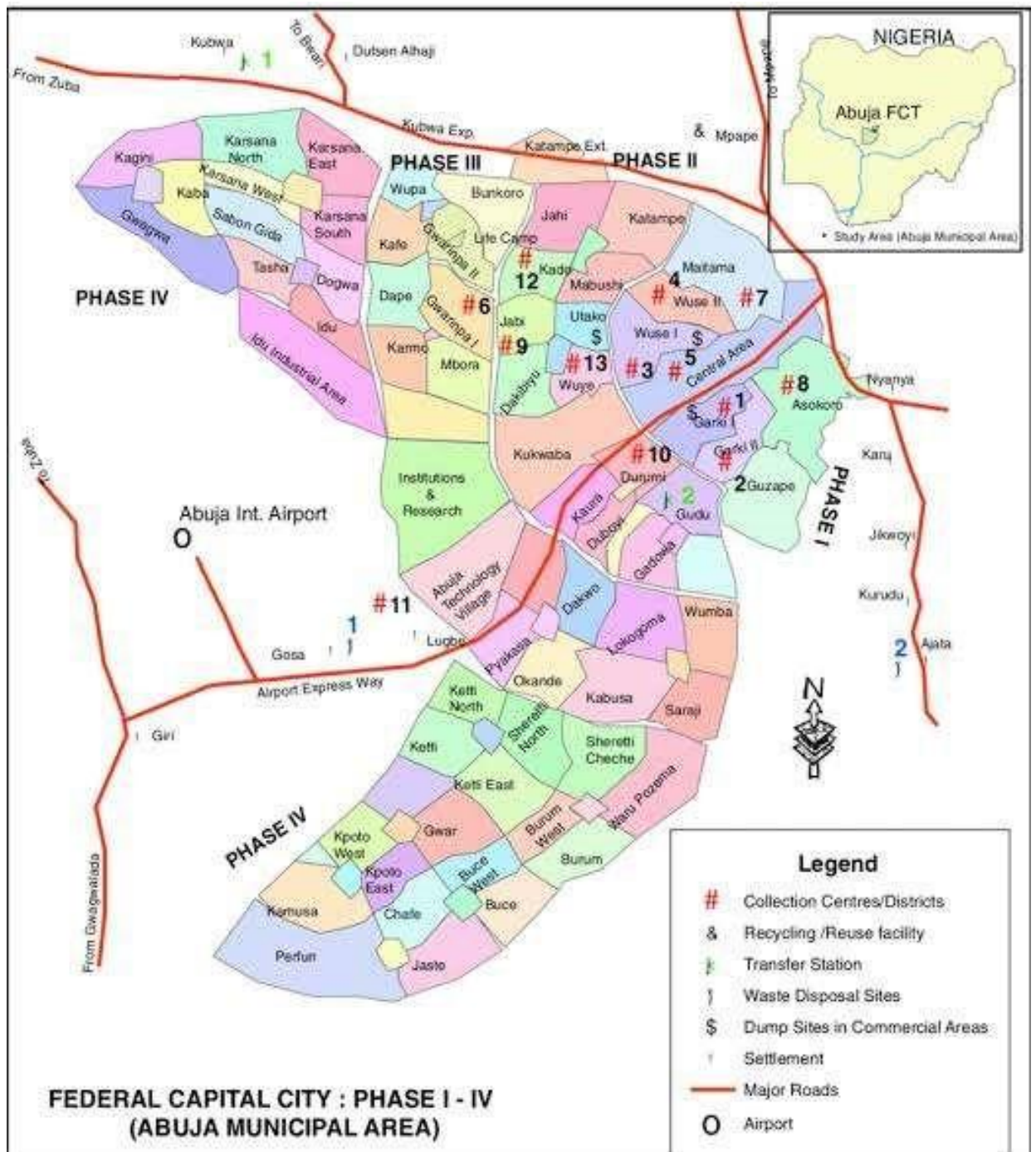
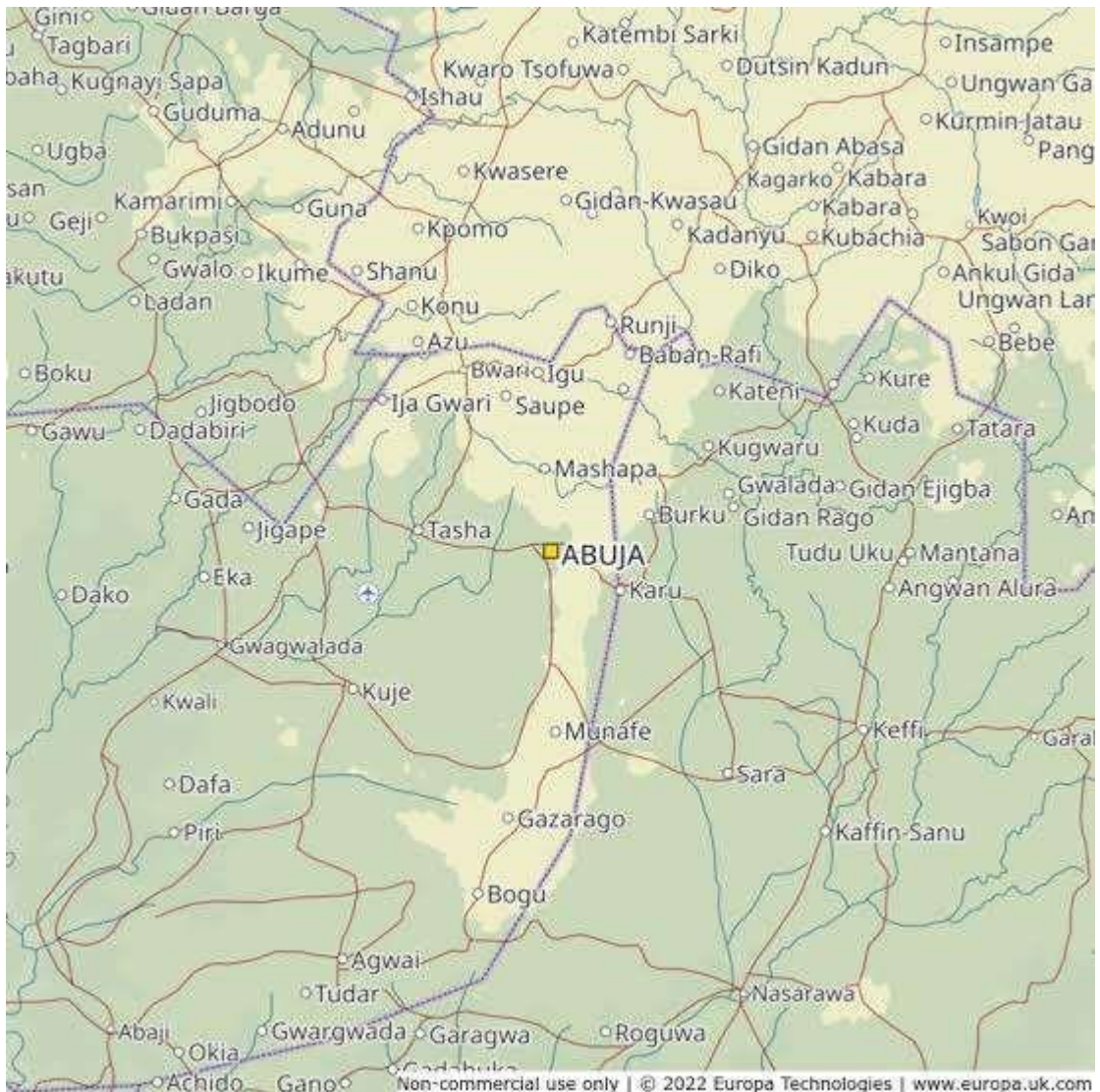


Fig. 2: Abuja municipal area (Federal Capital City of Nigeria)



**Fig. 3:** Map of Abuja, Nigeria | Global 1000 Atlas

Key residential locations where IoT adoption is gaining traction include:

- Maitama, Asokoro, and Wuse – These areas house some of Abuja’s most expensive properties, where smart home automation, biometric security, and IoT-driven energy management systems are becoming standard.
- Gwarinpa and Jabi – Known for their mix of luxury and mid-income housing, these areas feature residential developments that incorporate IoT-based security systems, smart lighting, and remote-controlled home devices.
- Lokogoma, Lugbe, and Galadimawa – These emerging residential hubs are experiencing significant real estate expansion. Some estates in these areas are

gradually adopting IoT applications, particularly in security (smart CCTV, electric fences with AI monitoring) and energy management (smart meters and solar automation).

With increasing digital transformation in Nigeria and growing investment in smart city initiatives, the future of IoT adoption in Abuja's residential sector looks promising. Government-driven policies, real estate innovations, and improved internet infrastructure are expected to drive wider adoption of smart home technology in the coming years. This study will provide insights into how IoT is reshaping residential property management in Abuja, highlighting both the opportunities and challenges of this technological shift.

## **1.9 Definition of Terms**

1. Internet of Things (IoT): The Internet of Things refers to a network of physical devices that contain sensors, software, and communication technologies which enable them to collect, process, and exchange data with other connected systems. These devices communicate either through the Internet or through private communication networks (Grillis & Alexander, 2021).

The concept brings together several fields such as electronics, computer science, and communication engineering. Although widely called the "Internet of Things," some scholars argue that the term is somewhat misleading because IoT devices do not necessarily require the public internet to function; they only need to communicate within a network environment (Beal, 2022). The IoT has grown because many technologies have come together. These include everyday smart devices, cheap sensors, stronger small computers, and the use of machine learning (Hu et al., 2022).

2. Residential Property Management –Residential property management is the process of managing a residential property on the owner's behalf. The residential property

manager serves as the land owner's representative when dealing with tenants and is also in charge of the property's upkeep. The types of properties that require residential property management include condos, single and multi-family homes, apartments, and townhouses. (Leon Altomonte, 2023).

3. Smart Home – A smart home refers to a convenient home setup where appliances and devices can be controlled automatically or remotely with an internet connection and using a mobile or other networked device. Devices in a smart home are interconnected through the internet, allowing the user to control functions such as security, access to the home, temperature, lighting, and a home theater. (Hayes, 2024).
4. Property Value – Property value refers to the estimated worth or price of a property, whether it is a residential, commercial, or industrial property. It is determined by various factors such as location, size, condition, amenities, and market demand. Property value is a crucial aspect of the real estate industry as it influences buying, selling, and investing decisions. Buyers and sellers rely on property value assessments to determine fair prices for properties, while investors consider property value as a key factor in evaluating potential returns on investment. Furthermore, property value serves as a benchmark for property taxes, insurance premiums, and mortgage lending. By understanding property value, individuals and businesses can make informed decisions and navigate the real estate market effectively. (Lark, 2024).
5. Home Automation – Home automation is a technology that lets users create and trigger automatic functions for home devices. That may be through schedules, rules, or scenes. With scheduled automations, for example, you can make lights turn on at a certain time. Using rules, you can make your devices respond to certain actions of yours or scenarios (e.g. turn on lights when a door is opened). And with scenes, you can group together home devices so each of them performs a specific action

whenever you trigger the scene. That means you can control multiple devices with just a touch of a button.

Home automation makes life more convenient and can even save you money on heating, cooling and electricity bills. Home automation can also lead to greater safety with Internet of Things devices like security cameras and systems (Xfinity, 2019).

6. Cyber security – Computer security (also cyber security, digital security, or information technology (IT) security) is a sub-discipline within the field of information security. It consists of the protection of computer software, systems and networks from threats that can lead to unauthorized information disclosure, theft or damage to hardware, software, or data, as well as from the disruption or misdirection of the services they provide. (Schatz, 2017).
7. Smart Security Systems – A smart security system seamlessly integrates your home security or business security system into your everyday life. It connects your security with your personal devices such as smart phones using home networks and wireless technology. Smart security, in practical terms, is the integration of digital and technological elements into a traditional human security force. Technologies such as sensors, robotics and IoT networks are enhancing the efficiency and effectiveness of building and facility security teams. This technology allows for more resilient systems that can be steered by smaller operator teams, with greater awareness and transparency for personnel, management and other stakeholders.
8. Energy Efficiency – Efficient energy use, also called energy efficiency, means reducing the amount of energy needed to deliver the same products and services. Many modern technologies are designed to save more energy than older systems. For example, adding insulation to a building helps reduce the energy needed for heating or cooling while still keeping the home comfortable (Overland, 2010).

Energy efficiency also works closely with renewable energy, and both are important for achieving sustainable energy policies (Prindle et al., 2007).

8. Real Estate Developers – Real estate developers are responsible for buying land, financing projects, and overseeing the entire development process from start to finish. They may build properties themselves or work with builders and joint-venture partners. Developers take on the highest level of risk in creating or renovating real estate, but they also earn the highest returns.

In most cases, a developer purchases land, studies the market, plans and designs the project, secures government approvals and financing, supervises construction, and later rents, manages, or sells the completed property (Richard, 2003).

9. Tenants—A tenant is generally described as a person who occupies or holds temporary possession of land or property belonging to another. According to the Merriam-Webster Dictionary, a tenant may be someone who rents or leases a dwelling from a landlord, or someone who holds real estate or personal property by any form of legal right (Merriam-Webster, n.d.).
10. Homeowners – A homeowner is generally defined as a person who owns a home, apartment, or similar residential property. According to the Britannica Dictionary, a homeowner is simply “a person who owns a home, apartment, etc.” Homeowners may also be individuals or entities who adopt smart technologies, such as IoT systems, to improve convenience, security, and energy efficiency in their living spaces (Britannica Dictionary, n.d.).
11. Urban Development – Cambridge Dictionary defines Urban Development as; the process of developing a town or city by building new buildings, or the process of building houses, etc. in an area. It can also refer to the process of planning and

improving city infrastructure, including residential housing, transportation, and technology integration, which affects the adoption of IoT in property management.

12. Data Privacy – Information privacy, also known as data privacy, refers to the relationship between how data is collected, used, and shared; the technologies involved; the public’s expectations of privacy; contextual norms; and the legal or political issues surrounding these processes (Michael et al., 2013). In smart homes, it involves protecting the personal and sensitive data collected by IoT devices, ensuring that residents’ information is not accessed or used without proper authorization.

13. Real Estate Market – According to the Cambridge Business English Dictionary, the real estate market involves the buying, selling, and leasing of land and buildings, and it plays a significant role in the global economy. It is commonly divided into three major categories: residential, commercial, and industrial.

In addition, the real estate market can be viewed as a broader industry that includes property management, renting, and investment activities. In recent years, Internet of Things (IoT) technologies have begun to influence this sector by shaping property valuation, improving building management, and affecting consumer demand.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter presents a comprehensive review of literature relevant to the adoption and impact of Internet of Things (IoT) in residential property management. It aims to establish a solid theoretical and empirical foundation for the study by examining existing knowledge, theories, and previous research findings in the field. The chapter begins with a conceptual review that provides a clear understanding of key concepts such as the Internet of Things, residential property management, and technological adoption.

Following the conceptual review, the chapter critically evaluates empirical studies conducted by scholars and practitioners on the integration of IoT in property management, with a focus on its benefits, challenges, and outcomes across various settings. Particular attention will be given to studies related to smart housing, tenant satisfaction, operational efficiency, and decision-making in property management.

The chapter concludes by identifying gaps in the existing literature, especially in the context of Abuja Metropolis, Nigeria. These gaps highlight the need for the current study and underscore its potential contributions to knowledge and practice in residential property management and the application of IoT technologies.

#### **2.2 Conceptual Review**

##### **2.2.1 Concept of the Internet of Things (IoT)**

The Internet of Things (IoT) refers to a network of interconnected devices that collect, transmit, and process data without requiring human intervention (Atzori, Iera, & Morabito, 2019). These devices include smart sensors, thermostats, security cameras, and automated lighting systems, all designed to enhance efficiency and convenience in

various applications, including real estate and property management. IoT is built on three core components:

- Smart Devices & Sensors – Devices embedded in buildings to collect real-time data (e.g., smart meters, motion sensors).
- Connectivity – Cloud-based platforms and wireless networks (Wi-Fi, 5G) that facilitate data transmission.
- Data Analytics & Automation – AI-driven platforms that analyze data and automate responses (e.g., predictive maintenance in buildings).

### **2.2.2 IoT in Residential Property Management**

The integration of IoT in residential property management has transformed traditional housing operations. Property managers and homeowners now leverage smart technologies to enhance security, reduce operational costs, and improve tenant experience.

Key IoT Applications in Residential Property Management:

- Smart Security Systems – Biometric access controls, motion-sensing surveillance cameras, and AI-powered threat detection.
- Automated Energy Management – Smart lighting, thermostats, and IoT-enabled appliances to optimize energy consumption.
- Predictive Maintenance – Sensors that detect faults in electrical, plumbing, and HVAC systems before they escalate.
- IoT-Enabled Rent Payment & Complaint Systems – Digital platforms that streamline rent collection and tenant communication.

Studies by Khan et al. (2021) and Olajide & Uchenna (2020) indicate that IoT adoption in property management has led to increased efficiency, tenant satisfaction, and cost reductions in real estate operations.

### **2.2.3. Adoption of IoT in Residential Property Management in Nigeria**

While the use of IoT in residential property management is still in its early stages in Nigeria, there are emerging trends of smart home integrations and IoT technologies in urban centers. The adoption of IoT in Nigerian residential properties is often driven by high-income earners, luxury apartments, and new residential developments. These developments feature smart devices such as security systems, smart thermostats, lighting, and energy meters, offering a glimpse into the future of property management.

In cities like Lagos, Abuja, and Port Harcourt, real estate developers are increasingly incorporating IoT technologies to cater to the growing demand for modern and efficient living spaces. For example, in Abuja, a few high-end residential estates have adopted smart home features like automated lighting, HVAC systems, and energy-efficient appliances, which are remotely controlled by residents through smartphones or voice assistants (Oni, 2020). These IoT applications aim to improve living conditions while minimizing energy consumption and operational costs. Furthermore, some property management companies have started using IoT-enabled systems to monitor and manage maintenance activities more efficiently.

Despite the presence of these smart homes in Nigeria, widespread adoption of IoT across the general residential sector remains limited. Several factors contribute to this slow adoption, including the high cost of technology, inadequate infrastructure, lack of awareness, and data privacy concerns (Akinyemi & Bello, 2021). Additionally, the need for specialized skills in IoT technology management and integration is another barrier to its widespread use.

## **2.2.4 Factors Influencing IoT Adoption in Residential Property Management**

Several factors affect the adoption of IoT in Abuja's residential property sector:

- Technological Infrastructure – Availability of stable internet, smart grids, and cloud computing platforms.
- Affordability & Cost of Implementation – High installation costs limit IoT adoption, especially among middle-income property owners (Kumar, 2020).
- Awareness & Adoption Rate – Lack of knowledge among property managers hinders widespread IoT implementation.
- Government Policies & Regulations – Supportive policies can encourage smart property development through tax incentives.
- Cybersecurity Concerns – Fear of hacking and data breaches discourages some tenants and property managers from adopting IoT systems.

## **2.2.5 IoT Adoption in Abuja's Residential Property Market**

In Abuja Metropolis, luxury estates in Maitama, Asokoro, Jahi, Gwarinpa, and Lugbe have begun integrating smart property management systems. These areas feature IoT-driven security systems, automated lighting, smart metering, and AI-enabled maintenance services. However, IoT adoption remains limited in middle-class neighborhoods due to cost constraints, unreliable internet connectivity, and low digital literacy (Okonkwo & Adebayo, 2022).

## **2.2.6 Challenges of IoT Adoption in Residential Property Management**

Despite its benefits, several challenges hinder the full-scale adoption of IoT in residential property management in Abuja:

- High Initial Investment Costs – IoT infrastructure, including sensors, cloud storage, and AI systems, requires significant capital (Olajide & Uchenna, 2020).

- Unstable Power Supply & Internet Connectivity – Nigeria's electricity challenges and inconsistent broadband services affect IoT efficiency (Akinyemi & Eze, 2021).
- Cyber security Risks & Data Privacy Issues – IoT devices collect vast amounts of personal data, making security breaches a major concern.
- Resistance to Change & Skill Gaps – Many property managers lack the technical knowledge needed to manage IoT-based systems effectively.

Gartner (2016), one of the advisories and leading Research organizations estimated that by the end of 2017, there would be a connection of some IoT devices of about 8.3 billion, it increased in 2018 to 11.2 billion, then by 2020, it nearly doubling to 20.4 billion. The applications that have to do with the consumer takes approximately the highest percentages of these forecasted figures. Greater China, North America, and Western Europe are the world's highest-tech regions and the first known Internet of Things (IoT) drivers of where the combination of the three countries represents in 2017 above 67% of the concept execution. What has made IoT a technology that is everywhere today is the speedy and continuous development in its popularity.

Internet of Things has some market opportunities; some of them are as follows:

- i. Connected cars of 152 million in 2020- HIS. Automotive Mobile subscriptions of 9.5 billion in 2020- Ericsson mobility.
- ii. Fifty billion connected devices in 2020- Cisco.
- iii. Households of 42% will have Wi-Fi in 2020- Strategy Analytics.

According to an enterprise software strategist called Louis Columbus, the highest potential of the Internet of Things is to be customer-oriented, transform the business to digitally efficient one, and be more flexible.

## **2.3 Empirical Review**

### **2.3.1 Extent of Application of IoT in Residential Property Management in Abuja**

The study by Park et al. (2017) titled “Motivations for IoT Use in Smart Home Environments” examined why people adopt IoT technologies and how users experience smart home systems. Using a structured questionnaire administered to 40 smart home users, they developed a technology acceptance model. Their findings showed that user attitude was the strongest predictor of IoT adoption, while cost and suitability also played significant roles. However, the study did not consider how these behaviours may differ in African or developing regions where infrastructure and affordability challenges exist.

In a related study, Teizer et al. (2017) explored IoT and Building Information Modelling (BIM) integration in real estate construction projects. Their experiments, which tracked IoT usage on real project sites and assessed workplace lighting conditions, showed that IoT improves real time safety and project management. Despite these benefits, the study did not investigate how such technologies evolve during residential use after construction, leaving a post occupancy gap.

Similarly, Louis and Dunston (2018) developed a sensor agnostic IoT decision making model aimed at improving construction operations. Their conceptual model demonstrated how IoT can enhance performance and operational control. However, the model was not tested in actual residential environments, particularly in regions with low technological infrastructure.

Xu et al. (2018) designed a cloud based IoT system for precast construction, focusing on improving accessibility for small and medium sized enterprises. Their application based research on Hong Kong construction sites confirmed IoT’s effectiveness in improving mechanization and efficiency. Yet, the study did not evaluate how such systems could be scaled or adapted to less developed environments.

Park et al. (2019) introduced an IoT deep learning safety system for construction environments. Their study demonstrated that integrating IoT sensors with deep learning can effectively detect hazards and enforce safety compliance. However, they did not extend their findings to residential property management or occupant level IoT adoption. Reja and Varghese (2019) conducted a comparative analysis on “5G and IoT Integration in Real Estate.” Their findings highlighted the potentials and challenges of implementing emerging technologies in construction and property management. They noted that IoT adoption remains difficult without continuous technological advancement, especially in developing countries, where implementation strategies remain unclear.

In assessing Africa’s readiness, Atayero, Oluwatobi, and Alege (2018) evaluated the preparedness of Sub Saharan African countries for IoT adoption. Their analysis revealed growing awareness but significant infrastructure and technical limitations that hinder widespread adoption.

Turning to Nigerian studies, Okonkwo and Fadairo (2021) examined IoT based security infrastructure in high end residential areas of Abuja. Their survey revealed that only 23 percent of homes in areas like Maitama and Wuse II use IoT enabled security systems. The study, however, did not investigate IoT usage in middle or low income neighborhoods.

Adebayo and Usman (2022) investigated the adoption of IoT in residential facility management within Abuja. Using surveys and interviews with 50 property managers, they found adoption rates below 20 percent. Their study identified a lack of research on how long term IoT benefits might increase adoption despite initial costs.

Oni (2020) evaluated the authenticity of “smart housing estates” in Abuja through field visits and marketing material reviews. The study revealed that many advertised smart

features were superficial and not fully functional. A major gap identified was the absence of post occupancy evaluation to determine users' actual experiences.

In a broader socioeconomic context, Oyetunde and Ibrahim (2019) assessed IoT deployment across 150 residential units in Abuja. They found IoT adoption concentrated mainly in wealthier districts. The study highlighted a gap in understanding how government or private partnerships could promote broader adoption.

Ahmed and Musa (2021) examined retrofitting patterns in Abuja buildings. Their findings showed that smart tools such as smart meters and surveillance systems were more common in new buildings. However, they did not provide a feasibility assessment for upgrading older buildings, creating a knowledge gap in retrofitting strategies.

Lastly, Chukwuemeka and James (2023) assessed smart home technology usage among tenants in Gwarinpa. Their survey revealed that fewer than 15 percent of tenants had access to IoT tools such as smart locks or automated lighting. The study did not explore whether tenants would be willing to pay extra for such features, leaving a demand side research gap.

### **2.3.2 Economic Impact of IoT in the Study Area**

Ghimire et al. (2017) in their study *Improving Decision-Making Efficiency with IoT in Real Estate* aimed to show how IoT can maximize project performance by speeding up operational processes. They developed a decision-support model and tested communication tools on real estate project sites. The study confirmed the potential of IoT in improving operational flow but did not examine user-level financial outcomes in residential properties.

Xu et al. (2018) also demonstrated economic potential through their cloud-based IoT system designed for SMEs in the construction sector. Their methodology showed that automation can reduce costs and increase project visibility. However, how such systems could be applied in residential property management remains underexplored.

Reja et al. (2019) revealed that IoT, especially when integrated with 5G, provides scalable solutions for cost efficiency in real estate. Their comparative analysis showed that although economic returns appear promising, widespread adoption is still challenged by infrastructural limitations, particularly in developing countries.

Obi and Akinola (2020) in their study *Energy Efficiency and IoT: Measuring Cost Reduction in Smart Residential Estates in Abuja* used longitudinal billing data to document a 30 percent reduction in energy costs. Their study did not differentiate savings across device types or between categories of residential estates.

Nwachukwu et al. (2021) examined *Smart Property Features and Rental Yield: An Abuja Case Study* using comparative market data. Their results showed that smart residential units attracted 8 to 12 percent higher rents and achieved better tenant retention. However, the study did not assess tenant satisfaction or non-monetary benefits associated with IoT adoption.

Lawal and Adeyemi (2022) in *Operational Cost Benefits of IoT for Property Managers in Urban Nigeria* used interviews and operational modelling to evaluate IoT's impact on water and energy tracking. While operational savings were evident, the study did not examine small-scale property firms or analyse cost-recovery periods.

Effiong and Yusuf (2021) in *Predictive Maintenance and IoT: Financial Implications for Estate Management* employed experimental methods and found a 28 percent reduction in repair and maintenance costs due to IoT-enabled monitoring. The study's gap was the

absence of an assessment of workforce training, which is crucial for maximizing financial gains from predictive maintenance systems.

Eze and Ibrahim (2020) through their study Smart Upgrades and Residential Property Valuation in Abuja used pricing models and sales data to demonstrate a positive relationship between IoT upgrades and property value. A key limitation was the lack of longitudinal analysis to determine whether these value increases persist over time.

Ayodele and Madu (2023) in IoT Integration and Service Delivery in Property Management found that smart technologies improved service delivery by 20 to 25 percent and contributed to extended tenant lease periods. However, they did not evaluate the actual investment return margin for property owners or managers.

### **2.3.3 Challenges Associated with IoT Adoption in Residential Property Management in Abuja**

Park, Cho, Han and Kwon (2017) identified that users' willingness to adopt IoT is strongly influenced by personal attitude, cost and ease of use. Their behavioural model provided useful insights but did not address structural barriers that exist in underdeveloped regions where infrastructure and affordability challenges may significantly alter adoption patterns.

Reja et al. (2019) emphasized the difficulty of sustaining IoT systems without continuous technological advancement and institutional support. Their analysis focused more on the potential benefits of IoT than on the practical constraints, leaving implementation strategies insufficiently examined.

Atayero, Oluwatobi and Alege highlighted Sub-Saharan Africa's readiness for IoT adoption and revealed that infrastructural deficiencies and low digital skills remain major

obstacles. However, their study did not propose concrete policy actions to guide national decision-makers.

Adetunji and Suleiman (2020) in their work *Barriers to IoT Adoption in Nigeria's Residential Property Sector* used Delphi-based expert interviews to identify high device costs, limited technical expertise and inadequate internet access as major challenges. Their study did not provide detailed policy-oriented recommendations to address these constraints.

Ogundele and Ekong (2023) in *Smart Technology Training Deficiency Among Abuja Property Managers* found that 62 percent of surveyed property managers lacked IoT-related training. Although the study revealed a significant skill gap, it did not examine the possible role of tertiary institutions in providing formal capacity-building solutions.

Umeh and Hassan (2021) explored tenant concerns in *Surveillance, Privacy and the Social Barriers to Smart Home Acceptance* using qualitative focus groups. Their findings highlighted strong ethical concerns around monitoring and data usage, yet the study did not analyse the legal frameworks necessary to protect users.

Aliu and Enemuoh (2022) in *Infrastructure Gaps in Abuja's Smart Housing Projects* showed through estate audits and power supply data that unstable electricity and limited broadband access constrain the use of IoT devices. The study did not explore feasible alternatives such as solar backup systems or fibre-based internet solutions.

Okeke and Ojo (2021) in *Technical Capacity and Outsourcing in IoT Deployment* reported that only 14 percent of property firms had in-house IoT support teams, leading to a heavy reliance on external vendors. Long-term risks associated with outsourcing were not assessed.

Ibrahim and Dauda (2023) in their study *Policy and Governance Deficits in Smart Real Estate Development* found that inadequate regulatory frameworks hinder the standardization of smart property systems. However, they did not provide detailed legislative pathways or stakeholder engagement strategies.

Despite the growing body of literature, a significant gap remains in context-specific empirical research on IoT adoption, economic implications and practical challenges within residential property management in Abuja Metropolis. This study seeks to address this gap.

#### **2.4 Literature on the Topic and Identified Gaps**

Globally, research has underscored the transformative role of IoT in property management. Studies from countries like Singapore, the United States, and the UK show that IoT integration can reduce operational costs, enhance energy efficiency, and improve tenant satisfaction (Sanchez & Noriega, 2019; Wang et al., 2020). IoT is increasingly used in smart homes to enable predictive maintenance, automate lighting and HVAC systems, and ensure data-driven decision-making in managing properties.

In Nigeria, however, most available literature focuses on commercial real estate or general smart city initiatives, with limited focus on residential property management. Studies by Akpan (2022) and Adedeji (2021) explore the broader application of smart technologies but do not delve deeply into residential-specific management practices or tenant experiences. Furthermore, while some works acknowledge the existence of smart estates, they often lack in-depth empirical data on how IoT is applied, its actual economic impact, and the sociotechnical challenges involved.

What remains largely unexplored is the extent to which IoT is truly implemented in residential buildings, especially in middle- and lower-income areas in Abuja. There is

also a notable gap in assessing the specific economic benefits for both landlords and tenants, as well as the real-world challenges they face in deploying or living with such systems. Additionally, very few studies consider the perspectives of tenants themselves, despite them being the endusers of smart technologies.

This study therefore seeks to fill these gaps by focusing specifically on Abuja's residential sector. It will provide empirical data on the level of adoption, investigate the economic implications for landlords and property managers, and document the challenges from both provider and user perspectives. By doing so, it contributes to localized policy and practical frameworks for IoT integration in Nigeria's residential property sector.

## **2.5 Gaps in Existing Literature**

Although there is an increasing body of research on the global use of IoT in residential property management, specific studies on the adoption and impact of IoT technologies in Nigeria remain sparse. Most studies on IoT adoption in Africa tend to focus on sectors like agriculture, healthcare, and energy management, with little emphasis on its application in the residential property sector (Akpan, 2022). Furthermore, the existing literature predominantly explores the benefits of IoT in urbanized and developed regions, leaving a gap in understanding how these technologies can be implemented and scaled in emerging economies like Nigeria.

Additionally, while IoT adoption in residential property management is mentioned in several studies, few of them address the economic impacts of such technologies in the Nigerian context. There is limited research on how IoT influences tenant satisfaction, property management efficiency, and energy consumption in Nigerian residential properties. This lack of localized research leaves a significant gap in understanding the

challenges and opportunities that come with IoT integration into the Nigerian real estate market.

Furthermore, the majority of the studies focus on the technological aspect, neglecting the cultural and infrastructural factors that could affect the successful implementation of IoT solutions in Nigerian homes.

The existing literature also lacks comprehensive studies on tenant behavior in response to IoT adoption in residential properties. Most of the available studies focus on developers' and property managers' perspectives, while tenants' experiences and perceptions are often overlooked. This gap in tenant-centric research could provide valuable insights into how IoT technologies impact tenant satisfaction, retention, and the overall living experience.

## **2.6 Justification**

This study aims to address the identified gaps by exploring the role of IoT in enhancing tenant satisfaction and retention in Nigeria residential properties. Specifically, it will focus on the impact of IoT adoption in Abuja Metropolis, analyzing how IoT influences energy management, maintenance efficiency, security, and overall tenant experience. The research will also examine the barriers to IoT adoption in Nigeria's residential property market and offer recommendations on overcoming these challenges.

Furthermore, the study will explore the behavioral responses of tenants to IoT-enabled features in residential buildings. By assessing both tenants' and property managers' perspectives, this research intends to provide a more balanced view of the benefits and challenges of IoT integration in residential property management.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Preamble**

This chapter describes the plan and method by which the research activity is carried out. Rajasekar, Philominathan, and Chinnathambi, (2006) defined methodology as a systematic way to solve a problem. According to the study, it is the procedure by which researchers go about their work describing, explaining and predicting phenomenon.

This chapter provides details on the method for conducting the study. Areas considered include the research design, the population, the sample and the technique for its selection, the research instrument, data collection procedure and data analysis procedure. The chapter concludes with the statistical techniques utilized for the data analysis.

#### **3.2 Research Design**

Research design is the detailed outline of how the research is conducted which include how data is collected, what research instrument is used, how it is used and the means for analyzing the data collected.

##### **3.2.1 Descriptive Research Design**

This type seeks to describe the characteristics of a population or phenomenon, using methods like surveys, observations, and case studies.

##### **3.2.2 Exploratory Research Design**

Used when a problem is not well defined, this design helps to gain deeper insights and understanding, typically using qualitative methods like interviews and focus groups.

##### **3.2.3 Explanatory (Causal) Research Design**

This focuses on identifying cause-and-effect relationships between variables, often through experiments or longitudinal studies.

### **3.2.4 Experimental Research Design**

It involves manipulating one variable to determine its effect on another within a controlled environment.

### **3.2.5 Correlational Research Design**

It examines the statistical relationship between two or more variables without manipulation.

### **3.2.6 Diagnostic Research Design**

This is used to identify the root causes of a particular issue or problem, often in applied fields like business or healthcare.

### **3.2.7 Mixed-Methods Research Design**

A mixed-method research design is an approach that combines both quantitative and qualitative methods in a single study to provide a more comprehensive understanding of a research problem. It involves collecting and analyzing numerical data (quantitative) alongside detailed, descriptive information (qualitative) to capture both measurable trends and deeper insights. This design strengthens the validity of findings and offers a balanced perspective that one method alone may not achieve.

The study will adopt the mixed-methods research design, combining both quantitative and qualitative approaches.

#### **3.2.7.1 Quantitative Approach**

A survey research design was used to collect data from residents living in IoT integrated residential properties and firms that manage IoT-enabled properties in Abuja.

### **3.2.7.2 Qualitative Approach**

The research design employed in this study is an exploratory and quantitative survey, which was used to achieve the outlined objectives and structured questionnaires as the most suitable technique for such a survey. The survey research collects information from the population for intensive analysis by the researcher.

### **3.3 Research Area**

The study focused on Abuja Metropolis, specifically on residential properties within the city. Abuja, being the capital city of Nigeria, is a hub for technological innovation and adoption. The city's residential properties are managed by various stakeholders, including estate surveyor and valuers, and tenants.

### **3.4 Population of Study**

Population refers to the totality of a universal set contained in particular study area i.e. prospective respondents that possess the characteristics or that have the knowledge of the particular study in question from which a sample would be selected. In this, the relevant population will include residents and real estate firms located within the study area.

### **3.5 Data Types and Sources**

The data for the study will be obtained from primary and secondary sources. The primary data will be sourced from structured questionnaires administered to respondents during field surveys, where respondents are to record their responses to the questions asked by the researcher. The result of the analysis of the data to be collected, will be presented in chapter four of this research. The questionnaires are to be self-administered.

### **3.6 Sample Size**

In this study, the sample will be drawn from residential estates in Abuja that are known to have integrated Internet of Things (IoT) technologies into their property management systems, as well as from real estate firms actively involved in smart housing projects. To ensure manageability and representativeness, a systematic sampling technique will be employed.

For the residential buildings, a 1-in-every-5 sampling approach will be used. This means that for every five identified smart buildings, one will be selected (i.e.,  $25 \times 5 = 125$ ). From each of these selected buildings, one questionnaire will be administered to a tenant, preferably the head of the household, in order to obtain user-level data on the application, benefits, and challenges of IoT in residential property management.

Similarly, for the real estate companies, a 1-in-every-4 selection method will be adopted (i.e.,  $52 \times 3.54 = 184$ ). In each selected firm, a questionnaire will be distributed to either the principal partner or managing partner, who is presumed to have strategic knowledge and oversight on the firm's involvement with IoT-enabled developments.

### **3.7 Instruments of Data Collection**

The nature of the environment was taken note of through observation, including the conditions of the amenities, housing and other infrastructural facilities. Then, a total number of 77 questionnaires will be distributed to the tenants and managing firm in the study area and questionnaires will be given out and the information on the field of study. The questionnaire will be analyzed to find out the appropriateness of the questionnaire items and research questions and objective of the study. Then also oral interviews will be conducted and the information will be contained in the returned questionnaires.

### **3.8 Method of Data Collection**

The data gathering procedure will be accomplished by administering the questionnaires to the respondents who are residing in the Study area. Personal interviews will also be conducted to supplement the questionnaire and get the respondents view on salient points.

### **3.9 Method of Data Analysis**

Data realized from administration of the research instruments will be analyzed and processed with the aid of Statistical Packages for Social Sciences (SPSS 2016). Data measured on nominal scale will be analyzed using descriptive statistics such as frequency distribution tables and percentages. In the analysis, the Mean Score method will be adopted to establish management problems observed among residential and commercial properties within the study area. This will enable the researcher assign positions (rank) these effects, with the most sensitive effect ranked first, while the least sensitive effect is ranked at the bottom of the table.

<b>Objectives</b>	<b>Data Requirements</b>	<b>Data Respondents</b>	<b>Data Measurement</b>	<b>Method of Data Analysis</b>
To assess the extent of the application of Internet of Things in residential property management in Abuja.	The extent with respect to how much of some identified IoT technology is being adopted in residential property management in Abuja.	Estate surveyor and valuers & Tenants	Quantitative data, ordinal scale	Frequency distribution Standard deviation
To identify the economic benefits of	The economic benefits over VVC 5 years to landlords and real estate surveyors and valuers and also tenants (in terms of conservation of resources)	Estate surveyor and valuers & Tenants	Quantitative data	Frequency distribution Standard deviation
To examine the challenges associated with IoT adoption in property management in the study area.	Challenges are inevitable, finding out is crucial. The challenges associated with IoT adoption faced by tenants and real estate surveyors and valuers in managing and using said technology in Abuja.	Estate surveyor and valuers & Tenants	Quantitative data, ordinal scale.	Mean Standard deviation

## **CHAPTER FOUR**

### **DATA PRESENTATION, ANALYSIS, AND INTERPRETATION**

#### **4.1 Introduction**

This chapter presents the analysis of data collected from the respondents through the questionnaire distributed to estate surveyors and valuers, as well as tenants residing in smart buildings within Abuja Metropolis. The analysis aims to evaluate the impact of the adoption of the Internet of Things (IoT) in residential property management, highlighting trends, challenges, and benefits as perceived by key stakeholders in the real estate sector. The collected data is systematically analyzed to provide insights into the level of IoT adoption in residential properties, its effects on property value, operational efficiency, security, and tenant satisfaction. Responses from estate surveyors and valuers will help determine how IoT influences property valuation, maintenance, and investment decisions, while feedback from tenants will assess the usability, affordability, and convenience of smart technologies in daily living.

This chapter employs both descriptive and inferential statistical methods to interpret the responses, ensuring that findings are presented in a clear and structured manner. The results obtained will serve as a foundation for discussions in subsequent chapters, drawing meaningful conclusions on how IoT-driven property management affects the economic landscape of Abuja's real estate sector.

#### **4.2 Questionnaire Response Rate**

Questionnaires were distributed to 52 Real Estate Surveyor and Valuers and 25 Tenants, all within the study area. The information is presented in the table below.

**Table 4.1: Questionnaire Response Rate**

	<b>Frequency</b>	<b>Percentage</b>
Questionnaire distributed	77	100
Questionnaire retrieved	77	100

**Source:** Researcher's field survey (2025)

### 4.3 Characteristics of the Respondents

The characteristics of the respondents examined include Gender, Age Group, Occupation, location of residence, length of stay in the subject property. The characteristics of the respondents examined include Gender, Age Group, Occupation, location of residence, length of stay in the subject property. The results are as presented in table 4.2 below:

**Table 4.2: General Characteristics of the Respondents**

<b>Gender</b>				
	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Male	14	56.0	.507	1
Female	11	44.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		
<b>Age group</b>				
	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
18 – 25 years	4	16.0	.866	3
26 – 35 years	9	36.0	0.000	
36 – 45 years	10	40.0	0.000	
Above 45 years	2	8.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

<b>Occupation</b>				
	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Student	4	16.0	1.108	3
Civil Servant	8	32.0	0.000	
Business Owner	5	20.0	0.000	
Private Sector Employee	8	32.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		
<b>Location of Residence in Abuja:</b>				
	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Lugbe	8	32.0	1.758	<b>4</b>
Maitama	7	28.0	<b>0.000</b>	
Asokoro	10	40.0	<b>0.000</b>	
<b>Total</b>	<b>25</b>	<b>100.0</b>		
<b>How long have you been living in this smart estate/building?</b>				
	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Less than 1 year	4	16.0	.723	<b>2</b>
1 – 3 years	11	44.0	<b>0.000</b>	
4 – 6 years	10	40.0	<b>0.000</b>	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

**Source:** Researcher's field survey (2025)

It can be deduced from Table 4.2 above that we had 14 (56%) male respondents and 11(44%) Female respondents. Respondents within the age group 18 – 25 years were 4(16%), while 26 – 35 years 9(36%), 36 – 45 years were 10(40%) respondents, then

Above 45 years were 2(8%). We had 4(16%) who were Students by Occupation, 8(32%) Civil Servants, 5(20%) Business owners, and 8(32%) Private Sector Employee.

Their location varied from Asokoro, to Lugbe, to Maitama, with frequencies and percentages of 10(40%), 8(32%), 7(28%), respectively. When asked how long they(as individuals) have been living in this smart estate/building, the result above reveals 10(40%) picked 4 – 6 years, 11(44%) selected 1 – 3 years, and 4(16%) chose Less than 1 year. Their Standard Deviation and Range are also presented in their respective tables.

#### 4.4 The Extent of the Application of IOT in Residential Property Management in Abuja

##### TENANTS

##### 4.4.1 Awareness of IoT technology in residential buildings

Enquiries as to respondents awareness of their buildings’ use of IoT is made with the aid of our distributed questionnaire, and the results are presented in Table 4.3

**Table 4.3: Are you aware that your residence uses Internet of Things (IoT) technology?**

	Frequency	Percent	Std. Deviation	Range
YES	25	100.0	.000	0

**Source:** Researcher’s field survey (2025)

The result above reveals that all our respondents are aware of their residence use of IoT Technology.

#### 4.4.2 IoT features available in the residential estate

**Table 4.4: Which IoT features are available in your residential estate?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Smart security systems (CCTV, biometric access)	4	16.0	.995	3
Smart lighting and energy management	6	24.0	0.000	
Automated rent payment & billing system	10	40.0	0.000	
Smart home appliances (e.g., smart thermostats, voice assistants)	5	20.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

**Source:** Researcher’s field survey (2025)

The options provided for respondents to choose from include; Automated rent payment & billing system, Smart lighting and energy management, Smart home appliances (e.g., smart thermostats, voice assistants), Smart security systems (CCTV, biometric access), these options realized frequencies and percentages of 10(40%), 6(24%), 5(20%), 4(16%), respectively. And also, a std. deviation of .995 and a range of 3.

#### 4.4.3 Frequency of IoT feature usage among respondents

Respondents were also interviewed on how often they use these IoT features, and the result of the analyzed data is shown in Table 4.2.4 below.

**Table 4.5: How often do you use these IoT features?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Daily	14	56.0	.507	1
Occasionally	11	44.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

**Source:** Researcher's field survey (2025)

Responses recorded above with respect to the question asked are presented thus, 14(56%) respondents indicated they use IoT features Daily, while 11(44%) said they Occasionally use IoT Features. The std. deviation of this question is .507, while the range is 1

#### 4.4.4 Ease of use of IoT technology in respondents' residences

Table 4.6 gives us better insight on this subject matter.

**Table 4.6: How easy is it to use the IoT technology in your residence?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Very easy	25	100.0	.000	0

**Source:** Researcher's field survey (2025)

The foregoing table reveals that all our respondents agreed that it is Very Easy to use the IoT Technology integrated in their residence.

#### 4.5 Economic Impacts experienced from IoT in the residence

In trying to evaluate the economic impact of the adoption of the Internet of Things (IoT) in residential property management, an investigation needs to be carried out on residents' main benefits they have experienced from IoT in their respective properties.

**Table 4.7: What are the main impacts you have experienced from IoT in your residence?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Improved security	3	12.0	1.323	4
Lower utility bills (electricity, water)	2	8.0	0.000	
More convenient rent payment & billing	9	36.0	0.000	
Faster response to maintenance issues	4	16.0	0.000	
Increased property value and aesthetics	7	28.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

**Source:** Researcher's field survey (2025)

Respondents were presented with a list of options to choose from, after compilation and analysis of the shared questionnaires the following results presented above were discovered;

More convenient rent payment & billing 9(36%), Increased property value and aesthetics 7(28%), Faster response to maintenance issues 4(16%), Improved security 3(12%), Lower utility bills (electricity, water) 2(8%). These responses have a Standard Deviation of 1.323 and a range of 4.

##### 4.5.1 Improvement in residential experience through IoT usage.

To throw more light to our subject matter, on evaluating the economic impact of the adoption of the Internet of Things (IoT) in residential property management, further exploration needs to be done to get an authentic research work.

**Table 4.8: Has IoT improved your overall residential experience?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Yes, significantly	25	100.0	.000	0

**Source:** Researcher's field survey (2025)

Table 4.8 above gives us a clearer picture on the response of our respondents when asked if IoT has improved their overall residential experience. They all selected Yes, Significantly as their response.

#### **4.5.2 Influence of IoT on Respondents decision to remain in their estate.**

Still on the economic effect of the adoption and implementation of IoT technology, respondents who have been exposed to this technology were asked if it has affected their decision to continue living in their respective estates, and their responses were recorded in table 4.9 below.

**Table 4.9: Has IoT affected your decision to continue living in this estate?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Yes, it has encouraged me to stay	25	100.0	.000	0

**Source:** Researcher's field survey (2025)

Results from the forgoing table suggests that all our respondents were willing to stay in occupation of their estates, as they all voted Yes, it has encouraged me to stay.

#### 4.5.3 Perceived reduction in utility bills since the introduction of IoT

**Table 4.10: Have you noticed a reduction in utility bills (electricity, water) since? IoT was introduced?**

	Frequency	Percent	Std. Deviation	Range
Yes, a significant reduction	14	56.0	.507	1
Yes, but only slightly	11	44.0	0.000	
Total	25	100.0		

**Source:** Researcher's field survey (2025)

With the variety of options presented to our respondents to choose that which best suits them,

14(56%) selected Yes, a significant reduction, while 11(44%) voted Yes, but only slightly.

This result produced a Standard Deviation of .507 and a Range of 1

#### 4.5.4 Perception of rent value for IoT-enabled buildings compared to traditional ones

For a more comprehensive research work, tenants were asked which building type should command more rental value between IoT Buildings and the Traditional Building.

And their responses are recorded and analyzed in Table 4.11 below.

**Table 4.11: Do you think smart buildings with IoT should cost higher rent than traditional buildings?**

	Frequency	Percent	Std. Deviation	Range
Yes, because of the added convenience and security	25	100.0	.000	0

**Source:** Researcher's field survey (2025)

The results from the table above reveals that all our respondents were in agreement to the fact that IoT Buildings should command more rental value as oppose the Traditional Building type. They all voted Yes, because of the added convenience and security as their answer to the question asked.

#### 4.6 Challenges associated with the adoption of IoT in residential property management in Abuja

The study looks at the tenant’s interaction with this technology and how the experience has been so far. This question exposes any IoT related challenge the residents must have experienced during the course of their occupation in their respective properties.

**Table 4.12: Which IoT-related challenges have you experienced in your residence?**

Challenges	Mean	Std. Deviation
High service/maintenance costs	2.48	1.229
Unstable internet connectivity	3.60	1.080
Cyber security/privacy concerns	4.80	.408
Difficulty using smart devices	4.88	.332
System malfunctions Or breakdowns	3.76	1.128

**Source:** Researcher’s field survey (2025)

The tenants were presented with a list of challenges and presented with options to select the rate of their occurrence. From the table above, High service/maintenance Costs got a mean score of 2.48 and a Std. Deviation of 1.229, Unstable internet connectivity got a mean score of 3.60 and a Standard Deviation of 1.080, Cyber security/privacy concerns got 4.80 as its mean score and .408 as its standard deviation, while Difficulty using smart devices, and System malfunctions or breakdowns, both got mean scores of 4.88, and 3.76 respectively and standard deviations of .332, and 1,128 respectively as well.

##### 4.6.1 Respondent’s willingness to pay extra for an advanced IoT-enabled apartment

This is a follow up question to the above question. Table 4.13 tells us more.

**Table 4.13: Would you be willing to pay extra for an advanced IoT-enabled apartment**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
YES	14	56.0	1.013	2
Maybe, on depending the cost	11	44.0	0.000	
<b>Total</b>	<b>25</b>	<b>100.0</b>		

**Source:** Researcher’s field survey (2025)

The above table shows that 56% (14) of our respondents would be willing to pay extra for an advanced IoT-enabled apartment, while 44% (11) said maybe, depending on the cost. The standard deviation and range of this response are; 1.013, and 2 respectively.

#### **4.6.2 Impact of IoT on communication between tenants and property managers/landlords**

Analysis of this response rate is presented in Table 4.14 below.

**Table 4.14: How has IoT impacted communication with property managers/landlords?**

	<b>Frequency</b>	<b>Percent</b>	<b>Std. Deviation</b>	<b>Range</b>
Improved communication and faster responses	25	100.0	.000	0

**Source:** Researcher’s field survey (2025)

From the options presented to our respondents, they all selected Improved Communication & faster responses, as their response to the question regarding how IoT has impacted communication with property managers/landlords.

#### **4.6.3 Respondents’ willingness to recommend IoT-enabled properties to others**

Awareness, recommendations and referrals on IoT enabled properties as it pertains to the future of this property type in Abuja metropolis needs to be considered. Table 4.15 explains more.

**Table 4.15: Would you recommend IoT-enabled properties to others?**

	Frequency	Percent	Std. Deviation	Range
YES	25	100.0	.000	0

**Source:** Researcher’s field survey (2025)

Respondents of this survey all opted that they would be willing to recommend IoT-enabled properties to others.

#### **4.6.4 Respondent’s opinion on the future standardization of IoT in Abuja’s residential properties**

Forecasting into the future on the acceptance and adoption of this building type amongst Abuja residential properties in the next 5-10 years was also required from the respondents. Their response is recorded in Table 4.16 below.

**Table 4.16: Do you think IoT will become a standard feature in residential properties in Abuja in the next 5–10 years?**

	Frequency	Percent	Std. Deviation	Range
YES	25	100.0	.000	0

**Source:** Researcher’s field survey (2025)

The table above aids our interpretation after analyzing the data collated. Drawing inference from the table above, it can be seen that all our respondents agreed that IoT will become a standard feature in residential properties in Abuja in the next 5-10 years.

#### **4.7 Characteristics of respondents (Estate Surveyor & Valuers)**

For a more comprehensive research work, Estate Surveyor and Valuers were also interviewed and served questionnaires to get their perception on the subject matter and to provide a form of clarity to this research work. Table 4.17 provides more insight to this.

**Table 4.17: Characteristics of respondents**

<b>Position in the Firm:</b>			
	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Principal Partner	32	62	62
Estate Surveyor	20	38	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	
<b>Years of Experience in Property Management:</b>			
	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
0 – 5 years	15	29	29
6 – 10 years	30	58	87
11 – 15 years	7	13	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	
<b>Location of the Estate/Firm in Abuja:</b>			
	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Lugbe	15	29	29
Maitama	15	29	58
Asokoro	22	42	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	
<b>Is your firm actively involved in managing smart buildings or estates with IoT integration?</b>			
	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
YES	50	96	96

NO	2	4	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

General characteristics of the respondents examined include; Position in firm, which revealed 62%(32) of our respondents were Principal Partners, and 38%(20) are Estate Surveyors. 30(58%) chose 6 – 10 years as their years of experience in property management, 15(29%) of our respondents chose 0 – 5 years, and 7(13%) voted 11 – 15 years as their year of experience in property management. Further investigation revealed the location of their real estate firms, 42%(22) are situate at Asokoro, then 29%(15) 29%(15) are located at Maitama and Lugbe respectively.

Respondents were also asked if their firms were actively involved in managing smart buildings or estates with IoT integration. Analysis of the data gathered revealed 50(96%) were managing smart buildings, while 2(4%) were not.

#### **4.8 Respondent's level of familiarity with IoT applications in residential property management**

Estate surveyors and valuers examined their familiarity with IoT applications in residential property management. The responses are presented in Table 4.18 below.

**Table 4.18: How familiar are you with IoT applications in residential property management?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Very familiar	42	81	81
Somewhat familiar	9	17	98
Not familiar	1	2	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

Options presented to Estate Surveyors include Very Familiar, Somewhat Familiar, Not Familiar. These options obtained frequencies and percentages of 42(81%), 9(17%), 1(2%), respectively.

#### 4.8.1 IoT features integrated into the estates managed by respondents

A list of IoT features was provided for Surveyors to choose which feature has been integrated into the estate they manage. The results of this finding are presented in Table 4.3.3 below.

**Table 4.19: Which IoT features are integrated into the estates you manage?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Smart security systems (CCTV, biometric access)	7	13.5	13.5
Smart lighting and energy management	7	13.5	27
Automated rent payment & billing	14	27	54
Smart home appliances	10	19	73
IoT-based maintenance tracking	14	27	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher’s field survey (2025)

IoT-based maintenance tracking, and Automated rent payment & billing, got 27%(14), 27%(14) respectively, 10(19%) voted Smart home appliances, 7(13.5%), 7(13.5%), were the frequency and percentage of Smart security systems (CCTV, biometric access), and Smart lighting and energy management.

#### 4.8.2 Motivating factors behind the adoption of IoT in estate management.

Table 4.20 tells us more.

**Table 4.20: What motivated the adoption of IoT in your estate(s)?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Demand for smart homes	7	13.5	13.5
Cost reduction in property management	7	13.5	27
Improved security	14	27	54
Energy efficiency	10	19	73
Competitive advantage in the real estate market	14	27	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher’s field survey (2025)

Competitive advantage in the real estate market, and Improved security, were the top selected options with frequency and percentage of 14(27%), 14(27%), followed by Energy Efficiency at 10(19%), and Demand for smart homes 7(13.5%), also Cost reduction in property management 7(13.5%).

#### **4.8.3 Challenges encountered in adopting IoT in estate management**

For a more detailed and informed report on the socio-economic impact of the adoption of the Internet of Things (IoT) in residential property management, the perception of Surveyors on the challenges encountered in adopting IoT in their respective Estates they manage. Below is the result and analysis in Table 4.21

**Table 4.21: What challenges did you encounter in adopting IoT in your estate management?**

<b>Challenges</b>	<b>Mean</b>	<b>Std. Deviation</b>
High initial cost of implementation IoT	2.13	.834
Lack of technical know-how	1.67	1.175
Poor internet connectivity	2.93	1.534

Resistance from tenants	4.07	.799
Cybersecurity risks	4.40	.828
Maintenance issues	1.60	.828

**Source:** Researcher's field survey (2025)

Examination and analysis by taking the mean of their responses and deriving the standard deviation reveals that, High initial cost of IoT implementation as a challenge faced by Surveyors/Landlords got a mean score of 2.13 and Std. Deviation of .834, Lack of technical know-how 1.67 as mean score and 1.175 as the standard deviation, Poor internet connectivity got a mean score of 2.93 and a std. deviation of 1.534, while Resistance from tenants, Cybersecurity risks, Maintenance issues, each got mean scores 4.07, 4.40, 1.60, and standard deviations of .799, .828, .828, respectively.

#### **4.8.4 Observation of cost savings in property management since IoT integration**

The sole purpose of any business is to make profit, this question is aimed at understanding if since the integration of IoT technology into estates managed by surveyors, if there has been any cost saving advantage for both the property owners and the tenants. Table 4.22 tells us more.

**Table 4.22: Have you observed any cost savings in property management since integrating IoT?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
YES	50	96	96
NOT SURE	2	4	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

The table above reveals that close to 97% of our respondents acknowledge the fact that there has been cost saving in the properties they manage since the integration of IoT. 50(96%) selected Yes, while 2(4%) went for the option Not sure.

#### 4.8.5 Effect of IoT integration on tenant satisfaction in managed properties.

Optimizing returns for the landlords and satisfying the tenants of estates they manage is one of the set goals of any property manager. Entertaining complaints and providing solutions to handle said problems is another, but for now we will be concentrating on the former and not the latter. Table 4.23 tells us more.

**Table 4.23: Has the integration of IoT improved tenant Satisfaction in your managed properties?**

	Frequency	Percent	Cumulative Percent
Yes, significantly	50	96	96
System (Missing)	2	4	100.0
Total	52	100.0	

**Source:** Researcher’s field survey (2025)

The table above shows that more than 90% of our interviewed Surveyors all agree that since The Integration of IoT into the estates they manage, the tenants satisfaction levels have increased. 50(96%) voted Yes, Significantly, while 2(4%) left the question void of any answer.

#### 4.8.6 Aspects of property management that have improved due to IoT adoption

To better understand why the tenants satisfaction levels have improved, we need to look at what aspect of property management has improve due to IoT adoption to make the satisfaction level as it is.

**Table 4.24: What aspects of property management have improved due to IoT adoption?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Faster response to maintenance issues	7	13.5	13.5
Increased security	10	19.2	32.7
Better tenant communication & feedback	35	67.3	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

Better tenant communication & feedback 35(67.3%) comes in first with the highest vote, Increased security at 10(19.2%) comes next, Faster response to maintenance issues is the last selected option 7(13.5%).

#### **4.8.7 Tenants' willingness to embrace smart technology in IoT-enabled estates.**

Table 4.25 tells us more.

**Table 4.25: Do tenants in IoT-enabled estates willingly embrace smart technology?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Yes, majority are excited about it	40	77	77
Some tenants accept it, but others are reluctant	12	23	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

Yes, majority are excited about it got 40(77%) as its frequency and percentage, while the next option which says; Some tenants accept it, but others are reluctant, comes in next with a frequency of 12 and percentage of 23%.

#### 4.8.8 Impact of IoT adoption on property value and profitability

We looked at the tenant's satisfaction level since the adoption of this technology, under this heading we will be considering if IoT has affected the value and profitability of smart residential properties.

Table 4.26 tells us more.

**Table 4.26: In your opinion, how has IoT affected the value and profitability of smart residential properties?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
Increased rental & resale value	40	77	77
It has made properties more expensive but not necessarily profitable	12	23	100.0
<b>Total</b>	<b>52</b>	<b>100.0</b>	

**Source:** Researcher's field survey (2025)

From the options provided for surveyors to choose from, Increased rental & resale value 40(77%) is the first option most surveyors agree with, It has made properties more expensive but not necessarily profitable at 12(23%) is the next voted option with respect to the question asked.

#### 4.8.9 Perception of IoT becoming a standard feature in property management across Abuja within the next 5–10 years.

To forecast into the future of this property type, experts were asked if they think IoT will become a standard feature in property management across the study area (Abuja) in the next

5-10 years. Their responses are recorded, analyzed and presented in Table 4.27

below.

**Table 4.27: Do you think IoT will become a standard feature in property management across Abuja in the next 5–10 years?**

	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
YES	52	100.0	100.0

**Source:** Researcher’s field survey (2025)

All our respondents were in agreement that Yes IoT Integrated apartment will become a standard feature in property management across Abuja in the next 5-10 years.

#### **4.9 Discussion of Findings**

##### **4.9.1 The extent of the Application of IoT in residential property management in Abuja**

###### **TENANTS**

The findings clearly indicate a high extent of adoption of Internet of Things (IoT) technology in residential property management within Abuja Metropolis. The results show that all respondents were aware that their residences incorporate IoT systems, signifying full awareness and acceptance of the technology among residents. Furthermore, the presence of multiple IoT features , such as automated rent payment and billing systems, smart lighting and energy management, smart home appliances, and smart security systems demonstrates a broad level of integration of IoT applications across various aspects of residential management. The frequent daily use of these features by most respondents further confirms that IoT has moved beyond the introductory stage and is now actively embedded in the operational and management practices of modern residential estates in Abuja. Therefore, it can be concluded that the extent of IoT adoption in residential property management in the study area is significantly high, both in awareness and practical utilization.

## **Estate Surveyors and Valuers**

In assessing the extent of IoT adoption in Abuja, the findings revealed that most estate surveyors were highly familiar with IoT applications in residential property management, with 81% indicating they were very familiar, 17% somewhat familiar, and only 2% not familiar. This shows a high level of awareness and exposure to IoT technologies among property professionals in the study area. In terms of practical implementation, the most widely adopted IoT features included IoT-based maintenance tracking and automated rent payment and billing, each representing 27% of responses. These were followed by smart home appliances at 19%, while smart security systems and smart lighting and energy management each accounted for 13.5%.

Furthermore, the major factors motivating IoT adoption among property firms were improved security and competitive advantage in the real estate market, both receiving 27% of responses. Other motivating factors included energy efficiency (19%), cost reduction in property management (13.5%), and demand for smart homes (13.5%). Overall, these results indicate that IoT adoption in Abuja's residential property sector is at an advanced stage, driven by the need for enhanced operational efficiency, improved security, and increased competitiveness in the real estate market.

### **4.9.2 Economic Impacts of the adoption of IoT in the study area**

#### **TENANTS**

The findings revealed that the introduction of IoT has brought several economic impacts to residential property management. Most residents indicated that IoT has made **rent payment and billing more convenient**, improving financial transactions between tenants and property managers.

Many respondents also noted that IoT has **increased the value and aesthetic appeal** of properties, making them more desirable and competitive in the housing market. In

addition, IoT systems have **enhanced maintenance response**, reducing repair costs and improving the overall management process.

Furthermore, residents acknowledged that IoT has **improved security**, helping to prevent property loss and damage, which indirectly contributes to financial stability. It was also discovered that IoT has **encouraged residents to continue living in their estates**, showing that the technology promotes **tenant retention** and **steady rental income**.

Finally, a majority of residents reported **a reduction in utility bills**, particularly electricity and water costs, since IoT devices were introduced. This shows that IoT contributes to **efficient resource use** and **cost savings**.

Overall, the findings demonstrate that IoT enhances economic performance by reducing costs, improving efficiency, increasing property value, and sustaining long-term occupancy in residential estates.

## **ESTATE SURVEYORS AND VALUER**

Findings revealed that a large proportion of estate surveyors (96%) acknowledged that there had been noticeable cost savings in property management since the integration of IoT systems. This indicates that smart technologies have contributed to reducing operational and maintenance costs for both property owners and tenants. Only 4% of respondents were uncertain, and none disagreed, showing strong agreement that IoT has made property management more efficient.

In relation to tenant satisfaction, 96% of respondents confirmed that satisfaction levels had significantly improved in the estates they manage since adopting IoT. This improvement was attributed mainly to better communication and feedback between tenants and managers, which accounted for 67.3% of responses, followed by increased security (19.2%) and faster response to maintenance issues (13.5%). These results

emphasize that IoT adoption has enhanced management performance and service delivery within residential estates.

When assessing the effect of IoT on property value and profitability, 77% of estate surveyors agreed that the technology has increased the rental and resale value of smart residential properties. However, 23% observed that while IoT makes properties more expensive, it does not always guarantee higher profitability. Overall, the findings indicate that IoT integration has contributed positively to the efficiency, satisfaction, and market value of managed estates in Abuja.

#### **4.9.3 Challenges associated with the adoption of IoT in the study area**

##### **TENANTS**

The analysis revealed that residents encountered various IoT-related challenges within their residences. The most prominent issues identified were difficulty in using smart devices (Mean = 4.88; SD = 0.332) and cybersecurity or privacy concerns (Mean = 4.80; SD = 0.408), indicating that usability and data security remain major areas of concern among users. System malfunctions or breakdowns (Mean = 3.76; SD = 1.128) and unstable internet connectivity (Mean = 3.60; SD = 1.080) were also reported as moderate challenges. In contrast, high service and maintenance costs (Mean = 2.48; SD = 1.229) were considered less significant by the respondents.

Despite these challenges, all respondents (100%) affirmed that the adoption of IoT technology had positively influenced their decision to continue residing in their respective estates, as it had encouraged them to stay. Furthermore, every respondent (100%) agreed that IoT integration had improved communication with property managers and landlords, resulting in faster and more effective responses to residents' needs.

Overall, the findings suggest that while residents experience some technical and security-related difficulties, the adoption of IoT has contributed positively to their residential satisfaction, communication efficiency, and willingness to remain within their estates.

### **Estate Surveyors and Valuers**

Findings from the analysis revealed that tenants in IoT-enabled estates generally show a positive attitude toward smart technology, as 77% of estate surveyors and valuers reported that most tenants are excited about it. However, 23% indicated that while some tenants accept IoT, others remain reluctant. This variation in acceptance highlights that tenant resistance still poses a behavioral challenge to the full adoption of IoT in estate management.

Further analysis of the challenges faced by estate surveyors and valuers showed that cybersecurity risks (Mean = 4.40; SD = 0.828) and resistance from tenants (Mean = 4.07; SD = 0.799) are the most significant obstacles encountered in implementing IoT systems. Poor internet connectivity (Mean = 2.93; SD = 1.534) and high initial costs of implementation (Mean = 2.13; SD = 0.834) were identified as moderate challenges, while lack of technical know-how (Mean = 1.67; SD = 1.175) and maintenance issues (Mean = 1.60; SD = 0.828) were considered less severe.

Overall, these findings indicate that while tenants are largely receptive to IoT adoption, challenges related to cybersecurity, user resistance, and infrastructural limitations continue to hinder the seamless integration of IoT technologies in property management.

#### **4.9.4 General Opinions from Estate Surveyors & Valuers, and Tenants**

The general opinions obtained from both estate surveyors and valuers, as well as tenants, indicate a strong and consistent optimism regarding the future of IoT integration in residential property management within Abuja. All participating estate professionals unanimously agreed that IoT-enabled apartments are likely to become a standard feature

in property management within the next five to ten years. Their responses suggest a shared belief that smart technologies will continue to enhance operational efficiency, improve service delivery, and elevate the overall quality of living in managed properties. Similarly, tenants expressed favorable perceptions toward IoT-enabled residential buildings. All respondents agreed that such properties should command higher rental values than traditional buildings due to the added convenience, security, and technological advancement they offer. More than half (56%) indicated a willingness to pay extra for advanced IoT-enabled apartments, while the remainder (44%) stated that their willingness would depend on the associated cost. Furthermore, all tenants expressed readiness to recommend IoT-enabled properties to others and unanimously agreed that IoT would become a standard feature in residential developments across Abuja within the next five to ten years.

In summary, both professionals and tenants demonstrated a unified perspective that IoT integration represents a transformative development in property management and is poised to become an integral part of the future residential real estate landscape in Abuja.

## CHAPTER FIVE

### SUMMARY, CONCLUSION AND RECOMMENDATION

#### 5.1 Introduction

The summary of findings for the study is presented in this section, conclusion reached with recommendation made as regarding the impact on the adoption of internet of things in residential property management, using Abuja Metropolis in Nigeria as a case study.

#### 5.2 Summary of Findings and Implications

This study found out most tenants of IoT integrated apartments were familiar with the working principles and procedures of this software, and have found it easy to use and operate, thereby making the incorporation into their lifestyle stress-free. IoT seem to have improved the overall residential experience of tenants', but residents are still faced with the challenge of high service/maintenance costs. Not only has IoT made the living experience easier for residents, it has also brought about significant reduction in utility bill tariffs, and as such tenants believe this type of accommodation should cost more than regular accommodations and are willing to pay more for IoT integrated apartments. IoT has made communication between tenants and property managers easier as well, and they believe this will be a standard feature in residential apartments in Abuja in the next 5-10 years. These were responses collated and analyzed from tenants of IoT integrated accommodation within Abuja Metropolis.

Responses gathered from property managers shows that they are also familiar with IoT software integrated into these homes, improved security and competitive advantage in the real estate market are factors that motivated the adoption of IoT in estates managed by them. Lack of technical know-how and high initial cost of IoT implementation, happen to be the challenges encountered by property managers in adopting IoT in estates they manage. Property managers stated that tenants have experienced cost saving since

the adoption of IoT, and also the tenant satisfaction level has increased as IoT as enhanced better tenant communication & feedback. Property managers also indicated that since the adoption of IoT, property rental and resale values have increased, and tenants are willing to embrace this technology in Abuja.

### **5.3 Conclusion**

In conclusion, the integration of Internet of Things (IoT) technologies in residential property management within the Abuja Metropolis has shown significant potential in enhancing tenant satisfaction, improving property value, and fostering efficient communication between tenants and property managers. However, challenges such as high initial installation costs, elevated service and maintenance expenses, and a general lack of technical know-how among tenants continue to pose limitations to full-scale adoption.

The recommendations provided in this chapter are geared towards addressing these challenges by promoting inclusive financing models, capacity building, strategic partnerships, and phased IoT implementation. By adopting a stakeholder-driven approach where developers, landlords, tenants, and government agencies collaborate, residential property management can be transformed into a more efficient, responsive, and economically viable system.

Ultimately, the successful adoption and sustainability of IoT in residential property management will depend on continuous innovation, policy support, and a commitment to delivering long-term value to all parties involved.

### **5.4 Recommendations**

This study found that tenants were faced with the challenge of high service/maintenance cost, and from the standpoint of property managers, lack of technical know-how and

high initial cost of IoT implementation are identified challenges that both parties have faced and are still facing in IoT integrated accommodations.

It is therefore recommended that;

1. Instead of tenants bearing the full cost, cost can be shared between developers (Initial investment), Landlords (maintenance), and Tenants (usage). Also, the cost of IoT installation can be spread overtime in rent or service charges to make it more affordable.
2. Start small, scale gradually. Starting with smart meters, lighting, or access control, and expanding over time. Also making use of open-source and compatible devices, which reduce costs and allow integration with multiple systems without vendor lock in.
3. User-friendly guides and brief tutorials to help tenants operate smart systems confidently upon move-in. Also, periodic training for tenants and facility managers on IoT device usage, troubleshooting, and safety, can be organized.
4. Public-Private Partnerships to develop affordable smart housing initiatives can be advocated for.
5. Centralized Monitoring & predictive maintenance via IoT, can be established smart maintenance schedules, where sensors to detect and report issues early (e.g., leaks, power surges), and dashboard for facility managers to track all systems in real-time, reducing emergency repairs and maintenance costs.
6. Stakeholders (developers, investors, regulators) be educated on the long-term economic benefits of IoT, such as; higher rental yields, lower vacancy rates, and reduced long-term maintenance costs.

7. Regularly evaluate performance indicators like tenant satisfaction, cost savings, energy use, and system uptime to justify Return On Investment (ROI) and make improvements.

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## APPENDIX

### QUESTIONNAIRE

(For Estate Surveyors & Estate Surveying Firms Managing Smart Buildings in

Abuja)

**Dear Respondent,**

I am a final-year student of Estate Management at the University of Benin (UNIBEN) conducting a study on “The Impact of the Adoption of Internet of Things (IoT) in Residential Property Management: A Case Study of Abuja Metropolis.”

This questionnaire is designed to gather information from estate surveyors and property management firms managing smart buildings or estates that have integrated IoT into their operations. Your responses will be strictly confidential and used solely for academic purposes.

Thank you for your cooperation.

#### SECTION A: RESPONDENT'S PROFILE

1. Name of Firm/Organization: \_\_\_\_\_ (Optional)
2. Position in the Firm: this  
 Principal Partner  Estate Surveyor  Property Manager  Other  
(Please specify): \_\_\_\_\_
3. Years of Experience in Property Management:  
 0 – 5 years  6 – 10 years  11 – 15 years  Above 15 years
4. Location of the Estate/Firm in Abuja:  
 Lugbe  Gwarinpa  Jahi  Maitama  Asokoro  Other (Please specify): \_\_\_\_\_

5. Is your firm actively involved in managing smart buildings or estates with IoT integration?

Yes  No

**SECTION B: AWARENESS & ADOPTION OF IoT IN PROPERTY MANAGEMENT**

6. How familiar are you with IoT applications in residential property management?

Very familiar  Somewhat familiar  Not familiar

7. Which IoT features are integrated into the estates you manage? (Select all that apply)

Smart security systems (CCTV, biometric access)  Smart lighting and energy management

Automated rent payment & billing  Smart home appliances  IoT-based maintenance tracking  Smart parking & access control  Others (Please specify): \_\_\_\_\_

8. What motivated the adoption of IoT in your estate(s)? (Select all that apply)

Demand for smart homes  Cost reduction in property management  Improved security

Energy efficiency  Competitive advantage in the real estate market  Others (Please specify): \_\_\_\_\_

9. What challenges did you encounter in adopting IoT in your estate management? (Select all that apply)

S/n	Challenges	Always	Periodically	Often	Sometimes	Never
1	High initial cost of IoT implementation					
2	Lack of technical know-how					
3	Poor internet connectivity					
4	Resistance from tenants					
5	Cybersecurity risks					
6	Maintenance issues					

10. Have you observed any cost savings in property management since integrating IoT?

Yes  No  Not sure

### **SECTION C: IMPACT OF IoT ON PROPERTY MANAGEMENT & TENANT SATISFACTION**

11. Has the integration of IoT improved tenant satisfaction in your managed properties?

Yes, significantly  Yes, but slightly  No noticeable impact  No, it has caused challenges

12. What aspects of property management have improved due to IoT adoption? (Select all that apply)

Faster response to maintenance issues  Increased security  Reduced utility bills for tenants

Better tenant communication & feedback  Increased rental value of properties

Others (Please specify): \_\_\_\_\_

13. Do tenants in IoT-enabled estates willingly embrace smart technology?

Yes, majority are excited about it  Some tenants accept it, but others are reluctant

No, most tenants prefer traditional property management

14. In your opinion, how has IoT affected the value and profitability of smart residential properties?

Increased rental & resale value  No significant effect

It has made properties more expensive but not necessarily profitable

#### **SECTION D: RECOMMENDATIONS & GENERAL OPINION**

16. Do you think IoT will become a standard feature in property management across Abuja in the next 5–10 years?

Yes  No  Not sure

THANK YOU FOR YOUR TIME!

**QUESTIONNAIRE (For Tenants/Residents of Smart Buildings with IoT Integration in Abuja)**

**Dear Respondent,**

I am a final-year student of **Estate Management** at the **University of Benin (UNIBEN)** conducting a study on **“The Impact of the Adoption of Internet of Things (IoT) in Residential Property Management: A Case Study of Abuja Metropolis.”**

This questionnaire is designed to gather insights from tenants/residents living in smart buildings or estates with IoT integration. Your responses will be strictly confidential and used solely for academic purposes.

Thank you for your cooperation.

**SECTION A: RESPONDENT’S PROFILE**

1. Gender:

Male  Female  Prefer not to say

2. Age Group:

18 – 25 years  26 – 35 years  36 – 45 years  Above 45 years

3. Occupation:

Student  Civil Servant  Business Owner  Private Sector Employee

Others (Please specify): \_\_\_\_\_

4. Location of Residence in Abuja:

Lugbe  Gwarinpa  Jahi  Maitama  Asokoro

Other (Please specify): \_\_\_\_\_

5. How long have you been living in this smart estate/building?

Less than 1 year  1 – 3 years  4 – 6 years  Above 6 years

6. Are you aware that your residence uses Internet of Things (IoT) technology?

Yes  No  Not sure

**SECTION B: AWARENESS & USAGE OF IoT IN PROPERTY MANAGEMENT**

7. Which IoT features are available in your residential estate? (Select all that apply)

Smart security systems (CCTV, biometric access)

Smart lighting and energy management

Automated rent payment & billing system

Smart home appliances (e.g., smart thermostats, voice assistants)

IoT-based maintenance request system

Smart parking & access control

Others (Please specify): \_\_\_\_\_

8. How often do you use these IoT features?

Daily  Occasionally  Rarely  Never

9. How easy is it to use the IoT technology in your residence?

Very easy  Somewhat easy  Difficult  Very difficult  I do not use it

**SECTION C: IMPACT OF IoT ON TENANT SATISFACTION & RESIDENTIAL EXPERIENCE**

10. What are the main benefits you have experienced from IoT in your residence?

- Improved security
- Lower utility bills (electricity, water)
- More convenient rent payment & billing
- Faster response to maintenance issues
- Increased property value and aesthetics
- Others (Please specify): \_\_\_\_\_

11. Has IoT improved your overall residential experience?

- Yes, significantly
- Yes, slightly
- No noticeable change
- No, it has caused challenges

12. From the table below, select appropriately which IoT-related challenges have you experienced in your residence? Indicating their levels or rate of occurrence.

S/n	Challenges	Always	Periodically	Often	Sometimes	Never
1	High service/maintenance costs					
2	Unstable internet connectivity					
3	Cybersecurity/privacy concerns					
4	Difficulty using smart devices					

5	System malfunctions or breakdowns					
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13. Has IoT affected your decision to continue living in this estate?

Yes, it has encouraged me to stay  No, it does not influence my decision

No, it has made me consider moving out

**SECTION D: ECONOMIC IMPACT OF IoT IN RESIDENTIAL PROPERTY MANAGEMENT**

14. Have you noticed a reduction in utility bills (electricity, water) since IoT was introduced?

Yes, a significant reduction  Yes, but only slightly  No, no noticeable change

No, my bills have increased

15. Do you think smart buildings with IoT should cost higher rent than traditional buildings?

Yes, because of the added convenience and security  No, rent should remain the same  Not sure

16. Would you be willing to pay extra for an advanced IoT-enabled apartment?

Yes  No  Maybe, depending on the cost

17. How has IoT impacted communication with property managers/landlords?

Improved communication & faster responses  No difference from traditional management  Made communication worse

**SECTION E: GENERAL PERCEPTION & RECOMMENDATIONS**

18. Would you recommend IoT-enabled properties to others?

Yes  No  Not sure

19. Do you think IoT will become a standard feature in residential properties  
in Abuja in the next 5–10 years?

Yes  No  Not sure

THANK YOU FOR YOUR TIME!