

## The Effect of Motivating Factors Influencing the Use of ICT on Adoption of the New Technology by the Real Estate Professionals in Abuja, Nigeria

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**Abstract:** *Recently, real estate professionals are now faced with new strategies and more effective ways of managing and storing information for faster and more effective management. The aim of the paper is to explore the Effect of motivating factors influencing the use of ICT on adoption of the new technology by the real estate professionals, with a view to understanding how new technologies influence the modern real estate professional practice in Abuja Nigeria. The paper determined the motivating factors influencing the use of ICT in modern real estate profession in the Abuja. The study used quantitative design and data were collected through questionnaire survey from 260 real estate professionals, the study adopted convenient simple random sampling technique and SPSS software version 22 was used for data analysis and the results were presented in tables. The study observed that the motivating factors influencing the use of ICT in modern real estate profession were enhanced quality of customer services, improved decision making, the competitor's pressure, increased productivity of staff and reduce overall cost ranked first to fifth respectively. The paper concluded that top three motivating factors enhanced customer service, improved decision making, and increased staff productivity, all focus on internal improvements within the real estate firm. This concludes that firms are primarily motivated by the benefits of ICT for their own operations rather than external pressures. Motivating factors influencing the use of ICT in modern real estate profession has a large effect size on the adoption of new technologies in the real estate profession. This implies that increasing motivating factors influencing the use of ICT in modern real estate profession can significantly promote the adoption of new tools and technologies by professionals. Real estate professionals should invest in training and education on advanced ICT tools and applications relevant to the real estate industry, such as virtual tours, property management software, and data analytics platforms. The paper recommended that the*

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*policymakers and industry should Provide access to affordable technology solutions and promote collaboration between technological companies and real estate firms.*

**Keywords:** motivating factors, use, ICT, adoption, new technology, real estate, professionals

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## INTRODUCTION

Information is thought to be a crucial component of every industry since it appears to be the foundation of human association or interaction and the maintenance of a society (Babatunde & Ajayi, 2018). Information could be compared to blood moving from one point to another in the structure of an organization or society, much as blood is necessary for man to survive as a living person (Babatunde & Ajayi, 2018). Due to the dependence of all human endeavors on information management, including socio-cultural, economic, and service delivery endeavors like estate surveying, Information and Communication Technology (ICT) has forced every professional and researcher to adopt various forms or types of technologies to aid the services provided (Babatunde & Ajayi, 2018). Rapid technological research and development has an impact on how professionals handle information and other tasks and influences new technology breakthroughs (Adeyemo, Kemiki, Adama & Ayoola, 2015). Due to the new and quickly growing information and communication technology (ICT) business, estate surveyors and valuers (ESV) and other professionals in the built environment are currently dealing with completely new situations (Ogunnowo, Iroham & Oloke, 2021).

The infrastructure and product development industries adopted the modern ICT technologies, on the other hand are what makes it possible prospered, by deploying ICT technology to collect, store, and analyse information that can be delivered electronically (Sepehrdoust, Ahmadvand & Mirzaei, 2022). While Ngozi, Ogunode and Olatunde-Aiyedun (2022) cited the World Bank definition of ICT as the set of activities which facilitates electronic means of processing, transmission and displaying of information. The pace of changes brought about by the introduction of various ICT trends have led to re-organisation, changes in work pattern, and demand for new skills and job retraining in every profession and it also has significant impact on the living condition of people worldwide (Okon & Ogbodo, 2014). The way information travels through the use of computers and the internet for communication appears to have been made easier by the introduction and development of technology. Information and Communication Technology (ICT) is a subset of information technology (IT) that includes telephony and media transmission as well as digital equipment used to process digital information in communication systems (Lee & Witchel, 2022). In light of this, ICT seems to have had an impact on every element of human endeavor and has allegedly turned the globe into a global village where information flows without much to no restriction (Babatunde & Ajayi 2018).

However, real estate professionals are now faced with new strategies and more effective ways of managing and storing information for faster and more effective management, which calls for the use of information and communication technology in real estate. Information communication technological developments have emerged as a result of the globalisation trend and the emergence of new inventions, infiltrating all sectors of life, including the real estate profession (Alonso & Calvo, 2015). Thus, the idea of globalisation and the development of new technology have brought up new difficulties. These issues have affected every facet of life, including real estate practice (Satter, 2009). The use of information and communication technology, such as computers and computer networks, has become essential in real estate practice as a result of the challenges posed by new methods and more effective means of managing and storing information for quicker and more effective management decisions (Babatunde & Ajayi, 2018). Therefore, some of the studies undertaken in ICT related field includes. A study by Babatunde and Ajayi (2018) founded that; ‘‘Effects of Information and Communication Technology on Real Estate Agencies in Nigeria’s Lagos Metropolis’’. Ajaelu, Nzotta and Okaka (2021) ‘‘Evaluated use of Information and Communication Technology, Nigeria’s Real Estate Administration with focus on Enugu State’’. ‘‘Urban Real Estate Information Systems’’ (Kirkwood, 2014). Kwabe (2021) ‘‘Information and Communication Technology and the Development of Accounting Profession in Nigeria’’. Therefore, this necessitate the need for this paper which serve as a study gap this paper intends to fill by identifying the motivating factors influencing the use of ICT in modern real estate profession and to assess the level of adoption of the new technology by the real estate professionals in Abuja, Nigeria.

## **LITERATURE REVIEW**

### **The Concept of ICT**

Information and Communication Technology (ICT) refers to a broad range of activities, tools, and resources, including all those that can be accessed and used on computers. It includes a variety of information distribution methods, including radio, television, newspapers, computers, and the internet (Kwabe, 2021). The development process requires a wide variety of information and communication technologies, many of which have been made possible by technological advances, the most common way that information and communication technologies (ICTs) are defined is in terms of their ability to gather, store, process, and send data (Ward, 2015). (Camngca, Amoah & Ayesu-Koranteng, 2022) said, "The Nigerian government through recent policies on trade liberation, regional integration and Information Communication Technology (ICT) shows some commitment to globalisation and the adoption of information technology". The world market has become homogenised, converting the domestic market into a twenty-four hour global market and Globalisation are the two global phenomena that influenced the modem practice of real estate in many nations of the world including Nigeria. Real estate practice in Nigeria is experiencing a

transformation in response to globalization. This trend according to Bauman and Lucy (2020) has brought unprecedented degree of competition among nations and among business organizations, goes further to defined information and communication technology as the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numeric information by a micro-electronic based combination of computing and telecommunications; a revolution that has penetrated almost all fields of human activity, thus transforming our economic and social life, it has been recommended that efforts be made to create conducive environment for the acquisition and usage of ICT equipment.

Akinola and Olatidoye (2015) observes that, there are now net managers of information, about millions of users, corporate and individual web sites, as the flow of information globally. Babatunde and Ajayi (2018) stated that, Nigeria as a nation is not left behind in her desire to join the global internet race. The Federal Government of Nigeria in March 2001 approved a national ICT policy and established a National Information Technology Development Agency (NITDA), to oversee its implementation. The National ICT Policy has a vision of making Nigeria an ICT capable country in Africa and a key player in the information society by the year 2007, using ICT as the engine for sustainable development and global competitiveness. Also the Information Technology Association of America (ITAA) defined ICT as the study design, development, Implementation, support or management of computer-based information systems, particularly software applications and computer hardware. However, ICT deals with the use of electronic computer and computer software to convert, store, protect, process, transmit, and securely retrieve information (Babatunde & Ajayi 2018).

### **Information and Communication Technology and the Practice of Real Estate Profession**

Information and communication technology has lately begun what seems to be a revolution in real estate practice, according to (Babatunde & Ajayi 2018). Real estate professionals are spending more money on gear and software for technology. Online technologies and improved information accessibility have caused significant changes in real estate practice. Anyone with a home computer and internet access can obtain real estate sales information thanks to the widespread use of websites by real estate professionals. The establishment of an industry standard is a crucial component of the changes that are going place since it will speed up and simplify data interchange between real estate professionals, mortgage lenders, property inspectors, and other practice. According to Fu (2022) heightened interest in internet online searches by consumers has led most real estate professionals to change the way they operate their businesses. Real estate brokers/agents can use the internet to send-up-to-date information to potential clients at very low cost, accurately and quickly. The internet can also help real estate practitioners increase sales, save time and provide a noticeably higher level of service to both buyers and sellers. Virtual “model” homes may also be

distributed on CD-ROM, very much like brochures, and can be accessed directly through the internet.

This traditional business model for real estate brokerage firm use to concentrate on the real estate transaction process Fu (2022) Real estate brokers/sales people are essentially market intermediaries, providing information to customers, connecting buyers with sellers and facilitating the real estate transaction process. But now real estate business use computer automation to speed the real estate transactions and brokers/sales people can concentrate on adding value for customers. Information about properties and real estate brokers/sales people are collected in one place through the websites. For instance, technology is prompting similar advances method, the areas of title insurance, homeowners insurance, appraisal and real estate auctions. Those changes mostly revolve around computerized appraisal services, electronic primary mortgage loan origination and electronic secondary mortgage market sales. As a result, information cost is much reduced and most areas in real estate business have a much more competitive environment. A small brokerage firm has the advantages of flexibility in organisation and operation and the ability to capitalize quickly on new sales opportunities. However, the growth in the availability of database providing real estate market information and services actually reduce the need for traditional market services. E-mail, voice mail cellular phones and pagers have increased the efficiency and productivity of real estate practice. Once buyers, seller, borrowers and lenders are able to obtain relatively cost free real estate (or real estate related) information. Therefore, it should cause a reduction in the amount of routine work for real estate practitioners.

Dixon (2010) noted that in over hundreds of years, when technological changes has brought about radical changes to market boundaries, increasing the scope to exploit intellectual capital, examples includes painting, steam power (electricity), canals, and railways, mass media and more recently information and communication technology also, (Bartke & Schwarze, 2021) asserted that the real estate practice of the twenty-first century is different from any other practice in the past and highlight three main aspects as follows: Infrastructure to assemble, analyse, communicate and manage information with computer mediated networks; Transactions to purchase goods and services carried out through Electronic Data Interchange (EDI) or over the internet and Interactions transferring information between enterprises of individuals, which add to value. Furthermore, Emenike (2022) posited that information and communication technology application to property management provide the professional property manager with an extremely powerful and flexible information management tool for property management and lease administration. ICT enable proper documentation of virtually everything about a property, information about the owners' construction details; photographs, sketches, lease agreement including records of receipts and payments. Also, information about any property can be called up at any time and in variety of ways.

According to Regona, Yigitcanlar, Xia and Li (2022) computer can also be programmed with handy reminders, shortlists of which administrative actions are due or are pending at all times reducing the incident of failing to keep appointments or sending out belated reminders. Also, apart from the database function, notices and reminders to tenants are made via the internet and not by post. In her words, ICT application is cost saving and the processes of negotiation for rent renewals is properly documented and saved on the computer for future reference.

The issue of distance is almost completely removed with ICT. Accordingly where surveyors in the property management specialty are sufficiently trained, a computerised approach to property management will assist the property manager as follows: Maintain a lively and active property data base which would be useful for planning and budget preparation, information may be found whenever it is required and it can automatically extract and highlight important dates such as lease renewal dates and also prepare letters, reminders and demand notices. It is quite obvious that there is no management without measurement an effective management can only be realised if there are data about the features in an estate.

In order to overcome the inherent problem of limitation in the old system of management of an estate, hence the invention of the Geographic Information System (GIS) Nuhu, Manan, Alwi and Reba (2021) described geo-informatics as a body of knowledge that deals with the acquisition, processing and management of geo-information, that is, science and technology for the acquisition, storage, analysis, manipulation and dissemination of geo-information. They defined GIS as a computerised tool for capturing, storing, checking, integrating, manipulating, analysing and displaying of data which are spatially referenced towards an effective decision making. Further stated that GIS performs three fundamental operation of database; query, derivative mapping and processing modeling, GIS has enhanced capability of executing proximity analysis, various site selection model such as trade area analysis, spatial interaction, location factors, etc. argued that at the application level, GIS is often called by different names e.g. practitioners in land surveying, land administration and real estate commonly used the term Land Information System (LIS) to denote those information systems used in support of land management activities.

Land management refers to the decision making and implementation of decisions about the land and its resources, Nuhu et al. (2021) also emphasised on application of GIS in estate management activities in the following areas; market monitoring and non-king site selection, brokerage, property management portfolio management, appraisal, property tax assessment, management of publicity owned real estate assets, sales of data layers by public agencies, etc. The applications are not exhaustive; GIS has more advantages than the analogue way of keeping the tracks of information in an estate, Estate information managed with GIS is more versatile because it can be

subjected to many applications without introducing errors. Among "the many benefits derivable from application of GIS in an estate are; New and flexible form of output (customized mapping), quick and easy access to large volume of data about the feature in the estate, selection of terrain details through answering some spatial problem, ability to answer complex land related questions. Another way in which GIS has revolutionised the real estate industry is in the area of internet, whereby the estate managers display their services on the internet thereby enabling the customers to see the properties of their choice, its price, location; amenities in the estate and its neighbourhood influence without visiting the manager's office.

Nuhu, et al, (2021) further posited that the application of GIS in real estate practice has more advantages than the analogue way of keeping the tracks of information in an estate because the spatial data base is directly linked to the spatial entities on the map of the estate. Estate information managed with GIS is more versatile because it can be subjected to many applications without introducing errors. Among the many benefits derivable from application of GIS in real estate practice are: New and flexible form of output (Customised mapping), quick and easy access to large volume of data about the features in the estate, selection of terrain data: is through answering some spatial problem, ability to merge on data set to another, capability of speedy up dating and the ability to answer complex land related questions. There is no doubt that manual method of analysis is not only tedious and time consuming, especially where complex investment projects with multiple variables are involved, but it also has limitations of scope and accuracy. Nuhu et al. (2021) further noted that computer-aided approach is more effective, less time consuming with better and more secured storage capability, quicker display or retrieval and much easier manipulation than the manual approach. Nuhu et al. (2021) further also stated that in the field of Geo-informatics (Land surveying) and Geography, the computer has been adapted to use surrogate information such as land sat or spot images, aerial photographs, etc. in addition to the base maps to give an up-to-date information on the study area further advocated for Land Information System (LIS) which would be an estate surveying equivalent of Geographic Information System (GIS). In LIS such surrogate information as design, state of repairs and maintenance and facility status in the property investment area can be used. In addition to other factors to get an up-to-date and a more comprehensive information on the property investment area. Abd El-Aziz, Taloba and Alghamdi (2022) observed that with the advent of computers, maintaining accurate data on land records has become easier. Many of the new generation software like CAD and GIS can accommodate the basic information of the land records and provide additional tools to perform analysis.

The present technologies offer very wide range of the information applications. With the help of Global Positioning System accurate positions of the land locations can be established and similarly

remote sensing data can be utilised for updating the land and infrastructure features time and again on the same base map whenever required. Abd El-Aziz, et al. (2022) also, said that the advantage of advance GIS is that it can be very easily integrated to the GPS and RS tools and can directly pass the information into the designed system. Using the new technologists, once the individual land record is computerised, various space-specific parameters can be hooked-up to the land record, the same record can be utilised right from taxation purpose to the micro/regional level planning.

Abd El-Aziz, et al. (2022) obviously sounds the same note when they posits that, information and communication technology has significantly change the way firms are organised and methods many real estate professionals adopt in marketing properties, sellers can get directly involved in heterogeneous real estate practice. Business survival is becoming more closely tied to real estate sales, firm's abilities to adapt to technological changes and to use technology to attract customers. Through much debate and careful consideration along with a variety of successes and mistakes, the real estate sales business has been adapting itself to take advantage of the internet over the past several years. With such explosive growth in electronic commerce, a number of industries, including real estate, are leveraging themselves to benefit from the new technology. Kampamba, Kachepe and Lesobe (2022) agreed to the earlier view when they said, that real estate is an information business. Consequently, it is deeply impacted by information technology and resulting change, including the assembly, analysis and transfer of information. According to them this escalating changes appear to alter the structure of the real estate market when (a) studying the firm that serves it, as well as (b) the consumers it serves. The information revolution that is inescapably penetrating all facets of industry is propelling the real estate industry as well into territories unknown.

Kampamba et al., (2022) Stated the structure of the industry has evolved toward small, clearly identified specialised firms and large market-share brokerages. The middle-sized firm has been shrinking and appears to continue doing so. They noted that new ICT help to reshape how people come to think about access to information. That is, as people begin to use a new ICT to access information and to interact with one-another, they begin to rethink their relationships with information and communication. It is this reshaping or redefining that often leads to innovation and change. For example, sellers have more information available, which allows them to better assess their market value. This in turn allows them to rethink how they handle their house – as an asset that they can manage relative to refinancing, renovations etc.

Aihie (2019) The changes in access to information on real estate allows a series of subtle changes to redefine what it means to use the ICT available However, the current advantages in computer



technology, near friction-less, low-cost transmission of transactions easily crossing continents in seconds, as well as the growth of the World Wide Web have placed pressures on the real estate transactions. Due to the pervasiveness of the internet, we anticipate an eroding power of real estate professionals, as they adapt to the loss of exclusive access to the use of ICT in development appraisal assists the real estate practitioners in a number of key areas in the practice.

### **Real Estate Information Systems**

Property has been acknowledged as important and significant throughout history. For instance, it has been explained that Sir John Fortescue convinced Henry VI of the connection between his political stability and his ability to maintain his estate. According to Denman, property is a social and legal institution that is fundamental to the structure of all civilized civilizations. It functions as a tool of power in interpersonal interactions and as a factor in determining who has the right to use, acquire, and own land (Gitau, 2014).

Real estate is thought to be the second- or third-largest contribution to overhead for the majority of enterprises. According to a different study, more than half of the firms surveyed stated that their property assets made up at least 30% of their entire asset value. Since land is the source of all material wealth, it seems sense that serious attempts would be made to employ ICT to support real estate development, management, and appraisal (Gitau, 2014). Unfortunately, the evidence shows that, in general, within the United Kingdom the sector has been slow to innovate compared to other areas. Also, much of the innovation that has occurred has been driven by those operating on the fringe of the sector, such as property software companies and academics.

According to Bresnahan, (2019) it seems paradoxical that a sector that appears to be quintessentially an information-based industry should be so resistant to the opportunities provided by the Information Revolution. Understanding why this is so is not straight forward because of the complexities of the real estate industry with its diversity of functionality, wide range of organizational types, and the paucity of research on the topic. From the general literature on innovation, it is reasonable to surmise that the suppression of the radical potential of ICT within real estate is caused by a combination of influences, including political, cultural, economic, financial, and educational. In addition, there are issues related to balancing access to information and privacy, the application of standards (e.g., for data transfer), and the degree of disruption caused by any new technology. These factors are commented on in the examples that follow, but the author is cognizant of the need for further research aimed at removing barriers to innovation. There have been some notable successes using ICT within the real estate sector, both for industry-specific applications and for general-purpose office automation. Property management systems are now widespread, and there are numerous specialist computer packages for investment valuation,

development appraisal, and commercial and residential agency (Bresnahan, 2019). Also, online, subscription-based market intelligence systems, such as Estates Gazette have emerged to exploit the power of the Internet. Similarly, the use of office automation tools, like word processing, spreadsheets, and e-mail, is routine in real estate offices. But these “successes” have essentially been based upon the automation of mundane tasks rather than a genuinely innovative approach to real estate practice. There is evidence of a lack of a strategic vision within the sector and it has been shown that many organizations are a long way from realizing the full potential of ICT (Thompson & Walsham, 2010). There is a parallel lack of emphasis on training and education to meet the demands of this new commercial environment. A survey conducted on behalf of the Property Computer Show in 1999 revealed that 51 percent of the property firms interviewed had not spent a single day on ICT training during the previous 12 months. This lack of innovation is not unique to the United Kingdom. It has been reported that in Singapore’s property management companies, computer applications are lagging behind the advancement of computer hardware and software. Even in the United States seen by some as the originator of the Information Revolution it has been observed that resistance to technological advances penetrates the entire real estate sector. Kirkwood (2014) even compares the industry’s resistance to technology to the Luddites of the first Industrial Revolution.

### **Real Estate Applications**

Property management, property upkeep, commercial and residential agency, valuation and assessment, and property portfolio management are the key ICT applications in real estate. These are looked at below utilizing the innovation model that was previously proposed. The technologies of geospatial information systems span all of these fields (GIS) (Awasthi, Nagarajan, & Deininger, 2021).

### **Property Management**

The creation and maintenance of property databases, the creation of estate accounts, the monitoring of diary days, and the management and accounting of service charges are only a few of the fundamental procedures involved in property management that are perfectly suited for computerization (Awasthi, et al., 2021). As a result, this was one of the first real estate locations to catch the eye of early systems developers. For instance, in the early 1970s, Jones Land Wotton implemented a computerized accounting system. At the yearly Property Computer Show (PCS) in London, it is also the sub-sector with the most systems. Property management systems are essentially property data bases linked to accounting procedures, with real estate professionals being responsible for the maintenance of the former and accounts staff taking control of the latter. As the purchase of systems must inevitably be justified on financial grounds, it is not unusual for the accounting functions to dominate and for property information, particularly of a non-financial nature, to be peripheral (McCluskey, 2018).

Real estate professionals may lose influence because accountants control the financial engines of such systems. Unlike accounts staff, who are obliged to enter data in advance of regular accounting functions (e.g., quarterly reports) much of the data entered by real estate professionals is optional (e.g., lease terms, areas) (Gitau, 2014). A pattern can emerge of failing to update data, which creates uncertainty about the validity of the database that, in turn, leads to a lack of commitment to update. Consequently, the innovative use of such systems to aid the strategic management of portfolios is probably the exception rather than the rule. In this case, the suppression of the radical application of ICT results from a combination of an anti-technology culture and an absence of appropriate education and training. As Dixon states, there is a need to “promote the education of senior managers in matters relating to the strategic use and value of IT (Poister, 2010).

### **Property Maintenance/up keeping**

Property software companies have paid less attention to property maintenance, which theoretically is a part of property management but is typically seen as a distinct, technically based job (Cusumano, Kahl & Suarez, 2015). Less than five maintenance systems were listed in the PCS Property Software Directory 2002. The majority of maintenance systems are developed in house to suit local requirements and there is a lack of standardization.

Everyone benefits from maintaining the built environment, which directly supports the economy by creating jobs in the construction sector and indirectly by having an impact on our homes, workplaces, and factories (Akadiri, Chinyio & Olomolaiye, 2012). But innovation in this field is influenced more by political will and the establishment of standards and improvements in the education of maintenance managers than by technological capability. All the technical elements needed to establish comprehensive maintenance management systems are currently available computer networks, database systems, remote data capture devices, and digital photography but, innovation in this field is suppressed by an absence of appropriate political leadership, a lack of strategic vision by managers, and the need for universal standards for data capture, storage, and exchange (Trappey, Trappey, Govindarajan, Sun & Chuang, 2016).

### **Commercial and Residential Agency**

The industry of commercial and residential agency, which is dominated by the vested interests of the experts engaged, provides a striking example of the suppression of radical innovation. Agents fall under the category of intermediaries, and it has been noted that their influence on economic activity, which accounts for more than 25% of the U.S. gross domestic product, may be significant (GDP), essentially this brokerage function helps to facilitate the relationship between buyers and sellers. Typical agency software provides database structures for storing details about properties, companies, agents, applicants, clients, tenants, and landlords. Functions include the creation of

requirement files, a diary of events, mailing lists, archiving, and the storage of comparable. Systems are sold on their capacity to undertake applicant and property matching and to generate property particulars automatically.

In addition, listing services on the Internet have emerged that have become highly developed in the United States but are still rather fragmented in the United Kingdom. The technology allows prospective purchasers to search for properties online and even undertake virtual tours of listed properties (Philippon, 2015).

It has been observed by Philippon, (2015) that ICT significantly reduces the matchmaking role of agents and forces them to develop other professional services (such as expert appraisal) critical to real estate transactions. But it appears that these changes are forced upon agents by the demands of more enlightened clients. As the Internet spreads, people become more aware of its potential from a range of non-property applications and then demand the same level of service from the real estate industry. There is very little evidence that the majority of agents have proactively investigated the use of ICT to improve either efficiency or quality of service. Many agents have, in the past, viewed these developments as threatening and disruptive and have instead sought justification for suppressing the technology. A combination of enlightened clients and the standards set by other industries, such as banking, has forced them to change.

### **Valuation and Appraisal**

The valuation and appraisal of real estate is undertaken for a wide variety of reasons including sales, purchases, development, and taxation. This activity is a blend of art and science. Valuers, or appraisers as they are known in the United States, use their market knowledge and their judgment to supply the inputs for a variety of mathematical models, such as discounted cash-flow techniques. Computer systems have been developed both in-house and as packages to support this activity. (Baum, Crosby & Devaney, 2021) The models used range from traditional, rather discredited techniques (e.g., Term and Reversion) to advanced systems, such as Multiple Regression Analysis (MRA) and MonteCarlo risk analysis. However, in general, there is an antipathy towards more sophisticated methods of appraisal in the United Kingdom, with most practitioners characterizing the process as more art than science. Consequently, although the use of software for valuations is now widespread throughout the profession, there is little evidence of the innovative use of ICT. This conservative culture has led to some suspect methods being enshrined within computer software. The suppression of innovation within this sector results partly from the professional culture, partly from a misunderstanding of methods and outputs, and partly from secrecy about data. Increased access to data, for example, would enable computer-assisted mass appraisal to be undertaken by MRA (Baum, Crosby & Devaney, 2021).

### **Property Portfolio Management**

Active property portfolio management involves restructuring portfolios of properties by using a combination of buying, selling, lease restructuring, development, redevelopment, and refurbishment (Jones, Dunse, Livingstone & Cutsforth, 2017) The portfolio manager's objective is to optimize the financial returns from the property and, hence, some measure of these returns, no matter how crude or naive, is required. The complexity of property combined with the intricacy of many of the valuation models and the detailed data used necessitates the use of computers for processing purposes. Portfolio managers would be severely limited if their decisions had to be based on computations undertaken by hand. It could reasonably be argued that this specialist activity has only emerged because of the availability of cheap processing power and purpose-designed software. Nevertheless, only a handful of property portfolio systems have been developed for sale since Stephen Sykes designed one of the first, COMPAS, for chartered surveyors St. Quintin in London in 1982 currently there are fewer than five fully comprehensive portfolio packages available in the United Kingdom, plus some systems developed in-house by financial institutions. One of the major constraints to innovation in this highly specialist sub-sector is the combination of high development costs and very limited market opportunities. Such systems are only purchased by organizations with multimillion pound portfolios to manage and are of little or no use to the large number of small- to medium sized real estate practices. In addition, these are systems that require high levels of competence in both investment valuations and systems use.

### **Geographic Information Systems**

A geographic information system (GIS) links a computerized map, in digital form, to underlying information about objects shown on the map, held in a relational or in an object-oriented database (Burrough, McDonnell & Lloyd, 2015) This form of technology potentially cuts across all real estate applications and offers a wide range of functionality from simple map production and information retrieval (e.g., terrier data) to spatial analysis (e.g., site finding and valuation). The following examples illustrate this diversity successfully used GIS to identify sites for retail clients; Data were sourced for postcode boundaries (Geoplan), raster mapping (Bartholomew), digital mapping (Goad), demographic data (CACI) and business information. Targeted analysis was used to identify potential sites for business operation. This approach, however, depended on the specific skills of a limited number of users and, possibly for that reason, was not replicated across the profession (Akinola & Olatidoye 2015).

There may also be a perceived threat that the technology replaces traditional functions. In 1999 the Staffordshire county council's property and estates division pioneered the use of a geospatial data management system developed by Laser-Scan of Cambridge. This employed object oriented (OO) technology in a way that was particularly appropriate for property applications. The property

and estates division needed a system based on real-world objects, which could automatically apply updates throughout the entire database. In essence, this involved creating a model of the world, rather than just a record of it. This approach has been adopted by other authorities, possibly because there is a wider skills base to draw upon than there is in small and medium-sized surveying practices. Nevertheless, progress is slow because of the complexity of the technology, the capital investment required, and the disruption to existing practices Vasistha, Kothari, Mishra, Deandress, Lierena and Nair (2020).

In contrast, simple technologies are adopted quickly. Pro-map, for instance, originally consisted of 12 CDs containing Ordnance Survey (OS) large-scale, digital mapping and small-scale, AA mapping (1:200,000) for Great Britain. The system, which is now available via the Internet, provides a powerful, flexible tool for locating, customizing, and printing maps. It was adopted quickly throughout the real estate sector in the United Kingdom. The reasons for this are a combination of simplicity and ease of use, targeting of a limited but important functionality, and lack of threat to existing roles and responsibilities (Lee & Witchel, 2022).

## **METHODOLOGY**

A descriptive and exploratory survey research methodology was used. Since this paper was collected and analyzed numerical data, a quantitative method was thought to be the most suitable. This paper also employed survey research approach, which collects data using questionnaires. The sample frame for this paper is the total registered estate surveyors and valuers practicing in Abuja metropolis which are seven hundred and fifty four (754) NIESV Abuja office, 2022. The study adopted convenient simple random sampling technique, convenient sampling is a sampling strategy (a method for gathering participants for a study) used when the population is composed of several subgroups that are vastly different in number. Statistical Package for Social Science (SPSS, version 22) was used for statistical analysis of the data generated from the questionnaire survey. The data achieved using questionnaire survey was a thoroughly screened, analysed and sorted out for analysis depicting the information responses from the respondent. As the study contained descriptive, for research question 1 and 2 while linear regression was used for research while 3 which is inferential research questions. The result of the analysis revealed that a minimum sample size of 74 was required to achieve the desired power of 95% with a moderate effect of 0.15 at 5 percent alpha value as shown in Figure 1.

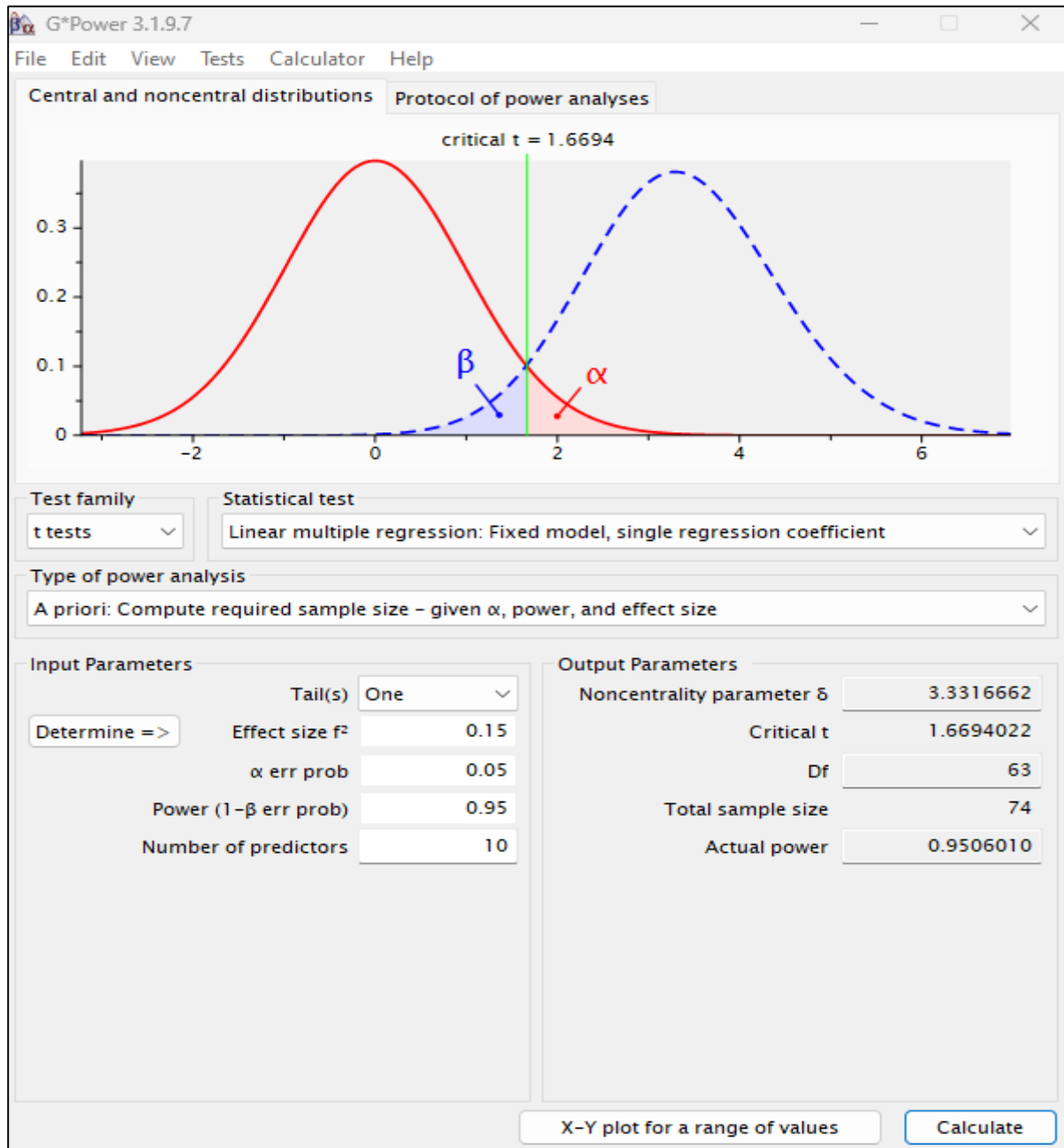


Figure 1: Minimum Sample Size

## RESULTS

### Demography Information

The demographic information of the respondents was collected. The frequency and percentage analysis was carried out and the results presented to explore the respondents' characteristics.

Table 1: Demographic of the Respondents

S/N	Questions	Options	Frequency	Percent
1	Gender	Male	148	69.2
		Female	66	30.8
		<b>Total</b>	<b>214</b>	<b>100</b>
2	Experience	1-5 Years	111	51.9
		6- 10Years	94	43.9
		11 to 16 Years	9	4.2
		<b>Total</b>	<b>214</b>	<b>100</b>
3	Qualification	ND	9	4.2
		HND	102	47.7
		BSc	85	39.7
		M.Tech	18	8.4
		<b>Total</b>	<b>214</b>	<b>100</b>
4	Profession	Probationer	84	39.3
		Association member	95	44.4
		Fellow	9	4.2
		None	26	12.1
		<b>Total</b>	<b>214</b>	<b>100</b>

Table 1 shows the respondent's results where males respondents are the majority of respondents who were answered the questionnaire with the high percentage of 69.2% and least was female respondents with lower percentage of 30.8%. Then working experience of the respondents, majority of the respondents have an experience of 1-5years with highest percentage of 51.9%. With regard to qualification of the respondents, HND holders were constituted the majority with highest percentage of 47.7%. Also with regard to profession, association member constituted the majority with the highest percentage of 44.4%.



## The Motivating Factors Influencing the use of ICT in Modern Real Estate Profession in Abuja

Table 2: Motivating Factors Influencing the use of ICT in Modern Real Estate Profession

<b>Motivating Factors Influencing the use of ICT in Modern Real Estate Profession</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Level</b>
Enhanced Quality of Customer Services	4.56	.577	High
Improved Decision Making	4.32	.614	High
The competitor's pressure	4.28	.767	High
Increased Productivity of Staff	4.12	.513	High
Reduce Overall Cost	4.08	.567	High
Knowledge sharing factor and information accessibility	4.07	.688	High
Time Saving	4.05	.603	High
Availability of ICT Infrastructure	3.83	.835	Moderate
Management and business Size	3.77	.658	Moderate
Government stability	2.64	.836	Moderate

Table 2 shows that the motivating factors influencing the use of ICT in modern real estate profession in the study area. The results observed that motivating factors influencing the use of ICT in modern real estate profession are enhanced quality of customer services, improved decision making, the competitor's pressure, increased Productivity of staff and reduce overall cost with mean scores of  $M = 4.56$ ,  $SD = 0.577$ ,  $M = 4.32$ ,  $SD = 0.614$ ,  $M = 4.28$ ,  $SD = 0.767$ ,  $M = 4.12$ ,  $SD = 0.513$  and  $M = 4.08$ ,  $SD = 1.567$  ranked first to fifth respectively. This aligns with research by Ekanem & Ekpenyong (2021), who emphasize the positive impact of ICT on customer service efficiency, responsiveness, and engagement. Real estate professionals can leverage ICT tools to better manage inquiries, provide personalized information, and enhance overall customer experience. ICT empowers real estate professionals with data-driven insights for informed decision-making, as highlighted by Li et al. (2019). Access to real-time market data, property analytics, and predictive tools allows for strategic decision-making, risk management, and maximizing investment returns.

**The Level of Adoption of the New Technology by the Real Estate Professionals in Abuja**

This study adapted the mean score decision interval based on the works of Ramli, et al., (2017) from which the following interval decisions were deduced. (1-1.80) = Very low (1.81-2.60) = Low (2.61-3.40) = Moderate (3.41-4.20) = High (4.21-5.0) Very high.

Table 3: Level of Adoption of the new Technology by the Real Estate Professionals

<b>Level of Adoption of the new Technology by the Real Estate Professionals</b>	<b>Mean</b>	<b>Std. Deviation</b>	<b>Level</b>
Use of social media platform for advertising	4.47	.500	High
Word processing application	4.29	.663	High
Use of hyper-personalised message to market property	4.03	.604	High
Use of Online listening services	3.85	.545	High
Online marketing of products to clients	3.81	.632	High
ICT For Marketing	3.73	.665	High
Transaction management system	3.72	.608	High
ICT For Administration	3.69	.685	High
Company Website	3.64	.683	High
Spreadsheet application	3.56	.759	Moderate
Online archive photograph for Completed Projects	3.51	.809	Moderate
Project management software	3.18	.856	Moderate
Design software (CAD)	3.14	.740	Moderate
Use of smart contract	2.79	.704	Moderate
Use virtual walk technology for inspection	2.56	.819	Moderate
Webcam	2.46	1.120	Moderate
Ai chat boot	2.45	1.064	Low
Video conferencing	2.33	1.125	Low
Use of Airbnb or a B&B on rentals	2.11	.584	Low

Table 3 shows that the level of adoption of the new technology by the real estate professionals in the study area. The results observed that the level of adoption of the new technology by the real estate professionals are use of social media platform for advertising, word processing application, use of hyper-personalised message to market property, use of Online listening services and Online marketing of products to clients with mean scores of  $M = 4.47$ ,  $SD = 0.500$ ,  $M = 4.29$ ,  $SD = 0.663$ ,  $M = 4.03$ ,  $SD = 0.604$ ,  $M = 3.85$ ,  $SD = 0.545$  and  $M = 3.81$ ,  $SD = 0.632$  ranked first to fifth in the

study area. The low level of adoption of the new technology by the real estate professionals in the study area are Webcam, Ai chat boot, Video conferencing and use of Airbnb or a B&B on rentals with mean score of  $M = 2.46$ ,  $SD = 1.120$ ,  $M = 2.45$ ,  $SD = 1.064$ ,  $M = 2.33$ ,  $SD = 1.125$  and  $M = 2.11$ ,  $SD = 0.584$  ranked seventeen to nineteen in the study area. This aligns with research by Anoma & Kem (2023) who identified social media as a primary marketing tool for real estate agencies. Platforms like Facebook, Instagram, and YouTube offer cost-effective ways to reach a wider audience, target specific demographics, and engage potential clients. These tools monitor social media conversations and online forums, allowing real estate professionals to track brand mentions, gather customer feedback, and identify industry trends, as noted by Smith & Zook (2011). This data-driven approach facilitates informed decision-making and enhances the ability to adapt to market dynamics.

### The Effect of Motivating Factors on the Adoption of the New Technology by the Real Estate Professionals in Abuja

Table 4: Effect ICT Usage on the Adoption of the New Technology by the Real Estate Professionals

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate	F	Sig.
1	.608 <sup>a</sup>	.369	.338	.25380	11.884	.000b

a. Dependent Variable: Adoption of ICT

b. Predictors: (Constant), Government stability , Availability of ICT Infrastructure, The competitor's pressure, Time Saving, Knowledge sharing factor and, Management and business Size, Increased Productivity of Staff, Improved Decision Making, Enhanced Quality of Customer Services, Reduce Overall Cost

The r square value shows how much of the variance in the dependent variable Adoption is explained by the independent variables of ICT usage. In this case, the value was  $r^2 = .369$ ,  $f = 11.884$ ,  $p < 0.000$ . This means that the independent variables of ICT usage explained 36.9% large effect size in ICT adoption, with significance at  $p < 0.000$ . The results of this study demonstrate that motivating factors have a large effect size in ICT adoption in the study area. ICT tools streamline processes, automate tasks, and facilitate collaboration, ultimately freeing up resources and time for real estate professionals to explore and adopt new technologies, as noted by Kummerow & Lun (2005). ICT facilitates access to industry trends, research findings, and best practices related to new technologies, fostering awareness and encouraging experimentation among professionals, as highlighted by Ekanem & Ekpenyong (2021). ICT tools enable real estate professionals to connect

with peers, experts, and technology vendors, facilitating knowledge exchange, troubleshooting, and collaborative adoption of new technologies, as emphasized by Lee et al., (2018).

Table 4 Coefficients on Effect of motivating factors on the Adoption of the New Technology by the Real Estate Professionals.

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	t	
1	(Constant)	3.070	.254		12.069	.000
	Enhanced Quality of Customer Services	.004	.061	.007	.058	.954
	The competitor's pressure	.010	.032	.024	.308	.758
	Knowledge sharing factor and	.097	.032	.214	2.998	.003
	Increased Productivity of Staff	-.209	.049	-.344	-4.305	.000
	Improved Decision Making	.022	.046	.043	.473	.636
	Availability of ICT Infrastructure	.125	.032	.336	3.884	.000
	Management and business Size	-.265	.039	-.558	-6.859	.000
	Reduce Overall Cost	-.075	.076	-.136	-.992	.322
	Time Saving	.293	.063	.566	4.663	.000
	Government stability	.081	.023	.216	3.490	.001

The model indicate that the variable with largest beta value in the standardised coefficients are 0.566 For time saving, 0.336 for availability of ICT Infrastructure, 0.216 for Government stability, 0.214 for knowledge sharing factor. 0.-344 for increased productivity of staff and 0. -.558 for management and business size. It further shows that motivating factors variable is making a statistically significant ( $p < 0.001$ , 0.000, 0.000, 0.000, 0.000 and 0.003) unique contribution to the equation. In contrast, enhanced quality of customer services, improved decision making, reduce overall cost and the competitor's pressure have the lowest positive and negative beta values of .007, .043, -.136 and 0.024 which are insignificant at ( $p = 0.954$ , 0.636, 0.322, and 0.758) contribution in explaining the dependent variable ICT adoption. The most important factor when attempting to ICT adoption is the availability of ICT infrastructure, Government stability and

knowledge sharing factor. However, each of these factors has its own set of strengths and weaknesses. Consequently, it is important to weigh all of these factors carefully before making a decision, in order to ensure the best possible outcome for the adoption.

## **CONCLUSION AND RECOMMENDATIONS**

The paper observed that the motivating factors influencing the use of ICT in modern real estate profession were enhanced quality of customer services, improved decision making, the competitor's pressure, increased productivity of staff and reduce overall cost ranked first to fifth respectively. The paper established that the level of adoption of the new technology by the real estate professionals are use of social media platform for advertising, word processing application, use of hyper-personalised message to market property, Use of Online listening services and Online marketing of products to clients observed moderate level and ranked first to fifth in the study area. The study also observed that the least level of adoption of the new technology by the real estate professionals in the study area were webcam, Ai chat boot, Video conferencing and use of Airbnb or a B&B on rentals ranked seventeen to nineteen in the study area.

The study concluded that top three motivating factors enhanced customer service, improved decision making, and increased staff productivity, all focus on internal improvements within the real estate firm. This concludes that firms are primarily motivated by the benefits of ICT for their own operations rather than external pressures. While reduced overall cost ranks fifth, it receives a lower score than other factors. This implies that while cost savings are desirable, they are not the primary driver of ICT adoption in the real estate industry. The study concluded that the level of adoption of the new technology by the real estate professionals are use of social media platform for advertising, word processing application, use of hyper-personalised message to market property, Use of Online listening services and Online marketing of products to clients observed moderate level and ranked first to fifth in the study area. The study also observed that the least level of adoption of the new technology by the real estate professionals in the study area were webcam, Ai chat boot, Video conferencing and use of Airbnb or a B&B on rentals ranked seventeen to nineteen in the study area. Factors motivating has a large effect size on the adoption of new technologies in the real estate industry. This implies that increasing ICT usage can significantly promote the adoption of new tools and technologies by professionals. Real estate professionals with higher factors tend to be more receptive to new technologies and are likely to recognize their potential benefits. The paper reinforces the importance of promoting ICT literacy among real estate professionals to facilitate technology adoption and enhance their competitiveness in the digital age. Real estate professionals should invest in training and education on advanced ICT tools and applications relevant to the real estate industry, such as virtual tours,

property management software, and data analytics platforms. The study recommended that the policymakers and industry associations should Provide access to affordable technology solutions and promote collaboration between technology companies and real estate firms. Technology providers should design solutions specifically tailored to the needs and preferences of real estate professionals, ensuring ease of use and integration with existing workflows.

## REFERENCES

- AbdEl-Aziz, R. M., Taloba, A. I., & Alghamdi, F. A. (2022). Quantum Computing Optimization Technique for IoT Platform using Modified Deep Residual Approach. *Alexandria Engineering Journal*, 61(12), 12497-12509.
- Adeyemo, A. A., Kemiki, O. A., Adama, U. J., & Ayoola, A. B. (2015). Factors influencing the use of information and communication technology in real estate practice in Minna. *ATBU Journal of Environmental Technology*, 8(2), 1-10.
- Aihie, V. U. (2019). The Property Technology Revolution: The imperatives for Nigeria's estate surveying and valuation professionals to catch up or get left behind. *Journal of African Real Estate Research*, 4(2), 56-75.
- Ajaelu, H. C., Nzotta, S., & Okaka, O. (2021) Assessment of the application of information and communication technology in real estate management in Enugu State, Nigeria.
- Akadiri, P. O., Chinyio, E. A., & Olomolaiye, P. O. (2012). Design of a sustainable building: A conceptual framework for implementing sustainability in the building sector. *Buildings*, 2(2), 126-152.
- Akinola, S. O., & Olatidoye, A. A. (2015). On the image quality and encoding times of LSB, MSB and combined LSB-MSB steganography algorithms using digital images. *International Journal of Computer Science & Information Technology*, 7(4), 79-91.
- Alonso, E., & Calvo, E. (2015). Developing a blueprint for a technology-mediated approach to translation studies. *Meta: Journal des Traducteurs/Meta: Translators' Journal*, 60(1), 135-157.
- Anoma, M. G., & Kem, K. (2023). Effect of Information and Communication Technology on Estate Agency Practice in Abuja, Nigeria. *International Journal of Environmental Research & Earth Science*, 27(4), 9-17.
- Awasthi, R., Nagarajan, M., & Deininger, K. W. (2021). Property taxation in India: Issues impacting revenue performance and suggestions for reform. *Land Use Policy*, 110, 104539.

- Babatunde, T. O., & Ajayi, C. A. (2018). The impact of information and communication technology on real estate agency in Lagos Metropolis, Nigeria. *Property Management*.
- Bartke, S., & Schwarze, R. (2021). The economic role and emergence of professional valuers in real estate markets. *Land, 10*(7), 683.
- Baum, A. E., Crosby, N., & Devaney, S. (2021). *Property investment appraisal*. John Wiley & Sons.
- Bauman, A., & Lucy, C. (2020). Social media: Exploring entrepreneurial opportunities. In *Understanding Social Media and Entrepreneurship* (pp. 15-28). Springer, Cham.
- Bresnahan, T. F. (2019). Technological change in ICT in light of ideas first learned about the machine tool industry. *Industrial and Corporate Change, 28*(2), 331-349.
- Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). *Principles of geographical information systems*. Oxford university press.
- Camngca, V. P., Amoah, C., & Ayesu-Koranteng, E. (2022). Under utilisation of information communication and technology in the public sector construction project's implementation. *Journal of Facilities Management*, (ahead-of-print).
- Cusumano, M. A., Kahl, S. J., & Suarez, F. F. (2015). Services, industry evolution, and the competitive strategies of product firms. *Strategic management journal, 36*(4), 559-575
- Dixon, T. (2010). The impact of information and communications technology on commercial real estate in the new economy. *Journal of Property Investment & Finance.11*(2), 15-19.
- Ekanem, I. U., & Ekpenyong, E. E. (2021). Impact of information communication technology (ICT) on the quality of customer service delivery in the real estate industry in Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences, 12*(7), 180-184.
- Emenike, K. C. (2022). The Aim of the Study Is to Examine Impact of Sustainable Housing Infrastructure and Its Effect on Property Values In Umuahia Capital Abia State, Nigeria. *01*(1), 12-16.
- Fu, B. (2022). Does Property Technology Facilitate Liquidity in the Property Transaction Process? A Qualitative Study on the Swedish Real Estate Market.
- Gitau, S. W. (2014). *The application of information technology in real estate firms in Kenya* (Doctoral dissertation, University of Nairobi).

- Jones, C., Dunse, N., Livingstone, N., & Cutsforth, K. (2017). The restructuring of the institutional real estate portfolio in the UK. *Journal of Property Research*, 34(2), 129-146.
- Kampamba, J., Kachepa, S., & Lesobe, K. (2022). An assessment of real estate cycles and their impact on property values in Gaborone, Botswana. *International Journal of Housing Markets and Analysis*, (ahead-of-print).
- Kirkwood, J. (2014). Urban real estate information systems: The suppression of radical innovation. *Journal of Urban Technology*, 11(1), 29-42.
- Kirkwood, J. (2014). Urban real estate information systems: The suppression of radical innovation. *Journal of Urban Technology*, 11(1), 29-42.
- Kummerow, M., & Lun, Y. (2005). Technology adoption in the real estate industry. *Journal of Real Estate Research*, 26(3), 287-310.
- Kwabe, M. V. (2021). Information and Communication Technology and the Development of Accounting Profession in Nigeria.
- Lee, M. W., & Witchel, H. J. (2022). Introduction: Intentional Innovation in Educational Technology and Media to Promote Students' Holistic Development. In *Technologies in Biomedical and Life Sciences Education* (3-34). Springer, Cham.
- Lee, M. W., & Witchel, H. J. (2022). Introduction: Intentional Innovation in Educational Technology and Media to Promote Students' Holistic Development. In *Technologies in Biomedical and Life Sciences Education* (3-34). Springer, Cham.
- Li, X., Wang, S., & Zhao, W. (2019). Big data in the real estate industry: A review. *Sustainability*, 11(14), 4050.
- McCluskey, W. (2018). *Property tax: An international comparative review*. Routledge.
- Ngozi, A. L., Ogunode, N. J., & Olatunde-Aiyedun, T. G. (2022). Assessment of Information and Communication Technology (ICT) Usage for School Administration in Early Child Care Centre in Gwagwalada Area Councils, FCT. *Abara, LN, Ogunode, NJ & Olatunde-Aiyedun, TG (2022). Assessment of Information and Communication Technology (ICT) Usage for School Administration in Early Child Care Centre in Gwagwalada Area Councils, FCT. Spanish Journal of Society and Sustainability*, 2, 1-9.
- Nuhu, S. K., Manan, Z. A., Alwi, S. R. W., & Reba, M. N. M. (2021). Roles of geospatial technology in eco-industrial park site selection: State-of-the-art review. *Journal of Cleaner Production*, 309, 127361.



- Ogunnowo, O. E., Iroham, C. O., & Oloke, O. C. (2021). Utilization of property valuation software among estate surveying and valuation firms in Lagos state, Nigeria. In *IOP Conference Series: Earth and Environmental Science* 655(1), 012063. IOP Publishing.
- Okon, M. E., & Ogbodo, C. I. (2014). Information and Communication Technology (ICT) as a necessity for libraries and librarians of Nigerian Universities in the 21st century. *Review of Information Engineering and Applications*, 1(1), 39-54.
- Philippon, T. (2015). Has the US finance industry become less efficient? On the theory and measurement of financial intermediation. *American Economic Review*, 105(4), 1408-38.
- Poister, T. H. (2010). The future of strategic planning in the public sector: Linking strategic management and performance. *Public administration review*, 70(2), 246-254.
- Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and adoption challenges of AI in the construction industry: a PRISMA review. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(1), 45.
- Sepehrdoust, H., Ahmadvand, S., & Mirzaei, N. (2022). Impact of information, communication technology and housing industry on financial market development. *Technology in Society*, 69, 101962.
- Smith, M. J., & Zook, M. A. (2011). Digital dashboards: Visualizing real-time data for social science research. In *The SAGE handbook of online research methods* (479-492). SAGE Publications Ltd.
- Thompson, M., & Walsham, G. (2010). ICT research in Africa: Need for a strategic developmental focus. *Information Technology for Development*, 16(2), 112-127.
- Trappey, A. J., Trappey, C. V., Govindarajan, U. H., Sun, J. J., & Chuang, A. C. (2016). A review of technology standards and patent portfolios for enabling cyber-physical systems in advanced manufacturing. *IEEE Access*, 4, 7356-7382.
- Vasistha, A., Kothari, R., Mishra, A., De Andrés, F., LLerena, A., & Nair, S. (2020). Current insights into interethnic variability in testicular cancers: population pharmacogenetics, clinical trials, genetic basis of chemotherapy-induced toxicities and molecular signal transduction. *Current Topics in Medicinal Chemistry*, 20(20), 1824-1838.