

**ASSESMENT OF INFORMATION TECHNOLOGY APPLICATION IN BUILDING
CONSTRUCTION SITES IN ABUJA, NIGERIA**

BY

CHIDI EZEH

2016 /1/63761TI

**DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION,
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE.**

APRIL, 2023.

**ASSESSMENT OF INFORMATION TECHNOLOGY APPLICATION IN BUILDING
CONSTRUCTION SITES IN ABUJA, NIGERIA**

BY

CHIDI EZEH

2016/1/63761TI

**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL
AND TECHNOLOGY EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF
BACHELOR OF TECHNOLOGY (B. TECH) DEGREE IN INDUSTRIAL AND
TECHNOLOGY EDUCATION**

APRIL, 2023

DECLARATION

I, CHIDI EZEH, with matriculation number **2016/1/63761TI**, an undergraduate student of the department of Industrial and Technology Education, certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

.....
Name & Matric No.

.....
Sign and Date

CERTIFICATION

This project has been read and approved as meeting the requirement for the award of B. Tech degree in Industrial and Technology Education, School of Technology Education, Federal University of Technology, Minna.

Dr. C.O Igwe
Project Supervisor

Signature and Date

Dr T.M. Saba
Head of Department

Signature and Date

External Examiner

Signature and Date

DEDICATION

With profound joy and gratitude in my heart, I dedicate this project to God Almighty for His Unshakable and Unbreakable Faithfulness. His Divine and constant guidance in my life has made this project a reality today. Thank you Jesus.

ACKNOWLEDGEMENTS

My sincere gratitude goes to God almighty, the originator and giver of life for this Divine protection, his selfless love towards me, his Grace, Wisdom and Knowledge during the period of writing this project and beyond.

My sincere appreciation also goes to my project supervisor Dr. C.O Igwe for the guidance, assistance, and suggestions given to me on this research study. I would also like to extend my words of appreciation to project coordinator Dr. A.M. Hassan, my Head of Department Dr. T.M. Saba.

My joy and happiness will not be complete without specially thanking my parents Mr and Mrs P.E Ezeh and my siblings, Johnson, Peace, Christiana and Goodluck Ezeh for their support and prayers throughout my stay in School.

I also want to extend my appreciation to my friends Margret, Faith, David, Sunday and Isaac for their wonderful support. God almighty Crown their effort with success.

ABSTRACT

This study examined the application of information technology in building construction sites in Abuja, Nigeria. This paper presents the results of investigation conducted to examine the application, benefits, cost implication and challenges of information technology in building construction sites in Abuja, Nigeria. Four research questions were developed to guide the study. The study used a four-point scale questionnaire, which contains a total of 90-items, as instrument for data collection which each section consists of 15-items each. The questionnaire was validated by three lecturers from the Federal University of Technology Minna, Department of industrial and technology education. The validated instrument was prepared for 200 building professionals which consists of builders, architects, quantity surveyors, project manager etc. Including IT engineers like computer aided designers, building information modelling (BIM) engineers, predictive software engineers. The findings of the study are the extent information technology is applied in construction sites, among them are building information modelling (BIM), mobile technology application, cloud storage and site sensors. The benefits of information technology application in construction sites, among them are to save cost, makes complex works easier, reduce construction error and increase document quality. The need for cost implications are hardware cost, maintenance cost and network cost. The need for challenges are lack of adequate jobs, lack of staffs and issue with cash flow. To maximize its benefits, government should do all within its power to halt epileptic power supply in Nigeria. The professional bodies of each profession should organize workshops and seminars to introduce their members to work with software and equipment which will aid their work without wasting time. Awareness should be made in order for the professionals to internalize the benefits and adopt new technology.

TABLE OF CONTENTS

	Pages
Cover Page	i
Title Page	ii
Declaration	iii
Certification	iv
Dedication	v
Acknowledgement	vi
Abstracts	vii
Table of Contents	viii
List of Tables	ix
CHAPTER ONE: INTRODUCTION	
1.1 Background of Study	1
1.2 Statement of the Problem	4
1.3 Purpose of the Study	5
1.4 Significance of the Study	6
1.5 Scope of the Study	8
1.6 Research Questions	8
CHAPTER TWO: LITERATURE REVIEW	
2.1 Theoretical framework of the study	9
2.2 Conceptual framework	10
2.2.1 Challenges of information technology at building construction sites	10

2.2.2	Strategies for improving the challenges of information technology at building construction sites	13
2.2.3	Information technologies currently used at building construction sites	14
2.2.4	Impact of information technology at building construction sites	21
2.2.5	Information technology applications at building construction sites	22
2.2.6	What are the benefits of information technology Application at building construction sites?	23
2.2.7	Implementation of information technology in the construction industry	25
2.3	Review of Related Empirical Studies	27

2.4 Summary of Literature Review

CHAPTER THREE: RESEARCH METHODOLOGY

3.1	Design of the study	30
3.2	Area of Study	30
3.3	Population of the Study	31
3.4	Sample and Sampling Techniques	31
3.5	Instruments for Data Collection	32
3.6	Validation of Instrument	33
3.7	Administration of Instrument	33
3.8	Reliability of the Instrument	33
3.9	Method of Data Collection	34
4.0	Method of Data Analysis	34

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1	Research Question 1	35
4.2	Research Question 2	36
4.3	Research Question 3	38
4.4	Research Question 4	39
4.5	Findings of the Study	40
4.6	Discussion of Findings	43

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1	Summary of the Study	44
5.2	Implications of the Study	44
5.3	Contribution of Knowledge	45
5.4	Conclusion	45
5.5	Recommendations	46
5.6	Suggestions for Further Research	48
	References	50
	Appendixes	55

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The digital world is experiencing a revolution in the magnitude of data and information that is being captured and recorded in different fields (Omran, 2016). The field of construction is experiencing this trend toward digitization and automation. Innovative methods that make use of the immense amount of data that can be gathered at every stage of the construction process are now possible thanks to technological advancement. Particularly in many human endeavors, data analytics has experienced a Renaissance. The development of new technologies offers businesses and industry processes new ways to gain a competitive edge. (Bilal & Oyedele, 2020)

The construction sector is considered as one of the biggest investment-draining sectors worldwide, with extremely high influence and contribution to economic development. However, this sector faces considerable barriers and challenges, such as low performance, frequent construction delays, quality issues and cost overruns. Therefore, finding solutions to improve construction project performance and make the project management knowledge more efficient is the main challenge for organizations to achieve client requirements. One of these solutions is to apply new technologies and implement effective information technology applications in construction projects.

Construction includes the activities involved in the erection, installation or construction of a portion or an entire project. These activities are actually provided on the job site by the contractor, subcontractors, material suppliers and equipment suppliers. This is separate from the production or manufacture of structures and equipment off-site, which is also part of the production. Activities

in this phase include site layout and control, foundation construction, forms, structure reinforcement and so on. The construction process is carried out with labour, machinery, equipment, materials, methods and money. The world is undergoing profound and rapid changes due to the development of information super highway. The digital revolution in Information Technologies has created a platform for a free flow of information, ideas and knowledge across the globe (Shafique and Mahmood, 2008). This development has provided the potential for bringing significant changes in the use of data, and information in the construction industry (Datti, 2017).

Many companies in the construction industry do not generally appear to have appreciated the positive changes and advantages that the new technology was providing to companies in other sectors of the economy. Today, a large number of software packages are available to all the disciplines of the construction team at every stage of the construction process. They provide support for a broad range of activities such as computer aided design and drafting, building visualization, design appraisal, project management, information storage and retrieval, cost estimation, structural analysis, on-site management, facilities management, etc.

Global information technology policy in the construction industry has received general recognition in current industrial applications worldwide. Information technology has been recognized as the primary tool for communication and data exchange schemes. Shen et al. (2004) emphasized that the implementation of information technology has become one of the most important factors in determining the success or failure in almost all industry sectors including the construction industry. Despite the apparent need for the information technology in the construction industry, the pace of adoption of the information technology into the construction industry was low compared to other industries (Hosseini et. al., 2012, and Ern et al., 2017). Nevertheless, Hosseini et. al. (2012)

revealed that the construction industry awareness for the need to implement the information technology into the construction practices has increased over the time and there exist many studies that were conducted to perceive the potential benefits for information technology utilization in the construction industry. The authors (Hosseini et. al., 2012) further explained that there were studies dedicated to expose the gap between information technology and the construction industry and to reveal the challenges for information technology application into the construction process. Hosseini et. al. (2012) summarized the driving forces behind the implementation of information technology within construction industry into: increasing the level of productivity in the construction processes, globalization, and unique characteristics of the construction industry. They are also active in identifying the factors that influence the application and use of information technology. Li J et al. (2020) looked at the relationship between construction equipment and construction management progress. They ended up with three factors that mainly determine the impact of equipment of information technology benefits, which are information technology implementation control, information technology implementation acceptance, and the project condition. Daniotti et al. (2020) suggested that a lack of information about information technology and its benefits and an unclear competitive advantage may have caused a construction management team to resent adopting new technologies.

According to Adafin et al. (2021), New Zealand's construction sector has increasingly utilized information technology in the design and the project operational phase, resulting in unstructured and discrete utilization strategies. Conversely, the construction management and onsite construction execution phases had the lowest information technology utilization levels in New Zealand's construction industry. Moreover, in the New Zealand construction industry, information technology utilization was most widespread in the second phase (design phase) and less

widespread during the fourth phase (project management phase). Afzal et al. (2021) claim that it was demonstrated the value of 4D models for visualizing and understanding construction methodology, schedule sequencing, communicating special constraints to a project, and formalizing design information. They also argue that 4D models can be used to anticipate safety hazards and the assignment and allocation of project resources and construction-related machinery to the worksite, as well as for constructability reviews. Alaloul et al. (2020) found that this visualization allows stakeholders of the construction projects to understand the construction schedule better than traditional construction management tools.

In every technological development, there are challenges that could hinder the progressive application of such technology. One of the major challenges of information technology application is the inability to effectively communicate, interact and engage with others online. Others include illiteracy, lack of adequate skilled workers, lack of capital, irregular power supply and vision syndrome.

1.2 Statement of the Problem

In this era of rapidly advancing technologies, many organizations and governments around the globe are spending a great amount of money on technologies in order to increase their productivity, efficiency and the quality of the work they do. Effective use of information technology will require those who are involved in information management to accept it first. Therefore, there is need to understand whether project leaders in construction organizations accept technological advances, what the primary elements of successful adoption and utilization of information technology are and what the primary factors affecting the application of information technology are. (Ajahana, 2018) observed that the cost of hardware and software and the expenses of maintaining them is one of the reason why professional builders are yet to fully adopt the use of softwares. Thus,

Nigerian government need to provide the necessary tools and technology in order to overcome such issues and identify the benefits and gains that this technology would contribute to construction benefits and gains that this technology would contribute to construction industries and project performance. By providing the necessary technology, it will most likely create conditions that will guarantee the adoption, acceptance and application of information technology. Various studies have demonstrated the potential of information technology application in the construction industry. For example, the application of information technology can improve the accuracy and speed of the construction process, and reduce the cost of project delivery. It can also improve the safety of the construction site by providing a better and more accurate safety assessment (Kumar et al., 2017).

In Nigeria, Oladapo, A (2007) argued that the level of application of information technology in Nigeria is low and one of the reasons is attributed to the project leaders' attitudes toward the application of technology in their organizations. As a result, it is important to determine if project leaders are willing to adopt the application of this technology in their daily work and why some may avoid using it.

1.3 Purpose of the Study

The aim of this study is to evaluate the use of information technology in project delivery and its impact on project performance with a view to promoting information technology based project delivery process in Abuja. The research objectives are to:

1. Determine the extent of the application of information technology in building construction sites in Abuja.
2. Determine the benefits of information technology application in building construction sites in Abuja.

3. Determine the cost implication of information technology application in building construction sites in Abuja.
4. Determine the challenges that affect the application of information technology in building construction sites in Abuja.

1.4 Significance of the Study

The assessment of information technology at building construction sites has the potential to benefit many parties involved. Construction companies can realize the advantages of using digital technologies to reduce costs, increase safety, and improve efficiency. Architects, engineers and designers may be able to use digital tools to improve the quality of their work. Building owners can use the assessment to ensure their building designs are up to code and meet their business objectives. Finally, the construction workers themselves can benefit from the assessment, as it can help to reduce the risk of accidents and improve their overall job satisfaction.

The use of information technology in building construction offers a range of benefits to architects. Firstly, the use of information technology in construction enables architects to create virtual designs easily and quickly. This reduces the amount of time and money spent in the design process, as it eliminates the need for physical models or drawings. Architects can also use information technology to create accurate and detailed designs to ensure that the building is constructed to the highest possible standards.

Engineers have long been at the forefront of building construction, but with the introduction of new information technology into the industry, engineers now have access to a variety of new tools that can help them to assess the quality of the construction more efficiently and accurately. By using information technology in their assessment of construction projects, engineers are able to

draw on a variety of data sources such as building plans, CAD drawings, and existing building models to gain a better understanding of the project they are working on.

Designers are among the main beneficiaries of information technology assessment in building construction. By assessing the various digital tools available, designers can identify which ones are best suited to their particular project. This helps designers take advantage of economies of scale, as well as utilize materials more efficiently. By using 3D modeling, designers can better plan the use of materials, reducing waste and saving money in the long run. In addition, information technology can help facilitate the sourcing of materials and other resources at reduced costs.

The importance of this study comes from the role that project leaders play in the management and execution of construction projects in Abuja, Nigeria. In order for the Project leaders to carry out this role successfully, they need an awareness of the benefits that information technology brings to construction. The study provides very helpful and important information regarding the organizational, project, technological and managerial characteristics and explains the factors influencing the adoption and application of information technology.

The significance of this study comes from the fact that information technology has an important role to play in the speed, cost and quality of project documentation which should translate to improved project performance. In order for this to be achieved, there is the need for greater understanding of the benefits that information technology brings to construction.

1.5 Scope of the Study

This study is concerned with determining the challenges affecting the use of information technology application at building construction sites in Abuja. Assessment of the level of application of information technology and its influence on project performance. The research covers a review of information technology adoptions and applications by some construction sites in Abuja. Many individuals and organizations in the construction industry, including clients, contractors, and consulting firms, will greatly benefit from this research work. This is because, in the end, a solution will be found to allow the workers to produce quality work. Contractors, in particular, would be grateful to read and apply the integration of information technology in their projects, as this would increase their output if properly applied.

1.6 Research Questions

Owing to the numerous problems encountered by construction companies from non -adoption or low adoption of information technology to the problems encountered even when it is adopted, the following research questions were formulated.

1. To what extent is information technology applied in building construction sites in Abuja.
2. What are the benefits of information technology application in building construction sites in Abuja
3. What are the costs implications of information technology application in building construction sites in Abuja.
4. What are the challenges of information technology application in building construction sites in Abuja.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical framework of the study

2.2 Conceptual framework

2.2.1 Challenges of information technology in building construction sites

2.2.2 Strategies for improving the challenges of information technology in building construction sites

2.2.3 Information technologies currently used in building construction sites

2.2.4 Impact of information technology in building construction sites

2.2.5 Information technology applications in building construction sites

2.2.6 What are the benefits of information technology Application in building construction sites?

2.2.7 Implementation of information technology in the construction industry

2.3 Review of empirical studies

2.4 Summary of literature review

2.1 Theoretical Framework of the Study

This chapter discusses the literature review for this study. The review has been divided into two sections. The first part deals with the construction industry generally, information technology in the construction, including providing a working understanding of issues relating to information and communication needs in construction and current roles of information technology in construction. The second part looks at the drivers for implementing information technology in the

construction industry, information technology tools and applications for the sector and perceived challenges for its implementation. However, the application of information technology is influenced by some factors. We believe that the understanding factors that influence information diffusion could provide an essential mechanism to encourage construction organizations to prepare for information technology adoption. Then, the information technology application will be linked to achieve project success and show the relationship between them.

Numerous studies of the construction industry have been published recently, and they are becoming more and more significant both theoretically and experimentally. There is a lot of literature on several industrial application fields. The body of literature on the construction industry is quite varied, but it varies on how it describes features and importance. The application of information technology within construction practices is the area of interest in this study. A review of available information and factors affecting performance in the construction sector will assist to determine the various elements required for this study. The focus is to identify the general limits in terms of importance for a better understanding of the issues to be obtained.

2.2 Conceptual Framework

2.2.1 Challenges of Information Technology in Building Construction Sites

In the recent past, there has been emergence of Information Technology revolution in Nigeria which has equally affected the advancement of technology in construction industry. As regards ICT software materials, Capron (2000) also provided reasons why they considered “unsuitable for Nigeria. Some of the reasons he gave was that the sophistication in construction and operations most equipment, the absence of adequately trained staff for maintenance and repair and the non-available of spare part for the different types of information technology equipment. Finally. The

reliance on electricity as the major source of power for most of the information technology equipment with little regard to the fact that these equipment may be mostly needed in rural part of Nigeria where no electricity is. From the above. The key challenges are as follows:

1. Limited Access to the Internet

In Nigeria there are few internet providers that provide internet gateway services to customers who are often exploited and defrauded. The few reputable companies, which render reliable services, charges high fees thus limiting access to the internet. The greatest technological challenges in Nigeria is how to establish reliable cost effective internet connectivity. Without access to the internet, construction companies in Nigeria have been unable to take advantage of the numerous advantages of the internet. They are unable to take advantage of e-commerce, which allows for quick and secure transactions. They are also unable to access the latest information related to the construction industry, which is essential for efficient operations. Additionally, without the internet, businesses in the construction industry have been unable to avail themselves of the most up-to-date technologies, which would allow them to remain competitive.

2. Lack of Relevant Software

Extensive software infrastructure is required more on the background servers and network to effectively manage the smart objects and give services to assist them (Mattern and Floerkemeier 2010). Muralidharan, Roy, and Saxena (2016) also explained that in smart objects software systems will have to function with minimum resources as in traditional embedded systems.

The lack of relevant software in the construction industry in Nigeria is a major issue that needs to be addressed. Construction is a complex process, and software technology can help make the process easier, faster and more efficient. Unfortunately, due to the lack of relevant software

solutions in Nigeria, the construction industry is lagging behind other countries in terms of technological advancements. Software developers and publishers in the developed countries have been trying for long to develop software and multimedia that have universal application but due to a great discrepancy between relevant software supply and demand in developing countries like Nigeria. Even if Nigerian tries to approach this software famine by producing software that would suit its educational philosophers, there are two major problems to be encountered. First, the cost of producing relevant software for the country construction industry system is enormous. Second, there is dearth of qualified computer software designers in the country to overcome this, people need to be trained in instructional design

3. Lack of Skill

In Nigeria, the lack of skilled labor in the construction industry is a major problem. According to a report by the Nigerian Institute of Construction Technology and Management (NICTM), the country is facing a crisis due to the shortage of skilled professionals in construction. This is due in part to the industry's lack of formal training and education for workers, resulting in a lack of properly trained professionals. Additionally, the poor infrastructure in the country has made it difficult for skilled labor to be effectively engaged in the industry. The lack of skilled workers also impacts the safety of construction sites. Poorly trained workers are more likely to make mistakes and result in accidents, putting workers and the public at risk. Additionally, the lack of quality control in the industry means that projects are often not built to the required standards, leading to costly repairs or replacements.

4. Cost

The price of computer hardware and software continues to drop in most development countries but in developing countries, such as Nigeria, the cost of computers is several times more expensive. While a personal computer may cost less than a month's wages in the United States, the average Nigeria worker may require more than years' income to buy one. Cost is one of the challenges when engaging in new investment but becomes insignificant when the return on that investment is easily understood. The cost has been one of the trickiest challenges in the adoption of information technology. The initial cost, maintenance cost and all other cost associated with information technology has slowed the rate of usage in the construction industry (Davies 2015a)

5. Power Supply

Movement of things occurs and most are not connected to power supply, for it to be smart they are self-powered from a sufficient energy source (Gubbiet al. 2013). There are passive RFID transponders that do not require their self-energy source, their communications and functionality range are very restricted. There is hope on future communications units and low power processors for embedded systems that could work with less significant vitality. Energy saving is an important factor not only in system architecture and hardware but also in software. Protocol stacks implementation is an example, where each transmission byte needs to justify its existence (Jain 2014)

2.2.2 Strategies for Improving the Challenges of Information Technology in Building Construction Sites

1. Information technology content of construction education in Nigeria suggestion that many information technology users are self-taught, or can be learnt at school, Private lessons, in service training given by employer, CPD training by professional bodies.
2. To make availability and Use of Computers and Communication Systems, Computer applications other than for communications. In this section, the types of computers, operating systems and software used by the respondent firms are examined. The software available for architectural/engineering design and drawing are CorelDraw, AutoCAD and ArchiCAD.
3. Be sure to select a project that is expected to demonstrate the greatest benefit for your target group.
4. Training, teaching or developing in oneself or others, in skills and knowledge that relate to specific useful competencies. Training has specific goals of improving one's capability, capacity, productivity and performance.
5. Environmental factor, change of environment in order to identify the right technology.
6. Do not underestimate the total cost of ownership (TCO) of information technology project.
7. Cloud Security.
8. Mobile Device Management: In the construction industry, employees use mobile devices as their main line of communication during a project.
9. Cloud Software for Financial Management Companies are adopting more and more cloud solutions without implementing the security policies to accompany them. Data is requested,

transmitted, and manipulated by an increasing number of devices, people, and companies through the cloud and according to these survey results, less and less is known about the quality and security of that data.

2.2.3 Information Technologies Currently Used In Building Construction Sites.

Information technologies or software application are available to support most aspects of a construction project. These applications can be grouped into the following categories (Sun & Howard, 2004):

- Building Information Modeling (BIM) Software
- Web-Based Management System
- Computer Aided Design and Visualization
- Building Engineering Applications
- Computer Aided cost Estimation
- Integration
- Business and Information Management
- Planning, Scheduling and Site Management

1. Building Information Modeling (BIM) Software

Building Information Modeling (BIM) Implementation: BIM is a digital representation of a building's physical and functional characteristics that can be used for design, construction, and operation. It has been increasingly adopted in the construction industry worldwide, including in

Abuja. Adewale et al, (2017). The use of BIM provides space for better collaboration because each person and expertise area can add their piece to the same model, instead of broken out onto multiple versions of a 2D paper drawing. This way, the model evolves immediately as people contribute, streamlining the process and increasing efficiency. BIM also helps with problem solving in the design and planning stages of a project, by automating clash detection and providing a more complete picture of the project. Succar and Kassem (2015), describe BIM as a collection of interacting structures, procedures, and technologies, creating a framework during the building's life cycle to handle the critical building design and project data in digital format. BIM functions as a shared network of information for a project and plays a supporting role in decision-making during its life cycle. Different stakeholders can have varying views on BIM roles. For example, architects tend to use BIM to improve productivity, coordination, and business transactions, while contractors are more likely to schedule, estimate, and carry out processing. Figure 1 shows the benefits of the building information model

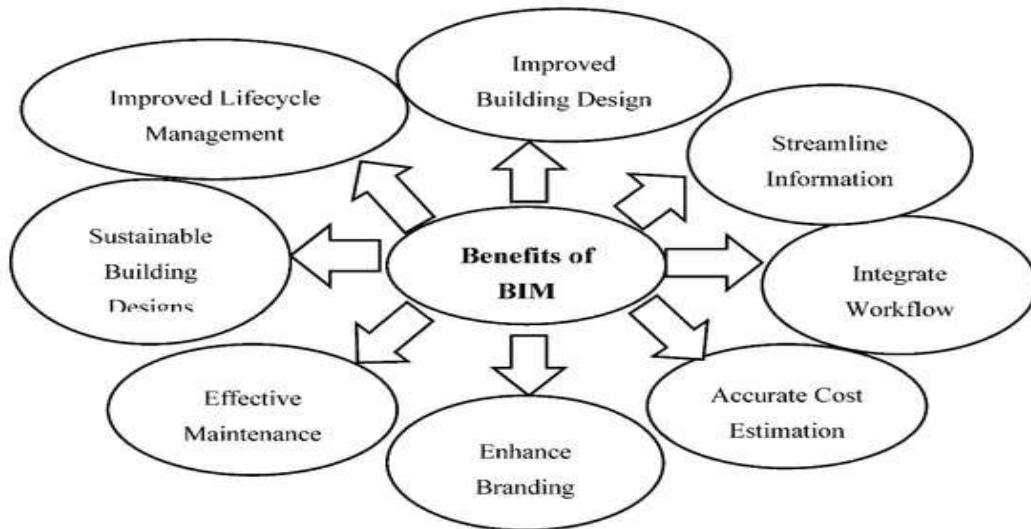


Figure 1. The benefits of the building information model

By using BIM in the preconstruction phase, it could increase design effectiveness by executing clash discovery and clash analysis; for scheduling, it could enable the project manager and contractor to track progress against logistics and timelines established while making the work sequence, equipment, and materials observable; also, it could allow generation of takeoffs, counts, and measurements by forming a three-dimensional project model and making specific estimation possible. Furthermore, in the construction phase, BIM enables the presentation of the construction method, comprising entrance and exit roads, traffic issues, site materials, and types of machinery; it enhances cost regulation by providing more accurate tracking of cash flow; and it enables real-time work tracking, quicker resource movement, and more useful site supervision. Researchers point out that it is beneficial to adopt BIM at the early stage of the project.

2. Web-Based Management System

From the very beginning of IT application, the benefit of web technologies in construction companies can be calculated. The web-based management framework is also used as an instrument for linking and obtaining multiple knowledge sets. There are different types of systems, such as a web-based decision support system, a web-based project management system, a shared online arrangement update, a web-based knowledge management system, and a management framework. Web-based management systems are expected as remedial solutions to enhance communications in construction projects while improving the productivity, efficiency, and quality of products. The method requires the transferring and processing of the project correlated data and dispersed project members to be linked in electronic bases with the project members. The use of web technology is proposed to have the benefits of bringing efficient collaboration, coordination, and communication, and decision-making methods.

3. Computer Aided Design and Visualization

Computer Aided Design (CAD) software is widely used by design professionals. Other popular CAD software includes Microstation, ArchiCAD, MiniCAD, FastCAD, Autodesk Revit etc. These CAD programs have largely replaced the traditional drawing board at the production information stage. The basic function of CAD tools is allowing the user to build up drawings by manipulating lines, circles, rectangles and texts interactively on the screen. The clear advantage of CAD software is the ability to allow editing which means delete, move, copy, rotate, scale, mirror etc.

Furthermore, since the drawing can be saved at any stage, the designers are able to keep various versions of the building layout for later study. Once the geometrical information of the building design is stored in a CAD package, different views of the building can easily be produced. Visualization and animation systems, like 3D studio, can produce photo-realistic, static, and moving images, so that the clients can view the final appearance of the building at the design stage. The emerging Virtual Reality technology even allows the user to interact with the design model and experience the building in simulated reality settings.

4. Building Engineering Applications

Nowadays, construction industry clients have ever-higher expectations. They want their buildings to look good, to be safe, to provide comfortable living environments for their occupants, to consume less energy in operation, etc. The ever more complex demands on the building design process have given rise to the need for a new approach to building engineering design based on computer software. Ali et al, (2018). Once a building is constructed, it is very costly to correct any design defects. It is, therefore, important to simulate accurately the building's performance at the design stage so that problems can be identified and solved. Over the years, a variety of methods

and algorithms have been developed to predict building performance in thermal, lighting, acoustics, and structural aspects. Because of the complex and tedious calculations that involve these simulations, it was nearly impossible to carry them out before computers. During the last two decades, a range of building engineering applications have been developed for energy analysis, HVAC design, structural analysis, lighting simulation, etc.

The benefit of these applications is that they allow designers to evaluate alternative design solutions in order to reach optimum design. Examples of this software are: ATEAN from Carrier, and CARGASW from Climasoft, that offer comprehensive range of software options for climatic energy design; CALCULUX for lighting and building services design, CYPE INGENIEROS S.A. for structural design, COSMOS for finite elements analysis, DUCTSIZE from Elite Software for electricity and water nets design.

5. Computer Aided Cost Estimation

Controlling costs is one of the most important requirements during a construction project. To achieve this, contractors and subcontractors must first make accurate cost estimation. Rigorous project accounting must then be used to control the spending. Today, there are sophisticated computer software packages, such as Esti-Mate, Manifest, FBS-Estimator, and PRESTO from Soft, GO from Star, ITEC and ARQ from AM2, which allow project managers to make estimations and to keep track of project spending.

Other software can help to measure, count, compute and tabulate quantities, lengths, areas, volumes, etc., of objects found in plans and specifications. Furthermore, most cost estimating programs can be integrated with databases of costs for labour, materials and equipment. The advantage is that cost data do not need to be re-entered, thus improving the celerity in estimating

and avoiding errors. Computer based estimation of costs archives and retrieves large volumes of resource, cost and productivity information, makes fast and accurate calculations and presents results in an organized, neat and consistent manner.

6. Integration

From the first software applications many different tools were developed. They use their own data formats, which are not compatible with each other. As a result, data cannot be electronically exchanged between them. In recent years, there is an increasing awareness of the need for integrated construction processes and many are investigating related issues. During the last two decades, advances in object oriented programming, database systems and product data modeling technologies have provided a solid platform for integration. Data standards are being developed first by the international standards being developed by the international standards organizations (STEP), and then by the International Alliance for Interoperability (IFC). At present, these standards are still evolving. An integrated project database that cover the whole life cycle of construction projects remains a future prospect.

7. Business and Information Management

The construction process is an information intensive one during which a huge amount of information is generated and consumed by all the professional involved. The common type of information includes site survey, cost analysis, design drawing, documents, correspondence, fax, computer files or e-mails. Electronic Document Management System can create an environment in which disparate forms of information can be linked together, within the context of a project or organization, to achieve easy access and control. All the previous tools and software for cost estimating, planning and scheduling are generated in a specific stage of the project. Sometimes

this information is updated, modified and consulted at any moment of the project. Consequently, Document Management Systems are tools that comprise whatever information throughout the life cycle of the project, from the conception of the need to the maintenance. Electronic Document Management Systems are applications that can be linked to Web Based Project Management Systems to improve communication among partners and between them and the management of 15 the project. In addition, Web Based Project Management Systems have other functionalities like project coordination, scheduling, etc.

8. Planning, Scheduling and Site Management

Construction works require careful planning and skilful management of human and physical resources. Computer system can assist on-site managers to plan ahead, 13 evaluate different options and adopt and execute the most efficient construction operation. Besides the widespread use of planning packages such as Microsoft project, primavera and Power project to plan and schedule detailed construction activities, some applications like Job Master, ICON, GEST, and Presto Control, are designed to log and track internal processes during the construction phase.

2.2.4 Impact of Information Technology in Building Construction Sites

The introduction of information technology to the construction industry has been both beneficial and detrimental. According to survey done over the years on the state of information technology in the Nigerian construction industry it has been seen to have improved the professional services in the industry by taking over operations like drawings, engineering designs, bills of quantities, etc. have been largely computerized. Although data and document management is still done traditionally in some cases. The main benefits achieved by the use of information technology is the increase in the speed of work done, a better financial control, better communications, simpler

and faster access to data, as well as reducing the number of mistakes while helping detect unrecognized problems in different projects.

The impact of information technology on the construction industry has been all about making jobs easier. But the ineffective national electric power supply coupled with the expensive computer hardware and software in the bad Nigerian economy makes it difficult to manage. However, about 80% of respondents are optimistic about the future of information technology. In the Nigerian construction industry with plans for new information technology investments. Therefore the understanding of information technology and its role is important for the realization of improved communications between participating organizations in construction projects. However, the 2002 global ICT rankings by the International Telecommunications Union (ITU) ranked Nigeria 27th among 51 African countries and 153rd among 178 countries in the world. (Adebayo, 2007). Investigations conducted later to assess the state of information technology utilization in the construction industry by Ugwuanyi, (2012) indicate that Nigerian Construction Industry has not fully appreciated the value of information technology and the impact of its use on the productivity value chain management.

2.2.5 Information Technology Applications in Building Construction Sites

During the 1980s computers were only used in few construction companies. Throughout the 1980s, although most building firms were using computer technology for many of their core functions such as accounting, wages and salaries, very few of them evolved formal policies or strategies concerning the application of information technology. By the latter part of the 1980s, about eight years after the introduction of reliable computer equipment, some companies had reached a situation in which their staff on many of their larger projects were experiencing the advantages of

the new technology through the use of planning, drawing, spreadsheet and word-processing software packages.

Today, a large number of software packages are available to all the disciplines of the construction team at every stage of the construction process. They provide support for a broad range of activities such as computer aided design and drafting, building visualization, design appraisal, project management, information storage and retrieval, cost estimation, structural analysis, on-site management, facilities management etc. Howard et al. (2008) assessed information technology application across design and construction organizations using the information technology barometer structured survey from the Finnish construction industry. Most organizations were mainly using computers for internal administrative and management tasks, including archiving. In contrast, fewer organizations use information technology tools to manage construction projects during delivery, or for document sharing and cloud application. Lu et al. (2019) conducted an analysis on construction industry and found similar results. They also reported widespread usage of basic information technology tools such as spreadsheets, accounting, word processing, and emailing. While a small number of organizations used advanced tools like 3D and 4D technology, according to Lu et al. (2019), larger organizations were using more of the most recent information technology tools compared with the medium- to small-sized organizations

2.2.6 What are the Benefits of Information Technology Application in Building Construction Sites?

1. Improved communication: Information technology tools such as project management software, cloud-based document management systems, and mobile apps facilitate better communication and collaboration among project stakeholders, including architects, engineers, contractors, and clients.

This leads to improved coordination, reduced delays, and enhanced decision-making (Adewale et al., 2018)

2. Accurate project planning and design: Computer-aided design (CAD) software can create accurate and detailed 2D and 3D drawings of building plans, reducing the likelihood of design errors and omissions. Additionally, project management software can help construction professionals to track progress and identify potential issues before they become problems.

3. Increased efficiency: Information technology applications such as Building Information Modeling (BIM) have been shown to improve the efficiency of construction processes in Abuja. BIM enables collaborative and integrated workflows, reduces rework, and minimizes errors, resulting in cost and time savings (Alinaitwe et al., 2017)

4. Improved safety: Information technology applications can help ensure better quality control and safety on construction sites in Abuja. For example, remote monitoring and sensing technologies can detect and address quality and safety issues in real-time, preventing accidents and improving overall construction quality (Adeleke et al., 2016)

5. Enhanced project cost control: Information technology applications can lead to cost savings in construction projects in Abuja. For instance, the use of construction management software can streamline procurement processes, optimize resource allocation, and reduce material wastage, resulting in cost-effective construction (Buba et al., 2020)

In the past few decades, the construction business has experienced a shift from the paper-based method of service delivery to electronic. The use of information technology systems in building construction has become intrinsic to the job role. In most developed countries, failure to use technology during construction would put you at an inconceivable disadvantage against other

building contractors. The construction industry woke up to the reality of integrating computers into its processes as early as 1980. Professionals in developed economies have shown commitments to the application of technology in their industry, and over the years, it has brought tremendous benefits. In the early days, computers advanced standard processes such as cash flow forecasting, project management, accounting, and cost control. But, there were very few specialist computer programmes for single roles within the construction industry. More recently, advancements in cloud computing have turned construction sites into offices, allowing for more accurate estimates made on site. It has also led to considerable increases in efficiency and the resultant cost savings. Technology has led to faster construction projects and increased client satisfaction. But, on top of this, there has been the development of specialist computer software, like BIM, to help with specific roles. Compared with the conventional usage of IT such as design and programming software, the application of advanced information technology tools such as “web based project management,” “3D design visualization,” “E-tendering” and “Geographical information system (GIS)” have not yet had a good penetration into the Nigerian construction industry. This finding is in line with the contribution of Oyediran (2005) which stressed that the construction industry has been sluggish in the application of information technology despite the amenability of its process to information technology operation.

Most of the organizations surveyed make use of computers as a tool for enhanced business process which is in line with Oldaapo (2006) which indicated that the construction industry in Nigeria has during the past few years increased its use of information technology. The response also agreed with Oladapo (2007), which indicated that most of the respondents were optimistic about the future of information technology applications in the Nigerian construction industry.

2.2.7 Implementation of information technology in the construction industry

Appropriate implementation of information technologies is a key focus area that must be addressed by the construction industry. The uniqueness of the construction industry poses challenges to the implementation of ICT technologies. In the face of these challenges however, there are several factors indicating that the nature of the construction industry is changing.

These factors include:

- i. An extensive lack of skilled workers and a growing average age of the staff;
- ii. An inability to attract and retain talented, educated personnel.
- iii. Increased industry competition.
- iv. A need for works in dangerous and inaccessible areas of operation.
- v. Increased requirements on the quality of the work execution; and
- vi. An increase in performance and reduction in costs is required to maintain a competitive advantage (Perkinson and Ahmad, 2006).

In addition to the above listed industry changes, organization owners are beginning to demand access to real-time data for their own automated site inspections and these owners expect this access to be available at all times. This has put increased pressure on contractor organizations to embrace new technologies in order to remain competitive and satisfy these changing owner demands (Perkinson and Ahmad, 2006).

Indeed the reality is that, many construction organizations have already begun implementing some form of automation. Then again, this create the need for players in the industry to consider expanding their technology programs to include information technologies which will utilize real-time data including those collected onsite to improve management and decision making functions According to Perkinson 2006, a construction contractor can increase his competitive advantage by

integrating the automation and information technologies thereby creating a total jobsite management tool capable of analyzing the construction project in the areas of:

1. Project performance control,
2. Materials and equipment management, and
3. Human resource management.

Furthermore, some notable potential advantages of integrating information technology for use as a total jobsite management tool may include:

- i. Real-time monitoring and documenting of construction operations,
- ii. Reduced paperwork,
- iii. Improved project management capabilities in terms of tracking people, equipment, and assets,
- iv. Early detection and fast response time to problems,
- v. Standardization of data collection and management,
- vi. More accurate performance data which can be used for planning of future projects,
- vii. Creation of a history or baseline for dispute resolution, and
- viii. Reduced contractor reporting requirements because the owner/engineer can continuously observe what is happening onsite.(Perkinson 2006)

2.3 Review of Empirical Studies

Studies have been carried out to determine the critical success factors, the challenges and enablers to information technology application in construction industries to harness the technology and streamline business process in emerging economies. The general problem addressed is what are the critical success factors and challenges that impact the implementation, adoption, application and diffusion of information technology in the construction industry. Such a framework should

enable identification of at-risk IT projects during the early stages of project evaluation and facilitate formulation of appropriate risk mitigation measures. Ugwu et al (2006) discuss further details on the research. There is an abundance of documented literature that describes various projects in construction, which focus on IT-driven construction process innovation. However, while the majority of the research focuses on developing improved products, process and computational models, there is a noticeable dearth of research that focuses on issues and factors that impinge on the uptake of IT systems in construction, including stakeholders' perceived benefits cost and risks of IT systems in practice Ugwu et al (2006). An adequate understanding of perceived and expected benefits would facilitate an unambiguous understanding of user requirements and subsequent translation into system functional specification during development. IT implementation in construction results in significant changes and potential improvements in design and management processes within the organization. It is therefore necessary to investigate critical success factors as well as inhibiting factors. According to Oyewobi (2015), many of the professionals in the Nigerian construction industry are still lagging behind in the adoption of information technology compare with their counterpart in other developing nations of the world despite the globalization in technological advancement.

Numerous academic studies have been conducted in the construction industry's use of information technology, especially in light of the development, application and adoption of building information modeling (BIM). They fall into the following categories:

- Some researchers have looked at information technology application and adoption in a particular country: (Yan and Damian 2008; Hosseini et al. 2016; Zhao and Pienaar 2018; Chan et al. 2019; Tan et al.2019; Ullah et al. 2019).

- Others have looked at information technology application and adoption in a particular field of construction (Okumus et al. 2017), (Zhang and Guo 2019). Particularly intensely was this researched into the application and adoption of the building information modelling (BIM) which has been a kind of a dominant and umbrella topic over the last two decades: (Dainty et al. 2017; Ahmed 2018; Alreshidi et al. 2018).
- More research looked at the issue methodological-ally, trying to group the challenges systematically and link them with one another (Stewart et al.2004; Peansupap and Walker 2005; Hosseini et al. 2016; Chen et al. 2017; Ahmed 2018; Oesterreich and Teuteberg 2019)

2.4 SUMMARY OF LITERATURE REVIEW

Construction industry has lagged behind other sectors in terms of applying Information Technologies. In the main, the boards of operating construction companies are dominated by engineers and surveyors whose knowledge of computing is very often limited to what systems have been implemented at head office, and whose interaction with computer is limited to occasional meetings with senior computer professionals rather than fellow engineers. Their general view is that the implementation of any new system takes a long time, is expensive and involves ‘outsiders’, and this is aggravated by with the degree of doubt in terms that it’s generally believed that the end product will in any case not achieve its initial specification.

Nevertheless, the construction industry uses a variety of technologies nowadays, including CAD tools, spreadsheets, word processors, and others. From the first stages of conception, design, and implementation through the stage of facility management, information is used and needs to be handled.

Manual classification becomes impractical when construction companies use information technology more frequently and electronic papers become more widely available. With such amount of information, Document Management Systems which are considered as a glue or integration of all the other software for cost estimating, planning, scheduling, etc., generated in a specific stage of the project, are an indispensable tool for the current Project Management activities.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter describe the methodology employed in carrying out the study. This chapter is therefore, focused on research design, area of the study, population of the study, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection and method of data analysis.

3.1 Design of the Study

The research design to be adopted for this study is descriptive survey research design. Survey research is the process of carrying out qualified observation which involve asking of questions to sample the opinion of the public at large or one specific group. According to Borg and Gall (2007) Survey is a method of data collection using questionnaire or interview to collect data, a sample that has been selected to represent a population to which the findings of data analysis can be generalized. The survey research design was chosen as an appropriate method for this study as it seeks the views of respondents about the application on the assessment of information technology application at building construction sites in Abuja, Nigeria.

3.2 Area of the Study

The study was conducted in Federal Capital Territory (F.C.T Abuja) which was formed in 1976 from parts of former Nasarawa, Niger and Kogi State. The territory is bordered by the states of Niger to west and North, Kaduna to Northeast, Nasarawa to east and South and Kogi to southwest. It is lying between latitude 8.25° and 9.20° north of the equator and longitude of 6.45° and 7.39° east of Greenwich meridian. Abuja is home to a large number of construction companies, contractors, and suppliers that can provide the necessary resources, knowledge, and expertise to

conduct the assessment. This allows for a comprehensive review of information technology implementation in the construction industry and the opportunities for improvement. Additionally, Abuja is located in a region with a strong and reliable telecommunications infrastructure, making it easier to access the latest technology and software for the assessment. Abuja is geographically located in the central region of the country.

3.3 Population of the Study

The research population comprises of 200 building professionals which consists of builders, architects, quantity surveyors, project manager etc. Including IT engineers like computer aided designers, building information modelling (BIM) engineers, predictive software engineers in construction companies in FCT, Abuja.

3.4 Sample and Sampling Techniques

In this study purposive sampling technique was used. This method of sampling is used when the researcher has prior knowledge or a particular interest in studying a specific subgroup of the population. The purpose of purposive sampling is to generate data from a sample that is highly knowledgeable about the topic and can provide rich insight into a particular issue or phenomenon. Purposive sampling is ‘used to select respondents that are most likely to yield appropriate and useful information. Kelly (2010) and is a way of identifying and selecting cases that will use limited research resources effectively. Palinkas et al (2015). The population for this study was 200 staffs currently working in the selected FCT, Abuja building construction firms in areas related to building professionals and IT engineers.

Table 3.1

S/N	Building construction firms	Building professionals	IT engineers
1	Dantat & Sowoe construction	Architect 34	CAD engineers 19
2	Setraco Nigeria LTD	Quantity surveyors 29	BIM engineers 20
3	Gilmor Construction Company	Builders 40	Predictive software engineers 26
4	Julius berger	Project managers 32	

3.5 Instrument for Data Collection

A comprehensive questionnaire was designed and administered to the respondents for data collection and analysis. To ensure consistency in respondent feedback, almost all questionnaires contain closed-ended questions. Additionally, Denscombe (2010) asserted questionnaires to be economical, in the sense that they can supply a considerable amount of research data for a relatively low cost in terms of materials, money and time and relatively easy to arrange.

The questionnaire is divided into two parts (I and II). Part I consist of respondents “personal data”, containing information about gender, age, qualification and part II is grouped into (A, B, C and D) Section A consists of 15 items which sought to elicit information on the extent of information technology application at building construction sites in FCT, Abuja. Section B consists of 15 items which sought to elicit information on the benefits of information technology application at building construction sites in FCT, Abuja. Section C consist of 15 items which sought to elicit information

on the cost implication of information technology application at building construction sites in FCT, Abuja. Section D also consist of 15 items which sought to elicit information on the challenges of information technology application at building construction sites in FCT, Abuja.

3.6 Validation of the Instrument

To ensure the validity of the instrument, it was validated by three lecturers from the Federal University of Technology, Minna, Department of Industrial and Technology Education. They were asked to read the test items and offer criticism, suggestions, and make recommendations to ensure that the test captures the objectives of the test. The critiques, suggestions and recommendations on the validates was used to make final corrections on the instrument before it was administered to the respondents.

3.7 Administration of the Instrument

The instrument used for the data collection was administered to the respondent by the researcher with the help of three research assistant within the area of study. A period of four days was allowed for the administration of the questionnaire, however all the completed questionnaires were retrieved on the fifth day.

3.8 Reliability of the Instrument

Cronbach Alpha statistic was used to determine the reliability coefficient and the reliability coefficient of the instrument was found to be 0.7 Statistical Package for Social Science (SPSS) was used. The Cronbach Alpha Statistics reliability index ranging from 0.70 and above is considered to be internally consistent, reliable and suitable for use in a research study. The high

reliability coefficient of 0.76 implies that the items in the instrument have good internal consistency and are considered suitable for use in gathering data for this study.

3.9 Method of Data Collection

The questionnaire was collected by the researcher from the research coordinator and taken with the questionnaire to individual respondent used for this research. The questionnaire was administered to software engineers, project managers and architects by the researcher and with a research assistant from the area used for the study. A copy of the validated instrument was administered to each of the respondent with the help of three research assistant. The administered questionnaire was collected back after four days.

4.0 Method of Data Analysis

Most of the data collected for the study were ordinal in nature. To be able to rank the challenges perceived by the respondents to impact the various aspects of the study, it was necessary to highlight these techniques used to analyze the questionnaire data. These consist of mean, standard deviation and t-test as statistical tools. A four-point rating scale was employed with the following response.

Alternative Value		Abbreviation	Rating
Strongly Agree	=	“SA”	4
Agree	=	"A”	3
Disagree	=	“D”	2
Strongly Disagree	=	“SD”	

CHAPTER FOUR

PRESENTATION AND DATA ANALYSIS

This chapter deals with the presentation and analysis of data with respect to the research questions formulated for this study, the result of this data analysis for the research questions are presented first.

4.1 Research Question 1

To what extent is information technology applied in building construction sites in Abuja.

Table 4.1.1: mean response on the extent to which information technology is applied in building construction sites in Abuja. N1=98 N2=52.

S/N	ITEMS STATEMENT	X ₁	X ₂	X _t	Remark
1	Application of building information modelling software (BIM)	2.7	2.8	2.8	Agreed
2	Mobile technology application	2.5	2.5	2.5	Agreed
3	Cloud storage	2.5	2.8	2.7	Agreed
4	Site sensors	3.0	3.0	3.0	Agreed
5	Use of drones and robots	2.3	2.2	2.2	Disagreed
6	Use of electric vehicles	3.1	3.1	3.1	Agreed
7	Smart clothing and wearables	3.5	3.3	3.4	Agreed
8	3D modelling	2.2	2.3	2.3	Disagreed
9	Building material advancement	2.0	2.4	2.2	Disagreed
10	Augmented reality	3.3	3.2	3.2	Agreed
11	Automotive heavy equipment's	2.6	2.5	2.5	Agreed

12	Exoskeleton	2.7	2.8	2.7	Agreed
13	Artificial intelligence and machine learning	3.4	3.2	3.3	Agreed
14	Block chain	2.0	2.4	2.2	Disagreed
15	3D Printing	2.3	2.4	2.3	Disagreed

KEY:

X1= average mean responses of building professionals,

X2= average mean responses of IT engineers,

N1= number of building professionals,

N2= number of IT engineers.

Table 4.1.1 shows that both respondents agreed on the extent to which information technology is applied in building construction site in Abuja, the item 1,2,3,4,6,7,10,11,12 and 13 as reflected by their own mean score greater than 2.50 respectively. While 5, 8,9,14 and 15 disagreed.

4.2 Research Question 2

What are the benefits of information technology application in building construction sites in Abuja?

Table 4.1.2: mean response on the extent to which information technology is applied in building construction sites in Abuja. N1=98 N2=52.

S/N	ITEMS STATEMENT	X ₁	X ₂	X _t	Remark
1	Saves considerable time and cost for document transfer	3.4	3.2	3.3	Agreed
2	Provide adequate supervision of construction work	3.3	3.0	3.1	Agreed
3	It makes complex tasks easier	2.9	2.7	2.8	Agreed
4	Reduces construction error	3.9	3.5	3.7	Agreed

5	Aid in monitoring each stage of construction stage	3.5	3.1	3.3	Agreed
6	Facilitate decision making	3.9	3.0	2.9	Agreed
7	It increases productivity	3.4	3.3	3.3	Agreed
8	Increases document quality	2.9	3.0	2.9	Agreed
9	It helps in administrative works	3.0	3.0	3.0	Agreed
10	Easy understanding of the work plan	2.6	2.5	2.5	Agreed
11	Helps in quality take off and reuse	2.5	2.6	2.5	Agreed
12	It reduces proportion for new work	2.8	3.1	2.8	Agreed
13	Aid in exchange of documented material	2.3	2.8	2.5	Agreed
14	It helps personal in detecting fault and correct it immediately	2.9	2.9	2.9	Agreed
15	Creativity amongst the construction industry	3.2	3.1	3.1	Agreed

KEY:

X1= average mean responses of building professionals,

X2= average mean responses of IT engineers,

N1= number of building professionals,

N2= number of IT engineers.

Table 4.1.2 shows that both respondents agreed on the benefits of information technology application in building construction sites in Abuja, the item 1,2,3,4,5,6,7,8,9,10,11,12,13,14 and 15 as reflected by their own mean score greater than 2.50 respectively. Which none disagreed.

4.3 Research Question 3

What are the costs implications of information technology application in building construction sites in Abuja?

Table 4.1.3: mean response on the costs implications of information technology application in building construction sites in Abuja. N1=75 N2=25.

S/N	ITEMS STATEMENT	X ₁	X ₂	X _t	Remark
1	Maintenance cost	2.5	2.6	2.5	Agreed
2	Consultancy Support	2.8	3.1	2.8	Agreed
3	Training Cost	2.3	2.8	2.5	Agreed
4	Hardware cost	2.9	2.9	2.9	Agreed
5	Overhead cost (eg running cost and consumables)	3.2	3.1	3.1	Agreed
6	Networking hardware and software	3.3	3.0	3.1	Agreed
7	Networking security	2.9	2.6	2.7	Agreed
8	Installation engineers	2.6	2.5	2.5	Agreed
9	Increase in power supply	2.5	2.6	2.5	Agreed
10	Direct cost	2.1	2.0	2.0	Disagreed
11	Subscription services (cloud/security)	3.4	3.2	3.3	Agreed
12	Running cost	3.3	3.0	3.1	Agreed
13	User management	2.9	2.7	2.8	Agreed
14	Higher change cost	3.9	3.5	3.7	Agreed
15	Incident response	3.5	3.1	3.3	Agreed

KEY:

X1= average mean responses of building professionals,

X2= average mean responses of IT engineers,

N1= number of building professionals,

N2= number of IT engineers.

Table 4.1.3 shows that both respondents agreed on the costs implications of information technology application in building construction sites in Abuja, the item 1,2,3,4,5,6,7,8,9,11,12,13,14 and 15 as reflected by their own mean score greater than 2.50 respectively. While item 10 disagreed with the mean score below 2.50.

4.4 Research Question 4

What are the challenges of information technology application in building construction sites in Abuja?

Table 4.1.4: mean response on the challenges of information technology application in building construction sites in Abuja. N1=75 N2=25.

S/N	ITEMS STATEMENT	X1	X2	Xt	Remark
1	Cost of training professionals	2.8	2.8	2.8	Agreed
2	Budget constraint for IT investment	2.6	2.5	2.6	Agreed
3	Lack of adequate jobs in the market	3.4	3.2	3.3	Agreed
4	Software and hardware reliability problems	2.0	2.4	2.2	Disagreed
5	Rapid changes in information technologies	2.3	2.4	2.3	Disagreed
6	Satisfaction with existing method of working	3.7	3.6	3.6	Agreed
7	Lack of staff with appropriate skill and knowledge in IT	3.5	3.3	3.4	Agreed

8	High cost of employing IT professionals	2.7	2.5	2.5	Agreed
9	Security concerns/privacy fears	3.7	3.6	3.6	Agreed
10	Fear of job loss/making professionals redundant	3.2	3.1	3.1	Agreed
11	Communication problem	2.6	2.5	2.5	Agreed
12	Issue with cash flow	2.7	2.8	2.7	Agreed
13	Vandalism/theft on site	2.5	2.8	2.7	Agreed
14	Forgetful clients	3.0	3.0	3.0	Agreed
15	Irregular equipment maintenance/replacement	2.3	2.2	2.2	Disagreed

KEY:

X1= average mean responses of building professionals,

X2= average mean responses of IT engineers,

N1= number of building professionals,

N2= number of IT engineers.

Table 4.1.4 shows that both respondents agreed on the challenges of information technology application in building construction sites in Abuja the item 1,2,3,6,7,8,9,10,11,12,13 and 14 as reflected by their own mean score greater than 2.50 respectively. While item 4, 5 and 15 disagreed with the mean score below 2.50.

4.5 Findings of the Study

The following are the principle findings of the study they are organized based on the research questions.

1. There is need to the extent at which information technology is applied in construction site in Abuja among them are the application of building information modelling software (BIM), mobile technology application, cloud storage, site sensors, use of electric vehicles, smart clothing and wearable, augmented reality, automotive heavy equipment's, exoskeleton and artificial intelligence and machine learning

2. There is need for the benefits of information technology application in building construction sites in Abuja among them are to save considerable time and cost for document transfer, provide adequate supervision of construction work, it makes complex tasks easier, reduces construction error, aid in monitoring each stage of construction stage, facilitate decision making, increase productivity, increase document quality, it helps in administrative works, easy understanding of the work plan, helps in quality take off and reuse, it reduces proportion for new work, aid in exchange of documented material, it helps personal in detecting fault and correct it immediately, creativity amongst the construction industry.

3. There is need for the costs implications of information technology application in building construction sites in Abuja among them are to maintenance cost, consultancy Support, train Cost, hardware cost, overhead cost (eg running cost and consumables), networking hardware and software, networking security, install engineers, increase in power supply, Subscription services (cloud/security), Run cost. User management higher change cost, Incident response.

4. There is need for the challenges of information technology application in building construction sites in Abuja among them are the cost of training professionals, budget constraint for information technology investment, lack of adequate jobs in the market, satisfaction with existing method of working, lack of staff with appropriate skill and knowledge in information technology, high cost of employing information technology professionals, security concerns/privacy fears, fear of job

loss/making professionals redundant, communication problem, issue with cash flow, vandalism/theft on site, forgetful clients.

4.6 Discussion of the Findings

The findings on the extent to which information technology is applied in building construction sites in Abuja revealed that the respondents agreed with all the items among them are application of building information modelling software (BIM), mobile technology application, cloud storage, site sensors, use of electric vehicles, smart clothing and wearables, augmented reality, automotive heavy equipment's, exoskeleton, artificial intelligence and machine learning. Rumbarge (2016) conducted a study on the potential impact of technology on skills requirement for the future jobs. The result revealed that new technological innovations are yielding an increased array of new components which are incorporated into modern machineries including the automobile. The dynamic and complex nature of construction works, diverse backgrounds and hostile attitudes of participants are also believed to be contributing greatly to rapid changes taking place within the construction industry in general. (Wong, 2016).

The findings on the benefits of information technology application in building construction sites in Abuja revealed that the respondents agreed with all the items among them are to save considerable time and cost for document transfer, provide adequate supervision of construction work. The findings from this study agree with those identified in the literature. Agyekum et al., (2015), Liston et al., (2000), Matipa (2009) identified increase productivity as one of the major benefit of information technology usage in construction industry while Mutesi and Kyakula (2015) result indicated improve productivity and time saving as benefit of information technology in construction industry in Abuja, Nigeria. It makes complex tasks easier, reduces construction error, aid in monitoring each stage of construction stage, facilitate decision making, increase

productivity, increase document quality, it helps in administrative works, easy understanding of the work plan, helps in quality take off and reuse, it reduces proportion for new work, aid in exchange of documented material, it helps personal in detecting fault and correct it immediately, creativity amongst the construction industry. According to (Tunji, 2021) the benefits accrue to the project as a whole, but the advantages to any one participant are not as easily quantified. In addition, the Savings resulting from information technology usage are difficult to specify, as they manifest in terms of turn savings, reduced waste, and work improvement, exchange of documented material bills of quantities, estimating and presentation.

The findings on the costs implications of information technology application in building construction sites in Abuja revealed that the respondents agreed with all the items among them are the maintenance cost, consultancy Support, train Cost, hardware cost, overhead cost (eg running cost and consumables), networking hardware and software, networking security, install engineers, increase in power supply, Subscription services (cloud/security), Run cost. User management higher change cost, Incident response as the cost implications of information technology application at building construction sites in Abuja.

The findings on the challenges of information technology application in building construction sites in Abuja revealed that the respondents agreed with all the items among them are the cost of training professionals, budget constraint for information technology investment, lack of adequate jobs in the market, satisfaction with existing method of working, lack of staff with appropriate skill and knowledge in information technology, high cost of employing information technology professionals, security concerns/privacy fears, fear of job loss/making professionals redundant, communication problem, issue with cash flow, vandalism/theft on site, forgetful clients are the challenges of information technology application at building construction site in Abuja

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATION

5.1 Summary of the Study

The research so far has presented the aim, objectives and the background problems that induced the formation of the theoretical framework as well as the research questions. Following this, a research methodology was sequentially adopted to answer the key objectives of the study as presented in the research analysis and findings. In addressing the aim and the objectives of the research. This was then followed by investigating the use and relevance of these findings in Abuja through survey questionnaire. At the ends of the empirical study, the level of information technology infrastructure in the firms, the extent of information technology application, benefits of information technology, cost implication of information technology and challenges hindering the application of information technology. The research came out with key findings some of which addressed the main aim and objectives.

5.2 Implication of the Study

This study has implication on both contractors and future researchers. The contractors involved in construction of building projects in Abuja, Nigeria can use this research as a guideline to identify types of information technology, benefit and challenges of the adoption of using information technology in management of building construction. Moreover the contractors can be more informed about direct and indirect benefit. Hence this gives the contractors opportunity to develop interest in the process, thereby this can improve the project delivery of building projects

implemented. Future researchers can use the information technology application process, the types and the challenges in this study to compare it with different context. This study will be contribution to the limited body of knowledge on construction field and can further open more doors for new areas to investigate.

5.3 Contribution of Knowledge

1. The findings will contribute to builder's experience as the study will generate a list of benefit of the adoption of information technology in management of building construction that can be used as a benchmark to control the existing and future sites. In addition to this how the benefit are related to the adoption of the computer software will give the builders to be more cautious.
2. Apart from this research being useful to the field professionals, this study will be valuable for the academicians too. As this study will serve as a support to the application in building construction project.

5.4 Conclusion

In conclusion, it can be deduced from the findings and the research as a whole. The service of construction companies is enhanced by the role of information technology to store, process and provide information almost instantly. Information technology has both their benefits and problems but despite these problems, they still have a key role to play in the activities of construction companies as well as other facet of human life. Also, the benefit of information technology has not been fully felt in Nigeria, due to the initial cost of installation, power irregularities, inadequate servicing facilities and existence of unqualified personnel. According to the survey, the organization affirmed that implementing information technology gives a competitive edge over

those that are yet to implement it. Organizations will be more able to satisfy client needs as a result of information technology adoption, however, skills are needed to harness the full benefit of information technology.

It is expected that these results will guide policy makers in Nigeria to identify where to concentrate their efforts to promote increased use of information technology, especially in the construction industry. Also, for the construction in a developing country such as Nigeria to maximize the returns on investment in information technology, it must go beyond basic application like design and programming software to more technical business allocations like, e-business, electronic data management, e-tendering, web base project management, and other advanced information technology applications.

5.5 Recommendations

On the basis of findings from the study, the following recommendations are proposed.

1. Construction companies in Abuja should invest in training and development programs to enhance the information technology skills of their workforce or consider partnering with specialized information technology service providers. Additionally, collaborating with local educational institutions to offer specialized information technology courses for the construction industry could help to develop a skilled workforce.
2. Information technology applications require regular maintenance and updates to ensure smooth operation. This includes software upgrades, security patches, and hardware maintenance. These maintenance costs can add up over time and need to be considered in the overall budget.
3. To maximize its benefits, government should do all within its power to halt epileptic power supply in Nigeria.

4. The professional bodies of each profession should organize workshops and seminars to introduce their members to work with software and equipment which will aid their work without wasting time.
5. Awareness should be made in order for the professionals to internalize the benefits and adopt new technology.
6. Efforts should be made by professional bodies to establish the use of information technology in Nigerian construction industry, basic application of information technology like word processing, design, detailing and costing should be known to improve technical business applications like e-business, electronic data management, and teleporting should be part of training for all the site personnel.

5.6 Suggestion for further studies

The following areas for further study were also suggested;

1. Comparative study on information technology in the construction industry by indigenous and foreign companies
2. Accessing the role of consultant in the application of information technology in building projects in Abuja, Nigeria.

REFERENCES

- Adafin, J.; Wilkinson, S.; Rotimi, J.O.B.; MacGregor, C.; Tookey, J.; Potangaroa, R. (2021). *Creating a case for innovation acceleration in the New Zealand building industry. Constr. Innov.* 22, 185–204.
- Adebayo, O. A: (2007) *An Investigation into the use of ICT in the Nigerian construction industry. ITcon* 12, 261 – 277,
- Adeleke, A. Q., Bahaudin, A. Y., & Kamaruddeen, A. M. (2016). Information technology and construction safety management: *An overview of applications. Engineering, Construction and Architectural Management*, 23(2), 227-247.
- Adewale, A. A., & Ajayi, S. O. (2017). Building information modeling (BIM) adoption in Nigerian construction industry: *Prospects and challenges. Journal of Engineering and Architecture*, 5(2), 15-27.
- Adewale, B. A., Babatunde, S. O., & Ojo, A. T. (2018). Information and communication technology (ICT) applications in Nigerian construction industry: *A review. Journal of Engineering, Design and Technology*, 16(2), 258-276.
- Afzal, M. Shafiq, M.T. (2021), Evaluating 4D-BIM and VR for Effective Safety Communication and Training: *A Case Study of Multilingual Construction Job-Site Crew. Build.* 1 1, 319.
- Agyekum, K; Ayarkwa, J and Adjarko, H: Perceptions of Quantity Surveyors on challenges to and benefits of Incorporating Information Technology in Quantity Surveying Practice in Ghana. *Asian Engineering Review*, 2 (3), 30-36. 2015.
- Ahmed S. (2018). Barriers to implementation of building information modeling (BIM) to the construction industry: *a review. J Civ Eng Constr.* 7(2):107–113
- Ajahana, (2018). Architectural Practice and their uses of IT in Western Cape Province, South Africa, *Journal of Information Technology in Construction*, 6,17-34.
- Alaloul, W.S.; Liew, M.S.; Zawawi, N.A.W.A.; Kennedy, I.B. (2020), Industrial Revolution 4.0 in the construction industry: *Challenges and opportunities for stakeholders. A in Shams Eng. J.* 11, 225–230.
- Ali, A. O., & Oyewobi, L. O. (2018). Evaluation of construction management software usage in Nigerian construction projects. *International Journal of Built Environment and Sustainability*, 5(2), 138-148
- Alinaitwe, H. M., Aigbaybo, C. O., & Thwala, W. D. (2017). Building information modeling in construction: *A review and directions for future research. Journal of Engineering, Design and Technology*, 15(3), 344-374.

- Alreshidi E, Mourshed M, Rezgui Y. (2018). Requirements for cloud-based BIM governance solutions to facilitate team collaboration in construction projects. *Requirements Eng.* 23(1):1–31.
- Bilal & Oyedele, (2020) Deep Learning in the Construction Industry: A Review of Present Status and Future Innovations. *Journal of Building Engineering*, 32, Article ID: 101827.
- Borg, W.R. & Gall, M. D. (2007). Applying Research: *Research and Development Model*. New
- Buba, H. B., Abba, M., & Nasiru, H. (2020). Leveraging information technology for construction project management in Nigeria. *International Journal of Engineering and Technology*, 12(3), 74-81.
- Capron, H. (2000) “*Computers for an information Age*” prentice Hall pp. 178
- Chen K, Lu W, Peng Y, Zheng L, Niu Y, Rowlinson SM. (2017). An investigation of the latent barriers to BIM adoption and development. Springer
- Dainty A, Leiringer R, Fernie S, Harty C. (2017). BIM and the small construction firm: a critical perspective. *Building Res Information*. 45(6):696–709
- Daniotti, B.; Gianinetto, M.; della Torre, S. (2020). Digital Transformation of the Design, Construction and Management Processes of the Built Environment; Springer Nature: Cham, Switzerland.
- Datti, YU. (2017). Appraisal of Information Technology Requirements in Quantity Surveying Firms in Northern Nigeria. *Arid Zone Journal of Engineering, Technology and Environment (AZOJETE)*, 13(3): 336-346.
- Davies, D. (2015a). The Internet of Construction. Accessed Construction Executive
- Denscombe, M. (2010). The Good Research Guide For small-scale social research projects, Fourth Edi.ed. McGraw-Hill Education, New York, USA.
- Ern, P. A. S., Kasim N., Masrom. M. A. N., and Chen G. K., (2017). Overcoming ict barriers in ibs management process in malaysia construction industry, MATEC Web of Conferences.
- Generation Computer Systems* 29: 1645 – 1660.
- Gubbi, J., R. Buyya, S. Marusic, and M. Palaniswami. 2013. “Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions.” *Future*
- Hosseini M, Oraee Namzadi M, Rameezdeen R, Banihashemi S, Chileshe N. (2016). Barriers to BIM adoption: Perceptions from Australian small and medium-sized enterprises (SMEs). AUBEA 2016: *Proceedings of the 40th Australasian Universities Building Education Association Annual Conference*; p. 271–280.
- Hosseini, M.R., Chileshe, N., Zuo, J. and Baroudi, B., (2012). Approaches for implementing ICT technologies within construction industry, *Australasian Journal of Construction Economics and Building, Conference Series*, vol. 1 no. 2, pp. 1-12.
- Howard, R & Björk, B.-C. (2008), Building information modelling–Experts’ views on standardization and industry deployment. *Adv. Eng. Inform.* 22, 271–280.

- Jain, R. 2014. "Internet of Things: Challenges and Issues." Proceedings of the 20th Annual Conference on advanced computing and communications (ADCOM 2014) Bangalore, September 19 – 22.
- Kelly S. (2010) Qualitative interviewing techniques and styles. In: Bourgeault I, Dingwall R, de Vries R. (eds) *The Sage Handbook of Qualitative Methods in Health Research*, Thousand Oaks: Sage Publications
- Kumar, M., Kumar, A., & Singla, R. (2017). Application of information technology in building construction sector. *International Journal of Engineering and Technology*, 7(3), 1279-1287
- Li, J.; Li, H.; Umer, W.; Wang, H.; Xing, X.; Zhao, S.; Hou, J. (2020). Identification and classification of construction equipment operators' mental fatigue using wearable eye-tracking technology. *Autom. Constr.* 109, 103000
- Liston, K. M; Fischer, M. A and Kunz, J. C: Designing and evaluating visualization techniques for construction planning, Proceedings of the 8th International Conference on Computing in Civil and Building Engineering (ICCCBE-VIII), Stanford University, Stanford, 1293-300, 2000.
- Lu, H.; Pishdad-Bozorgi, P.; Wang, G.; Xue, Y.; Tan, D. (2019), ICT implementation of small- and medium-sized construction enterprises: *Organizational characteristics, driving forces, and value perceptions*. *Sustainability* 11, 3441
- Matipa, W. M: A Strategic Perspective of ICT Supported Cost Management for Green Buildings in the Quantity Surveying Practice. Online publication, 2009. At <https://www.irbnet.de/iconda.CIB17618>.
- Mattern, F., and C. Floerkemeier. 2010. "From the Internet of Computers to the Internet of Things." In *From Active Data Management to Event-Based Systems and More*. Lecture Notes in Computer Science Vol 6462.
- Muralidharan, S., A. Roy, and N. Saxena. 2016. "An Exhaustive Review on the Internet of Things from Korea's Perspective." *Wireless Personal Communications* 90: 1463 – 1486.
- Mutesi, E.T and Kyakula, M: Application of ICT in the Construction Industry in Kampala. Online publication, 2015. At <https://www.researchgate.net/publication>
- Oesterreich TD, Teuteberg F. (2019). Behind the scenes: *Understanding the socio-technical barriers to BIM adoption through the theoretical lens of information systems research*. *Technol Forecasting Social Change*. 146:413–431.
- Okumus F, Bilgihan A, Ozturk AB, Zhao X. (Roy). (2017). Identifying and overcoming barriers to deployment of information technology projects in hotels. *JOCM*. 30(5):744–766
- Oladapo A.A. (2006). The impact of ICT on professional practice in the Nigerian construction industry, *The Electronic Journal of Information Systems in Developing Countries*, 24(2), 1-19.

- Oladapo, A. (2007). A Quantitative Assessment of the Cost and Time Impact of Variation Orders on Construction Projects. *Journal of Engineering, Design and Technology*, 5, 35-48.
- Omran A, (2016) Performance of glass-powder concrete in field applications. *Journal of Construction and Building Materials* (Elsevier), 109:84–95.
- Oyediran O. S. (2005): Awareness and Adoption of Information and Communication Technology (ICT) by Architectural, Engineering and Construction (ACC) Industry Educations in Nigeria.
- Oyewobi, L. O; Ibronke, O. T and Oladosu, I. T (2015): Information communication Technology (ICT) compliance among professionals of Nigerian construction industry Nigerian *Journal of Technological Research*, 10 (1), 32 – 39
- Palinkas LA, Horwitz SM, Green CA, et al. (2015) Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and Policy in Mental Health and Mental Health Services Research* 42(5): 533–544
- Peansupap V, Walker DHT. (2005). Factors enabling information and communication technology diffusion and actual implementation in construction organisations. *J Inform Technol Construct (ITcon)*. 10:193–218.
- Perkinson, C. L; Ahmad, I.U (2006): Computing Technology Usage in Construction Contractor Organizations, Fourth LACCEI International LatinAmerican and Caribbean Conference for Engineering and Technology(LACCET’2006)“*Breaking Frontiers and Barriers in Engineering: Education, Research and Practice*”21-23 June 2006, Mayagüez, Puerto Rico.
- Shafique, F. and Mahmood, K. (2008). Indicators of the Emergency Information Society in Pakistan. *Journal of Information Development*, 24(1), 66-76.
- Shen LY, Li QM, Drew D, Shen QP (2004). Awarding construction contracts on multicriteria basis in China. *J. Constr. Eng. Manag.* 130(3):385-393.
- Stewart RA, Mohamed S, Marosszeky M. (2004). An empirical investigation into the link between information technology *implementation barriers and coping strategies in the Australian construction industry. Construct Innovation.* 4(3):155–171
- Succar, B.; Kassem, M. (2015), Macro-BIM adoption: *Conceptual structures. Autom. Constr.* 57, 64–79.
- Sun S.M., and Howard R. (2004): Information Technology Applications for Construction, *Life Cycle Document Management System for Construction*. P.39-44
- Tan T, Chen K, Xue F, Lu W. (2019). Barriers to Building Information Modeling (BIM) implementation in China’s prefabricated construction: *An interpretive structural modeling (ISM) approach. J Cleaner Prod.* 219:949–959.
- Ugwu O. O et al, Kumaraswamy M.M., Ng T, Lee P.K.K. (2006): Information and Communication Technology (ICT) Applications in Construction, Repot of surveys on ICT Applications, Benchmarks, Benefits, Cost, Barriers & Research &Development Issues in the HKSAR construction industry.

- Ugwuanyi, D. C: (2012) An Appraisal of Information and Communication Technology (ICT) Application in Nigerian Construction Industry. MSc. Thesis, Department of Civil Engineering, University of Nigeria,
- Ullah K, Lill I, Witt E. (2019). An overview of BIM adoption in the construction industry: benefits and barriers.
- Yan H, Damian P. (2008). Benefits and barriers of building information modelling. In: *Proceedings of the 12th International Conference on Computing in Civil and Building Engineering & 2008 International Conference on Information Technology in Construction, October 16-18, 2008 Beijing, China. Presented at the 12th International Conference on Computing in Civil and Building Engineering, Tingshua University Press, Beijing; p. 6*
York: Longman. Inc.
- Zhang Q, Guo B. (2019). *Discussion on the development barriers of BIM construction costs in China. AJCE. 7(5):133.*
- Zhao X, Pienaar J. (2018). Critical barriers to BIM adoption in the Chinese architectural, engineering and construction industry. In: *Innovative production and construction. New Jersey, USA: World Scientific; p. 39–54*

APPENDIX I

Department of Industrial and Technology Education,
Federal University of Technology,
P.M.B. 65,
Minna,
3rd April, 2023.

Dear Respondent,

REQUEST FOR RESPONSE TO QUESTIONNAIRE

I am a final year student of the above mentioned institution, undertaking a study titled: **“Assessment of Information Technology Application in Building Construction Sites in Abuja, Nigeria”**. Your objective responses are highly needed in ascertaining the facts under investigation. Please feel free and open to share your mind objectively, for your responses have great impact on the findings. All collected responses will be used only for this research and treated confidentially.

Thank you

Yours faithfully

APPENDIX II

FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

QUESTIONNAIRE: On Assessment of Information Technology Application in Building Construction Sites in Abuja, Nigeria.

PART A

INTRODUCTION: Please complete this questionnaire objectively and sincerely by ticking the column that represent your opinion or perception about the above topic

Personal Data

Name of Construction Company _____

Make a choice of your category

Years of experience

(a). 5-10yrs

(b). 11yrs and above

PART B

Use the rating scale to indicate the item that best describe your level of agreement

1. Strongly Agree (SA)
2. Agree (A)
3. Strongly Disagree (SD)
4. Disagree (D)

RESEARCH QUESTION 1

To what extent is information technology applied in building construction sites in Abuja.

S/N	ITEMS STATEMENT	1	2	3	4
1	Application of building information modelling software (BIM)				
2	Mobile technology application				
3	Cloud storage				
4	Site sensors				
5	Use of drones and robots				
6	Use of electric vehicles				
7	Smart clothing and wearables				
8	3D modelling				
9	Building material advancement				
10	Augmented reality				
11	Automotive heavy equipment's				
12	Exoskeleton				
13	Artificial intelligence and machine learning				
14	Blockchain				
15	3D Printing				

RESEARCH QUESTION 2

What are the benefits of information technology application in building construction sites in Abuja?

S/N	ITEMS STATEMENT	1	2	3	4
1	Saves considerable time and cost for document transfer				
2	Provide adequate supervision of construction work				
3	It makes complex tasks easier				
4	Reduces construction error				
5	Aid in monitoring each stage of construction stage				
6	Facilitate decision making				
7	It increases productivity				
8	Increases document quality				
9	It helps in administrative works				
10	Easy understanding of the work plan				
11	Helps in quality take off and reuse				
12	It reduces proportion for new work				
13	Aid in exchange of documented material				
14	It helps personal in detecting fault and correct it immediately				
15	Creativity amongst the construction industry				

RESEARCH QUESTION 3

What are the costs implications of information technology application in building construction sites in Abuja?

S/N	ITEMS STATEMENT	1	2	3	4
1	Maintenance cost				
2	Consultancy Support				
3	Training Cost				
4	Hardware cost				
5	Overhead cost (eg running cost and consumables)				
6	Networking hardware and software				
7	Networking security				
8	Installation engineers				
9	Increase in power supply				
10	Direct cost				
11	Subscription services (cloud/security)				
12	Running cost				
13	User management				
14	Higher change cost				
15	Incident response				

RESEARCH QUESTION 4

What are the challenges of information technology application in building construction sites in Abuja?

S/N	ITEMS STATEMENT	1	2	3	4
1	Cost of training professionals				
2	Budget constraint for IT investment				
3	Lack of adequate jobs in the market				
4	Software and hardware reliability problems				
5	Rapid changes in information technologies				
6	Satisfaction with existing method of working				
7	Lack of staff with appropriate skill and knowledge in IT				
8	High cost of employing IT professionals				
9	Security concerns/privacy fears				
10	Fear of job loss/making professionals redundant				
11	Communication problem				
12	Issue with cash flow				
13	Vandalism/theft on site				
14	Forgetful clients				
15	Irregular equipment maintenance/replacement				

APPENDIX III

REQUEST LETTER TO VALIDATORS

Industrial and Technology Education Department
Federal University of Technology,
P.M.B. 65,
Minna,
3rd April, 2023.

Dear Sir,

REQUEST FOR FACE VALIDATION OF INSTRUMENT FOR ASSESSMENT OF INFORMATION TECHNOLOGY APPLICATION IN BUILDING CONSTRUCTION SITES IN ABUJA, NIGERIA

I am an undergraduate student of the above named address currently undertaking a study on the topic: ASSESSMENT OF INFORMATION TECHNOLOGY APPLICATION IN BUILDING CONSTRUCTION SITES IN ABUJA, NIGERIA

Attached is the draft copy of the instrument. As an expert in this area, your assistance is hereby solicited to enable me accomplish this task. Kindly go through the item to verify their clarity, relevance and appropriateness in the use of language. In addition to this you can also make further suggestions that will improve the status and quality of the instrument. Your contribution to this work is highly appreciated.

Thanks

Yours faithfully,

CHIDI EZEH
2016/1/63761TI