SOFTWARE APPLICATION IN THE CONSTRUCTION INDUSTRY: A CASE STUDY OF BUILDING PROJECTS IN ABUJA, NIGERIA

BY

MAMAH Wilfred Chinonso
2017/3/67643TI

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

AUGUST, 2021

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY DEGREE (B.Tech) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

AUGUST, 2021.

DECLARATION

I **MAMAH WILFRED CHINONSO** with matric number **2017/3/67643TI** 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.

MAMAH WILFRED CHINONSO
2017/3/67643TI

_____
Sign and Date

CERTIFICATION

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

Dr. C.O IGWE. _____
(Project Supervisor) Sign and Date

Dr I. Y UMAR _____
(Head of Department) Sign and Date

_____ _____
(External Examiner) Sign and Date

DEDICATION

I dedicate this work to late Engr Silas Ugwu, my loving parents Mr Anthony Mamah and Mrs Roseline Mamah, to my ever supporting Siblings and Friends.

ACKNOWLEDGEMENTS

My heartfelt gratitude goes to God who through his love and mercies saw me through my stay in school and gave me divine strength to pull through. Special thanks goes to my supervisor in person of Dr C. O Igwe for his guidance throughout the Period of this research. The researcher also wishes to thank his reader in person of Dr Ibrahim Dauda for improving the quality of this work. My filial gratitude goes to the dean prof A. I Gambari, the head of department, Dr I. Y Umar, the project coordinator Dr A. M Hassan, for their support, patience and trust in me to carry out this project successfully immeasurable. and to all lecturers of the department who helped me in one way or the other in form of advices, lectures, comments, correction and suggestions especially Mr Opeyemi, Dr Kagara, Dr Usman. I want to also appreciate my parents Mr Anthony Mamah and Mrs Roseline Mamah and my siblings for their prayers, love, encouragement and financial support. To the family of late Engr Silas Ugwu, I will forever remain grateful for bringing me out to the light of my academic pursuit. To very Rev. Fr. Nelson Onuh special thanks to you for your prayers and spiritual words of encouragement. To my friends Nwobodo Ifesinachi, Ugochukwu Henry, Gideon Yakubu, Uzoma Manasseh, Chikamso Igweagu Joseph Daniel, Andrew Istifanus and Suleman Ewugi. Thanks for your love and contributions in all aspects. To an important person in my life Justina Linus a big thanks to u for making me realize myself and for always being there for me. The researcher equally appreciates his course mates: Mr Haruna kawo, Adeeyo Adebisi, Oriyomi Salako, Abdul Nana Aisha and many others whose names I could not pen down. words would fail me to describe your impact to my life but I am very grateful that I met you all. Thank you.

Abstract

The research was designed to study the assessment of software application in building projects in the construction industry in F.C.T, Abuja. four research questions were answered and three hypotheses tested at 0.05 level of significance were formulated for the study. A descriptive survey research design was adopted for the study. The major purpose of this study is to look at the areas where software application has helped in the construction industry in F.C.T, Abuja, the cost implications of software application in the construction industry in F.C.T, Abuja, the risk factors in the application of software in the construction industry in F.C.T, Abuja and the benefit of using software in building projects in the construction industry in F.C.T, Abuja. The literature was reviewed in line with four research questions, and the null hypotheses were formulated to guide the study, in which several sub-headings were discussed as regard to the purpose of the study. The research design used for this study is a descriptive survey research design in which questionnaire was formulated to solicit information from respondents. The targeted population comprised of professionals and non- professionals in the construction industry in F.C.T, Abuja. The total population for the study is 104 which consisted of 72 professional builders and 32 non-professionals builders in five (5) construction companies in Abuja. Data obtained was analyzed using mean, standard deviation, and t-test statistics. The study concluded and recommended the following: The result should be communicated to the professional builders through software manuals as there is general ignorance or misleading information about the benefits of software in the construction industry, Workshops and seminars should be organized regularly on the need and importance of software in the construction industry, the construction workers should be trained on how to effectively use software in the construction processes, qualified staff and experts should be employed to take the lead in the usage of software

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Information and Communication Technology, also known as information technology (IT) has radically transformed the way we live, learn, work and play (Adejimi, 2015). 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. A major construction process demands heavy exchange of data and information between project participants on a daily basis (Masqsood et al., 2017). This makes the construction industry one of the most information-intensive industries, and requires close coordination among a large number of specialized but interdependent organizations and individuals to achieve the cost, time, quality and sustainability goals of construction project (Ugwu et al., 2015). software has been shown to be a vital tool in assisting the construction industry to cope with the increasing complexity of its product and services as well as the increasing demands of clients and regulators (Betts, 2016), and to enhance construction productivity (Liston et al., 2018). To assess the impact of software on construction in this regard, surveys on the use of software in the construction industries of various companies in different parts of the country have been carried out in recent times.

Oladapo (2017) has also carried out a survey into the use of software in the Nigeria construction industry. However, his survey apart from it being limited to South West Nigeria, focused more on the level of computer literacy of construction industry professionals and mode of acquisition. Oyediran (2015) studied the awareness and adoption of information and communication technology software by Architectural, Engineering and Construction industry educators in Nigeria. Adejimi and Iyagba (2017) compared E-construction technology for integrating building processes between Nigeria,

Canada and the Nordic countries. Their study however revealed that the digital divide between Nigeria and the developed world is closing up as more and more computer facilities are becoming accessible. However, they also indicated that modern and advanced information technology facilities such as internet, intra/extranet, virtual reality tools, tele/video conferencing, construction robots etc are grossly inadequate.

Information Technology (IT) describes technologies and equipment that can be used to store, retrieve, transmit and manipulate data. According to Axley (2017) "The impact of IT on modern society is profound". And its growing speed has enabled globalization especially through the introduction of a global system of interconnected computer networks known as the 'INTERNET', used for communication between individuals, companies and institutions for sharing and exchanging information and data. The construction industry is faced with the on-going challenge of changing and improving current work practices in order to become more client-orientated; more competitive as well as productive through adoption of software usage as an integral part of the construction process Bourque, (2016).

Information and Communications Technology (ICT) is a specialist application of Information Technology that has some aspect of communication. It includes areas such as; software development, mobile devices, cloud computing, data centers, cyber security, research networks, support and so on (Odubiyi, 2017). However, ICT has no universal definition, as "the concepts, methods and applications involved in ICT are constantly evolving on an almost daily basis. The broadness of ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, e.g. personal computers, digital television, email, robot.

Much effort has been directed toward improving construction productivity and the use of Information and Communication Technology (ICT) in construction industry and this is an

area worth concentrating upon because it can decrease the time for data processing, communicating information and increase overall productivity. Modem structural design software applications, such as 3D modelling and Building Information Modelling (BIM), provide an example where designing complex structures and organizing the electrical, mechanical, site, structural and quantifying of a project can be achieved in minimum time and increase the efficiency all in one data framework, whereas in the past this was almost impossible (Peansupap and Walker, (2014). therefore, the understanding of ICT and its role is important for the realization of improved communications between participating organizations in construction projects, the word Information communication and technology can be understood from different perspectives as well as towards an ICT view, as a whole new meaning of its own. (Adriaanse and Voordijk, 2015) give explanation from the functionalist (positivistic, 'scientific') perspective that "ICT is a neutral provider of input for decision making". In this point of view communication is no more than distribution of information.

ICT may be adopted by specific groups of users within an organization. For example, use of Computer Aided Drafting (CAD) by architects or estimating software used by engineers or project managers. (Anumba, 2016) identifies the reality that, communication between construction industry participants and organizations are concerned with information exchange, dealings with drawings, specifications; cost data, programme plus other design and management information. Certainly the case within the construction industry is a situation where excess of diverse communication occurs simultaneously as teams in different sectors of construction undertake tasks, activities and are constantly involved in Communication. Communication can include conversations, listening, networking, data and information the major forms of communication between architects, engineers and the builder's team is drawings and these drawings are now mostly generated on computers.

Like any other CAD software, construction oriented CAD are based on the same principles but may differ to some extent in their designing and application methods (Axley, 2017).

Software has been demonstrated to be an imperative instrument in helping the construction industry to adapt to the expanding multifaceted nature of its product and services just as the expanding request of clients and controllers and to upgrade construction productivity (Karam, 2016). To survey the effect of software on construction, modern structural design software applications, such as 3D modeling, building information modeling (BIM) and Microsoft project (MS project), provide an example where designing complex structures and organizing the electrical, mechanical, site, structural and quantifying of a project can be achieved in minimum time and increase the efficiency all in one data framework. Whereas in the past this was almost impossible (Peansupap and Walker, 2014).

The use of software can impact on the traditional processes of organization in construction and result in change in organizational processes, working methods and culture (Ugwu et al, 2015). In this regard, some benefits of software critical to the performance of the construction industry are to reduce the time for data processing and communicating information, and to improve communications for effective decision-making and coordination among construction participants (Peansupap & Walker, 2014) to enhance construction productivity (Liston, 2018).This is possible because the Internet-based tools of software allow communication between even remote users and enables them to share files, comment on changes and post requests for information (watson, 2014). The common types of software used in construction include word processing, spreadsheet, CAD and Internet software (Goh, 2015). This software is used for administration, communication, marketing, desktop publishing, presentation and project management (Karam, 2016).

Engineers, architects, project manager sand contractors, therefore, have the fundamental right of professional conscience (Chukwu-Okoronkwo, 2017).

The intent of this research work is to ascertain the level of use of software applications in the Nigeria construction industry.

1.2 Statement of the Problem

The potential of software for improving the quality of professional services in the construction industry is generally acknowledged. While report abounds on increase on the use of software in the construction industry in developed countries, very little exist in developing country like Nigeria. A survey of the current state of software in architectural, engineering and quantity surveying practices in Nigeria construction industries in south west Nigeria. (Oyediran, 2015) indicate in his survey that while core architectural, engineering, and quantity surveying functions like (drawing, engineering design and preparation of bill of quantity respectively) has been largely computerized, the professional builders are yet to key into this new development totally. (Ajahana, 2018) observed that the cost of hardware and software and the expenses of maintaining them is one of the reason why the professional builders are yet to fully adopt the use of software. According to (Maqsood, 2017) a major construction process demands heavy exchanges of data and information between the project participants on a daily basis (Rivarde 2014) also identify two vital roles of construction project which are specification of the resulting product (design information) and the initiation and control of the activities required for constructing the facility (management information).

The potential for improving the quality of professional service in the construction industry is the effective use of software. According to (Egbu, 2019) the effectiveness of software in meeting the needs of client in the built environment is influenced by their recognition and application context- relevant competencies. (Sun and Howard, 2016) stated that the

professionals in the construction industry need to upgrade from the traditional means of communication such as face -to -face meeting and exchange of paper documents in the form of technical drawing. Specification and site instructions is a computerize form of exchanging information, as such, the need of accessing the implication and benefit of the use of software in building project construction is of paramount importance, in these days of technological literacy.

1.3 Purpose of the Study

Oladapo (2017) had reported that the construction sector in Nigeria has during the previous couple of years expanded its utilization of software. Notwithstanding, almost none is thought about the effects of innovation on the industry and the prospect for its boundless entrance of the industry. This is on grounds that not many reports exist of research in software in creating nations, including Nigeria. Against this background, the purpose of the study is to assess the application of software in the construction industry in Abuja.

1. Identify areas of application of software in the construction industry.
2. Evaluate the cost implication of the application of software in the construction industry.
3. Identify the risk factors in the application of software in the construction industry.
4. Identify the benefit of software application in building projects in the construction industry.

1.4 Significance of the Study

The findings of this research will benefit the builders, engineers, architects, project managers, and clients in the construction industry, if the findings of this research are fully implemented it will enhance exchange of information between the Professional and their client through the use of software applications and these will in turn save time and energy.

The findings of the study will also be beneficial to the construction industries, as the findings will enable the construction industries to employ the fastest method of data processing, increase productivity, effective decision making and better service to their clients.

The findings of the study will also be of benefit to the students as the findings will enable them use it as a basis for further research; it will serve as board from which further research might take off. The data already gathered and documented in this project will serve as a source of information to students as well serve a reference material in their classroom work.

The client will also benefit from the findings of this study as the finding shows that communication of information or data can be done between the clients and the construction industry.

1.5 Scope of the Study

This study is delimited to the application of software in building project in the construction industry in Abuja. The study also covers the benefit of software application in building project in the construction industry, areas where software application helps in the construction industry, the cost implication of software application in the construction industry and also determine the risk factors in the application of software in the construction industry.

1.6 Research Questions

The following research questions will guild the study:-

1. In what areas has software application help in the construction industry?
2. What are the cost implications in the application of software in the construction industry?

3. What are the risk factors in the application of software in the construction industry?
4. What are the benefit of using software in building projects in the construction industry?

1.7 Hypothesis

The following null hypothesis was formulated and will be tested at 0.05 level of significance.

HO_1: There will be no significant difference in the mean response on the cost implication of software application in the construction industry in the federal capital territory. (F.C.T)

HO_2: There will be no significant difference in the mean response on the risk factors of software application in the construction industry in the (F.C.T) federal capital territory.

HO_3: There will be no significant difference in the mean response on the benefit of using software in building projects in the construction industry in the (F.C.T) federal capital territory.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The related literature shall be reviewed under the following sub-heading

1. ICT application in the global construction industry
2. The development of information and communication technology in the construction industry in Nigeria
3. Software application in the construction industry in Nigeria
4. Benefits of software application in the construction industry in Nigeria
5. Challenges of software application in the construction industry in Nigeria
6. Current information technologies and communication technologies for the construction sector
7. Review of related empirical study
8. Summary of literature review

2.1 ICT Applications in the Global Construction Industry

In 2015 PCs were just utilized in hardly any development organizations. Over time 2015, albeit most structural firms were utilizing computer innovation for a considerable lot of their center capacity like bookkeeping, wages and compensations, not many of them advanced conventional polices or methodologies concerning the utilization of information and communication technology. (Okagbue. H.I, 2020).

By the last piece of the 2017, around couple of years after the presentation of dependable PC equipment, a few organizations had arrived at a circumstance wherein their staffs on a significant number of their bigger projects were encountering the upsides of the new innovation using drawing and accounting page and word-processing software packages. (Ding et al, 2018).

Today, countless numbers of software packages are accessible to every one of the orders of the construction group at each phase of the construction process. They offer help for a wide scope of exercises, for example, PC supported plan and drafting, computer aided design (CAD), building perception, plan examination, project management, data stockpiling and recovery, cost assessment, structural investigation, on-site management, facilities management and so forth.

2.2 The Development of ICT in Nigeria Construction Industry

The utilization of ICT in the construction industry is creating new opportunities for cooperation, coordination and data trade among building firms that work on a construction project. Complex specialized frameworks don't advance full-fledged, yet rather as localized development. (Ajahana, 2018) Transformation of materials, this unbalanced evolution leads to the problem of "Islands of automation", where highly automated materials flow is mixed with completely manual ones. The same problems exist in the development of computerized information systems. The development of computing technology has meant that tools for analysis involving data manipulation have tended to develop earliest and in isolation. These tools show the enormous strengths of computer in the rapid analysis of complex data sets-analysis which is frequently impossible if manually attempted. Thus standalone applications dependent on numerical analysis, ranging from finite element analysis to critical path analysis, had been developed since before the year 2010. Information flows between these types of applications continued to use traditional information technologies such as the paper-based engineering drawing.

From 2015, new and redesigned type of graphical control was created to help the making of designing drawings and computer aided design (CAD). Once more, the yield from these frameworks generally depended on traditional technologies for communication between

various applications. The construction industry was at the bleeding edge of these development. By the twentieth century scaled specialized drawing, presumably the main information technology of the most recent thousand years after the printed book itself were grounded for use on strict and regal structure projects. (Egbu, 2019). In 2017, huge public sector projects-usually depending on broad normalization and prefabrication offered the chance to create CAD framework. Nonetheless, the destruction of the huge public sector development software engineers which have been fundamental for the advancement of ICT applications in each industrial area implied that this underlying force was lost (Okagbue, 2020).

In 2018, the improvement of the personal computer (PC) which significantly decreased the expense of registering power and empowered a lot more extensive dispersion of PCs inside the construction industry, while the preparing force of PC kept on developing dramatically. Above all, site workplaces could now be outfitted with PCs (Okagbue, 2020). This is to say That improvement of communication technologies has taken an autonomous way in Nigeria construction industry. In comparison with computer technologies, developments were earlier and more profound. The telegraph and, more importantly, the telephone, greatly improved communication capabilities. The fax and photocopier are more recent innovations which have had a significant impact. Nonetheless, these communication technologies did not allow any further manipulation of the received data. The advancement of nearby and wide range network (LANs and WANs) continued consistently, but interconnectivity between PCs was changed by the short of breath dispersion of the web in 2019. It is this rapid development of the interconnection between communication and information technologies that has both opened up tremendous new opportunities and posed new technical challenges.

2.3 Software application in the construction industry in Nigeria

In the construction industry (CI), the use of software application, which is also a part of information technology (IT), is becoming essential in fields of engineering, construction planning and control, cost control and financial planning, computer-aided facilities management, and others, offering a variety of opportunities for more productive and efficient project implementation within the sector. Software application research in the construction sector has concentrated on the prevalence of software and the contextual impact on its application; (Odubiyi 2017), from the point of view of developed nations such as the United States, Canada, and Sweden, explored this area. Many other reports on its uses and impact on companies' success in the construction sector have been published and project efficiency. Despite this exhaustive study around continents, only a few studies were undertaken from the standpoint of developing nations, such as Nigeria. This research suggests that software work in developing countries in the building industry may theoretically deliver a variety of new insights.

The reason is that what an organization could find to be major obstacles to the introduction and use of software in a developing country such as Nigeria may be markedly different from those in a developed economy such as the United Kingdom, where the software application is already defined with clear regulatory structures and cultural constraints (Oladapo, 2017). The planning and adoption of advanced, collective, and integrated information technologies are essential for the construction industry's sustainable improvement in the new era. The unindustrialized information technologies allow the construction industry great potential to improve the collective performance of management information systems in the project, engineering, and construction risk and project management.

In recent decades, the development of software has affected the construction industry. New technologies have made it easier for construction companies to manage and archive their data, and it is possible to rapidly move large volumes of data. A variety of technology-based approaches to enhancing the tracking of building materials have recently been proposed (Anumba, 2016). Software application has provided efficient collaboration methods for building companies, and the advent of new software tools has saved time and costs. The Internet serves as an essential database and medium for correspondence. Electronic records can minimize paperwork and increase precision and usability. However, during the introduction of software in their businesses, construction organizations face various barriers. There are internal obstacles and external hurdles to the building industry's addition of software application (Ajahana, 2018). Identifying these challenges will allow decision-makers to turn issues into opportunities. In Nigeria, the obstacles to software acceptance in the building industry lack examination. This study clarifies the existing challenges and opportunities that the Nigerian construction industry faces in the software adoption process. Therefore, the background of promoting software in the Nigerian construction industry is explained in the following.

First, the construction method produces enormous volumes of information. The information varies from sketches that were created in the strategy and plane phase to various project descriptions that developed throughout the construction phase. Data are collected throughout the whole period until the completion of the structure. Therefore, the synthesis and supervision of construction information in Nigeria are essential due to the information's variety and strength (Ozumba, 2019). Building project management requires the collection, review, and real-time transmission of information for the prompt disclosure of time, cost, range, and position variations from planned execution and appropriate decision-making for reacting to the obstacles, conflicts, and irregularities identified from

the scheduled production (Oladapo, 2017). However, with conventional communication instruments, project managers usually lack timely change management.

Second, the construction companies have a remarkably complicated, fractured, and unique combination of market relations and approach to deal with. Both construction phases involve the efficient exchange of fundamental knowledge and collaboration between different project partners, such as project managers, consultants, operators, engineers, vendors, and subcontractors.

This will lead to issues with timing and technological gratified contact transmission. The project is unique in its associated construction standard, location, and plan. The coordination problem among the project crew members normally triggers project delays, expensive reworks, and development failures in the Nigerian construction industry (Zaini, 2016). Conventional techniques in construction management cannot overcome any of those contact hurdles. In this situation, software application is a catalyst for service productivity and a key enabler of efficient information management and networking systems by which the company can collaborate and manage deals with its clients, experts, and supply chain associates (Karam, 2016). Especially where project crews are globally dispersed beyond internal borders or when broad nations are placed within domestic boundaries, software may be used to handle information successfully.

Third, by combining more complex development models, an increasing number of outsourced project suppliers, closely engineered fast-track design strategies, and an internationally competitive marketplace, the opportunity to execute effective projects on schedule and within targets is becoming a critical challenge (Tunji-Olayeni, 2021). Through the effective use of software to facilitate the knowledge management process amongst project teams, it is unlikely that there can be significant improvements to the

distribution system by using conventional methods. In fact, the implementation of software has become imperative for the construction industry because of the prevailing circumstances in today's manufacturing world, such as globalization, extreme competition, and the need to retain exceptional efficiency standards to survive (Karam, 2016). For example, the requirement for more effective project efficiency in construction firms around the globe has been applied to change two-dimensional, three-dimensional, and current BIM design procedures. software's value has evolved from being a product and utility to becoming a critical tool for every company to attain market growth and profit. Besides this, the effect of software-based adjustment is seen in its efficiency, providing the sector with an active sustainable benefit.

In response to the above reasons, the construction industry is promoting the use of software in both construction organizations and projects. The planned implementation of software in the construction industry could be perceived as both protective and sensitive because customers and supply chain associates frequently rely on these instruments; therefore, failing to utilize these devices makes a firm unattractive (Chukwu-Okoronkwo, 2017).

2.4 Benefit of software application in the construction industry in Nigeria.

The benefits of software application in the Nigerian construction industry cannot be over-emphasis. Therefore, construction industry and management requires effective collaboration and co-ordination between all the stakeholders involved in order to achieve a successful project delivery. It is even more so in construction where project teams may be geographically separated from the head office and the client or consultants.

The use of software therefore provides means of effective management and communication. The construction industry has been show in adoption of software applications compared to other sector of the economy. The complexity of the construction

industry is exhibited in the fact that, it is so hierarchical and fragmented in nature that some of the major participants do not consider themselves to be part of the same industry. Thus close co-ordination among a large number of specialized but interdependent organizations and individuals to achieve the cost, time and quality goals of a construction project is necessary. Hence, according to Masqsood et al. (2017) cited by (Ajahana 2018), a major construction process demands heavy exchange of data and information between project participants on a daily basis. Architectural, engineering and quantity surveying professionals are the consultants traditionally responsible for the production and management of most of the project information and documents required by such other project participants such as contractors, and suppliers for the execution of construction project. Some of the benefits of software application in the Nigeria construction industry are listed as follows:

2.4.1. Globalization

Software application has not only brought the world closer together, but it has also allowed the world's economy to become a single interdependent system. This means that we cannot only share information quickly and efficiently, but we can also bring down barrier of linguistic and geographical boundaries. The world has developed into a global village due to the help of information technology allowing countries like Chile and Japan who are not only separated by distance but also by language to share ideas and information with each other.

2.4.2. Communication

With the help of software application, communication has also become cheaper, quicker and more efficient. We can now communicate anywhere around the globe by simply text messaging or sending email for an almost instantaneous response, the internet has also

open up face to face direct communication form different parts of the world and has created effective communication channels among construction firm and between the construction industry and their clients.

2.4.3. Bridging the cultural gap

Software application has helped to bridge the cultural gap by helping people from different cultures to communicate with one another and allows for the exchange of views and ideas, thus increasing awareness and reducing prejudice.

2.4.4. Cost effectiveness

Software application has helped to computerize the construction process thus streamlining construction firms to make them extremely cost effective money making machines. This in turn increases productivity which ultimately gives rise to profits that means better pay and less strenuous working conditions.

2.4.5. More time

Software has made it possible for construction firms to open round the clock all over the globe. This means that a firm can open any time anywhere, thereby making purchases from different countries easier and more convenient. It also means that you can have our goods delivered right to your door step within a very short period of time.

2.4.6. Creation of new jobs

Probably the best advantage of software application in construction industry is the creation of jobs. Computer programmers, system analyzers, hardware and software developers and web designers are just some of the many new employment opportunities created with the help of software application

2.5 Challenges of software application in the construction industry in Nigeria

Software utilization in construction companies is comparatively low compared to aerospace companies and automotive companies. The construction companies in Nigeria are still in the relatively early stage of adopting software and remain behind other industries. Many construction industries in Nigeria still depend on hand-operated methods for successful communication, such as emails, phones, and faxes. Users' resistance to corporate software applications remains a problem in the construction industry (Adeleke, 2015).

Although many construction organizations invest a lot in software and try to obtain software application advantages, the benefits may be restricted if fewer people embrace and utilize software application because software achievement demands a significant mass of adopters to gain adequate communication and information interchange advantages (Zaini, 2016). An organization may spend on software practices while workers still communicate through the telephone and on paper. As a result, possible communication advantages of software application may not be sufficiently realized. If the organization operates with both hardcopy and electronic data, it will lose potential productivity gains. As a result, even though some software projects are technically completed, the desired benefits are not realized. Unsuccessful software implementation in the construction industry is not rare (Chukwu-Okoronkwo, 2017.

Transitioning from a paper-based to an utterly automated setting demands users to embrace and adopt software quickly. Peansupap and Walker (2014) claim that while several construction industries try to obtain software employment advantages, these may be limited when fewer people adopt and utilize software because this needs user approval. Even with full software approval, users will see it as being impossible to communicate electronically

with co-workers who bypass the use of software. Therefore, the industry can lose possible productivity increases by working with both hardcopy and automated data.

Adeleke (2015) find that the workers observed that further improvement of software application practices would enhance the company's competitiveness. Still, on the other hand, they did not aspire to develop their application of software. Ding et al. (2018) observe that in Nigeria, the process of BIM adoption among architect professionals differs meaningfully. An efficient BIM adoption approach should rely on the critical factors that impact architects' purpose of utilizing BIM. Bamgbade (2016), observe that members of the temporary project organization are sceptical about the benefits of the project software and disinclined to engage; thus, their consequent behaviour results in an overall state of software fragmentation.

Furthermore, while the theoretical challenges of software application have been shown, the realization of these advantages remains minimal in reality. The critical problem lies in the aversion of users to software application, for it is the actual software user who eventually uses software resources to optimize work processes.

In recent years, the impact of the current economic slowdown needs to be balanced by organizational and capital resources, which in turn involves a thorough optimization of software resources, leading to a "more improved for more limited" outcome. Application activity by persons plays a major role in ensuring software application. Therefore, creating a system for understanding the influencing factors of software application is essential (Egbu 2019).

2.6 Current Information Technologies for the Construction Sector

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, 2016)

1. Computer Aided Design and Visualization
2. Building Engineering Applications
3. Computer Aided Cost Estimation
4. Planning, Scheduling, site Management
5. Computer Aided Facilities Management
6. Integration
7. Business and Information Management

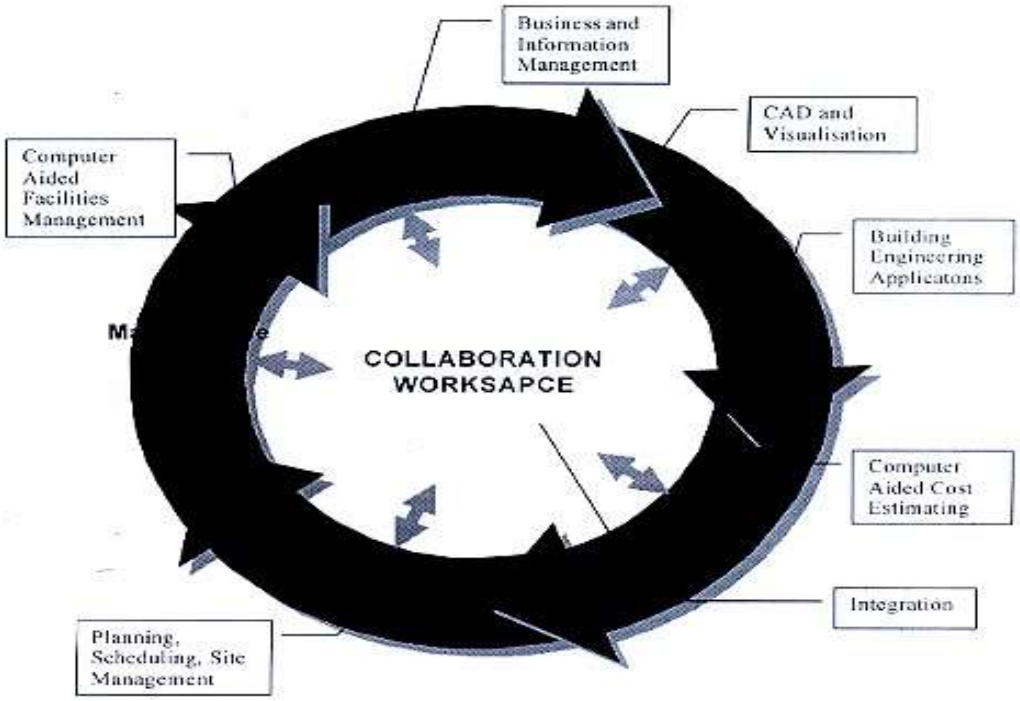

Figure 2.1 is a roadmap showing where and when these applications are being used along the construction process. The main purpose of the diagram is to indicate the main

application areas for the existing discrete software package in the construction supply chain.

Figure 2.1: Construction Process and IT application (adapted from, Life Cycle management system for construction. 2010)

2.6.1 Computer Aided Design and Visualization

Computer Aided Design (CAD) software is widely used by design professionals and AutoCAD have the largest share of the CAD market (Howard 2014). 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 photorealistic, static and moving images, so that the clients can view the final appearance of the building at the design stage. Virtual reality technology even allows the user to interact with the design model and experience the building in simulated reality settings, including simulated construction sequence.

2.6.2 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 environment for their occupants, to consume less energy in operations, 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. Once a building is constructed, it is very costly to correct any design defects. It is, therefore, important to simulate accurately the building 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 calculation 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. Examples of this software are: ATEAN from carrier, and CARGASW from climasoft, that offer comprehensive range of software options for climatic energy design; CALCULUX from lighting and building services design, CYPE INGENIEROS S.A. for structural design, cosmos for finite element analysis, DUCTSIZE from Elite software for electricity and water net design.

2.6.3 Computer Aided Cost Estimation

Controlling cost 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 EstiMate, 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 cost for labour, materials and equipment. The advantage is that cost data do not need to reentered, thus improving the clarity 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.

2.6.4 Planning, Scheduling and Site Management

Construction works require careful planning and skillful management of human and physical resources. Computer system software can assist on-site managers to plan ahead, evaluate different options and adopt and execute the most efficient construction operation. Besides the widespread use of planning packages such as Microsoft project, primavera, Power project, etc. 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. Site operation simulation programs can emulate what happens in a real construction site by representing workers, machines, and materials, and computing the cycle of each step taking into consideration many uncertain factors (Paulson 2015).

2.6.5 Computer Aided Facilities Management

Facilities management is a discipline that emerged rapidly in the early 2000 precisely 2010. It is based on the operation, maintenance and impact of the building operations on the life cycle cost. The available software for facilities management is a combination of CAD and database management system. Special routines enable blocking and stacking studies to be carried out to explore different layouts or to reflect organizational changes. Databases are the most important part of facilities management software. It holds data from people and their services so that when they move, their services can follow them. ITE (Inspeccion

Tecnica de Edificios), for example, is a tool that makes it possible to create a report of the state of the building.

2.6.6. 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 covers the whole life cycle of construction projects remains a future prospect.

2.6.7 Business and Information Management

The construction process is information intensive one during which a huge amount of information is generated and consumed by all the professionals 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, scheduling, etc, are generated in a specific stage of the project. Sometimes this information is updated, modified, consulted, etc, 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 the project. In addition, Web Based Project Management Systems have other functionalities like project coordination, scheduling, etc.

2.6.8 Current Communication Technologies for the Construction Sector

Communication technologies are the technologies dealing with the transmission of information. They support the process by which information is exchanged. Figure 2.2 shows the evolution of some information technologies (main communication technologies) in construction. They are positioned according to their complexity (Vertical axis) and construction specifics (horizontal axis). It is noted that the most specific services tend to use or rely upon the generic ones, and that the most complex service tends to integrate simpler ones.

The first services were generic and included networked file archives, e-mail communications and text-based group conferencing. The web provided a much friendlier navigation and presentation of the files on remote machines. It was at the time when first construction related content appeared. Out of the first 100 websites only two were related to construction. The first construction specific services used the web to publish information such as scientific papers, building codes, product specifications, etc. the next generation services were starting to use the internet as a collaboration platform for the companies involved in a construction project (Chukwu-Okoronkwo, 2017).

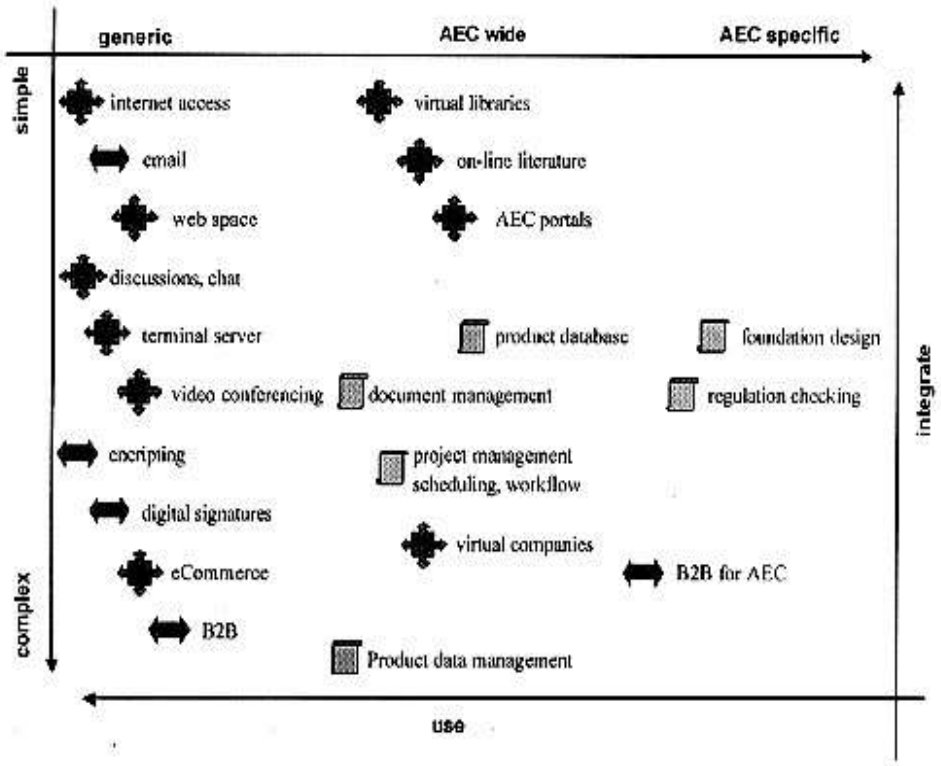

Figure 2.2: Evolution of Internet Related Communication Technologies (Adapted from, Life Cycle management system for construction. 2015)

Since 2015, however, construction has been following trends of general service supplied on the internet. A business model of the providers of various kind of internet related software (e.g. For managing mailing lists, discussion forums, help desk, photo albums, etc) has evolved from the sale of software for the users to install on their servers, to the offering of a service on their website, that offers the same functionality to the end user. In the construction context there are now dozens of companies providing collaboration tools such as document managing tools, project coordination and scheduling.

2.6.9 E-Business/Commerce: This is modern business methodology that addresses the needs of organization to cut cost while improving the quality of products and services and increasing the speed of service delivery. It can be viewed from multiple dimensions including communications and business processes. From

communication perspective, E-commerce is the electronic delivery of services and information. From a business process perspective, it is the automation of business transactions and process.

The main E-commerce application areas include

1. Company/product promotion
2. E-procurement through search engines and Web directories Project management/online project collaboration.

Future trends in E-commerce include

2.6.9.1 M-Commerce: Technology has now matured and makes it possible to connect, mobile devices such as mobile phones, and Personal Digital- Assistants (PDAs). Thus current researches are investigating the opportunities in mobile electronic commerce or M-commerce in infrastructure delivery and mega project management.

2.6.10 Wireless Communication (Bluetooth Technology): Bluetooth is a form of wireless technology that removes the need for cables connecting computer equipment. This should enable remote connectivity and distributed collaborative working.

2..6.11 Agent–Based Procurement of Goods and Services: Agent and Multi-Agent Systems (MAS) have been deployed in collaborative working to automate some tasks. In this situation, artificial agents representing their owners, execute delegated functions on their owner's behalf. Several potential application areas in construction include: Collaborative design, (Ugwu et al 2015) negotiation, claims management, procurement, (Hondeshel 2014) information searching and retrieval, supply chain coordination, and standards processing (Goh, 2015). Such state- of-the art applications mark fundamental

shift from software-as-tool to software-as-assistant. Anumba et al (2016) discussed details of applications of intelligent agents and multi-agent systems in construction.

2.6.12 WWW & Web Portals: This is the major trend in collaborative working with several applications in several sectors. It is now part of routine daily lives for business process improvement especially in developed economies that can provide the supporting infrastructure. This has also resulted in a bipolar digital divide (BDD) between rich and poor nations with significant impacts on ICT applications in the construction sector in different countries.

2.6.13 Peer-to-peer (P2P) computing: Peer-to-peer is a communication model in which each party has the same capabilities and either party can initiate a communication session. In some cases, peer-to-peer communication is implemented by giving each communication node both server and client capabilities. In recent usage, peer-topper has come to describe applications in which users can use the internet to exchange files with each other directly or through a mediating server [URL2P2P]. One potential advantage of P2P is that it could be used by corporations to enable their employees to share files through the internet network, without the expense involved in maintaining a centralized server. This means that employees (or more specifically their machines) are able to exchange business information with each other directly on a peer-to-peer basis. The technology has potential huge applications in integrating seamlessly, the construction supply chain, starting from product order receipt and configuration to manufacture and delivery (Ugwu et al 2015).

2.6.14 Service-Oriented Architectures (SOA) & Web services: Service-oriented Architecture (SOA) takes the WWW and Enterprise Integration Application (EIA) solutions to the next level. At the basic level, it involves mapping business processes to objects that are wrapped in software systems and not visible to the users. The objects are

dedicated to solving specific business process problems e.g. retrieve document, upload document, send message, search for information, compute sustainability index, etc. These functions are called services because they enable each application to call up other's services. The application's services are made available through the web interface, and are broadcast on WWW as web services. Consequently, any application can call up the services as long as the applications all adhere to defined protocols for service request and delivery. SOA applications rely on extensible Mark-up language **(XML)** to address interoperability problems. Additional information on the application of SOA concepts to sustainability appraisal and knowledge management can be found in (Ugwu et al 2015).

Studies have been carried out to determine the critical success factors, the barriers and enablers to ICT application in construction projects to harness the technology and streamline business process in emerging economies. The general problem addressed is what are the critical success factors, (CSFs), and barriers that impact the implementation, adoption, usage and diffusion of ICT 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 (2015) 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 (2015). 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.

Some research in mainstream computing and software development have investigated the socio-technical aspects of systems development and application in organization (Barrow, 2012), Bingi et al (2014), Bourque et al (2016), Hondeshel and Watson (2014), Watson et al (2014), liston (2018). Other researchers reported in literature have focused on investigating the various basic and niche application areas of IT in construction. Such studies have been conducted in Singapore (Hua, 2015), Norway (Samuelsom, 2012) Scandinavia (Howard et al 2014), (Ugwu et al 2015). The proliferation of research on IT barometers in construction on national and cross national basis indicates increasing interest to investigate socio-technical aspects of software development and use in the Architectural, Engineering and Construction (AEC) sector.

The research model was designed to investigate various related questions outlined. The research instrument includes a combination of structured open-ended interviews, questionnaires and evidence based research used for further validation. Several research methods were adopted in the multistage research. The first stage used a combination of pilot questionnaire survey, structured interviews with senior personnel of leading construction organizations, and deductive analysis techniques for interview protocol analysis (Oyediran, 2015). The second stage used a questionnaire-based survey and case-study/evidence-based research techniques.

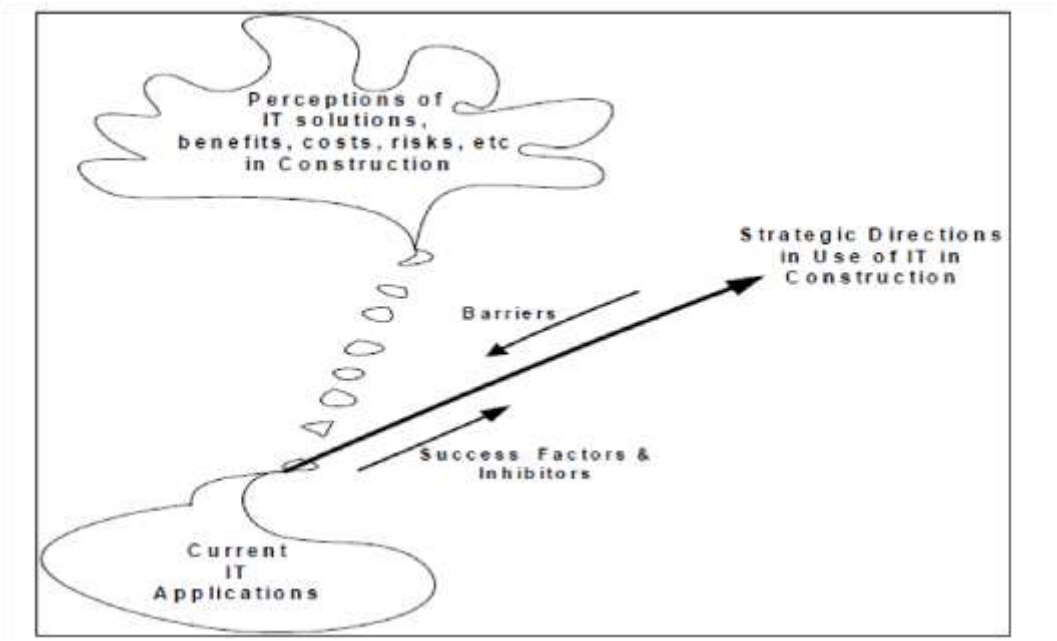

Figure 2.3: Research framework – ICT applications, success factors, barriers, benefits and risks. (Source: Ugwu et al 2015)

Fig.2.3 shows the research model used to investigate the various related questions. The research framework was broad and covered different dimensions of information and communication technology (ICT) in architecture, engineering and construction (AEC) sector. These include; current applications of IT in construction, success and inhibiting factors, perceptions of IT application areas in solving construction problems, and organization strategic directions in IT application.

Ugwu et al (2015) discussed detailed analysis of the results of research and case study projects that identified the key enablers and barriers to ICT application in construction projects in Hong Kong, and then posited several lessons for emerging economies of which the Nigerian construction industry is one of them.

Involvement and IT competence of in-house team. Further analysis of the responses reveals that contractors ranked “Ease of use” and “Change management at organizational level” as

the first and second most significant success factors respectively, while the whole group of respondents collectively ranks these as 5 and 6 respectively. Ease of use is a major issue that system developers must address in any ICT project to minimize training requirements and the associated operational cost. Change management is a wider issue to address by the management to ensure that adequate measures are taken to cushion the impact on the work force, often engendered by change in business process that result from introducing ICT systems.

2.7 Review of Related Empirical Study

Anumba (2016) carried out a research on the investigation into the use of software in the Nigerian construction industry. It was against this background that the paper investigated the state of software in the Nigerian construction industry to highlight the level of software penetration, its impact in the industry and the constraints to its adoption. The study identified the factors significantly impacting the level of software usage, grouping them into those internal to the industry and those external to it. A total of 136 respondents to a questionnaire survey, comprising, contractors, consultants and academic researchers, provided empirical data for the analysis. The results showed that some internal factors, i.e., the type of business (whether contracting, consulting or academic), chief executive officers (CEOs)/senior managers' perception of the benefits of software and the years of computer literacy of the CEOs/senior managers were significantly correlated with the level of software usage in the industry. However, none of the external factors were significantly correlated with the level of software usage. The main uses of software in the industry are word processing, Internet communications, costing and work scheduling. The top five constraints to the use of software are insufficient/irregular power supply, high cost of ICT software and hardware, low job order for firms, fear of virus attacks and high rate of obsolescence of ICT software and hardware. A comparison with the results of similar

studies in some industrialised and newly industrialised countries indicated that the proportion of firms using the computer is quite high for a developing nation like Nigeria. It also highlighted the large gap in access to electricity and other communications infrastructure between developed and developing countries.

Masqsood (2017) conducted a study on the barriers and benefits of software adoption in the Nigerian construction industry. In this work, he stated that Information and Communication Technology (ICT) is seen as a way to enhance knowledge collection in the construction sector. Although the theoretical benefits of software implementation have been clarified, realizing such benefits is insufficient. This paper attempted a systematic analysis of the literature using ATLAS.ti 9 software to save, identify, and analyze this study's data. A total of 102 articles were actively reviewed, including 82 Scopus journals and 20 conference papers published from 2003 to 2020. In this article, from a construction industry point of view, the software adoption process is considered as an interaction between technology, task, and an individual from a construction industry perspective. While software is acknowledged as a source of aggressive gain by both practitioners and scholars, software's sole presence would definitely not guarantee achievement in the industry's software approval. Companies cannot grasp the full benefits of software, except that users are able to adopt the technology. Hence, the issues related to software adoption need to be examined.

Ugwu (2015) carried out a research on the project management software application in the Nigerian construction industry. The desire to investigate the application of project management (PM) software in the Nigerian construction industry is imperative because despite a plethora of project management software packages with the capability of improving project performance, the rate of successful execution and delivery of construction projects remains alarmingly low. The research study surveyed 144

respondents involved in 16 construction projects in three states in Nigeria. Using t-test statistics and correlation analysis as analytical tools, two crunch findings were made: (i) there is a poor use of web-based project management software packages in the construction industry (ii) there is a misplaced emphasis on the cost of software and software graphic displays during selection. The study calls for the extensive application of PM software in the construction industry especially web-based PM software packages. It also recommends that in evaluating software for selection, other criteria more value-adding than cost and graphic displays be used. These include: user friendliness, report templates, task capacity, the speed of processing, collaboration and file sharing capacities, customizability, interoperability and integration.

Empirical research is playing a significant role in software engineering (SE), and it has been applied to evaluate software artifacts and technologies. There have been a great number of empirical research articles published recently. There is also a large research community in empirical software engineering (ESE). In this research, we identify both the overall landscape and detailed implementations of software application in the construction industry and investigate frequently applied methods, targeted research purposes, used data sources, and applied data processing approaches and tools in the application of software. The aim is to identify new trends and obtain interesting observations of software application across different construction companies in Abuja. It was observed that the trend of software application in the construction industry is continuously increasing and the most commonly applied methods are experiment, case studied and surveyed. Moreover, open source projects are the most frequently used data sources.

2.8 Summary of Literature Review

Information and communication technology, usually called ICT, is often used as a synonym for information technology (IT) but is usually a more general term that stresses the role of

communications (telephone lines and wireless signals) in modem information technology. ICT consists of all technical means used to handle information and aid communication, including computer and network hardware as well as necessary software. In other word, ICT consists of IT as well as telephony, broadcast media, and all types of audio and video processing and transmission. Computing and communication technology, also commonly known as information technology (IT) have been radically transforming the way we live, learn, work and play (Bamgbade, 2016). 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 sector of the economy.

Typically, the use of Internet-based online transactions, is fast replacing the conventional approach in carrying out operations amidst mortal and brick businesses. The Internet offers many beneficial features covering broad connectivity, speed, moderate cost, and user-friendliness. With a digital network economy, e-commerce and the Internet are quickly spreading internationally, bringing several countries in the world together. Because of the Internet's power, several industries depend on adopting software application, particularly the building industry. (Adejimi, 2015) reported that Internet usage might be a severe issue in improving a firm's operational efficiency and market reach. Many studies reported that the investment and adequate utilization of software application in the construction industry are the main techniques for enhancing productivity within the sectors.

Additionally, the government has devoted the maximum attention to improving the environment and infrastructure of software application in the construction sector to ensure the country's rapid growth in this information era. Moreover, a report has shown that software application is poised to become one of the key means of arousing economic growth by becoming an important sector due to its responsibility in enhancing the

development of other establishments in the nation. The adoption of software in all divisions, particularly in the construction industry, will facilitate a national economic extension (Axley, 2017).

Moreover, competition in the global market is becoming more demanding and multifarious, especially for a developing nation. Hence, to compete not only includes economic liberation but also the extent to which software application is being utilized in a nation. For example, the use of software (advancement in the communication) has drastically reduced both transaction and information costs (zaini, 2016). Thus, there is a need for broader dissemination to guarantee national development. For this reason, it has become pertinent for developing countries to ensure widespread software application in the economy to enjoy the optimum benefit from it. Therefore, instead of building production capabilities in relative isolation, decisive policies must be set up to address the failures in attaining global competitiveness. This implies that the necessary resources available in the country should be properly channelled into the worldwide market to benefit maximally from the payoffs of software investment in the construction industry (Betts, 2016)

The study identified project and site managers and quantity surveyors as the main software users in the Nigerian construction industry for the range of software resources. This study's functional implications would enhance the understanding of software application in construction management practices by front-line managers and could potentially encourage the complete deployment of software application in the industry, particularly in Nigeria, where many software potentials have yet to be exploited. This study also identified the antecedents of software use's productivity impacts as the most significant overall driver and the most critical issue contributing to the complete construction project progress. The research has significant practical ramifications, which suggest that productivity as a critical

factor in building project success in satisfying stakeholders is a key instigator of expanded software usage

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

This chapter describes Research design, Area of study, population of the study, Instrument for data collection, Validation of the instrument, Administration of the instrument, Method of data analysis and Decision rules respectively.

3.1 Research Design

The descriptive survey research design with the use of a structured questionnaire was used to collect the required information from the respondents. The survey research was adopted because survey design generally can be used to effectively investigate problems in realistic settings. Nworgu (2018) described survey research as that which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group.

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 the west and North, Kaduna to the Northeast, Nasarawa to the 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 the Greenwich meridian, Abuja is geographically located in the central region of the country. (Wikipedia, 2017).

This study covers five (5) building construction firms in FCT, Abuja. The following are the building firms:

1. Dantata & Sawoe,
2. Setraco Nig Ltd,
3. Nahman construction Ltd,
4. Julius Berger Nig Ltd,

5. Dumez Nig Ltd,

3.3 Population of the Study

The target population for this study comprises of building professionals and the non-professional. Which comprises of 72 registered builders and 32 non-professional builders practicing with the construction company in 5 construction companies in Abuja. This sum up to be 104 building practitioners. There was no need of sampling since all the population in their companies were used

3.4 Instrument for data Collection

The instrument used for data collection is questionnaire. The questionnaire is to determine the opinion of the respondents that comprises of the project managers, engineers and architects in construction companies in FCT, Abuja. 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) where question A consist of 10 items which sought to elicit information on the areas software application has helped in the construction industry in FCT, Abuja, sub-section B consist of 10 items which sought to elicit information on the cost implications in the application of software in the construction industry in FCT, Abuja, sub-section C consist of 11 items which sought to elicit information on the risk factors in the application of software in the construction industry in FCT, Abuja and sub-section D consist of 15 items which sought to elicit information on the benefits of using software in building projects in the construction industry in FCT, Abuja.

3.5 Validation of the Instrument

The instrument for the data collection was designed by the researcher and was validated by three lectures in the Department of Industrial and Technology Education (I.T.E), The

validators were requested to check the suitability and clarity of the item who found it appropriate for the study before administering.

3.6 Administration of the Instrument

The instrument use for data collection was administered to 5 construction companies in Abuja. The instrument was retrieved back after one week for computation. The instrument for the data collection was administered by the researcher and one research assistant.

The table below shows the percentage of instrument administered.

S/N	Companies	Professionals	Non-Professionals
1	Danata & Sawoe	17	6
2	Setraco Nig Ltd	14	9
3	Nahman Construction Ltd	8	4
4	Julius Berger Nig Ltd	21	9
5	Dumez Nig Ltd	12	4
	Total	72	32 104

3.7 Method of Data Analysis

The data collected by the researcher was analyzed using 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"	1

$\frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$

The mean response of each item was obtained by using the following formula

$$\overline{X}_1 \frac{\sum FX}{N}$$

Where

£ = Summation of

X = normal value of option (mean)

N = number of response of an item

F = frequency of response of each option

$\overline{X}_2$= Grand mean of each item

Decision Rule

To determine the level of acceptance, mean response. 2.50 And above was considered agreed or accepted. While mean response of 2.49 and below was equally considered disagreed or rejected. For testing hypothesis ± 1.67 will be the critical value, any item that has its t- value equal or less than t- critical was considered not significant, and any item that has its calculated t- value above t-critical was considered significant.

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, followed by those of the hypotheses tested for the study.

4.1.1 Research Question 1

In what areas has software application help in the construction industry?

Table 4.1.1 Mean responses of the respondents on the areas of application of software in the construction industry. N1= 72, N2=32

S/N	ITEMS	X1	X2	Xt	Remark
1	Administrative management	3.1	2.8	2.95	Agreed
2	Data collection	3.1	2.8	2.95	Agreed
3	Information dissemination	1.8	1.8	1.8	Disagreed
4	Service delivery	1.8	1.5	1.65	Disagreed
5	Design	3.7	3.8	3.75	Agreed
6	Speeding up the modernization drive of the industry structural aspect	3.2	3.2	3.20	Agreed
7	Organizational productivities	2.8	3.0	2.90	Agreed
8	Time management	3.6	3.7	3.65	Agreed
9	working drawings	3.9	3.9	3.90	Agreed
10	Construction management	3.7	3.8	3.75	Agreed

KEY: $\mathbf{X_1}$= Average mean responses of Professionals in the construction industry; $\mathbf{X_2}$= Average mean responses of non-professionals in the construction industry; $\mathbf{X_t}$= Average mean of professionals and non-professionals in the construction industry; $\mathbf{N_1}$= Number of professionals in the construction industry; $\mathbf{N_2}$= Number of non-professionals in the construction industry

Table 4.1.1 reviews that a set of 10 items were used to gather information from male and female professional in the construction industry on the areas of application of software in the

construction industry. The table shows that both respondents agreed on the areas of application of software in the construction industry, item 1, 2, 5, 6, 7, 9 and 10 as reflected by their own mean score greater than 2.50 respectively. While item 3 and 4 disagreed with the mean score below 2.50 respectively.

4.1.2 Research Question 2

What is the cost implications in the application of software in the construction industry?

Table 4.1.2 Mean responses of the respondents on the cost implications in the application of software in the construction industry. N1= 72, N2=32

S/N	ITEMS	X1	X2	Xt	Remark
1	Direct cost	3.2	3.6	3.40	Agreed
2	Hardware accessories	1.7	1.2	1.45	Disagreed
3	Overhead cost (e.g running cost and Consumables)	3.4	3.7	3.55	Agreed
4	Increase in process power	1.5	1.2	1.35	Disagreed
5	Maintenance cost	3.6	3.1	3.35	Agreed
6	consultancy support	2.9	3.6	3.25	Agreed
7	Installation Engineers	3.5	3.5	3.50	Agreed
8	training cost	3.7	1.4	2.55	Agreed
9	networking security (e.g firewalls)	1.5	3.6	2.55	Agreed
10	Networking hardware and software	2.7	3.5	3.10	Agreed

KEY: $\mathbf{X_1}$= Average mean responses of Professionals in the construction industry; $\mathbf{X_2}$= Average mean responses of non-professionals in the construction industry; $\mathbf{X_t}$= Average mean of professionals and non-professionals in the construction industry; $\mathbf{N_1}$= Number of professionals in the construction industry; $\mathbf{N_2}$= Number of non-professionals in the construction industry

Table 4.1.2 shows that a set of 10 items were used to gather information from male and female professional in the construction industry on the constraints in the application of software in the construction industry. The table shows that both respondents agreed on the constraints in the application of software in the construction industry, item 1, 3, 5, 6, 7, 9

and 10 as reflected by their own mean score greater than 2.50 respectively. While item 2 and 4 disagreed with the mean score below 2.50 respectively.

4.1.3 Research Question 3

What are the risk factors in the application of software in the construction industry?

Table 4.1.3 Mean responses of the respondents on the risk factors in the application of software in the construction industry. N1= 72, N2=32

S/N	ITEMS	X1	X2	Xt	Remark
1	Capital outlay with no guarantee of likely returns	3.1	2.8	2.9	Agreed
2	Uncertainty about how to measure potential benefit	3.1	2.8	2.9	Agreed
3	Lack of information systems infrastructure support for the IT investment	3.7	3.8	3.7	Agreed
4	Maintenance cost	3.9	3.9	3.9	Agreed
5	Uncertainty about how to measure the cost involved				
6	Minimal IT expertise	1.8	1.5	1.6	Disagreed
7	Security issues				
8	Theft of software and hardware	2.8	3.0	2.9	Agreed
9	Reluctance of employees to adapt to change	3.2	3.2	3.2	Agreed
10	Training expenses on staff that leave the organization	3.7	3.8	3.7	Agreed
11	Technical uncertainties and lack of knowledge	1.8	1.8	1.8	Disagreed

KEY: $\mathbf{X_1}$= Average mean responses of Professionals in the construction industry; $\mathbf{X_2}$= Average mean responses of non-professionals in the construction industry; $\mathbf{X_t}$= Average mean of professionals and non-professionals in the construction industry; $\mathbf{N_1}$= Number of professionals in the construction industry; $\mathbf{N_2}$= Number of non-professionals in the construction industry

Table 4.1.3 reviews that a set of 11 items were used to gather information from male and female professional in the construction industry on the areas of application of software in the

construction industry. The table shows that both respondents agreed on the areas of application of software in the construction industry, item 1, 2,3,4, 5, 7,8, 9 and 10 as reflected by their own mean score greater than 2.50 respectively. While item 6 and 11 disagreed with the mean score below 2.50 respectively.

4.4 Research Question 4

What are the benefits of using software in building projects in the construction industry?

Table 4.1.4: Mean response of the benefit of using software in building project in the construction industry. N1=72, N2=32.

S/N	ITEMS	X1	X2	Xt	Remark
1	There is creativity benefit amongst the construction industry	3.7	3.8	3.75	Agreed
2	work improvement benefit exists in the use of software applications	3.7	3.8	3.75	Agreed
3	Ease of new ideas using software application	1.4	1.7	1.55	Disagreed
4	Ease of designing of modern structure of building	3.9	3.9	3.90	Agreed
5	Improvement of productive activities in the construction industry	3.8	3.7	3.75	Agreed
6	Aid in the exchange of documented material	3.2	3.1	3.15	Agreed
7	Provide adequate supervision of construction work	3.9	3.8	3.85	Agreed
8	Help personnel in detecting fault and correct it immediately	1.2	1.1	1.15	Disagreed
9	It brings about a level of commitment in the construction industry	3.2	3.1	3.15	Agreed
10	Aid in monitoring each stage of the construction process	3.7	3.6	3.65	Agreed
11	easy understanding of the work plan	3.7	3.6	3.65	Agreed
12	Reduce degree of difficulty in each stage of the construction process.	3.3	3.1	3.20	Agreed
13	Saves considerable time and cost for document transfer	3.3	3.3	3.30	Agreed
14	Help in administrative work	3.3	2.9	3.10	Agreed
15	Help in quantity take off and reuse	2.7	2.9	2.80	Agreed

KEY: $\mathbf{X_1}$= Average mean responses of Professionals in the construction industry; $\mathbf{X_2}$= Average mean responses of non-professionals in the construction industry; $\mathbf{X_t}$= Average mean of professionals and non-professionals in the construction industry; $\mathbf{N_1}$= Number of

professionals in the construction industry; N_2= Number of non-professionals in the construction industry

Table 4.1.4 reviews that a set of 15 items were used to gather information from male and female professional in the construction industry on the benefits of using software in building projects in the construction industry.

The table shows that both respondents agreed on the benefit of using software in building project in the construction industry, item 1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14 and 15 as reflected by their own mean score greater than 2.50 respectively. While item 3 and 8 disagreed with the mean score below 2.50 respectively.

4.2 Testing of Hypotheses

4.2.1 Hypotheses 1:

There will no significant different in the mean response between male and female professionals in the construction industry on the cost implication of software application in the construction industry in the federal capital territory. (F.C.T)

Table 4.2.1 t-test Analysis of the respondents on the cost implication of software application in the construction industry in the federal capital territory. (F.C.T) N1=72, N2=32

S/N	ITEMS	SD1	SD2	t-test	Remark
1	Direct cost	0.81	0.68	-1.65	A
2	Hardware accessories	0.79	0.40	2.86	NA
3	Overhead cost (e.g running cost and consumables)	0.67	0.47	-1.69	NA
4	Increase in process power	0.64	0.40	1.90	NA
5	Maintenance cost	0.71	0.30	3.44	NA
6	Consultancy support	0.91	0.51	-3.30	NA
7	Installation Engineer	0.72	0.52	0.00	A
8	Training cost	0.53	0.51	1.39	A
9	Network security (e.g firewalls)	0.64	0.68	-9.16	NA
10	Network hardware and software	1.10	0.69	-2.93	NA

Table 4.2.1: Presents test of this hypotheses

Key

1. **SD_1** = standard deviation of professionals in the construction industry
2. **SD_2** = Standard deviation of non-professionals in the construction industry
3. **A** = Accepted
4. **NA** = Not Accepted

The result shown in table 4.2.1 above indicates the comparison between the male and professionals in the construction industry. Data revealed that items 1,7 and 8 has a calculated t-value less than the t-critical value of ±1.67, hence the hypothesis for these items were upheld at 0.05 level of significance, except for item 2,3,4,5,6,9 and 10 which has a t-calculated value above the t-critical value of ±1.67, thus $H0_1$ was rejected for this item.

4.2.2 Hypothesis 2

There will be no significant difference in the mean response between male and female professionals in the construction industry on the risk factors of software application in the construction industry in the (F.C.T) federal capital territory.

Table 4.2.2: t-test Analysis of the Respondents on the risk factors of software application in the construction industry in the federal capital territory. N1=72, N2 =32

S/N	ITEMS	SD1	SD2	t-test	Remark
1	Capital outlay with no guarantee of likely returns	0.58	0.87	1.84	A
2	Uncertainty about how to measure potential benefits	0.61	1.10	0.87	A
3	Lack of information systems infrastructure support for the IT investment	0.77	0.75	0.00	A
4	Maintenance cost	0.51	0.69	1.34	A
5	Uncertainty about how to measure the cost involved	0.44	0.40	-0.72	A
6	Minimal IT expertise	0.68	0.40	0.00	A
7	Security issues	1.01	1.00	-0.58	A
8	Theft of software and hardware	0.59	0.47	-0.57	A
9	Reluctance of employees to adapt to change	0.23	0.30	0.00	A
10	Training expenses on staff that leave the organization	0.46	0.40	-0.71	A
11	Technical uncertainties and lack of knowledge	0.87	0.58	1.08	A

Table 4.2.2: Presents test of this hypotheses

Key

1. **SD_1** = standard deviation of professionals in the construction industry
2. **SD_2** = Standard deviation of non-professionals in the construction industry
3. **A** = Accepted
4. **NA** = Not Accepted

The result shown in table 4.2.2 above indicates the compares between the male and female professionals in the construction industry. Data revealed that all the items in this category has a calculated t-value less than the t-critical value of ±1.67, hence the hypothesis for these items were upheld at 0.05 level of significance, thus the null hypothesis was accepted for the items,

4.2.3 Hypotheses 3:

There will be significant difference in the mean response between male and female professionals in the construction industry on the benefit of using software in building projects in the construction industry in the federal capital territory. (F.C.T)

Table 4.1.3 t-test Analysis of the respondents on the benefit of using software in building project in the construction industry in the federal capital territory. (F.C.T) N1=72, N2=32

S/N	ITEMS	SD1	SD2	t-test	Remark
1	There is creativity benefit amongst the construction industry	0.53	0.40	-0.68	A
2	work improvement benefit exists in the use of software applications	0.57	0.40	-0.66	A
3	Ease of new ideas using software application	0.64	0.22	-2.46	NA
4	Ease of designing of modern structure of building	0.31	0.30	0.00	A
5	Improvement of productive activities in the construction industry	0.14	0.47	0.70	A
6	Aid in the exchange of documented material	0.41	0.30	0.89	A
7	Provide adequate supervision of construction work	0.05	0.40	0.83	A
8	Help personnel in detecting fault and correct it immediately	0.49	0.30	0.84	A
9	It brings about a level of commitment in the construction industry	1.02	1.04	0.28	A
10	Aid in monitoring each stage of the construction process	0.53	0.66	0.46	A
11	easy understanding of the work plan	0.21	0.51	0.64	A

12	Reduce degree of difficulty in each stage of the construction process.	0.56	0.30	1.57	A
13	Saves considerable time and cost for document transfer	0.56	0.65	0.00	A
14	Help in administrative work	0.75	0.94	1.30	A
15	Help in quantity take off and reuse	1.10	1.14	-0.52	A

Table 4.2.3: Presents test of this hypotheses

Key

1. **SD_1** = standard deviation of professionals in the construction industry
2. **SD_2** = Standard deviation of non-professionals in the construction industry
3. **A** = Accepted
4. **NA** = Not Accepted

The result shown in table 4.2.3 above indicates the comparism between the male and female professional in the construction industry. Data revealed that items 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 has a calculated t-value less Than the t-critical value of ±1.67, hence hypothesis for these items were upheld at 0.05 level of significance. Except for item 3 which has a t-calculated value above the t-critical value of ±1.67, thus HO_3 was rejected for this item.

4.3 Summary of the finding

The following findings were made according to the research questions raised for the study. The findings related to the areas where software have helped in the construction industry

1 Administrative management

2 Information dissemination

3 Design

4 Speeding up the modernization drive of the industry structural aspect

5 Organizational productivity

6 Time management

7 Working drawings

8 Construction management

Finding related to the cost implications in the application of software in the construction industry

1 Direct cost

2 Hardware accessories

3 Overhead cost (e.g. running cost and consumables)

4 Increase in process power

5 Maintenance cost

6 Consultancy support

7 Installation Engineers

8 Training cost

9 Networking security (e.g. firewalls)

10 Networking hardware and software

The finding related to the risk factor in the application of software in the construction industry

1 Capital outlay with no guarantee of likely returns

2 Uncertainty about how to measure potential benefits

3 Lack of information systems infrastructure support for the IT investment

4 Maintenance cost

5 Uncertainty about how to measure the cost involved

6 Minimal IT expertise

7 Security issues

8 Theft of software and hardware

9 Reluctance of employees to adapt to change

10 Training expenses on staff that leave the organization

11 Technical uncertainties and lack of knowledge

The findings related to the benefit of using software in building project construction in the construction industry

1	There is creativity benefit amongst the construction industry
2	work improvement benefit exist in the use of software applications
3	Ease of new ideas using software application
4	Ease of designing of modern structure of building
5	Improvement of productive activities in the construction industry
6	Aid in the exchange of documented material
7	Provide adequate supervision of construction work
8	Help personnel in detecting fault and correct it immediately
9	It brings about a level of commitment in the construction industry
10	Aid in monitoring each stage of the construction process
11	easy understanding of the work plan
12	Reduce degree of difficulty in each stage of the construction process.
13	Saves considerable time and cost for document transfer
14	Help in administrative work
15	Help in quantity take off and reuse

4.4 Discussion of Findings

The discussions of the findings are based on the research question and hypothesis formulated. The findings on research question 1 indicate areas where software applications have helped in building projects in the construction industry, word processing, spreadsheet, CAD and Internet software, according to (Goh, 2015). This software is used for administration, communication, marketing, desktop publishing, presentation and project management (Ding, 2018). While architects, engineers and contractors use CAD mostly for design, drawing and presentation.

Rivard, 2014, professional builders use it for measurement, preparation of bills of quantities, estimating and presentation.

The findings on the research question 2 on the cost implications of software application in the construction industry, indicates that there are many cost implications in the application of software in the construction industry such cost includes cost of training newly employed personnel and re-training of already employed personnel, cost of hardware accessories, overhead cost i.e running cost and consumables.

The findings on the research question 3 on the risk factors in the application of software in the construction industry indicates that the construction industry is faces with the following risk factors; capital outlay with no guarantee of likely returns, uncertainty about how to measure potential benefits, lack of information systems infrastructure support for IT investment, uncertainty about how to measure the cost involved, minimal IT expertise, security issues, and theft of software and hardware.

The findings on the research question 4 on the benefits of using software in building construction project in the construction industry indicates that there are benefits of using software in building projects in the construction industry, such benefits include creativity amongst the construction industry. Also, software applications enhance work improvement benefit. Software applications aid in monitoring each stage of the construction process Professional builders does have benefit in the easy of new ideas using software applications. 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 IT usage are difficult to specify, as they manifest in terms of turn savings, reduced waste, work improvement, exchange of documented material

bills of quantities, estimating and presentation. The engineering analysis software for specific branches of engineering,

Also according to (Goh, 2015) The development of an EDM system for project management can save considerable time and cost for document transfer (Ajahana, 2018); while e- business provides an efficient infrastructure for remote consulting services to consultants and contractors who desire to provide their services through the Internet (Axley, 2013). Furthermore, the findings under this study adapted to the statement of (Sun S.M., and Howard R. 2016), 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 IT usage are difficult to specify, as they manifest in terms of time savings, reduced waste, work improvement, exchange of documented material.

HO_1: - The table of hypothesis 1 clearly shows the cost implications of software application in the construction industry. This revealed that there is no significant difference between the main response of male and female professionals in the construction industry; and was accepted because high majority of the calculated t-test does not equal or exceed the t-critical value (±1.67).

HO_2: - The table of hypothesis 2 also shows the analysis on the risk factors in the application of software in the construction industry. This revealed that there is no significant difference between the main response of male and female professionals in the construction industry. This was accepted because the whole calculated t-test in this table does not equal or exceed the t-critical value (±1.67). Therefore, the hypotheses are not rejected.

HO_3: - The table of hypothesis 3 clearly shows the analysis on the benefits of using software in building projects in the construction industry. This revealed that there is no significant difference between the main response of male and female professionals in the construction industry, and was accepted because high majority of the calculated t-test does not equal or exceed the t-critical value (±1.67).

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter deals with summary, conclusion and recommendations based on the findings. Suggestions for further studies were also highlighted.

5.1 Summary of the Study

The research was conducted to assess the application of software in building projects in the construction industry in F.C.T Abuja, the study used a survey design method and sought to assess the application of software in building projects in the construction industry. four research questions were formulated based on the purpose of the study, the literatures related to the study were also reviewed. A structured questionnaire was developed by the researcher. The instrument was in four sections and it was validated and used to get information from respondents. The population of the study was 109 professionals in the construction industry which consist of 72 male professionals and 32 female professionals in the construction industry in Abuja. A total of 109 questionnaires were distributed with a 100% return rate.

Data collected on the structured questionnaire were analyzed using mean statistic. The areas where software application have helped in the construction industry are as Follow: Administrative management of staffs and project, data collection, information dissemination, designs and service delivery. The cost implications in the application of software in the construction industry are as follows: direct cost, maintenance cost, hardware accessories, overhead cost, consultancy support, training cost and increase in process power. The risk factors in the application of software in the construction industry are as follows: Capital outlay with no guarantee of likely returns, Uncertainty about how to measure potential benefits Lack of information systems infrastructure support for the IT

investment Maintenance cost, Uncertainty about how to measure the cost involved, Minimal IT expertise Security Issues Theft of software and hardware.

5.2 Implication of the Study

From the findings, it is expecting that professional builders both (male and female professionals) in the construction industry in Federal Capital Territory. (F.C.T) Abuja, will adhere to the benefit of software in the construction industry as these is of tremendous important to them.

Finding of this study reveals that the application of software in the construction industry will lead to creativity among the professionals in the construction industry; these will enhance their productivity by saving time and reduction of work as well as the formulation of new ideas.

Secondly, software also improves construction management, as professionals in the construction industry control each stage of the construction process and these help to employ the fastest method of data processing, increase productivity, effective decision making and better service to humanity.

Thirdly, the result will assist the professional builders to examine the constraints to the use of software and to provide solution to them, by producing software manuals to staff, supervising or monitoring staff, staff training and retraining to be updated with new technology, organization of workshops and seminars for the constructional staffs to be aware with any latest development in the software that is consigned with the construction industry.

5.3 Contribution to Knowledge

This research work result has added so much value to the building professionals and non-professionals on the application of software in building project in the construction industry in FCT Abuja, by improving the digital skills of building professionals and non-

professional in software application in caring out their activities effectively and efficiently. The clients will also gain from this work by understanding the different procedures in the finishing achievement of clients' satisfaction and this will also lead to the improvement of long lasting business relationship.

5.4 Conclusion

Based on the findings of the study, it is clear and precise that, software has great impact on the professional builders in the following areas: easy understanding of the work plan, reduce degree of difficulty in each stage of the construction process, help in administrative work, Aid in monitoring each stage of the construction process. One other significant important of software to the professional builders include: time management, effective and efficient Design and organizational productivity.

However, there are some constraints to the use of software in the construction industry such as inadequate power supply, since most software gadgets are electronically operated. Use of non-standard applications, wherever standard applications are used it brings out the best of any construction work, software manuals are not provided to staff, lack of funds to software personnel are not involved in the purchase of software equipment, inadequate staff training and retraining to be updated with new technology.

5.5 Recommendations

Based on the findings and implication the following recommendations are made;

1. The result should be communicated to the professional builders through software manuals as there is general ignorance or misleading information about the benefits of software in the construction industry.

2. Workshops and seminars should be organized regularly on the need and importance of software in the construction industry.

3. The construction workers should be trained on how to effectively use software in the construction processes.

4. Qualified staff and experts should be employed to take the lead in the usage of software

5.6 Suggestion for Further Study

Base on the finding of the study the following topics were identified for further study:

1. Strategies for Adopting software in the construction industry for effective and efficient service delivery.

2. Factors affecting the successful implementation of software in the construction industry.

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APPENDIX

RESEARCH QUESTIONNAIRE

ON

SOFTWARE APPLICATION IN THE CONSTRUCTION INDUSTRY: A CASE STUDY OF BUILDING PROJECTS IN ABUJA, NIGERIA.

SECTION A

Please, complete the questionnaire as faithfully and sincerely as possible by ticking the column that best represent your perception about the above topic: the questionnaire is for research purpose and your view will be treated confidently.

Gender: Professionals ☐ Non-professionals ☐

AGE: 26-30 ☐ 30-35 ☐ 35-40 ☐ 40-45 ☐ 45-50 ☐ 50-55 ☐

Guide on how to respond to the questionnaire: use the following rating scale to indicate your opinion by ticking the phase that best describe your level of agreement to the items

Strongly Agree = SA

Agree = A

Disagree = D

Strongly Disagree = SD

APPENDIX A

SECTION A

RESEARCH QUESTION 1

In what areas has software application help in the construction industry?

S/NO	ITEM STATEMENT	SA	A	D	SD
1	Administrative management				
2	Data collection				
3	Information dissemination				
4	service delivery				
5	Design				
6	Speeding up the modernization drive of the industry structural aspect				
7	organizational productivity				
8	time management				
9	working drawings				
10	construction management				

APPENDIX B

SECTION B

RESEARCH QUESTION 2

What are the cost implications in the application of software in the construction industry?

S/N0	ITEM STATEMENT	SA	A	D	SD
1	Direct cost				
2	Hardware accessories				
3	Overhead cost (e.g. running cost and consumables)				
4	Increase in process power				
5	Maintenance cost				
6	Consultancy support				
7	Installation Engineers				
8	Training cost				
9	Networking security (e.g. firewalls)				
10	Networking hardware and software				

APPENDIX C

SECTION C

RESEARCH QUESTION 3

What are the risk factors in the application of software in the construction industry?

S/N0	ITEM STATEMENT	SA	A	D	SD
1	Capital outlay with no guarantee of likely returns				
2	Uncertainty about how to measure potential benefits				
3	Lack of information systems infrastructure support for the IT investment				
4	Maintenance cost				
5	Uncertainty about how to measure the cost involved				
6	Minimal IT expertise				
7	Security issues				
8	Theft of software and hardware				
9	Reluctance of employees to adapt to change				
10	Training expenses on staff that leave the organization				
11	Technical uncertainty and lack of knowledge				

APPENDIX D

SECTION D

RESEARCH QUESTION 4

What are the benefits of using software in building projects in the construction industry?

S/N0	ITEM STATEMENT	SA	A	D	SD
1	There is creativity benefit amongst the construction industry				
2	work improvement benefit exist in the use of software applications				
3	Ease of new ideas using software application				
4	Ease of designing of modern structure of building				
5	Improvement of productive activities in the construction industry				
6	Aid in the exchange of documented material				
7	Provide adequate supervision of construction work				
8	Help personnel in detecting fault and correct it immediately				
9	It brings about a level of commitment in the construction industry				
10	Aid in monitoring each stage of the construction process				
11	easy understanding of the work plan				
12	Reduce degree of difficulty in each stage of the construction process.				
13	Saves considerable time and cost for document transfer				
14	Help in administrative work				
15	Help in quantity take off and reuse				