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THE DIGITAL REVOLUTION- HOW ICT IS SHAPING THE FUTURE OF BUILDING INFORMATION MODELLING

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ABSTRACT

This study explored the roles of Information and Communication Technology knowledge of construction professionals in the adoption of Building Information Modeling. It is a mixed research study where questionnaires were distributed to respondents that interfaced with Building Information Modeling. The SPSS software was used for the data analysis and the result of the analysis shows that it is important for professionals to have ICT knowledge to properly fit into the adoption of BIM (mean = 5.18>3.00, RII = 86.27). The slow pace of ICT knowledge of professionals may have affected BIM adoption. Infrastructure issues, cost of software, staff training, and site location have affected the adoption of ICT and have a significant effect on BIM adoption. Therefore, this study recommends that ICT knowledge should be continuously encouraged for professionals. This can be done during workshops organized by the respective professional bodies while the professionals will be encouraged to practice them in their daily works.

Keywords: Digital Revolution, Building Information Modeling, Information and Communication Technology, Virtual Big Room, Architecture, Engineering and Construction

1. INTRODUCTION

The need to virtually create a model for a construction project before its commencement gave rise to the concept of Building Information Modeling such that elements can be identified, simulated, and analysed for possible that may occur during the project construction phase (Liu, Xie, Tivendal, & Liu, 2015). As the concept of BIM keeps increasing, it has extended to scheduling, control of cost, assessment of energy usage, consideration of safety issues, operation of the buildings, and management of facilities.

The application of computer-related processes in the Nigerian construction industry is presently at an early stage. BIM is expected to be used by professionals who have a certain level of ICT knowledge to use BIM efficiently. Knowledge of ICT is essential for major job roles since it enables the management of workload, enhances efficiency in the processes, and ensures access to digital information. Knowledge of ICT portrays the abilities required to efficiently deploy the components of ICT for the following purposes;

a. Booting a system and launching a desired program and platforms
b. Scanning, printing, and copying documents
c. Using cloud-based data storing and retrieval systems
d. By using search engines like Google or Bing.
e. Taking photos or videos using a digital camera
f. To use computers and the internet safely, for instance, to avoid revealing personal information, as well as preventing viruses, identity theft, and other online threats.
g. Use of everyday software packages like Microsoft Office, Excel, Power point to create, edit, and save documents.
h. Use of social media accounts.
i. Surfing the internet or using AI-related applications
j. Editing of images using applicable software.
k. The knowledge of coding and programming languages which include HTML, CSS, and JavaScript.

According to Goh (2005), the most common types of software used in the construction industry are for word processing, presentation, spreadsheet, Computer-Aided Design, and Internet applications. They are important for communicating, presenting, administrative processes, marketing and managing projects. The CAD software is used by Builders, Architects, Engineers, and Contractors for drafting, designing, simulation, and presenting (De Lapp et al., 2004), while Quantity Surveyors use them for measurement, quantities take-off, and Bills of Quantities preparations. Modern structural design software has 3D modeling capacity, designing and detailing complicated structures is now possible unlike when it was almost impossible (Walker & Hampson, 2003). The quantity surveying-related software increases the pace and accuracy at which quantity surveyors do their work.

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1.1 ICT Usage in the AEC Industry

ICTs provide means of effective management and communication during the construction process. Available data show that there is an increase in the yearly growth of investment in the construction industry (Löfgren, 2007) since it enhances business prospects (Isikdaget, Underwood, Kuruoglu, and Acikalin, 2007).

Most professionals operating in Nigeria are still reluctant to embrace the possibilities of information and construction technology (ICT) when compared with other developing economies (Oyewobi, Ibironke, and Oladosu, 2015). It is important to know that ICT technologies help to enhance the sharing of information between project stakeholders, provide new vistas for enhanced management of information, and encourage collaboration (Bowden, 2005). To achieve the high demands of project delivery by the owner as noted by Songer (2001), the only viable option for adoption by construction firms is the adoption of information technologies.

Therefore, as pointed out by Peansupap (2004), ICT can be applied to:

a. Boost construction productivity by increasing efficiency in operations, cutting costs and project costs.
b. Provide information integration that in turn can assist in the reduction of the volume of information handled and prevent loss of data
c. Increase cooperation by facilitating communication between project participants and the exchange of data (Ahmad, 2002; Sriprasert & Dawood, 2002b).
d. Enhance business or offer better service to customers (Skibniewski and Nitithamyong, 2004).
e. Enhance the internal functioning of organisations (Sulakatko, 2016).

1.2 The Importance of ICT in BIM Adoption

The assessment of the importance ICT has to play in the AEC industry has focused on easy execution of jobs which has been hindered by the power issues, cost of infrastructure, cost of software, and issues of training professionals. Using the new technology efficiently can save a huge amount for contractors (Ganesh and Prakriti, 2018). Hence, developing countries like Nigeria must understand the need for new technologies of information and communication in construction and break the technical crises.

According to Azhar (2011), the building information model is applicable in the following areas;

a. Cost estimating: BIM-enabled applications can take off quantities, and adjust necessary changes as they occur through the design to construction phases.
b. Construction sequencing: Developed models can be used for the coordination of material ordering, fabrication of components, and delivery of schedules building components.
c. Code reviews: Relevant departments may use generated models for their review of building projects.
d. Clash detection: This allows the checking of interferences from different 3D models generated by distinct professionals.
e. Fabrication of shop drawings: The developed model makes it easy for the shop drawings to be generated once the model is finished.
f. Visualization: When a model is developed, the team can view it from different locations.
g. Facility managers use this system to develop as-built designs for maintenance and renovation purposes.
h. When chips are integrated into the system, possible failures can be detected.

1.3 Challenges of ICT Deployment

a. ICT deployment in organisations requires good investment which most business owners are not willing to make. There is also a problem of internet connectivity in rural places where most construction works are sited. Therefore, spending funds for internet connectivity in rural places increases the project costs.
b. There is also a technical issue with the ability of personnel working on the sites since they have limited knowledge of ICT usage compared to those in the office. This will make companies pay more before they can send experts to such places.
c. Deploying ICT in projects can be quite complex especially if they have to get permissions. Ordinarily, it should cost the government less to set up ICT infrastructure in a locality instead of relying on individual efforts.
d. Usually, there is no financial justification for the training of ICT personnel for small jobs. It is impractical to also train local workers over the period of the project.

1.4 Building Information Modelling (BIM) Concept

As an intelligent model-based 3D process, Building Information Modeling (BIM) provides professionals in AEC with the necessary details needed for project conception, planning, designing, constructing, operating, and managing of building structures and infrastructures. Davies and Harty (2013), see BIM as a digital environment used for building

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projects and its associated activities at the design and pre-construction phases to retrieve data from a three-dimensional model-based component by multiple several project team members operating at different locations during the project.

Building Information Modeling has been shown to be a great knowledge area within the design, construction, maintenance, and operation industry. According to Gu and London (2010), it is an IT-enabled approach implies the application, and maintenance of a single digital representation of the information for different stages of a building development from conception to delivery in the form of a data repository. The United States National BIM Standard presented its vision for Building Information Modeling as an enhanced process of planning, designing, constructing, operating, and maintaining of facilities through the use of standard information model that are readable by machines for each building facility regardless of its stage, which contains the needed information, generated or obtained about the facility in a form that can be used all through its lifecycle (NBIMS, 2007).

Furthermore, BIM has an essential function within the Big Room context as the designer and construction team synchronize and visualize the various designs as they progress, thereby eliminating the necessity for interfacing with 2D drawings and enhancing the quality of design (Do, Ballard, and Tillmann, 2015). According to Dave et al. (2015), it has been proposed to be one of the underlying technologies for developing Virtual Big Room concept (ViBR). ViBR supports communication between project stakeholders virtually through the use of tools and processes is a set of new tools and processes that allow them to interface from different geographical locations. Through the help it provides with planning, designing, estimating, budgeting and operation throughout the project life cycle, it reduces uncertainties during the building process and delivering projects faster, economically with little interference to the environment.

As BIM gets adopted, standards are been developed by countries that mandate the required levels to be achieved for projects (Lorek, 2018). For instance, in the United States, several public sector organisations have set different BIM programmes, established BIM targets, initiated BIM implementation strategies and developed BIM standards (Porwal and Hewage, 2013). Apart the USA, Countries that have used BIM include United Kingdom, Germany, France, Switzerland, etc.

BIM has great advantage in the construction from the beginning to the end of the project. In construction, there are many BIM softwares which may include: Revit, Autodesk BIM 360, Archicad, AECOsim, Navisworks, PriMus IFC, Hevacomp, etc.

a. Autodesk BIM 360 is designed to harmonise the management, design, and construction aspects of projects. It is considered the best building information modeling software since it links model data from projects and teams physically from the design phase to operations.
b. Autodesk Revit is developed by Autodesk as a BIM tool for architectural design, structural design and detailing, Mechanical, Electrical, and Plumbing designs.
c. Navisworks software was developed by Autodesk to aid model coordination and detection of clashes between various designs. This is particularly helpful since it identifies possible clashes among the various designs to forestall conflicts at the site during the construction phase.
d. ArchiCAD is used in architectural designs, modeling, and simulation.
e. AECOsim Building Designer is mainly used for designing, analysing, documenting, and visualizing structures regardless of their complexity.
f. Hevacomp is used to aid energy efficiency in buildings through the simulation of real-world scenarios.
g. PriMus IFC automatically generates Bills of Quantities from 3D files.
h. Midas Gen is used by Engineers for structural analysis.
i. Buildertrend is used for construction project management by Builders, Maintenance Managers, Maintenance Managers, Contractors, and general contractors. As a cloud-based solution, it is used for managing finance, time, customers and various services.

Generally, BIM software can also be used to monitor site safety during the construction phase. It is capable of monitoring the performance of building components for maintenance purposes.

Therefore, this study aims to explore the roles of Information and Communication Technology knowledge of construction professionals in the adoption of Building Information Modeling.

2. METHODOLOGY

The mixed research method combines both quantitative and qualitative methods. It was best for this study as it shuttles freely through the various methods, techniques, and procedures typically associated with quantitative or qualitative research; hence, enjoys the benefit of triangulation. For instance, a significant benefit of the qualitative methods is that it facilitates an in-depth understanding of contextual issues; hence, it helped to outline the various challenges and benefits of BIM adoption in the study area and also to establish the roles of the different construction professionals in

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the BIM processes in the study area. On the other hand, a significant benefit of the quantitative approach is that it facilitates the generalisation of findings through the collection of a large amount of data and the use of statistical methods of analysis. Generalization was significant for this study because the goal was to develop an appropriate framework for Building Information Modeling adoption in the study area, FCT . Abuja.

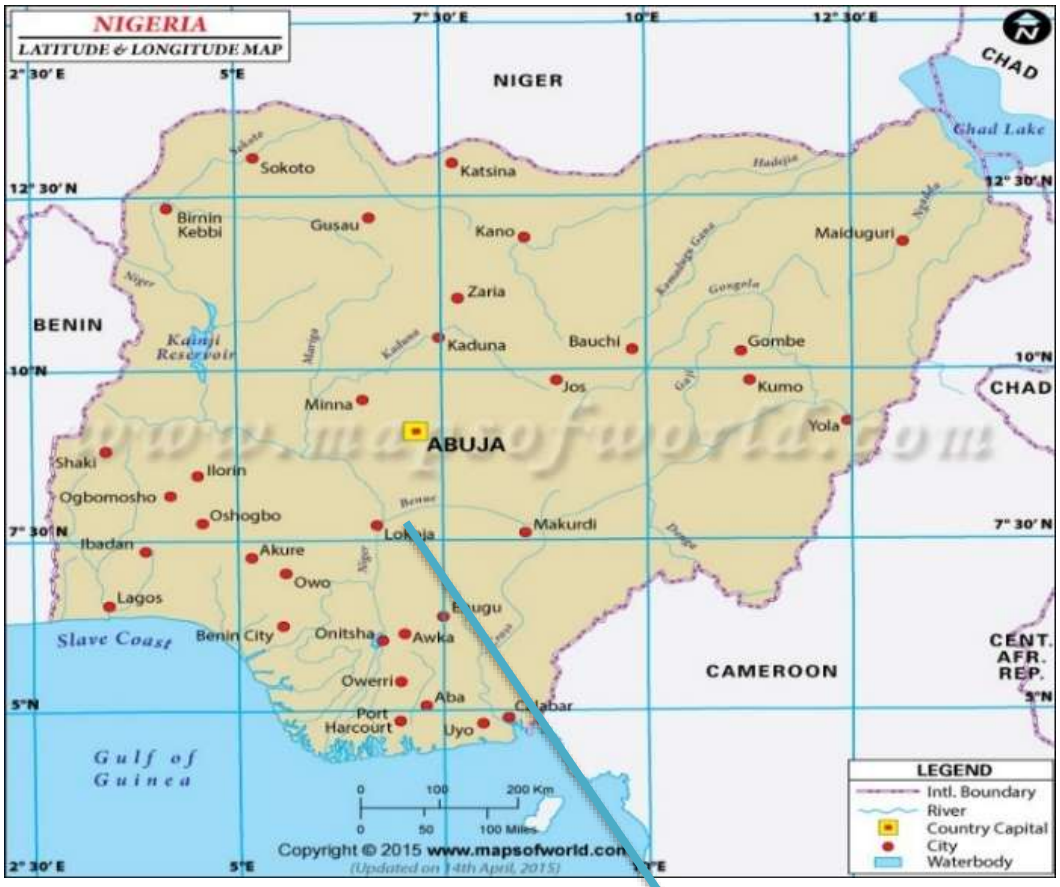

Fig. 1. Map of Nigeria

Source: mapsofworld.com (Date Accessed: 2025)

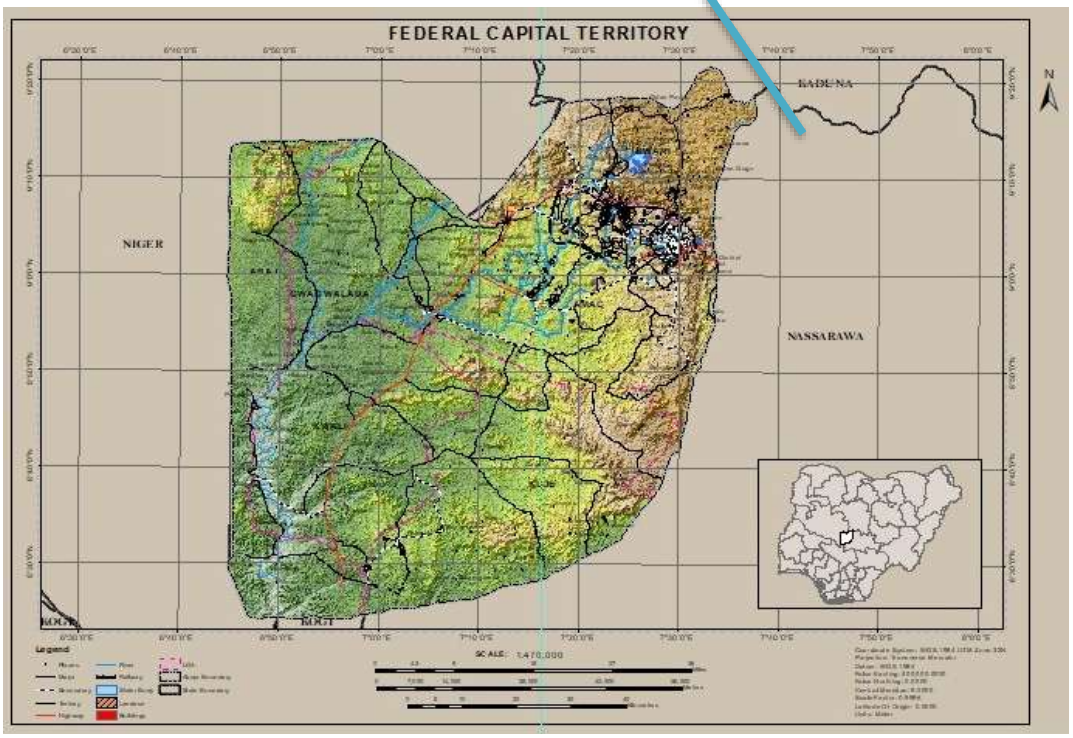

Fig. 2. Map of FCT- the Study Area

Source: sundiatapost.com (Date Accessed: 2025)

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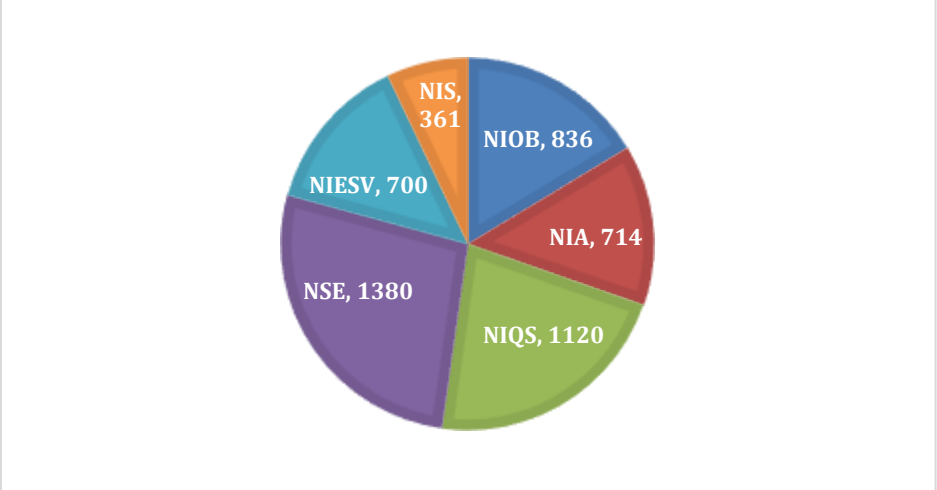
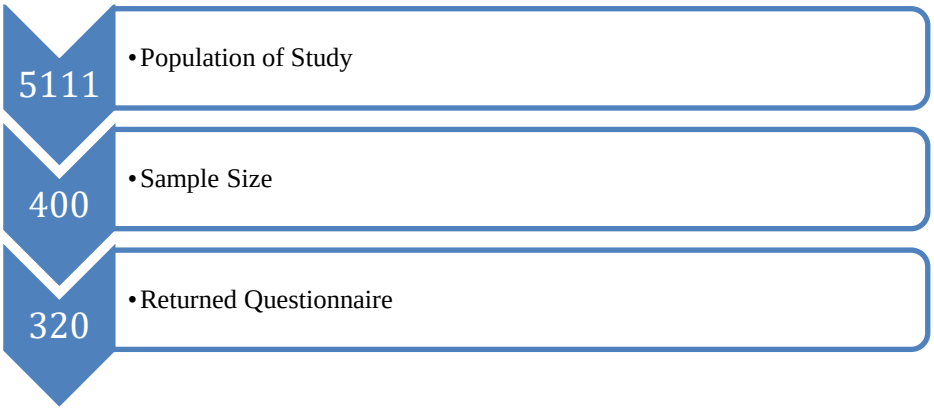


Fig 3 Population of the Study

Source: Field work



The population of the study was obtained based on the number of professionals working in FCT-Abuja. A purposive sampling technique was used for the study so respondents could be restricted to persons with knowledge of ICT and BIM usage. Questionnaires structured using the 5 Points Likert scale was adopted as the primary source of data. They were distributed in hard and soft copies respectively. 320 questionnaires were returned and used for the analysis.

3. RESULTS AND DISCUSSION

Table 1. The roles of Information and Communication Technology knowledge of construction professionals in the adoption of Building Information Modeling.

	Mean ± SD	WiXi	RII
Information and Communication Technology plays an important role in construction.	5.48 ± 1.95	1753	92.26
ICT is relevant from the conceptual to the maintenance stage of buildings.	5.39 ± 0.90	1726	90.33
The slow pace of ICT knowledge of professionals has affected BIM adoption.	4.37 ± 1.06	1438	70.08
Infrastructure issues, cost of software, staff training, and site location have affected the adoption of ICT	5.27 ± 0.82	1692	87.97
The adoption of BIM will help with visualization, collaboration among professionals, clarity of jobs, cost saving, avoid rework.	5.40 ± 0.84	1731	90.72
	5.18±1.114		86.27

The table above was generated to explore the roles of Information and Communication Technology (ICT) knowledge of construction professionals in the adoption of Building Information Modeling (BIM). It highlights that it is important for professionals to have ICT knowledge to properly fit into the adoption of BIM (mean = 5.18>3.00, RII = 86.27). The slow pace of ICT knowledge of professionals may have affected BIM adoption. Infrastructure issues, cost of software, staff training, and site location have affected the adoption of ICT have significant effect on BIM adoption.

4. CONCLUSION

The adoption of Building Information Modeling is gaining traction all over the world but the speed of adoption in Nigeria seems very slow. Since it is anchored on Information and Communication Technology, in exploring the relationship between the usage of ICT by construction professionals and the adoption of BIM, this study found a strong relationship between the two variables.Therefore, ICT knowledge should be continuously encouraged for professionals. This can be done during workshops organized by the respective professional bodies while the professionals will be encouraged to practice them in their daily works.

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