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EFFECT OF BUILDING INFORMATION MODELLING ON QUANTITY SURVEYING SERVICE DELIVERY IN NIGERIA.

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ABSTRACT

The main thrust of this study is to investigate the effect of building information modelling on quantity surveying service delivery in Nigeria. A descriptive survey design was adopted. The population of consulting and contracting firms in north-eastern Nigeria, in which 75 were randomly selected for the study. The instrument for data collection was structured questionnaire designed by the researcher. Over budget, delays, rework, standing time, material waste, poor communication and conflict are typical issues that have been faced by todays construction industry, with the added pressures from the current global economic difficulties the need to address and resolve these problems has never been greater, key to tackling such widespread and internationally recognized was could be through optimizing building design information exchange efficiency and accuracy with a view to creating great certainty in delivery of construction projects (Hooper, 2012).The data for the study was analyzed using descriptive statistics (mean and standard deviation). The findings of the study revealed that Quantity surveyors in traditional-based and BIM-based environments engage in tasks such as project cost estimation, design change management, and sustainability assessment. Moreover, the result revealed that lack of standardized protocols for BIM implementation. Furthermore, The Perceived impact of Building Information Modelling on quantity surveyors service delivery include efficiency of project workflows, greater transparency in project information, better risk management and data management and documentation. Based on the findings, it is recommended amongst others that To improve the integration of BIM in quantity surveying, organizations should invest in more comprehensive BIM training programs and promote collaborative practices that fully utilize BIM functionalities for cost estimation, project management, and sustainability assessments.

INTRODUCTION

Background of the study

The concept of BIM has been define by Mordue, Swaddle & Philp, (2015) as "a process of combining information and technology to digitalize a project which integrates data and information about the project from several sources and that model evolves with the complete timeline of the actual project". Kim and Park (2016) described that BIM tools enhance the productivity and fragmented practice in the construction industry. BIM has shaped the traditional role of construction professionals which was shaped by the traditional construction procedures (Liu et al., 2017). Thus, making holistic insights into refined job roles requiring upgraded skills and competencies become significant.

Quantity surveyors are ubiquitous in the construction industry (Poon, 2003) Conventionally, quantity surveyors' services include the preparation of preliminary estimates and feasibility studies, cost plans and schedules, and bills of quantities. Quantity surveyors draft and compile documentation for construction contracts, and prepare and analyse construction contract tenders. They also provide advice on contractor selection and financial management of all construction works and allied reporting, including auditing, planning cost and indexing. They provide construction project management services as well as value management, facilities management, management contracting, construction dispute resolution, research, and other forms of consultancy services (Nkado, 2000)

BIM based project delivery can be known as the project which is based on BIM application spans over the entire lifecycle of a facility such as: project programming, design, preconstruction and post construction phases (Gayathri, Suranga , & Ranadewa, 2013) reliable cost estimate demands accurate building information to minimise estimation errors, especially in the early phase process (Choi, Kim, & Kim, 2015). As described by Monteoiro and Martins ,(2013) using 2D measurements and 2D designs can lead to errors and omissions throughout the various construction stages, which lead to inaccurate estimation for budgeting. BIM implementation specifically plays a significant role in improving information in the early stages of construction projects.

Conventional construction estimating practices have been criticized because there is hardly an estimate without its own peculiarities (Sutrisna, Buckley, Potts, & Proverbs, 2005) and current estimating processes are seen by some as too rigid. However, BIM measurement represents an approach that could have a marked impact on preconstruction processes. Such measurement and its link with estimating are very real possibilities, but there are considerable challenges still to be overcome.

The construction industry is one of the vital contributors to the national economy of any country (Blayse and Manley, 2004). Yet, the industry has faced several changes such as globalization, technological evolution and increased regulation which has led to a competitive environment (Horta and Camanho, 2014). In order to keep pace with this dynamic nature, the construction industry requires to be more innovative and informative (Aouad et al., 2010). However, compared to other industries, the construction industry has been criticized for being inefficient due to its excessive use of energy and natural resources as inputs and generation of extensive amounts of waste and greenhouse gases (Abanda et al., 2017, Winch, 2003, Xu, 2017). In order to address the issue of inefficiency in the construction industry, Building Information Modelling (BIM) has been introduced. Several definitions are found interpreting BIM as a tool of communication, project management, cost management and information technology (NBIMS, 2015, Mordue et al., 2015).

Building Information Model is a perception which has been identified and viewed by many authors in different ways. Karen (2014) defined BIM as an integrated, structured digital database, informed by the architecture, engineering, and construction, operations (AECO) industry that consist of 3D parametric objects and allow for interoperability. BIM is an improved process and tool, which contains a set of virtual aspects, concepts and systems of a facility within one environment (Azhar, Khalfan , & Maqsood, 2012). Sacks (2010) described BIM as the utilization of a database infrastructure to summarize built facilities with specific viewpoints of stakeholders, so that stakeholders can query, simulate and estimate activities and monitor the building process as a lifecycle entity. Arayici and Aouad (2010) also defined BIM as the use of ICT technologies to streamline the building lifecycle processes to provide a safer and more productive environment for its occupants, to assert the least possible environmental impact from its existence, and to be more operationally efficient for its owners throughout the building lifecycle.

Arayici and Coates (2012) also viewed BIM in most simple terms as the utilization of a database infrastructure to encapsulate built facilities with specific viewpoints of stakeholders. It is a methodology to integrate digital descriptions of all the building objects and their relationships to others in a precise manner, so that stakeholders can query, simulate and estimate activities and their effects on the building process as a lifecycle entity.

However, Despite these previous studies, there is limited empirical study on its effect to quantity surveying service delivery, as the basis of practice of the profession in Nigeria still remain the traditional mode and that the major cause of the challenges faced by practicing on their project due to rework (Sahil, 2016) hence this study becomes imperative with a view of investigating and assessing the role of BIM in improving quantity surveying service delivery.
The aim of this research is to assess the effect of Building information modelling on Quantity

Surveying service delivery with a view to addressing some challenges faced by QS in discharging their professional obligations.

Objectives

1. To identify the Quantity surveyor's function in traditional based environment.
2. To identify the Quantity surveyor's function in BIM based environment.
3. To identify the challenges Quantity surveyors are facing in adjusting to BIM based project delivery process.
4. To assess the influence of BIM in quantity surveying service Delivery.
5. To evaluate appropriate ways to overcoming the challenges of BIM usage in Quantity surveying firms.

Research Questions

1. What are the Quantity surveyor's function in traditional based environment be identified?
2. What are the Quantity surveyor's function in BIM based environment be identified?
3. What challenges does Quantity surveyors faced in adjusting to BIM based project delivery process?
4. To what extent can the influence of BIM in quantity surveying service Delivery be assessed?
5. How can these appropriate ways to overcoming the challenges of BIM usage in Quantity surveying firms be evaluated?

LITERATURE REVIEW

Building Information Modelling (BIM) is one of the most promising developments in the architecture, engineering and construction (AEC) industries. Although the concepts, approaches and methodologies that we now identify as BIM can be dated back nearly thirtyyears, it is first now that BIM is beginning to change the way we plan, design and construct buildings and other infrastructure.

Concept and Evolution of Building Information Modelling (BIM)

Building Information Modelling (BIM) has emerged as a transformative approach in the architecture, engineering, and construction (AEC) industry. It integrates various tools, technologies, and processes to generate and manage digital representations of physical and functional characteristics of places. This literature review examines the concept of BIM, its benefits, challenges, and its role in enhancing project delivery. BIM is defined as a digital representation of physical and functional characteristics of a facility, serving as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward (National Institute of Building Sciences, 2007). The concept of BIM dates back to the 1970s but gained significant traction in the 2000s with advancements in computing power and software capabilities. The evolution of BIM can be traced through several stages: BIM Level 0 involves basic 2D CAD (Computer-Aided Design) drawings; BIM Level 1 encompasses managed CAD in 2D or 3D format; BIM Level 2 introduces collaborative working in 3D, but created in separate discipline models; and BIM Level 3 represents fully integrated, interoperable BIM, where a single shared model is utilized.

Benefits of BIM

BIM offers numerous benefits, including improved collaboration and communication, enhanced visualization, increased efficiency and productivity, cost and time savings, and improved facility management. By using a shared model, stakeholders can collaborate more effectively, reducing misunderstandings and errors (Eastman et al., 2011). BIM allows for better visualization of the project through 3D models, which can aid in identifying potential issues before they arise (Azhar, **2011**). Furthermore, BIM reduces the time required for documentation and improves the accuracy of information, leading to more efficient project delivery (Hardin & McCool, 2015). By detecting conflicts early and streamlining the construction process, BIM can result in significant cost and time savings (Azhar et al., 2011). Post-construction, BIM provides a comprehensive database for facility management, aiding in maintenance and operations (Teicholz, 2013).

Challenges in BIM Adoption

Despite its benefits, BIM adoption faces several challenges. High initial costs, interoperability issues, resistance to change, and a skill gap in the industry are notable barriers. The initial investment in BIM software and training can be substantial, deterring smaller firms from adoption (Gu & London, 2010). Different BIM software may not always integrate seamlessly, leading to interoperability challenges (Succar, 2009). The AEC industry is traditionally resistant to change, and the adoption of new technologies like BIM can face significant cultural and organizational barriers (Yan & Damian, 2008). Moreover, there is a notable skill gap in the industry, with a shortage of professionals proficient in BIM (Eadie et al., 2013).

Role of BIM in Enhancing Project Delivery

BIM enhances project delivery through various mechanisms, including clash detection, simulation and analysis, lifecycle management, and lean construction. Identifying and resolving clashes in the design phase prevents costly rework during construction (Eastman et al., 2011). BIM allows for various simulations and analyses, such as energy performance, structural integrity, and lighting, enhancing the design quality (Azhar, 2011). BIM supports the entire lifecycle of a building, from design and construction to operation and maintenance, facilitating better decision-making (Teicholz, 2013). Additionally, BIM promotes lean construction principles by reducing waste and improving workflow efficiency (Dave et al., 2013).

Building Information Modelling (BIM) in Quantity Surveying

Building Information Modelling (BIM) has emerged as a transformative tool in the field of Quantity Surveying (QS), offering digital solutions that enhance the accuracy and efficiency of cost estimation, budgeting, and project management. BIM facilitates the creation of 3D models embedded with data that support cost-related decisions throughout a building's lifecycle (Succar & Kassem, 2018). The adoption of BIM in QS practices has gained momentum due to its ability to improve the accuracy of quantity take-offs, reduce manual errors, and foster collaboration among project stakeholders (Bryde et al., 2019). This literature review examines the role of BIM in Quantity Surveying, focusing on its benefits, challenges, and future potential.

Benefits of BIM in Quantity Surveying

BIM provides several benefits to quantity surveyors, particularly in automating quantity take-offs and cost estimation. According to Won and Cheng (2019), BIM-integrated cost estimation tools can improve accuracy by up to 80%, compared to traditional methods. The automation capabilities of BIM reduce time spent on manual calculations and allow surveyors to focus on value-adding tasks such as cost analysis and forecasting. Moreover, BIM enhances visualization of cost-related data, enabling better communication with clients and other stakeholders (Ismail et al., 2020). In addition, BIM supports lifecycle cost analysis, which is critical for sustainable construction practices (Ghaffarianhoseini et al., 2019).

Challenges of BIM Adoption in Quantity Surveying

Despite its benefits, the adoption of BIM in Quantity Surveying is not without challenges. One major barrier is the lack of adequate training and technical skills among professionals (Olatunji, 2019). Many quantity surveyors are accustomed to traditional methods and may resist transitioning to BIM-based practices. Furthermore, the initial cost of software acquisition and implementation is a significant deterrent for some firms (Oke et al., 2021). Issues related to data interoperability and collaboration among different software platforms also pose challenges to seamless integration of BIM in QS (Abubakar et al., 2020).

BIM and Collaborative Practices in Quantity Surveying
BIM fosters improved collaboration across disciplines in construction projects, which is essential for accurate and efficient quantity surveying. For example, studies by Saka and Chan (2020) indicate that BIM enhances real-time communication among architects, engineers, and surveyors, thereby reducing errors and rework. Through cloud-based BIM platforms, quantity surveyors can access and update cost-related data in real-time, which promotes more dynamic and responsive project management (Zhang et al., 2021). Collaborative BIM practices are particularly beneficial in complex and large-scale construction projects where communication breakdowns can lead to significant cost overruns.

Future Prospects of BIM in Quantity Surveying
The future of BIM in Quantity Surveying appears promising, with ongoing advancements in digital technologies such as artificial intelligence (AI) and machine learning. Research by Hamza et al. (2022) suggests that AI-driven BIM tools can predict project costs with greater accuracy by analyzing historical data and identifying potential risks. The integration of BIM with Internet of Things (IoT) technologies also holds potential for real-time monitoring of construction progress and cost management (Mohammed et al., 2022). As the construction industry continues to embrace digital transformation, the role of BIM in Quantity Surveying is expected to become even more significant.

Functions of Building Information Modelling (BIM) in Quantity Surveying
Building Information Modelling (BIM) has significantly transformed the field of quantity surveying by enhancing the accuracy and efficiency of cost estimation and quantity take-off processes. Traditionally, quantity surveyors relied on manual methods to extract quantities from two-dimensional drawings, a time-consuming and error-prone task. With BIM, three-dimensional models embedded with detailed information about materials and components allow for automated quantity take-offs, reducing human error and expediting the estimation process. This automation enables quantity surveyors to provide more reliable cost estimates, thereby improving project budgeting and financial management (Alashwal et al., 2018).
Beyond cost estimation, BIM facilitates enhanced collaboration among project stakeholders, which is crucial for effective project management. The shared digital models serve as a single source of truth, ensuring that architects, engineers, contractors, and quantity surveyors are aligned in their understanding of the project scope and specifications. This collaborative environment minimizes discrepancies and misunderstandings, leading to more coordinated efforts and streamlined workflows. For quantity surveyors, this means they can access up-to-date information promptly, allowing for timely adjustments to cost plans and ensuring that financial considerations are integrated throughout the project lifecycle (Kulasekara et al., 2016).
Moreover, BIM's role in facilitating clash detection and constructability analysis has a direct impact on the quantity surveying profession. By identifying potential conflicts and issues in the design phase, BIM allows for the resolution of these problems before construction begins, thereby preventing costly rework and delays. For quantity surveyors, this proactive approach means that cost implications of design changes can be assessed early, and more accurate contingency allowances can be incorporated into the budget. This foresight not only enhances the precision of cost estimates but also contributes to more effective risk management in construction projects (Alashwal et al., 2018).

Challenges in Adjusting to Building Information Modelling (BIM) in Quantity Surveying
The integration of Building Information Modelling (BIM) into quantity surveying practices has been met with several challenges, particularly concerning the lack of expertise and training among professionals. A study focusing on South African quantity surveyors identified a significant deficiency in BIM expertise as a primary barrier to adoption. This lack of proficiency hinders the effective implementation of BIM, as professionals are not adequately equipped with the necessary skills and knowledge to utilize the technology efficiently (Otasowie et al., 2023). Similarly, research conducted

in Malaysia highlighted that the unfamiliarity with BIM among industry practitioners leads to the non-utilization of BIM models and files, further impeding its adoption within the quantity surveying profession (Tee et al., 2022).

Financial constraints also pose a significant challenge in the adoption of BIM within quantity surveying. The initial costs associated with BIM implementation, including software acquisition and the necessary hardware upgrades, are considerable. Additionally, the expenses related to training personnel to become proficient in BIM tools add to the financial burden. These costs can be particularly prohibitive for small and medium-sized enterprises (SMEs), which may lack the financial resources of larger firms. This financial barrier contributes to a slower rate of BIM adoption among quantity surveying firms, as the return on investment may not be immediately apparent (Otasowie et al., 2023).

Resistance to change within the industry further complicates the transition to BIM-based practices. Many professionals are accustomed to traditional methods and may be reluctant to adopt new technologies that require changes in established workflows. This resistance is often rooted in a lack of understanding of the benefits that BIM can offer, leading to hesitation in embracing the technology. The reluctance to change is compounded by a lack of client demand for BIM services, which diminishes the incentive for firms to invest in BIM capabilities (Otasowie et al., 2023).

The absence of standardized protocols and guidelines for BIM implementation presents another significant hurdle. Without a unified set of standards, there is a risk of inconsistencies in BIM practices, which can lead to miscommunication and errors in project execution. This lack of standardization makes it challenging for quantity surveyors to integrate BIM into their existing processes seamlessly. The development and adoption of comprehensive BIM standards are essential to facilitate a more uniform and effective implementation across the industry (Otasowie et al., 2023).

Interoperability issues between different BIM software platforms also pose challenges in the adoption process. Quantity surveyors often work with various stakeholders who may use different BIM tools, leading to compatibility problems. These interoperability issues can result in data loss or misinterpretation, undermining the efficiency gains that BIM promises. Addressing these challenges requires the development of more robust data exchange standards and improved collaboration between software developers to ensure seamless integration across platforms (Keung and Shen, 2022).

Perceived Impact of Building Information Modelling (BIM) on Quantity Surveyors' Service Delivery

The adoption of Building Information Modelling (BIM) has significantly influenced the service delivery of quantity surveyors, particularly in enhancing cost estimation and project management. BIM allows for the automation of quantity take-offs, reducing human errors and improving the accuracy of cost estimates. According to Olatunji et al. (2020), BIM enhances the precision of cost-related information by integrating design and construction data into a single platform. Similarly, Keung and Shen (2022) highlighted that BIM's ability to generate real-time cost data supports better financial decision-making during project execution. Yusuf, Mohamed, and Musa (2022) also noted that BIM streamlines the measurement of materials and resources, contributing to more efficient cost management practices.

Despite these benefits, several challenges hinder the effective utilization of BIM in quantity surveying practices. One major obstacle is the lack of skilled professionals who can effectively operate BIM tools. Keung and Shen (2022) found that many firms struggle to find personnel with adequate BIM knowledge, resulting in underutilization of the technology. Similarly, Yusuf et al. (2022) observed that the steep learning curve associated with BIM software discourages firms from fully embracing its capabilities. Additionally, RICS (2021) emphasized that insufficient training programs further exacerbate this issue, limiting the widespread adoption of BIM among quantity surveyors.

BIM has also been perceived as a tool for improving collaboration among construction project stakeholders. By providing a shared digital model, BIM fosters better communication between architects, engineers, and quantity surveyors. Olatunji et al. (2020) explained that this collaborative environment minimizes discrepancies in project information, leading to more cohesive project execution. Keung and Shen (2022) supported this view, stating that BIM promotes real-time information sharing, which enhances project coordination. Yusuf et al. (2022) further asserted that improved collaboration through BIM reduces delays caused by miscommunication and incomplete information.

However, interoperability issues remain a significant challenge to BIM adoption in quantity surveying. Different BIM software platforms often struggle to communicate seamlessly, leading to data loss and inconsistencies. Keung and Shen (2022) reported that software compatibility issues create difficulties in exchanging information between stakeholders. Similarly, RICS (2021) identified that the lack of standardized data exchange protocols hinders effective BIM implementation. Otasowie et al. (2023) noted that developing universal standards for BIM software would help mitigate these interoperability challenges.

Financial considerations also influence quantity surveyors' perceptions of BIM. The costs associated with software acquisition, hardware upgrades, and staff training can be substantial. RICS (2021) found that small and medium-sized enterprises (SMEs) are particularly affected by these financial burdens. Keung and Shen (2022) indicated that firms often weigh the initial costs against the perceived long-term benefits of BIM before committing to its adoption. Yusuf et al. (2022) observed that despite the high initial investment, firms that successfully implement BIM experience long-term cost savings through improved efficiency.

In conclusion, the perceived impact of BIM on quantity surveyors' service delivery is largely positive, particularly in terms of enhancing cost estimation accuracy, collaboration, and project management efficiency. However, challenges related to skills shortages, interoperability issues, and financial constraints persist. Addressing these challenges through targeted training programs, standardized protocols, and financial support mechanisms could enhance BIM adoption in the quantity surveying profession.

Ways of Improving Services Rendered by Quantity Surveyors in Building Information Modelling (BIM)

The integration of Building Information Modelling (BIM) into quantity surveying practices has significantly transformed the construction industry. One of the primary strategies to enhance the services rendered by quantity surveyors (QS) is through continuous professional training and development. According to Adeniran et al. (2020), training programs focused on BIM-related competencies improve QSs' ability to utilize digital tools for cost estimation and project management. Similarly, Okoye and Umeh (2021) emphasized the importance of BIM certifications in equipping QSs with the necessary skills for digital project delivery. Furthermore, Adebayo et al. (2019) highlighted that professional development initiatives not only improve individual competencies but also enhance the overall efficiency of QS services in BIM environments.

Another critical approach is the adoption of advanced BIM software and tools tailored for quantity surveying tasks. Eze et al. (2022) noted that integrating tools like CostX, Navisworks, and Revit facilitates accurate quantity takeoff and cost estimation. Similarly, research by Ibrahim et al. (2021) indicated that software upgrades and customization contribute to better collaboration between QSs and other construction professionals. In addition, Musa and Bello (2020) observed that software tools that support real-time data sharing improve the accuracy and reliability of cost-related decisions in BIM projects.

Collaboration and teamwork are also essential in enhancing QS services in BIM-integrated projects. As highlighted by Yusuf et al. (2021), inter-professional collaboration through BIM platforms like Common Data Environments (CDEs) fosters effective communication and coordination. Similarly, Akintola et al. (2020) found that BIM-based collaboration improves project outcomes by minimizing errors and reducing rework. Research by Olatunji and Adamu (2019) further supports the assertion that collaborative practices in BIM environments lead to more accurate cost forecasting and streamlined project execution.

Educational institutions and curricula adjustments play a pivotal role in preparing future QSs for

BIM-integrated roles. According to Ojo et al. (2022), incorporating BIM-related courses into quantity surveying programs enhances graduates' readiness for digital construction processes. Moreover, research by Suleiman and Garba (2023) revealed that universities offering`1R2 hands-on BIM training produce professionals with superior technical and analytical skills. This finding is corroborated by Ahmed et al. (2021), who observed that graduates with BIM knowledge adapt more quickly to industry demands.

The development of standardized BIM protocols and guidelines for quantity surveying practices is another vital improvement strategy. Bello et al. (2021) reported that industry-specific BIM standards reduce ambiguity and improve consistency in cost estimation practices. Similarly, research by Ibrahim et al. (2022) demonstrated that standardized protocols facilitate better integration of QS tasks with other project activities. According to Yusuf and Ahmed (2023), the implementation of national and international BIM standards supports the delivery of high-quality services by QSs.

Finally, the implementation of policy and regulatory frameworks to guide BIM adoption in quantity surveying practices can significantly improve service delivery. Musa et al. (2019) argued that government policies mandating BIM use in public projects accelerate the adoption of digital practices among QSs. Research by Okoro et al. (2022) further emphasized the role of professional bodies in advocating for regulatory frameworks that support BIM integration. Additionally, Aliyu and Ibrahim (2023) suggested that policies promoting BIM education and certification contribute to more effective QS services.

RESEARCH METHODOLOGY

The study objectives entailed exploration of literature effect of building information modelling on quantity surveying service delivery in Nigeria. The literature reviewed were used to design a structured questionnaire to get the opinion of construction professionals on effect of BIM. Thus, this study adopted descriptive designs for all its objectives. The study was conducted in Gombe State of Nigeria. Gombe metropolis is the administrative and political headquarter of Gombe State. It is located in the north eastern geopolitical zone of Nigeria. The population of the study comprised of construction professionals registered with regulatory bodies overseeing the activities of members under their body and certified by the Nigerian government to practice. As core building procurement professionals saddled with the management construction projects: Architect, Builders; Construction Managers, Engineers, and Quantity. The study used an accessible population of 75 construction professionals that are identified to be involved in construction project. The accessible population serve as the study sample frame. From a sample frame of 90 construction professionals, this study arrived at a sample size of 75 using Krejcie and Morgan (1970). The advantages of the Krejcie and Morgan Table is that it gives very high sample sizes for small to medium sized population and as such, the bigger the sample, the better the representation of the population, and the more accurate the research result (Dawson, 2002; Sambo, 2008; Guthrie, 2010). The heterogeneous nature of the study population makes it impossible to apply simple random sampling. Thus, study adopted a convenience sampling technique so as to access the respondents that are available at the time of the study and reflects the proportional distribution of the population (Dawson, 2002; Sambo, 2008).

RESULT AND DISCUSSION

Table 4.1 showed that 48 of the respondents representing 64.0% are contractors, while 27 representing 36% are consultants.

Demographic Information of the Respondents

Table 4.1: Frequency and percentage of area of specialization of the respondents

S/N	Contractors	Consultants	TOTAL
1	27 (36.0%)	48 (64.0%)	75 (100%)

Table 4.2 showed that 15 of the respondents (20.0%) are in top management level, while 18 (24.0%) and 42 (56.0%) are in middle management and lower management levels respectively.

Table 4.2: Frequency and percentage management level of the respondents

S/N	Top Management	Middle Management	Lower Management	TOTAL
1	15 (20.0%)	18 (24%)	42 (56.0%)	75 (100%)

Table 4.3: Frequency and percentage educational specialization of the respondents

S/N	Architects	Builders	Civil Engineers	Quantity Surveyors	Service Engineers	TOTAL
1	24 (32.0%)	11 (14.7%)	19 (25.3%)	14 (18.7%)	7 (9.3%)	75 (100%)

Table 4.3 showed that 24 of the respondents representing 32.0% are Architects, 11 (14.7%) are builders, 19 (25.3%) are civil engineers, 14 (18.7%) are quantity surveyors and 7 (9.30 %) service engineers

Table 4.4: Frequency and percentage educational qualification of the respondents

S/N	OND	B.Sc/HND	M.Sc/M.Tech	PhD	TOTAL
1	8 (10.7%)	34 (45.3%)	24 (32.0%)	9 (12.0%)	75 (100%)

Table 4.4 showed that 8 of the respondents representing 10.7 % have educational qualification of OND, 34 (45.3%) have B.Sc/HND, 24 (32.0%) have M.Sc/M.Tech, and 9 (12.0%) PhD.

Table 4.5: Frequency and percentage years of experience of the respondents

S/N	Less than 5 years	5-10 years	11-15 years	15-20 years	20 years and above	TOTAL
1	22 (29.3%)	27 (36.0%)	7 (9.3%)	12 (16.0%)	4 (9.3%)	75 (100%)

Table 4.5 showed that 22 of the respondents representing 29.3% have less than 5 years of experience, 27 (36.0%) have 5-10 years, 7 (9.30%) have 11-15 years, 12 (16.0%) have 15-20 years, and 7 (9.30%) have above 20 years of experience.

Research question one: what are the Quantity surveyor's function in traditional based environment be identified?

Table 4.6: Mean and standard deviation of the responses of the respondents on Functions of Quantity surveyors in traditional based environment

S/N	Items	Mean	Standard Deviation	Remark
1	accurately values work done for interim payments to contractors	3.84	1.053	High
2	provide expert advice and support in resolving contractual and financial disputes	3.59	1.285	High
3	effectively identify, analyzes, and manages financial risks associated with construction projects	3.53	1.266	High
4	use BIM tools effectively to identify and resolve design conflicts	2.47	.935	Low
	Grand mean	3.36	1.135	

The mean and standard deviation values from Table 4.6 show how the respondents evaluated the functions of quantity surveyors in a traditional-based environment. Most functions, such as accurately valuing work done for interim payments (Mean = 3.84, SD = 1.053) and providing expert advice in resolving contractual disputes (Mean = 3.59, SD = 1.285), were rated "High," indicating a strong acknowledgment of these responsibilities by the respondents. However, the use of BIM tools to resolve design conflicts (Mean = 2.47, SD = 0.935) was rated "Low," showing that the integration of BIM tools in traditional environments is less prominent. The grand mean of 3.36 with a standard deviation of 1.135 suggests that quantity surveyors are generally perceived to have significant roles in traditional environments, though technological advancements like BIM are underutilized.

Research question two: What are the Quantity surveyor's function in BIM based environment be identified?

Table 4.7: Mean and standard deviation of the responses of the respondents on Functions of Quantity surveyors in Building Information Modelling based environment

S/N	Items	Mean	Standard Deviation	Remark
6	provide enhanced project visualization using 3D models, aiding in client decision-making	2.52	1.155	Moderate
7	utilize BIM data to analyze and estimate the total cost of ownership over the project's lifecycle	2.84	1.231	Moderate
8	facilitate improved collaboration among project stakeholders through shared BIM models	2.75	1.116	Moderate
9	manage and evaluates the impact of design changes effectively using real-time data from BIM models	2.77	1.203	Moderate
10	use BIM to assess and optimize the sustainability and environmental impact of construction projects	2.80	1.294	Moderate
11	maintain accurate and up-to-date digital records of the project using BIM	2.56	1.106	Moderate
	Grand mean	2.71	1.184	

Table 4.7 presents the functions of quantity surveyors in a Building Information Modelling (BIM) based environment, with a grand mean of 2.71 and a standard deviation of 1.184. The results show that the functions in this environment were generally rated as "Moderate." Tasks such as utilizing BIM data to estimate total project lifecycle costs (Mean = 2.84, SD = 1.231) and managing design changes with real-time BIM data (Mean = 2.77, SD = 1.203) were moderately recognized. This reflects a developing but not fully integrated role for quantity surveyors in BIM-based environments. While there is some utilization of BIM for project collaboration and sustainability assessments, the moderate scores suggest that further adoption and training are needed for these functions to be fully realized.

Research question three: what challenges does Quantity surveyors faced in adjusting to BIM based project delivery process?

Table 4.8: Mean and standard deviation of the responses of the respondents on Challenges faced by Quantity surveyors in adjusting to Building Information Modelling

S/N	Items	Mean	Standard Deviation	Remark
11	face difficulties in adapting to new BIM software and tools requires significant time	3.47	1.070	Moderate
12	Difficulties in integration of BIM data with existing cost management systems	3.57	1.141	high
13	High cost of BIM software and training	3.53	1.256	high
14	face challenges in ensuring the accuracy and reliability of data entered into the BIM model	2.25	.960	Rarely
15	compatibility issues between different BIM software used by various project participants.	3.47	1.057	Moderate
16	Difficult to manage frequent changes and updates in the BIM model	2.56	1.003	Moderate
17	Lack of standardized practices and protocols for BIM implementation across different projects and organizations	3.93	.963	High
18	Lack of Access to adequate technical support and	2.73	1.201	Moderate

	resources for troubleshooting BIM-related issues			
19	encounter resistance from colleagues and stakeholders who are accustomed to traditional methods and skeptical about adopting BIM	2.20	1.103	low
	Grand mean	**2.97**		

The results in Table 2 indicate that quantity surveyors in Nigeria, generally exhibit a low to high level challenges in Building Information Management. Items 12, 13 and 17, which focus on aspects like Difficulties in integration of BIM data, challenges in ensuring the accuracy and reliability of data, Lack of standardized practices and protocols for BIM implementation, all fall within the high level, with means ranging from 3.53 to 3.93. These indicate that the high cost of BIM software makes it difficult to be conversant with the software and also the implementation in several organizations. Moreover, items 11, 15, 16 and 18 which focused on the challenges like difficulties in adapting to new BIM software, compatibility issues between different BIM software, Difficult to manage frequent changes and updates, and Lack of Access to adequate technical support with mean ranges from 2.53 to 3.47. this suggests that the quantity surveyors are not consistently and effectively manage frequent changes and updates due to lack of proper technical support.
Interestingly, items 19 shows that there is low resistance from colleagues and stakeholders who are accustomed to traditional methods and skeptical about adopting BIM. This suggest that the use of BIM over traditional ways in building environment is encouraging. The grand mean of 3.27 indicates a challenge faced by quantity surveyors in BIM environment was moderate.

Research question four: To what extent can the perceived impact of BIM in quantity surveying service Delivery be assessed?

Table 4.9: Mean and standard deviation of the responses of the respondents on Perceived impact of Building Information Modelling on quantity surveyors service delivery

S/N	Items	Mean	Standard deviation	Remark
20	Using BIM has significantly improved the accuracy of cost estimation and quantity take-offs in our projects	2.73	1.277	Moderately impact
21	BIM has increased the efficiency of project workflows and reduced the time spent on manual calculations	3.79	1.398	Highly Impact
22	BIM has improved collaboration and communication with other project stakeholders, leading to better coordination	3.63	.955	Highly Impact
23	The use of BIM has resulted in greater transparency in project information, aiding in better decision-making	3.81	1.259	Highly Impact
24	BIM allows for better risk management	3.99	1.020	Highly Impact
25	BIM enhances ability to control and monitor costs throughout the project lifecycle	3.37	1.024	Moderately impact
26	BIM facilitates more effective change management through real-time updates and impact analysis	2.56	1.003	Moderately impact
27	BIM improved data management and documentation	3.67	.991	Highly Impact
28	BIM helps in assessing sustainability and lifecycle costing	3.00	1.346	Moderately impact

29	Adopting BIM gives competitive advantage by utilizing advanced technologies and methods in project delivery	3.23	1.226	Moderately impact
	Grand mean	**3.01**		

The results in Table 3 indicate that quantity surveyors in Nigeria, generally exhibit a moderate to high level of perception on the impact of Building Information Management on their service delivery. Items 20, 25, 26, 27 and 28 which focus on aspects like improved the accuracy of cost estimation, control and monitor costs, effective change management, assessing sustainability, all fall within the moderate impact, with means ranging from 2.56 to 3.37.

Moreover, items 21, 22, 23, 24, and 27 which focused on the perceived impacts like efficiency of project workflows, collaboration and communication with other project stakeholders, greater transparency in project information, better risk management and data management and documentation, fall within the highly impact with mean ranges from 3.67 to 3.99.

The grand mean of 3.01 indicates that Perceived impact of Building Information Management on quantity surveyors service delivery was moderate.

Research question five: How can these Appropriate ways to improving the services rendered by QSs be evaluated?

Table 4.10: Mean and standard deviation of the responses of the respondents on Appropriate ways of improving service rendered by Quantity surveyors in Building Information Modelling

S/N	Items	Mean	Standard Deviation	Remark
30	Regular training and professional development programs have improved our proficiency in using BIM technologies	3.76	1.025	Highly Appropriate
31	The implementation of standardized BIM processes	3.11	1.146	Moderate Appropriate
32	Collaborative BIM platforms for better communication and coordination among project stakeholders	3.65	1.109	High level
33	Integrating BIM data with cost management systems	3.65	1.072	Highly Appropriate
34	Regular audits and reviews of BIM models	3.28	1.279	Moderate Appropriate
35	Educating clients about the benefits of BIM and involving them in the process	2.73	1.212	Moderate Appropriate
36	Implementing robust data security measures for effectively protection of sensitive project information	2.41	1.187	Low Appropriate
37	Using BIM for sustainability assessments and lifecycle cost analyses	2.24	1.038	Low Appropriate
38	Establishing a system for continuous feedback from stakeholders	3.91	.903	Highly Appropriate

The results in Table 4 indicate that Appropriate ways of improving service rendered by Quantity surveyors in Building Information Modelling are generally low to highly appropriate. Items 31, 34 and 35 which focus on aspects like implementation of standardized BIM processes, Regular audits and reviews of BIM models, and Educating clients about the benefits of BIM are moderately appropriate, with means ranging from 2.73 to 3.28. Interestingly, items 30, 32, 33, and 38 which focused on the Regular training and professional development programs, Collaborative BIM platforms, Integrating BIM data, and establishing a system for continuous feedback from stakeholders are highly appropriate, with the mean ranges from 3.65 to 3.91. Moreover, items 36 and 37 which focused on the Implementing robust data security, Using BIM for sustainability assessments and lifecycle cost analyses fall within low level with mean ranges from 2.24 to 2.41.

Summary of Major findings

The findings of this study include:

i. Quantity surveyors in traditional-based environments are highly effective in valuing work for payments, resolving disputes, and managing financial risks, but they utilize BIM tools less frequently.
ii. In BIM-based environments, quantity surveyors moderately engage in tasks such as project cost estimation, design change management, and sustainability assessment, indicating room for increased integration of BIM functionalities.
iii. The challenges faced by quantity surveyors faced in adjusting to Building Information Modelling include difficulties in integration of BIM data, accuracy and reliability, and lack of standardized protocols for BIM implementation
iv. The Perceived impact of Building Information Modelling on quantity surveyors service delivery include efficiency of project workflows, greater transparency in project information, better risk management and data management and documentation
v. The appropriate ways of improving service rendered by Quantity surveyors in Building Information Modelling include maintaining regular professional development programs, Collaborative BIM platforms, Integrating BIM data, and establishing a system for continuous feedback from stakeholders

DISCUSSION

The study highlights that the functions of quantity surveyors (QS) in Building Information Modelling (BIM) encompasses several critical functions. Firstly, QSs are instrumental in ensuring accurate interim payments to contractors. The integration of BIM provides quantity surveyors with comprehensive and precise data about the construction project, from design to completion. This detailed information allows for accurate assessment of work done, leading to precise interim payments.

Additionally, QSs provide expert advice in resolving contractual and financial disputes. This is in lined with the finding of Smith (2014), who reported that BIM's ability to provide precise quantity data helps in producing reliable cost estimates, ultimately enhancing the accuracy of project budgeting and planning. Similarly, BIM facilitates the tracking of project changes and variations, offering a clear and detailed record that can be used to settle disputes efficiently, this is in agreement with the finding of Azhar (2011), who found that the ability of BIM to manage and document changes helps in minimizing disputes and ensuring that all stakeholders are informed about the impacts of changes, thereby improving overall project management..

BIM also offers a centralized repository of project information, which helps in resolving disputes by providing clear and transparent data, this finding agreed with Hardin and McCool (2015), who reported that using BIM for clash detection, quantity surveyors can ensure that the project design is fully coordinated, reducing the risk of unexpected issues during construction. This function not only saves time and money but also contributes to smoother project execution. Finally, managing financial risks is a key function where QSs leverage BIM to foresee potential financial issues, enabling proactive risk management. the predictive analytics capabilities of BIM enable better financial risk management by forecasting potential cost overruns and identifying areas where financial risks might arise.

In respect to research question two, the study revealed that the integration of BIM into quantity surveying practices presents several challenges. One primary issue is the difficulty in integrating BIM data across different platforms and stakeholders. BIM requires a seamless flow of information between various parties involved in a construction project, which can be hindered by compatibility issues or lack of technical expertise. This finding is in lined with Succar (2009) who reported that lack of standardization across various BIM tools can lead to difficulties in exchanging and integrating information seamlessly. Another significant challenge is ensuring the accuracy and reliability of BIM data. Inaccurate data can lead to flawed decisions, increased risks, and potential disputes. QSs must develop stringent validation and verification processes to maintain data integrity. This finding is in lined with Teicholz (2013), who reported that effective data management is critical to realizing the full potential of BIM, as it ensures that the information used for decision-making is accurate and reliable. Moreover, the lack of standardized protocols for BIM implementation poses a challenge. Without standardized procedures and guidelines, QSs may struggle with inconsistencies and inefficiencies, making it harder to achieve the full potential of BIM in improving project outcomes. This is in lined with Gu and London (2010), who reported that there is a shortage of experienced BIM professionals, making it difficult for firms to find and hire personnel with the requisite expertise.

In respect of research question three, the study revealed several perceived impacts on the service delivery of quantity surveyors using BIM. The use of BIM enhances the efficiency of project workflows by streamlining processes and reducing redundant tasks. The integrated nature of BIM means that QSs can access comprehensive project data in real-time, leading to quicker decision-making and improved coordination. Another notable impact is greater transparency in project information. BIM allows all stakeholders to access the same up-to-date information, fostering a more collaborative environment and reducing misunderstandings, this is in lined with McCuen (2019), the integration of BIM enhances communication and coordination, leading to more efficient project execution and better decision-making processes. Lastly, BIM significantly improves data management and documentation, ensuring that all project information is accurately captured, stored, and retrievable, which is crucial for project audits and future reference.

In respect to research question four, the study revealed the appropriate ways of Improving Service rendered by Quantity Surveyors in BIM. To enhance the services provided by quantity surveyors within a BIM framework, several strategies can be adopted. Maintaining regular professional development programs is crucial. These programs ensure that QSs remain updated on the latest BIM technologies and best practices, enhancing their capability to leverage BIM effectively.

Collaborative BIM platforms are also essential for improving communication and coordination among project stakeholders. Such platforms can facilitate the seamless exchange of information and foster a more integrated approach to project management. Integrating BIM data across different systems and stages of the project lifecycle is another key strategy. This integration ensures that QSs have access to comprehensive and accurate data, enabling better decision-making and project outcomes. This is in line with Succar (2009) who reported that significant challenge in BIM implementation is the lack of uniform standards, leading to inconsistencies and inefficiencies.

Finally, establishing a system for continuous feedback from stakeholders can significantly improve service delivery. By regularly collecting and analyzing feedback, QSs can identify areas for improvement, adapt their practices accordingly, and ensure that their services consistently meet the evolving needs of the construction industry.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The main thrust of this study is to investigate the effect of building information modelling on quantity surveying service delivery in Nigeria. A descriptive survey design was adopted. The population of consulting and contracting firms in north-eastern Nigeria, in which 75 were randomly selected for the study. The instrument for data collection was structured questionnaire designed by the researcher. The question consists of two sections: section A and B. section A of the question captures the information about the respondents. While section B on the other hand comprised 38 items spread in four clusters for functions of quantity surveyors, challenges faced by quantity surveyors in adjusting to BIM, perceived impacts and appropriate ways of improving services rendered by quantity surveyors using BIM. All the items in the questionnaire are on five Likert scales.

The data for the study was analyzed using descriptive statistics (mean and standard deviation). The findings of the study revealed that the functions of quantity surveyors in BIM conduct accurately interim payments to contractors, provide expert advice in resolving contractual and financial disputes, as well as manages financial risks associated with construction projects (mean = 3.53 to 3.85). it further reveals that, the challenges faced by quantity surveyors faced in adjusting to Building Information Management include difficulties in integration of BIM data, accuracy and reliability, and lack of standardized protocols for BIM implementation (mean = 3.53 to 3.93). Furthermore, the study found that the perceived impact of Building Information Modelling on quantity surveyors service delivery include efficiency of project workflows, greater transparency in project information, better risk management and data management and documentation (mean = 3.67 to 3.99). Finally, it was found that the appropriate ways of improving service rendered by Quantity surveyors in Building Information Management include maintaining regular professional development programs, Collaborative BIM platforms, Integrating BIM data, and establishing a system for continuous feedback from stakeholders (mean = 3.65 to 3.91). To fully harness these findings, the study recommends ongoing professional development, the use of collaborative BIM platforms, effective data integration, and a robust feedback system to continually refine practices and address emerging challenges.

Conclusion

The study concludes that while the integration of Building Information Modelling (BIM) presents significant benefits for quantity surveyors, including enhanced accuracy in interim payments, improved dispute resolution, and superior financial risk management, it also poses notable challenges such as data integration difficulties, accuracy and reliability concerns, and the absence of standardized implementation protocols. The positive impacts of BIM on service delivery, such as increased efficiency, transparency, and better risk and data management, underscore the transformative potential of BIM in the construction industry.

Recommendations

Based on the findings of the study, the following five recommendations are made:

It is recommended that quantity surveyors in traditional-based environments undergo specialized training in Building Information Modelling (BIM) to enhance their ability to use BIM tools effectively, especially for resolving design conflicts and improving project efficiency.

To improve the integration of BIM in quantity surveying, organizations should invest in more comprehensive BIM training programs and promote collaborative practices that fully utilize BIM functionalities for cost estimation, project management, and sustainability assessments.

Standardized BIM Protocols should be established. This will address integration and consistency issues, ensuring that all stakeholders have a common framework for using BIM, thus improving data reliability and project efficiency.

Deploy collaborative BIM platforms that facilitate seamless information sharing among all project stakeholders. These platforms should support interoperability between different software systems to overcome integration challenges and improve overall project communication and coordination.

Implement stringent data validation and verification processes to ensure the accuracy and reliability of BIM data. This will help mitigate risks associated with data errors and improve the decision-making process throughout the project lifecycle.

Create a system for continuous feedback from all stakeholders, including contractors, clients, and project managers. This feedback loop will help identify areas for improvement in BIM practices, allowing for ongoing refinement and adaptation to better meet the needs of the construction projects and industry standards.

Contribution to Knowledge

This study outlined the following as its contribution to knowledge:

i. The study provided more insight into factors effect of building information modelling applied and preferred in among the construction professionals in Gombe state Nigeria.
ii. The study has also examined the of effect of building information modelling industry, in Gombe state, Nigeria.

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