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QUANTITY SURVEYORS' FUNCTIONS IN A BIM-BASED ENVIRONMENT: EMPIRICAL EVIDENCE FROM BAUCHI METROPOLIS, NIGERIA

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Abstract
This study examined Quantity Surveyors' (QS) functions in a Building Information Modelling (BIM)-based environment in Bauchi Metropolis, Nigeria. A quantitative descriptive survey design was adopted. A self-administered questionnaire was distributed to 132 registered construction professionals, with 130 valid responses retrieved (98.5% response rate). Data were analysed using descriptive statistics with SPSS version 23. Findings revealed that digital valuations (M = 3.7094), change management (M = 3.6749), progress monitoring (M = 3.6453), payments progress (M = 3.5961), and automated quantities (M = 3.5862) ranked highest, indicating high QS function in a BIM-based environment. Conversely, automated take-offs (M = 3.4631), real-time cost feedback (M = 3.1972), and LOD verification (M = 3.1946) recorded moderate ratings. The results suggest a strong alignment between traditional QS competencies and digital evolution, particularly in financial administration functions, while full automation of measurement functions remains constrained by data quality and standardization issues. The study provides empirical evidence that QS professionals in Bauchi Metropolis have successfully adapted their core financial functions to BIM-based environments, signalling a professional readiness that outpaces current industry infrastructure. It highlights the need for unified Level of Development (LOD) frameworks to facilitate reliable automated quantity extraction.

Keywords: Building Information Modelling, Quantity Surveying, Digital Valuation, Change Management, Bauchi Metropolis, Nigeria.

Introduction
Building Information Modelling (BIM) is transforming the global construction industry by enhancing collaboration, efficiency, and accuracy in project delivery. BIM is an intelligent 3D model-based process that provides tools for more efficient planning, design, construction, and management of buildings (Azhar, 2021). In Quantity Surveying, BIM facilitates automated quantity take-offs, cost estimation, and real-time project monitoring (Eastman et al., 2021). Studies indicate that BIM improves accuracy in cost estimation by reducing human errors and enhancing data interoperability (Smith, 2019).

The concept of BIM has been defined by Mordue, Swaddle, and Philp (2017) 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 (2021) described BIM tools as enhancing productivity and reducing fragmented practice in the construction industry. BIM has shaped the traditional role of construction professionals which was shaped by traditional construction procedures (Liu et al., 2017), thus making holistic insights into refined job roles requiring upgraded skills and competencies significant. Quantity surveying services are universal in the construction industry (Aibinu & Venkatesh, 2019). 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 (Adebowale & Agumba, 2018). They also provide advice on contractor selection and financial management of all construction works and allied reporting, including auditing, planning

cost, and indexing (Ebekozien *et al.,* 2021). Despite its benefits, BIM adoption in Nigeria is still in its early stages (Liu *et al.,* 2017). Studies by Olatunji (2017) and Aibinu and Venkatesh (2019) identified barriers such as high implementation costs, lack of skilled personnel, and resistance to change affecting BIM adoption in Nigeria. However, Ebekozien *et al.* (2021) argue that BIM can improve cost management and reduce project delays in Nigeria if properly integrated. Despite its prospects, several challenges hinder BIM adoption in Nigeria: BIM software and training require significant investment and few QS professionals are proficient in BIM tools (Olatunji, 2017). Traditional QS practices are deeply entrenched, and inadequate technological support limits BIM implementation (Adebowale & Agumba, 2018).

The aim of this paper is to examine the barriers in the application of BIM for QS services project delivery with a view to improving the efficiency and effectiveness of quantity surveying service delivery in Bauchi Metropolis. The specific objective is to identify the Quantity Surveyor's functions in a BIM-based environment in Bauchi Metropolis.

Literature Review

Conceptual Review of BIM

Building Information Modelling (BIM) is one of the most promising developments in the architecture, engineering, and construction (AEC) industries. 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 (RICS, 2021).

The evolution of BIM can be traced through several stages: BIM Level 0 involves basic 2D CAD 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.

BIM-based project delivery spans the entire lifecycle of a facility including project programming, design, preconstruction, and post-construction phases (Ashworth & Hogg, 2017). Reliable cost estimates demand accurate building information to minimise estimation errors, especially in the early phase process (Otasowie *et al.,* 2023). As described by Mordue *et al.* (2017), using 2D measurements and 2D designs can lead to errors and omissions throughout the various construction stages, which lead to inaccurate estimation for budgeting.

Quantity Surveyor's Functions in a Traditional (Non-BIM) Environment

Quantity Surveyors (QS) play a critical role in cost management, procurement, and contract administration in construction projects. In a traditional (non-BIM) environment, their functions rely heavily on manual processes, 2D drawings, and fragmented communication.

QS professionals manually extract quantities from 2D drawings, leading to potential errors and delays (Ashworth & Hogg, 2017). Reliance on spreadsheets and manual take-offs increases the risk of inaccuracies (Alashwal *et al.,* 2018). Preparation of Bills of Quantities (BoQ) is time-consuming due to manual measurement (Smith, 2019). Traditional procurement methods often lead to disputes due to measurement discrepancies (Akintola *et al.,* 2020). Progress payments are based on manual site measurements, which can be subjective (Cartlidge, 2017). Variations and claims are harder to track without digital integration (Olatunji & Adamu, 2019). Limited real-time cost monitoring leads to reactive rather than proactive cost management. Lack of integration between design and cost data increases financial risks (Suleiman & Garba, 2023).

Studies show that manual quantity take-offs have an error rate of 5–10%, impacting project budgets (Olatunji, 2017). Traditional methods require 30–50% more time compared to digital measurement tools (Aibinu & Venkatesh, 2019). Fragmented communication between architects, engineers, and

QS leads to delays and rework (Eastman *et al.,* 2021). Any design modification requires complete re-measurement, increasing project timelines (Smith, 2019).

Quantity Surveyor's Functions in a BIM-Based Environment

The integration of Building Information Modelling (BIM) has revolutionized the role of Quantity Surveyors (QS) by enhancing accuracy, efficiency, and collaboration in construction projects. Unlike traditional methods, BIM enables automated quantity extraction, real-time cost estimation, and improved data interoperability.

BIM enables automatic extraction of quantities directly from 3D models, reducing human errors (Azhar, 2021). 5D BIM integrates cost data, allowing real-time budget adjustments (Smith, 2019). Studies show up to 30% improvement in measurement accuracy compared to manual methods (Olatunji et al., 2020). Dynamic cost databases linked to BIM models allow instant updates when design changes occur (Eastman *et al.,* 2021). Predictive cost analytics help in risk assessment and contingency planning (Aibinu & Venkatesh, 2019). Automated Bills of Quantities (BoQ) reduce tendering time by 40–50% (Eadie et al., 2023). Clash detection minimizes post-contract variations, reducing disputes (Arayici *et al.,* 2021). BIM facilitates whole-life cost analysis, improving sustainability decisions; scenario-based cost simulations help in optimizing material and labor costs (Tee *et al.,* 2022). Cloud-based BIM platforms enable seamless communication between QS, architects, and contractors (Bryde et al., 2019). Single-source-of-truth models reduce discrepancies in cost reporting (Hardin & McCool, 2015).

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 (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 (Alashwal *et al.,* 2018).

Empirical Review

Ebekozien *et al.* (2021) investigated the effect of building information modelling on quantity surveying service delivery in Nigeria. A descriptive survey design was adopted with 75 consulting and contracting firms in north-eastern Nigeria randomly selected. The findings 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. The result revealed a lack of standardized protocols for BIM implementation. The perceived impact of BIM on quantity surveyors' service delivery includes efficiency of project workflows, greater transparency in project information, better risk management, and data management and documentation.

Aliyu and Ibrahim (2023) assessed the prospects of the Quantity Surveying profession in Nigeria. The study revealed a high level of performance of the basic functions of the quantity surveyors which include feasibility and viability studies, contract documentation, life cycle costing, and preliminary cost advice. The study also identified factors militating against the effective performance of the quantity surveyor's functions in the Nigerian Construction industry, including widespread corruption (mean score of 4.53), obsolete curriculum and inadequacy in modern equipment (mean score of 4.41), and professional rivalry from kindred professions (mean score of 4.35).

Alashwal (2018) emphasized the need for the adoption of BIM in the Nigerian construction industry. A survey was carried out using 191 copies of structured questionnaire on construction professionals in Akwa Ibom State, Nigeria. The findings revealed that the most prevailing challenges are the lack of knowledge of BIM application and its benefits, the unavailability of skilled staff, cost of purchasing

software packages, and the lack of clients' demand for BIM in projects. The most important strategies to BIM adoption are advanced manpower training for stakeholders and the public sector-led factor.

Otasowie *et al.* (2023) investigated the barriers to implementing BIM by the Nigerian Quantity surveyor. A field survey was constructed with the use of a structured questionnaire, self-administered to quantity surveying firms within Lagos state. Cost and client's failure to demand the use of BIM was rated as the biggest barrier to the implementation of BIM among Quantity surveyors in Nigeria. The study concludes that for BIM to be fully implemented among Quantity surveyors in Nigeria, clients will be a major driver and subsidy by the government will also play a large role.

METHODOLOGY

The research work adopted a quantitative research approach where field survey was employed. According to Creswell (2014), quantitative research approach is the best research approach when the problem is deterministic in nature and reflects the fact that causes determine outcome. Descriptive survey design was adopted for this research because it uses the question of what and seeks to obtain information that describes existing phenomena by asking individuals about their perceptions, attitudes, and behavior. The population of the study comprised 200 registered construction professionals 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 of construction projects. These professionals included architects, builders, civil engineers, and quantity surveyors. The sample size for this study was 132 as determined using the Krejcie and Morgan table (1970). Convenience sampling technique was adopted because the study sought to elicit views of professionals who have specific expertise in construction project delivery.

The survey instrument used in this research was a self-administered questionnaire. The questionnaire consisted of sections designed to obtain information on the socio-economic background of the respondents, Quantity surveyor's functions in BIM-based environment, challenges Quantity surveyors are facing in adjusting to BIM-based project delivery, and the effect of BIM adoption in quantity surveying service delivery. A 5-point Likert scale was adopted, ranging from Very High (5) to Very Low (1).

The validity of the instrument was ensured through construct validity testing, which was concerned with a variable measurement measuring particularly that which it is intended to measure. The study used Cronbach's Alpha test for testing the reliability of the questionnaire for internal consistency, with a threshold of 0.7 considered acceptable (Pallant, 2011). The data collected were analysed using descriptive statistics (frequencies, percentages, means, and standard deviations) with SPSS version 23. The decision rule attached to the response of the questionnaire was based on a five-point Likert rating scale: Strongly Agreed = 4.50–5.00, Agreed = 3.50–4.49, Neutral = 2.50–3.49, Disagreed = 1.50–2.49, Strongly Disagreed = 0.05–1.49.

Results and Findings

Questionnaire Administration

One hundred and thirty-two (132) questionnaires were administered to construction professionals in the study area, out of which one hundred and thirty (130) questionnaires were retrieved, representing a 98.5% response rate. Only two (2) were invalid, and as such, one hundred and thirty (130) were used in the analysis.

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Table 1: Questionnaire Administration

Questionnaire		**Number**	**Response Rate**
Administered		132	100%
Returned		130	98.5%
Invalid		2	1.5%
Analysed		130	98.5%

Demographic Information of Respondents

Table 2: Demographic Information of Respondents

S/N	Attributes	Options	Frequency	Percentage
1	Educational Qualification	ND/HND	35	26.9
		B.Sc/B.Tech	77	59.3
		MSc/M.Tech	13	10.0
		PhD	5	3.8
		Total	**130**	**100.00**
2	Profession	Architecture	2	1.5
		Builders	13	10.0
		Engineers	58	44.6
		Quantity Surveyors	57	43.8
		Total	**130**	**100.00**
3	Role on Projects	Consultant	2	1.5
		Project Engineer	13	10.0
		Site Supervisor	48	35.3
		Client	10	9.3
		Contractor	57	43.8
		Total	**132**	**100.00**

Table 2 showed the result of the respondents' demographic which revealed that majority of the respondents were having B.Sc/B.Tech with the highest percentage of 59.3%. The result also showed that majority of the respondents were engineers and quantity surveyors with the percentages of 44.6% and 43.8% respectively. Also, the result showed that majority of the respondents were contractors with 43.8% in the study area.

The demographic profile reveals a respondent base heavily skewed toward experienced, highly educated professionals, which suggests the findings are grounded in significant technical expertise. The dominance of Engineers, Quantity Surveyors, and Contractors (comprising nearly 90% of the sample) indicates that the study's conclusions are highly industry-specific, drawing directly from the front lines of project execution and cost management. This ensures high data reliability regarding technical and operational processes.

Quantity Surveyor's Functions in BIM-Based Environment

Table 3: Quantity Surveyor's Functions in BIM-Based Environment

S/N	**Indicators**	**Mean**	**Std. Deviation**	**Rank**	**Interpretation**
1	Digital valuations	3.7094	0.9580	1	High
2	Change management	3.6749	1.0050	2	High
3	Progress monitoring	3.6453	1.0622	3	High
4	Payments progress	3.5961	1.0373	4	High
5	Automated quantities	3.5862	1.0523	5	High

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6	Model auditing	3.5691	1.0347	6	High
7	Information requirements	3.5443	1.1469	7	High
8	Lifecycle costing (LCC)	3.5296	1.0410	8	High
9	Automated take-offs	3.4631	1.0738	9	Moderate
10	Real-time cost feedback	3.1972	1.1614	10	Moderate
11	LOD verification	3.1946	1.1457	11	Moderate

The results show that digital valuations, change management, progress monitoring, payments progress, and automated quantities with mean values of 3.7094, 3.6749, 3.6453, 3.5961, and 3.5862 ranked 1st to 5th respectively. This indicates highly quantity surveyor's function in BIM-based environment in the study. While automated take-offs, real-time cost feedback, and LOD verification with mean values of 3.4631, 3.1972, and 3.1946 ranked 9th to 11th respectively, indicating moderate quantity surveyor's function in BIM-based environment in the study.

The findings suggest a strong alignment between traditional Quantity Surveying (QS) competencies and digital evolution, particularly in high-ranking functions like digital valuations (1st) and change management (2nd). These results agree with the research of Olanrewaju et al. (2020), who argued that BIM's greatest value to the QS profession lies in its ability to enhance the accuracy of interim valuations and streamline the traditionally tedious process of variations and claims management. By prioritizing these functions, respondents demonstrate that BIM is being utilized to solidify the QS's role as the financial watchdog of a project.

This high-ranking for-progress monitoring and payments also resonates with Smith (2014), who posited that the integration of 5D BIM is most effective when it focuses on real-time financial transparency and lifecycle cost control, rather than just simple measurement. Conversely, the moderate ranking of automated take-offs (9th) and real-time cost feedback (10th) presents a notable point of disagreement with some optimistic industry forecasts. For instance, Hore et al. (2018) suggested that automated take-offs would be the primary driver of BIM adoption for QS professionals due to the massive time-saving potential. The moderate ranking in this study may indicate a lack of trust in the push-button accuracy of current BIM models, or perhaps a lack of standardized Level of Development (LOD) protocols, which ranked 11th.

This lack of LOD verification supports the findings of Aibinu and Venkatesh (2014), who noted that many QS professionals are hesitant to rely on automated outputs because the architectural models they receive often lack the necessary data depth for precise quantity extraction. This recommends that while the profession is adapting to digital workflows, it remains cautious about full automation without rigorous data verification.

Discussion of Findings

The findings of this study reveal that Quantity Surveyors in Bauchi Metropolis have successfully adapted their core financial functions to BIM-based environments. Digital valuations (M = 3.7094), change management, and progress monitoring ranked highest, indicating that these functions are being performed at a high level in BIM-based project delivery. This aligns with the assertions of Olanrewaju *et al.* (2020) and Smith (2014), who emphasized that BIM's greatest value to the QS profession lies in enhancing the accuracy of interim valuations and streamlining variations and claims management.

The high ranking of automated quantities and model auditing further demonstrates that QS professionals are increasingly relying on BIM-generated data for quantity extraction and verification. This is consistent with the findings of Azhar (2021) and Eastman et al. (2021), who noted that BIM enables automatic extraction of quantities directly from 3D models, reducing human errors and improving measurement accuracy.

However, the moderate ranking of automated take-offs, real-time cost feedback, and LOD verification suggests that full automation of measurement functions remains constrained. This finding contradicts the optimistic forecasts of Hore *et al.* (2018), who suggested that automated take-offs would be the primary driver of BIM adoption for QS professionals. The moderate ranking may be attributed to a lack of trust in the accuracy of current BIM models or the absence of standardized LOD protocols, as noted by Aibinu and Venkatesh (2014). The results also indicate that lifecycle costing and information requirements are being performed at a high level, suggesting that QS professionals are leveraging BIM for whole-life cost analysis and information management. This is consistent with the findings of Tee *et al.* (2022) and Bryde *et al.* (2019), who highlighted the role of BIM in facilitating whole-life cost analysis and improving sustainability decisions.

CONCLUSION AND RECOMMENDATIONS

The study concludes that the transition to a BIM-based environment for Quantity Surveyors in Bauchi Metropolis is characterized by a high proficiency in financial administrative functions. The high ranking of digital valuations, change management, and progress monitoring confirms that the QS profession is successfully evolving its core competencies into the digital realm, maintaining its relevance as the primary manager of project finances. However, the move toward full automation remains stalled; while practitioners demonstrate readiness in financial functions, they remain cautious about automated take-offs and real-time cost feedback due to concerns about model quality and data standardization. Based on the findings of this study, the following recommendations are made:

1. Professional bodies (such as NIQS or RICS) should collaborate with architects and engineers to develop a unified Level of Development (LOD) framework.
2. Training programs should move away from basic software navigation**.** Instead, they should focus on interdisciplinary coordination, data validation, and 5D integration to help professionals navigate the complex technical risks associated with BIM-based project delivery.
3. Construction firms should invest in building internal capacity for automated quantity extraction. This includes providing access to high-quality BIM models with adequate LOD and establishing protocols for model auditing and verification.
4. Educational institutions should integrate BIM-related courses into quantity surveying curricula to prepare future professionals for digital construction processes. This will ensure that graduates possess the necessary skills to operate BIM tools for cost estimation and project management.

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