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PROFILING QUANTITY SURVEYING FIRMS FOR CAPABILITY MATURITY IN ADOPTING BUILDING INFORMATION MODELLING IN NIGERIA

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Abstract
The resource management role that quantity surveying firms (QSFs) play during project delivery makes innovations such as Building Information Modelling (BIM) instrumental for efficient service delivery. Existing studies have reported that only a small number of QSFs in Nigeria have adopted BIM. Moreover, there is a paucity of information on the profiles of the few QSFs that have adopted BIM that would guide other QSFs that intend to adopt BIM. The aim of this study is the profiling of QSFs that have adopted BIM in their practice with a view to determining their capability maturity for a successful BIM implementation. Using a survey instrument, the study employed the Delphi technique to obtain information on the profiles of QSFs from experts practicing in 18 QSFs that have adopted BIM based on the profiles of QSFs obtained from the literature. The experts' responses were analysed using descriptive statistical tools. The result indicates that QSFs that have adopted BIM are mature firms with employees holding relevant educational and professional qualifications. In addition, these firms had sufficient clients, adequate turnover, and were registered with both professional and regulatory bodies of quantity surveying (QS) practice in Nigeria. These attributes may be linked to the firms' capability maturity and also influence the adoption of BIM. The study would assist QSFs that intend to adopt BIM to be abreast with the profiles of QSFs that have adopted BIM and in working towards upgrading their profiles to enhance their capability maturity for the adoption of BIM.

Keywords: Adopted, Building Information Modelling, Nigeria, Profiles, Quantity Surveying Firms

INTRODUCTION

Quantity surveying firms (QSFs) are saddled with the task of meticulously handling resources in the Architectural, Engineering, and Construction (AEC) sector during the execution of projects to deliver value for money (Osunsanwo & Dada, 2019). Some of the traditional functions of QSFs include production of cost plans, cost estimates, project document preparations such as bills of quantities (BOQ), financial statements, and resolution of claims arising from contracts (Ashworth *et al*., 2013; Aibinu *et al*., 2012). However, these activities are tedious, time-consuming, and prone to human errors and inaccuracies (Babatunde *et al*., 2020; Ismail *et al*., 2018).

Building Information Modelling (BIM) is one of the innovations that is transforming the business and practice of the AEC industry globally by redefining traditional professional boundaries and improving project delivery and organizational performance(Babatunde *et al*., 2020; Adesi *et al*., 2018).Quantity surveying firms (QSFs) are among the AEC industry's stakeholders whose traditional roles have been transformed by BIM, offering them capabilities that enhance

their performance and practice (Zainon *et al*., 2018; Makenya & Ally, 2018). Studies have shown that BIM enables QSFs to generate reliable cost estimates, provide rapid and accurate automated quantity take-off, enhance project planning, and control and facilitate cost planning and BOQ production(Ismail *et al*., 2019; Marsh, 2017).

Quantity Surveying firms (QSFs) have a lot to lose by not adopting BIM, as they are confronted with myriads of challenges such as low productivity, a low profit margin, stiff competition from other QSFs, a lack of innovation, and inefficient service delivery (Ebunoluwa & Ojo, 2020; Osunsanwo & Dada, 2019). Despite the benefits of BIM and its advancement in developed countries like the UK, USA, AND Australia, its adoption is still low as BIM is still at its infancy stage in developing countries, particularly Nigeria (Ogunseiju, 2019;Olawumi & Chan, 2019; Saka *et al*., 2019). Many QSFs in Nigeria are aware of BIM, but its adoption is also low, as most of them are yet to embrace it in their practice (Aka *et al*., 2020; Babatunde *et al*., 2020; Ogunseiju, 2019).The low adoption rate of BIM among QSFs in Nigeria is due to some elements like financial constraints (Onyeagam *et al*., 2019), high cost of software and high cost of hardware upgrade (Babatunde *et al*., 2021; (Abubakre *et al*., 2020; Adebayo & Oyewobi, 2020), organizational readiness (Saka *et al*., 2020), and the lack of effective strategy for BIM implementation (Aka *et al*., 2020). However, reports indicate that some QSFs in various Nigerian cities, including Lagos and Abuja, have begun adopting BIM in their practices(Aka *et al*., 2020; Babatunde *et al*., 2020; Ogunseiju, 2019).

The low patronage of BIM by QSFs could be linked to their capability maturity (CM); as the adoption of any innovation or technology by organizations is hinged on their CM (Mahamadu *et al*., 2020; Marsh, 2017). Since the lack of effective strategy was one the elements identified to be one of the reasons for the low BIM adoption among QSFs in Nigeria, CM is used in this study as a palpable BIM adoption strategy. Capability maturity depicts how mature an organization is in achieving certain outcomes or a specific set of operations; be it the adoption of new technology, process, or system (Vivares *et al*., 2018; Arowosegbe & Mohamed, 2015). In assessing the CM of QSFs for successful BIM implementation, one of the objectives entail examining the profiles of QSFs that have adopted BIM. The profiles of QSFs are significant as it is connected to their capability maturity, which influences BIM adoption. Thus, the low patronage of BIM could be due to the paucity of information on the characteristics (profiles) QSFs need to possess to successfully adopt BIM.

The profiles of QSFs that have adopted BIM are significant, as it is one of the critical success factors (CSFs) that can enhance BIM adoption among QSFs (Marsh, 2017).These profiles provide valuable information on QSFs that have adopted BIM so that QSFs can use such information to improve and update their profiles towards BIM adoption. There are limited studies on the profiles of construction professionals that have adopted BIM, including Aka *et al*. (2020) and Babatunde *et al*. (2020). However, there is a paucity of studies that explored the profiles of firms that have adopted BIM. Hence, this study examined the profiles of QSFs that have adopted BIM in their practice with a view to determining their capability maturity for a successful BIM implementation.

LITERATURE REVIEW

Building Information Modelling

Building Information Modelling (BIM) is a repository of digital information that facilitates the efficient management of project information from conception by way of simplifying and presenting a real-world simulation of a preconceived project facility (Olawumi & Chan, 2019, p. 1225). BIM is used for cost estimating and facilities management and is reported to reduce cost estimation time, project costs, and time (Ibem*et al*., 2018; Ibrahim & Abdullahi, 2016).BIM also enhances the management of facilities and projects throughout a project's lifecycle (Olugboyega & Aina, 2018). It promotes collaboration through shared ownership of design and construction processes among the design team, enabling them to work together on a project (NBS, 2016b).These BIM capabilities reflect its significance in quantity surveying (QS) practice.

Due to the benefits of BIM to the construction industry globally, there have been an exponential demand for BIM in recent years (Kaduma, 2022; Safour *et al*., 2021). However, developed countries have made progress with BIM adoption and implementation of its tools, while developing countries are still struggling with BIM adoption (Olawumi & Chan, 2019). Countries like Finland, USA, Norway, Denmark, and Austria, have over the years introduced BIM mandate, standards, and policies in their respective countries leading to BIM part of the requirements for construction contracts and practice (Kaduma, 2022; Safour*et al*., 2021). The most significant stride made towards BIM adoption was in 2016 when the UK government mandated BIM level 2 for all key projects costing more than £5 million part of the Government's Construction Strategy. This initiative made BIM a compulsory for securing government contracts and led to accelerated its adoption among contractors in the UK (Kaduma, 2022; Hamma-Adama, 2020; Mtya, 2019). Although Middle Eastern countries like the United Arab Emirates, and South American countries like Argentina, Brazil, and Chile are already developing noteworthy initiatives towards BIM adoption, African countries like Nigeria are still in the early adoption phase (Kaduma, 2022; Olawumi & Chan, 2019). Figure 1and 2gives an overview of BIM adoption by country and across the world.

	United States of America	2003	National 3D-4D-BIM Program
	Finland	2007	Open-BIM mandate for new buildings
	Norway	2008	Open-BIM mandate
	Denmark	2011	BIM mandate for all government buildings
	Netherlands	2012	Open-BIM mandate for infrastructure
	Austria	2015	Introduction of Open-BIM standards
	Sweden	2015	BIM mandatory for transportation
	United Kingdom	2016	BIM compulsory for government contracts
	France	2017	Announcement of BIM roadmap
	Germany	2017	Phased BIM implementation for infrastructure
	Czech Republic	2017	Launch of BIM program
	European Union	2017	Handbook for the introduction of BIM
	Spain	2018	BIM mandatory for all the public construction tenders
	Italy	2019	BIM mandate for large public projects
	Russia	2021	BIM mandatory for federal contracts

Figure 1: An Overview of the Adoption of BIM by Country
Source: Kaduma (2022)

	Dubai	2013	BIM mandate for 40+ stories or 300,000+ square feet
	Hong Kong	2014	BIM mandate Roadmap
	New Zealand	2014	Launch of BIM program
	Singapore	2015	Mandate for BIM electronic submissions
	Chile	2015	BIM mandate for government projects by 2020
	South Korea	2016	BIM mandate for public projects >S$50 million
	Australia	2018	Start of BIM implementation strategy at state level
	Malaysia	2019	BIM obligatory for public projects >RM100 million
	Abu Dhabi	2019	BIM mandate
	Peru	2019	Launch of BIM program
	Argentina	2019	Plan for adaption of BIM by 2025
	Japan	2020	Guideline for BIM standard workflows
	China	2020	Proposed BIM mandate
	Brazil	2021	BIM mandatory for federal projects

Figure 1 (Cont'd): An Overview of the Adoption of BIM by Country
Source: Kaduma (2022)

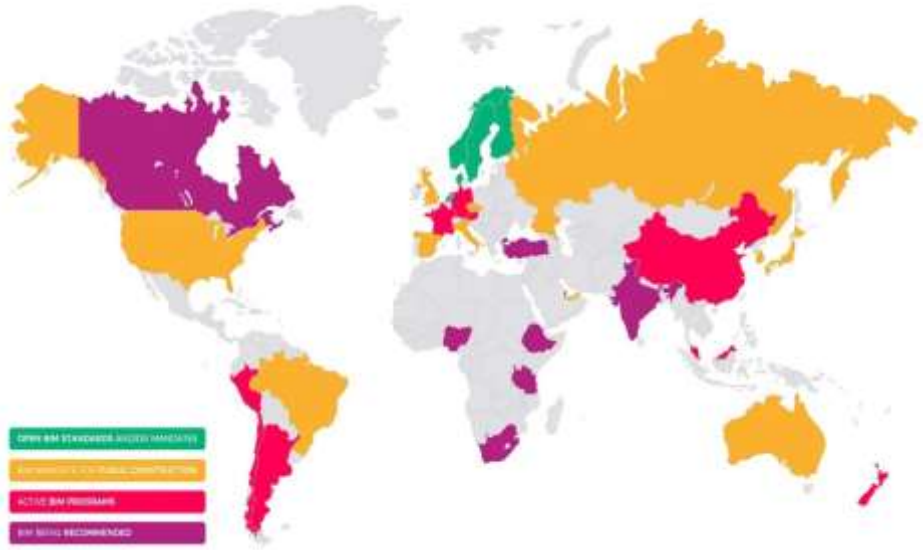

Figure 2: BIM Adoption Across the World
Source: Kaduma (2022)

Building Information Modelling (BIM) is categorised as dimensions based on its potential and capabilities (Kjartansdóttir*et al*., 2017). The BIM dimension associated with QS practice is the 5D as shown in Figure 3. The 5D BIM automatically generates accurate quantities for cost estimation and enables a corresponding change in costs to occur once project designs change. It also enables the client to determine the contractor's bill for a project at a specific time (Kjartansdóttir *et al*., 2017; Raphael & Priyanka, 2015; Kulasekara *et al*., 2013). Some of the BIM software utilised in QS practice include Autodesk Quantity Takeoff, BuildsoftTakeoff, Cubicost, Navisworks Manage, and Revit (Babatunde *et al*., 2020; Olanrewaju *et al*., 2020; Ismail *et al*., 2019).

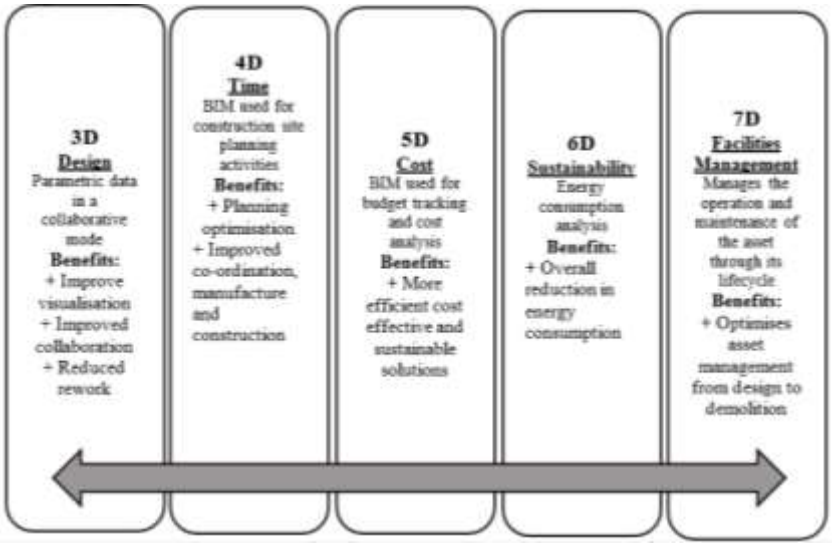

Figure 3: Building Information Modelling Dimensions
Source: Marsh (2017)

Organizational Profiles and Capability Maturity in BIM Adoption

The Institutional Theory put forth by Iacovou, Benbasat and Dexter in 1995, postulates that three contexts: perceived benefits, organizational readiness, and external pressure, have an impact on the adoption of technological innovation by a firm as shown in Figure 4(Mtya, 2019).The profiles of organizations align with the 'organizational readiness' arm of the Institutional Theory. BIM is portrayed as an innovation in extant studies (see Babatunde *et al*., 2020; Adesi *et al*., 2018; Kjartansdóttir *et al*., 2017). Thus, organizational readiness is requisite for the adoption of BIM and must be in the area of capabilities (resources and processes). Attributes such as financial resources, IT resources, firm size, annual turnover, firm's assets, etc., are needed by organizations to adopt innovations like BIM.

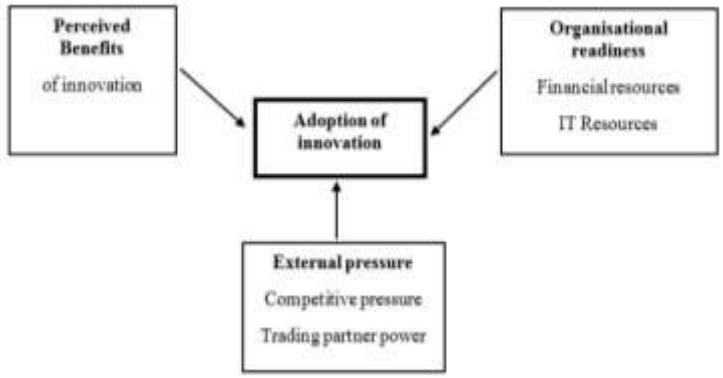

Figure 4: Institutional Theory
Source: Mtya (2019)

It is noteworthy that most firms will adopt BIM if they comprehend the benefits BIM will bring to their business and practice. However, the organizational readiness of the QSFs particularly, in terms of the extent of their capabilities plays a major role in their ability to adopt BIM. The three aspects of Institutional Theory (perceived benefits, organizational readiness, and external pressure) as shown in Figure 5, are significant but subject to the profiles of QSFs. This is why the profiles of QSFs are significant for the adoption of BIM(Marsh, 2017).The profiles of firms, which are characteristics of firms influence the adoption of BIM by QSFs, despite their perceived benefits of BIM. For instance, a firm's size, turnover, nature of projects handled and number/quality of clients will impact their financial ability to acquire hardware and software for BIM setup. Thus, the profiles of firms influence their adoption of BIM.

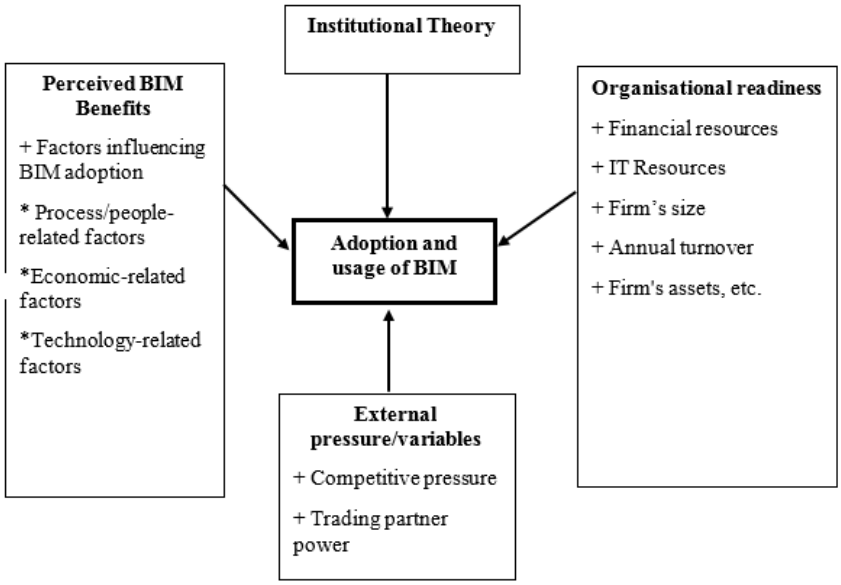

Figure 5: Linking Firms' Profile to BIM Adoption
Source: Adapted from Mtya (2019)

In linking profiles of firms to capability maturity, the profiles of QSFs can influence the capability maturity of QSFs for the adoption of BIM. Firms that are mature in capabilities like financial resources, trained employees, innovation, research and development, amongst others will effortlessly adopt BIM than firms that are immature in their capabilities (Olugboyega & Windapo, 2021; Mahamadu *et al*., 2020). Thus, the profiles of firms play a significant role in the capability maturity of firms for BIM adoption.

Profiles of Quantity Surveying Firms

The essential characteristics of an organization represent the profile of that organization (Miculeac, 2016). The attributes or characteristics (profile) of an organization is quite significant to the growth and survival of the organization. The profiles of organizations impact their access to resources, performance, and business (Taiwo *et al*., 2022; Musamali & Tarus, 2013). Although there is a scarcity of studies on the profiles of QSFs that have adopted BIM for their practice, there are studies that explored the profiles of QSFs. For instance, QSFs intending to practice in Nigeria need to be licensed by the Quantity Surveyors Registration Board of Nigeria (QSRBN), the regulatory body for QS practice (Onyeagam *et al*., 2019; Olanipekun *et al*., 2014; Ogunsemi *et al*., 2013). For legal practice in Nigeria, QSFs also need to be licensed by the Nigerian Institute of Quantity Surveyors (NIQS), the professional body for QS practice (Moyanga & Agboola, 2020; Ogunsemi *et al*., 2013).

Several studies reported that most QSFs in Nigeria have less than 10 employees (Moyanga & Agboola, 2020; Ogunseiju, 2019; Ekweani, 2017; Alutwela *et al*., 2016). In the area of educational qualification, the highest educational qualification of most employees in QSFs was a master's degree (Moyanga *et al*., 2019; Ogunmakinde & Umeh, 2018; Ekweani, 2017).The highest

professional qualification of the employees of most QSFs was corporate membership of the Nigerian Institute of Quantity Surveyors (NIQS) (Moyanga*et al*., 2019; Olanipekun *et al*., 2014). Some employees are also members and fellows of the Royal Institution of Chartered Surveyors (RICS) (Ogunseiju, 2019). Studies have shown that most employees in QSFs had 13-14 years of work experience (Moyanga*et al*., 2019; Oke *et al*., 2016).

Most QSFs had 10-20 clients and an annual turnover of11-20 million Naira (Moyanga & Agboola, 2020; Oke *et al*., 2016; Ogunsemi *et al*., 2013). Most QSFs have been in existence for 20-25 years (Adegbembo*et al*., 2020; Moyanga & Agboola, 2020; Ekweani, 2017). Most QSFs are reported to have one partner, originated from Nigeria, and operated as sole proprietorships (Moyanga & Agboola, 2020; Oke *et al*., 2016). Most QSFs undertake building and civil engineering works (Ogunmakinde & Umeh, 2018; Oke *et al*., 2016).Twelve (12) QSFs' profile characteristics were identified from literature, as shown in Table 1.These profile characteristics were used to collect data on the profiles of QSFs that have adopted BIM in this study.

Table 1 Profiles of Quantity Surveying Firms

S/N	Profile	Literature Sources
1	Number of employees	Moyanga & Agboola (2020), Ogunseiju (2019); Ekweani (2017), Oke *et al*. (2016), Alutwela & Perera (2016), Ogunsemi *et al*. (2013); Eastman *et al*. (2011)
2	Educational qualification of employees	Moyanga *et al*. (2019), Moyanga *et al*. (2019)Ogunseiju (2019), Ogunmakinde & Umeh (2018), Ekweani (2017)
3	Professional qualification of employees	Moyanga *et al*. (2019), Ogunseiju (2019), Oke *et al*., (2016); Olanipekun *et al*. (2014)
4	Years of experience of employees	Moyanga *et al*. (2019), Ogunseiju (2019), Ogunmakinde & Umeh (2018); Oke *et al*., (2016)
5	Current number of clients	Moyanga & Agboola (2020); Ogunsemi *et al*. (2013)
6	Firm's annual Turnover (apex value)	Oke *et al*. (2016)
7	The firm's years of operation	Moyanga & Agboola (2020), Adegbembo *et al*. (2020); Ebunoluwa & Ojo (2020), Ekweani (2017)
8	Number of partners	Moyanga & Agboola (2020)
9	Firm's country of origin	Moyanga & Agboola (2020)
10	Firm's ownership structure	Moyanga & Agboola (2020), Ekweani (2017), Oke *et al*. (2016), Olanipekun *et al*. (2014)
11	Type of projects handled	Ogunmakinde & Umeh (2018), Oke *et al*. (2016)
12	Registration with professional and regulatory bodies	Moyanga & Agboola (2020), Moyanga *et al*. (2019), Onyeagam *et al*. (2019), Olanipekun *et al*. (2014); Ogunsemi *et al*. (2013)

RESEARCH METHOD

The study's population comprised QSFs located in Lagos and Abuja, Nigeria, that are registered with the Quantity Surveyors Registration Board of Nigeria (QSRBN). A total of 205 QSFs (118 in Abuja and 87 in Lagos) were registered with QSRBN as of2023 (QSRBN, 2023). The sampling frame comprised QSFs in Lagos and Abuja that have adopted BIM in their practices. Given the limited information on BIM-adopting QSFs in the study areas, a non-probability purposive sampling method was initially used, followed by the

snowball sampling technique. Eighteen QSFs (12 in Lagos and 6 in Abuja) were found to have adopted BIM and constituted the sample size for the research.

Primary data for this study were gathered using the Delphi technique, chosen due to the anticipated sample size. The Delphi technique is a technique used to collect information from respondents who are competent in their field of expertise or an area, using a series of questionnaires to achieve consensus among the experts (Aghimien *et al*., 2020;Evans & Farrell, 2021;Olawumi *et al*., 2018; Babatunde *et al*., 2016). BIM experts from 18 QSFs that have adopted BIM were used for the Delphi survey. The number was sufficient, as most construction management studies utilised between 5 and 20 experts in their Delphi studies (Evans & Farrell, 2021; Aghimien *et al*., 2020).

The Delphi process consisted of developing the questionnaire, choosing the panel of experts, gathering initial data, and analysing the data gathered from the expert panel. The profile characteristics of QSFs were identified from the literature and formed the items of the Delphi questionnaire survey. Since the selection of respondents to form the expert panel is key to the successful outcome of the Delphi survey (Evans & Farrell, 2021; Ameyaw*et al*., 2016), some of the criteria the respondents for this study must fulfil include: (a) work in a QSF that has adopted and possesses a thorough grasp of BIM concepts; (b) possess a bachelor's degree, at the very least in construction, management, and engineering, or a closely connected profession; (c) be an affiliate of a professional body, in this case, quantity surveying.

In the first round of the Delphi survey, questions and instructions on how to answer regarding the profiles of QSFs obtained from related literature were sent to the experts electronically to provide their opinion. Responses from the panel of 18experts were retrieved and analysed (the first round). In a Delphi technique, the analysed data retrieved from the first round of data collection is normally sent back to the experts to compare their responses to the group mean and decide whether to review or confirm them in the second round. This process is repeated until a consensus is reached among the experts (Saunders *et al*., 2019). Most studies in construction management establish that consensus can be reached in 2-3 rounds of the Delphi survey (Evans & Farrell, 2021; Ameyaw*et al*., 2016).

In examining the profiles of QSFs as one of the objectives in determining the capability maturity of QSFs, there was no need for the second round of the Delphi survey since the experts were asked to give information on the profiles of the firm they represent. The nature of the questions did not require consensus among the experts. The data garnered were analysed using descriptive statistics, including frequency distribution and percentages. The nature of the data on the profiles of firms required that the data be analysed and presented in simple statistical formats for clarity, easy understanding, and interpretation of the data collected.

FINDINGS AND DISCUSSION

Demographic Information

The 18 experts responded to the Delphi survey, indicating a 100% response rate. The demographic information of experts in a Delphi survey is significant, as their backgrounds should show they have adequate knowledge in the explored area,

in this case, BIM adoption among QSFs. The data analysis showed that the highest educational qualification of the experts was a bachelor's degree (44.4%). The result also showed that the majority (55.6%) of the experts were members of the NIQS. The average years of the experts working in the construction industry were 12 years, as shown in Table 2.

From the preceding, it is evident the experts for the Delphi survey were well educated, had been working in the industry for a considerable number of years, and the majority of them were professionally qualified. Thus, each panellist met the specific criteria to be an expert in the Delphi survey. Therefore, the data provided by the panellists can be relied upon for this study.

Table 2 Demographic Information of Experts in the Delphi Survey

Background Information	Parameter	Frequency	Percent	Cumulative Percent	Mean
Highest Educational Qualification	HND	2	11.1	11.1	
	B.Sc./B.Tech	8	44.4	55.6	
	M.Sc./M.Tech/MBA/ M.Phil.	7	38.9	94.4	
	Ph.D.	1	5.6	100.0	
	Total	**18**	**100.0**		
Years Working in the Construction Industry	1-5	5	27.8	27.8	
	6-10	3	16.7	44.4	
	11-15	3	16.7	61.1	
	16-20	2	11.1	72.2	12 years
	Above 20	5	27.8	100.0	
	Total	**18**	**100.0**		
Highest Professional Qualification	MRICS	3	16.7	16.7	
	FNIQS	4	22.2	38.9	
	MNIQS	10	55.6	94.4	
	Non-member	1	5.6	100.0	
	Total	**18**	**100.0**		

Note. HND = Higher National Diploma; B.Sc. = Bachelor of Science; B.Tech = Bachelor of Technology; PGD = Postgraduate Diploma; M.Sc. = Master of Sciences; M.Tech = Master of Technology; MBA = Master of Business Administration; M.Phil = Master of Philosophy; Ph.D. = Doctor of Philosophy; MRICS = Member, Royal Institution of Chartered Surveyors; FNIQS = Fellow, Nigerian Institute of Quantity Surveyors; MNIQS = Member, Nigerian Institute of Quantity Surveyors

Profiles of Quantity Surveying Firms that have Adopted BIM

Table 3 presents the profile characteristics of QSFs that have adopted BIM in their practice. The study obtained various characteristics of firms that constitute their profiles from extant literature. Experts provided data on several aspects of their firms, including location, number of employees, educational qualification, professional qualification, years of experience, number of clients, annual turnover, years of operation, number of partners, country of origin, ownership

structure, type of projects handled, as well as registration with regulatory and professional bodies.

Regarding the location of BIM-adopting QSFs, the result in Table 3 shows that 6 (33.3%) of QSFs were located in Abuja, while 12 (66.7%) of QSFs were based in Lagos. From the result, it is evident that QSFs that have adopted BIM in this study were primarily based in Lagos. Few studies have specifically compared BIM adoption among firms in Abuja and Lagos. However, there are more extant studies on BIM adoption among firms in Lagos than in Abuja, which may translate to more BIM adoption in Lagos than in Abuja. Some of the studies that focused on Lagos include Babatunde *et al*. (2020), Ogunseiju (2019), and Ogunmakinde and Umeh (2018).

On the number of employees in BIM-adopting QSFs, Table 3 shows that 2 (11.1%) of the firms had 1-5 employees, and 5 (27.8%) of the firms had 6-10 employees. In addition, 6 (33.3%) of the firms had 11-15 employees, 2 (11.1%) firms had 16-20 employees, and 3 (16.7%) firms had more than 20 employees. Overall, almost 90% of BIM-adopting QSFs had up to 10 employees. Meanwhile, the average number of employees in BIM-adopting QSFS was 12 employees. From this result, it can be inferred that the majority of QSFs that have adopted BIM are classified as medium firms based on QSFs' classification by Ali *et al*. (2013). They classified QSFs with 11 to 20 employees as medium firms. The finding of this study aligns with that of Ogunsemi *et al*. (2013) that the majority of QSFs in Nigeria are medium firms. It can be said that QSFs with a good number of employees have human capability that enhanced their capability maturity and enabled them to adopt BIM. Also, there is a good chance that some of the employees were enthusiastic about BIM and were also available to be trained on BIM by the organization, or from their peers within the construction industry. Furthermore, there is a possibility that not all the employees would be enthusiastic about BIM, a good number will be interested due to the push for BIM adoption by the firms.

Table 3 Profiles of QSFs that have adopted BIM

Background Information	Parameter	Frequency	Percent	Cumulative Percent	Mean
Location of QSFs	Lagos	12	66.7	66.7	
	Abuja	6	33.3	100.0	
	Total	**18**	**100.0**		
Number of Employees	1-5	2	11.1	11.1	12 employees
in QSFs	6-10	5	27.8	38.9	
	11-15	6	33.3	72.2	
	16-20	2	11.1	83.3	
	Above 20	3	16.7	100.0	
	Total	**18**	**100.0**		
Highest Educational	B.Sc./B.Tech.	3	16.7	16.7	
Qualification of Employees in QSFs	M.Sc./M.Tech./MBA /M.Phil.	12	66.7	83.3	
	Ph.D.	3	16.7	100.0	

	Total	**18**	**100.0**		
Highest Professional	FRICS	6	33.3	33.3	
Qualification of	MRICS	4	22.2	55.6	
Employees in QSFs	FNIQS	2	11.1	66.7	
	MNIQS	6	33.3	100.0	
	Total	**18**	**100.0**		
Years of	1-5	2	11.1	11.1	16 years
Experience of	6-10	1	5.6	16.7	
Employees in QSFs	11-15	4	22.2	38.9	
	16-20	2	11.1	50.0	
	Above 20	9	50.0	100.0	
	Total	**18**	**100.0**		
Number of Clients in	1-5	1	5.6	5.6	14 clients
QSFs	6-10	6	33.3	38.9	
	11-15	2	11.1	50.0	
	16-20	2	11.1	61.1	
	Above 20	7	38.9	100.0	
	Total	**18**	**100.0**		
Annual Turnover	Not sure	2	11.1	11.1	63 million
(Millions of Naira) of	Less than 10	1	5.6	16.7	Naira
QSFs	10-20	3	16.7	33.3	
	30-40	3	16.7	50.0	
	50-100	2	11.1	61.1	
	Above 100	7	38.9	100.0	
	Total	**18**	**100.0**		

Table 3 Profiles of QSFs that have adopted BIM (Cont'd)

Background Information	**Parameter**	**Frequency**	**Percent**	**Cumulative Percent**	**Mean**
Number of Years of Operation of QSFs	1-5	2	11.1	11.1	16 years
	6-10	1	5.6	16.7	
	11-15	2	11.1	27.8	
	16-20	2	11.1	38.9	
	Above 20	11	61.1	100.0	
	Total	**18**	**100.0**		
Number of Partners in	Nil	3	16.7	16.7	
QSFs	1	2	11.1	27.8	
	2	9	50.0	77.8	
	4	4	22.2	100.0	
	Total	**18**	**100.0**		
Origin of QSFs	Nigeria	16	88.9	88.9	
	Foreign	2	11.1	100.0	
	Total	**18**	**100.0**		

	Sole proprietorship	3	16.7	16.7
Ownership Structure of QSFs	Partnership	15	83.3	100.0
	Total	**18**	**100.0**	
	Building works	2	11.1	11.1
Types of Projects handled by QSFs	Both Building and Civil Engineering Works	16	88.9	100.0
	Total	**18**	**100.0**	
Registration of QSFs	QSRBN	17	94.4	94.4
With Regulatory Body	Nil	1	5.6	100.0
	Total	**18**	**100.0**	
Registration of QSFs	NIQS	17	94.4	94.4
with Professional Body	Nil	1	5.6	100.0
	Total	**18**	**100.0**	

Note. B.Sc. = Bachelor of Science; B.Tech. = Bachelor of Technology; M.Sc. = Master of Sciences; M.Tech. = Master of Technology; MBA = Master of Business Administration; M.Phil. = Master of Philosophy; Ph.D. = Doctor of Philosophy; FRICS = Fellow, Royal Institution of Chartered Surveyors; MRICS = Member, Royal Institution of Chartered Surveyors; FNIQS = Fellow, Nigerian Institute of Quantity Surveyors; MNIQS = Member, Nigerian Institute of Quantity Surveyors; QSRBN = Quantity Surveyors Registration Board of Nigeria; NIQS = Nigerian Institute of Quantity Surveyors.

The result of the highest educational qualification of the employees of QSFs that have adopted BIM, as shown in Table 3, revealed that 3 (16.7%) had B.Sc./B.Tech. degrees, 12 (66.7%) of the employees (constituting the largest proportion of employees) had M.Sc./M.Tech./MBA/M.Phil. degrees, and 3 (16.7%) of the employees had a Ph.D. From the result, it can be inferred that the highest educational qualification of employees in QSFs that have adopted BIM was M.Sc./M.Tech./MBA/M.Phil. The finding of this study aligns with the findings of Moyanga *et al*. (2019), Ogunmakinde and Umeh (2018), and Ekweani (2017), who reported that the highest educational qualification of most employees in QSFs was a master's degree. The result shows that the high academic employees in most of the QSFs is an added human capability for the firms and also enhanced their capability maturity, propelling their adoption of BIM. Furthermore, the high educational qualification of the employees may be an indication for the quest for more knowledge and skills including BIM.

Moreover, the professional qualification of employees of QSFs that have adopted BIM, as indicated in Table 3 revealed that 6 (33.3%) of employees were Fellows of the Royal Institution of Chartered Surveyors (FRICS) and 4 (22.2%) of employees were members of the Royal Institution of Chartered Surveyors (MRICS). Furthermore, 2(11.1%) of employees were Fellows of the Nigerian Institute of Quantity Surveyors (FNIQS), and 6 (33.3%) of employees were members of the Nigerian Institute of Quantity Surveyors (MNIQS).The result inferred that most employees of QSFs that have adopted BIM have obtained professional qualifications that spread across various quantity surveying bodies within and outside Nigeria. The finding aligns with previous studies by Moyanga

et al. (2019) and Olanipekun *et al*. (2014) that most employees of QSFs are corporate members of NIQS. The finding further support Ogunseiju (2019), that some employees of QSFs are obtaining international professional qualifications from the RICS, as many of them are now corporate members and Fellows of the RICS.

The professional qualification of the employees of the firms is also a boost to their human capability, enhancing the capability maturity, and enabling them to adopt BIM. It is noteworthy that bodies like RICS are at the forefront pushing for BIM adoption in the construction industry. Thus, employees registered with these professional bodies will be challenged to be at the top of their practice by being exposed to innovations like BIM, becoming an added advantage to their firms. This will help the employees to adopt smart work methods and problem-solving techniques to meet deadlines, improve their performance, and meet clients' needs (Alutwela *et al*., 2016).

Table 3 also summarises the work experience of the employees of QSFs that have adopted BIM. The result revealed that 2 (11.1%) of employees had 1-5 years of work experience, 1 (5.6%) had 6-10 years of work experience, and 4 (22.2%) had 11-15 years of work experience. The result also indicated that 2 (11.1%) of employees had 16-20 years of work experience, while 9 (50.0%) of employees (which constituted the highest percentage) had more than 20 years of work experience. Meanwhile, the average years of work experience of employees of QSFs in the study was 16 years, indicating that almost 90% of the employees had up to 10 years of work experience, as shown in Table 3. The finding of this study is in agreement with that of Moyanga *et al*. (2019) and Oke *et al*. (2016), which established that most employees of QSFs had up to 10 years of experience.

The employees' years of experience indicates a compendium of wealth of experience, a boost to the human capability of the firms, and enhances their capability maturity. The employees' experience meant they are exposed to traditional and innovative practices either from projects handled or by relating with colleagues especially those that have adopted contemporary practices like BIM adoption in quantity surveying practice. Their experience should translate to adopting new technologies, awareness of technological advancements, and having trained staff to operate the technology (Adesi *et al*., 2018; Abidin *et al*., 2014).For the number of clients patronising QSFs that have adopted BIM, Table 3 revealed that 1 (5.6%) of QSFs in this study had 1-5 clients, 6 (33.3%) had 6-10 clients, and 2 (11.1%) had 11-15 clients. Also, 2 (11.1%) of QSFs had 16-20 clients, and 7 (38.9%) of QSFs (which constituted the highest percentage) had more than 20 clients. The average number of clients for the firms in this study was 14. Meanwhile, the result also shows that over 90% of the firms in the study area had up to 10 clients, as shown in Table 3. The finding of this study is in agreement with that of Moyanga and Agboola (2020) and Ogunsemi *et al*. (2013), which found that most QSFs had 10-20 clients; though these studies were not specific to BIM adoption. Clients are very important for the survival QSFs and influence the financial capability of firms (Abidin *et al*., 2014). Thus, having a good number of clients will enable the firms have the financial resources needed to run the firms and also invest in software and hardware requisite

for BIM adoption. The outcome of these due to the financial resources brought about by the clients is, improved capability maturity.

Concerning annual turnover of QSFs that have adopted BIM, as presented in Table 3, the result shows that 2 (11.1%) of the firms were unsure of their precise turnover figure and 1 (5.6%) of the firms had less than 10 million as annual turnover. Also, 3 (16.7%) of the firms had 10-20 million as annual turnover, and 3 (16.7%) had 30-40 million as annual turnover. Moreover, 2 (11.1%) of the firms had 50-100 million as annual turnover, while 7 (38.9%) had the largest proportion of annual turnover as they were earning above 100 million. The average annual turnover of QSFs that have adopted BIM, according to the findings of this study, was 63 million, as shown in Table 3. It is noteworthy that about 50% of the firms had an annual turnover of 50 million naira and above. The finding of this study showed that most QSFs currently have an annual turnover higher than the 20 million naira margin previously reported by Oke *et al*. (2016).

The financial capability of a QSF is a significant capability as it is integral in the firm's survival and influences other capabilities (Abidin*et al*., 2014). A good turnover enhances the capability maturity of QSFs as it enables them to have the needed finance to procure BIM software and hardware, train their employees on BIM, and acquire other resources required for efficient service delivery. Thus, availability of finance is integral to BIM adoption due to the cost of BIM software and set-up, training (Awodele*et al*., 2022;Gilchrist *et al*., 2021;Durdyev *et al*., 2021).

Regarding the years of operation of QSFs that have adopted BIM, the result presented in Table 3 shows that 2 (11.1%) of the firms had been in operation for 1-5 years, 1 (5.6%) had been operation for 6-10 years, and 2 (11.1%) had been in operation for 11-15 years. Also, 2 (11.1%) of QSFs had existed for 16-20 years, and 11 (61.1%) of the firms (constituting the largest proportion) had been in operation for more than 20 years. The average years of existence of QSFs in this study were 16 years. Meanwhile, about 72% of firms have been in existence for more than 10 years. The findings of the study inferred that QSFs that have adopted BIM are mature firms. This is based on the classification of QSFs by Moyanga and Agboola (2020)that QSFs of less than five (5) years are young firms; QSFs of five (5) to ten (10) years are middle-aged firms; QSFs of more than 10 years are mature firms.

The finding of this study agrees with the findings of Adegbembo *et al*. (2020), Moyanga and Agboola (2020), and Ekweani (2017), who reported that the majority of QSFs have been in existence for more than 20 years. However, those studies were not on QSFs that have adopted BIM in their practice. The years of operation shows that they have acquired wealth of experience from projects they have handled over the years, are abreast with the contemporary needs of clients such as innovation adoption, and are working towards meeting these needs. These experiences enhance the capability maturity of the firms.

The result for the nature of ownership of QSFs in this study, as shown in Table 3, revealed that 15 (83.3%) of QSFs operated as partnerships and 3 (16.7%) of QSFs were sole proprietorships. Indicating that

BIM-adopting QSFs are primarily partnerships. This finding corroborates the findings of Ekweani (2017) and Olanipekun *et al*. (2014), which reported partnership as the most common nature of QSFs' ownership. Although those studies were not on QSFs that have adopted BIM. The result in Table 3 also showed the number of partners in QSFs that have adopted BIM in the study area. The result revealed that 2 (11.1%) of the firms had one partner and 9 (50.0%) of the firms (which constituted the highest percentage) had two partners. In addition, 4 (22.2%) of the firms had 4 partners. The finding of this study revealed that most QSFs that have adopted BIM had two partners. QSFs' partnership structure indicates that it takes collaboration for BIM adoption to become a reality among firms. This entails the synergizing of resources, ideas and strategies, leading to an enhanced capability maturity for the firms.

In terms of the origin of the QSFs that have adopted BIM, the result in Table 3 revealed that 16 (88.9%) of the firms originated from Nigeria, and 2 (11.1%) of the firms originated from outside Nigeria. The result inferred that most QSFs that have adopted BIM originated from Nigeria. The finding of this study agrees with that of Moyanga and Agboola (2020), who established that most QSFs originated from Nigeria. The finding of this study indicates that local QSFs possess the capabilities needed to attain the requisite capability maturity to adopt BIM like their foreign counterparts. Hence, firms can strive to synergize their resources I order to adopt BIM.

The result of the nature of the jobs undertaken by QSFs in this study, as shown in Table 3, revealed that 2 (11.1%) of the firms engaged in building works, and 16 (88.9%) engaged in both building and civil engineering works. From the result, it can be concluded that most QSFs that have adopted BIM engaged in both building and civil engineering works. The finding is in agreement with that of Oke *et al*. (2016), who reported that most QSFs undertake both building and civil engineering works. The result shows that the nature of projects handled by QSFs make them versatile, enabling them to have the capabilities that enhances their capability maturity needed for BIM adoption.

Finally, in terms of professional and regulatory registration, the result in Table 3 shows that 17 (94.4%) of the firms were registered with the Quantity Surveyors Registration Board of Nigeria (QSRBN) and 1 (5.6%) firm did not register with QSRBN. From the result, it can be inferred that the majority of QSFs that have adopted BIM were registered with the regulatory body that oversees quantity surveying practice in Nigeria. Table 3 also shows that 17 (94.4%) of the firms were registered with NIQS, and 1 (5.6%) firm did not register with the professional body. The result infers that the majority of QSFs that have adopted BIM were registered with the professional body that oversees quantity surveying practice in Nigeria. The finding on professional and regulatory registration agrees with the study by Ogunsemi *et al*. (2013), that a substantial number of QSFs were registered with both quantity surveying professional and regulatory bodies. The registration of QSFs with professional and regulatory bodies enables them adhere to the regulations of those bodies and avoiding substandard quantity surveying practice. This is a managerial capability that boosts their capability maturity and enables them adopt contemporary practice like the use

of BIM to satisfy clients. From all the results, the profiles of QSFs that have adopted BIM are their capability attributes, and can be grouped under four major capability attributes as outlined in Adah andOdeyinka (2024). For instance, adequate staff with requisite educational and professional qualifications indicates having human capability. The handling of projects, ownership structure, and registration with relevant QS bodies indicates having managerial capability. Meanwhile, having sufficient number of clients indicate having marketing capability, and the substantial annual turnover indicates having financial capability. The capability attributes of these firms likely enhanced their ability to adopt BIM, which is an innovative capability.

CONCLUSION

In the quest to determine the capability maturity of QSFs for successful BIM implementation, the study examined the profiles of QSFs in Nigeria that have adopted BIM in two locations, Abuja and Lagos. The study used the Delphi technique to solicit information on QSFs' profile characteristics from BIM experts in QSFs that have adopted BIM. The following key findings were made from the study about BIM-adopting QSFs:

1) Majority of the firms were located in Lagos, had up to 10 employees, and had been operating for more than 20 years.
2) Most of their employees had master's degree as their highest educational qualification and more than 20 years of experience.
3) Majority of their employees were Fellows of the Royal Institution of Chartered Surveyors (FRICS) and members of the Nigerian Institute of Quantity Surveyors (MNIQS).
4) Most of the firms had more than 20 clients and had an annual turnover of above 100 million naira.
5) Majority of the firms had partnership ownership structure and had two partners.
6) Most of the firms originated from Nigeria and engaged in both building and civil engineering projects.
7) Majority of the firms were registered with the quantity surveying professional body (NIQS) and regulatory body (QSRBN).

The study concludes that QSFs that have adopted BIM are mature firms as they possess the capabilities and resources that enables them to adopt BIM. These capabilities and resources are in the areas of financial capability, human capability, marketing capability, and managerial capability requisite for BIM adoption.

RECOMMENDATIONS

This study contributes to the body of existing knowledge as it shows the profile characteristics of QSFs that have adopted BIM in Nigeria to guide other firms that intend adopt BIM. It is believed that the findings will assist QSFs that desire to adopt BIM to be abreast with the profiles of QSFs that have adopted BIM and work towards upgrading their profiles. The knowledge of the profiles of QSFs that have adopted BIM will help to increase BIM adoption among QSFs and other organizations in the AEC industry. The study shows that the profiles of QSFs is significant and linked to their capability maturity for the success implementation of BIM.

Based on the findings of this study, the following recommendations are proposed:

1) Professional and regulatory bodies of quantity surveying practice should organise forums where

mature QSFs that have adopted BIM can mentor QSFs that have not adopted BIM on the nitty-gritty of BIM adoption based on their experiences and their BIM journey.

2) Professional and regulatory bodies of quantity surveying practice should organise relevant seminars and training on how QSFs can improve their capabilities and attain the needed capability maturity level required to adopt BIM.
3) Professional and regulatory bodies of quantity surveying practice should encourage collaboration and synergy among QSFs where QSFs that have adopted BIM can work and share their capabilities' experience with QSFs that are yet to adopt BIM to encourage the latter to adopt BIM.

LIMITATIONS OF THE STUDY

While this study contributes significantly to the body of knowledge, care must be taken in generalising its findings. For example, while the study was conducted in two major states of the country, future studies would benefit more from broader coverage by engaging firms from more state in Nigeria, which would lead to a larger sample size than what is seen in the study. Also, this study adopted the Delphi approach; future studies could adopt other approaches, like the interview, focus groups, etc., for a more in-depth understanding of the subject.

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