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Extent of specialized software usage in the delivery of quantity surveying services in South West Nigeria

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Abstract

Purpose – This study was done to unearth the state of digital transformation in the delivery of construction cost management in Nigeria. The study investigated the extent of usage of specialized software in the delivery of Quantity Surveying Services (QSSs) to improve construction project delivery in Nigeria.

Design/methodology/approach – The study used a convenient sampling technique to randomly select 146 Quantity Surveyors in Ekiti and Osun State, Southwest Nigeria. Analysis of data was carried out with the use of frequency, percentile, mean score, Cronbach's alpha coefficient, ANOVA and factor analysis.

Findings – The study found that the average awareness level about the identified software for the delivery of QSSs among quantity surveyors is low (MS = 2.83). Analysis of individual software shows that the awareness of quantity surveyors is high on Microsoft Excel (MS = 4.28), AutoCAD (MS = 3.93) and QS CAD (MS = 3.71). More findings indicated that the extent of usage of the software by quantity surveyors is low. However, there was observable high usage of Microsoft Excel. The important factors that influence the usage of specialized software in the study area are lack of accessibility (MS = 4.17), the high initial cost of mounting the software (MS = 4.05), and poor digital education (MS = 3.85). The result of the factor analysis indicated that the factors influencing the usage of specialized software in the delivery of quantity surveying services could be categorized into three component groupings – cost-related, education issues and ease of use factors.

Practical implications – The study will improve digital education for Quantity Surveyors from the Nigerian Institute of Quantity Surveyors (NIQS) and a policy from the National Information Technology Development Agency (NITDA) to improve access to specialized software for Quantity Surveyors.

Originality/value – This research contributes to the existing body of knowledge by shedding light on the current landscape of software adoption in the field of quantity surveying in Nigeria.

Keywords Construction industry, Extent of use, Nigeria, Quantity surveying services, Specialized software, Technology

Paper type Research paper

Introduction

The growth in the trends of digital transformation in the ways businesses are conducted all over the world is phenomenal. While many sectors and nations have advanced in their digital

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evolution, many other sectors and nations are still lagging in this regard. The complexity of 21st-century construction activities, the need to deliver within a stringent timeline, more reliable accuracy in quantities quantification demand, the enormity of work to cope with and the more prevailing need to survive in the world of the intensely competitive business environment (Shen *et al.*, 2003) have created the need to adopt innovative technologies that have been proven to reduce man-power hours expended on professional services as well as enhancing the efficiency of service delivery as necessitated for the adoption of digital tools in delivering of QSSs just as other sectors of the economy embraced disruptive technologies peculiar to them (Ojo *et al.*, 2019; Olatunde *et al.*, 2022). The use of innovative technologies in the world of information and communication technology (ICT) has been proven to be effective and efficient in service delivery in different sectors such as health, manufacturing, finance, education as well as the Engineering and Construction. The end of the last century heralded the invention of software that replaced the traditional and complete human input in delivering professional services in the engineering and construction sector. From the last decade of the last century and now, the inevitability of computer software in project design, planning, budgeting and cost control is documented by Ikediashi and Ogwueleka (2016). Quantity Surveyors perform a variety of functions ranging from measurement of construction works, cost control of construction works, valuation of work, budgeting, advice on tendering methods, procurement advice, project management, claim management, project life cycle costing, preparation of project final account, among others (Kirkham, 2007; Mbachu, 2015; Spellacy *et al.*, 2020).

The use of software in enhancing construction project performance has been researched by Rasli *et al.* (2011). The study established the use of information technology (IT) in improving project delivery in terms of cost, time and quality as well as in project scope. Yang (2007) found that there is a reduction in the delivery time of professional services by the use of software in comparison to the manual man total input, while the cost and quality of construction projects are also improved where IT is deployed, most especially in developed countries. The study by Oladapo (2007) found similar results in developing countries. The performance of firms that are proficient in the use of IT is better than those that are analog in their operations (Gaith *et al.*, 2009). Ikediashi and Ogwueleka (2016) asserted that ICT has greatly impacted the way construction professionals carry out project design, contract procurement, tendering, project administration and day-to-day site evaluation and reporting. The need for the use of information communication technology and software in construction project design, administration and management has been established (Ikediashi and Ogwueleka, 2016). The inevitability of the deployment of this software has been affirmed to enhance project efficiency in terms of a reduction in man-hour input, which eventually reduces construction costs. Oladapo (2007) specifically found that the use of ICT improved work quality, simplified complex tasks and increased productivity. The study by Awolesi (2015) examined in quantitative terms the efficiency rate of software usage for quantity surveying services and found that an efficiency rate of 14.3 times faster could be achieved in terms of the delivery time of professional quantity surveying services as compared to the traditional man input.

Previous studies (Oyediran and Odusanmi, 2005; Jagun, 2003) have established low awareness and adoption of information and technology and specialized software usage in developing countries. Extant literature opined that the factors that influence the quantity surveyors' usage of software and automation in the delivery of QSSs included lack of specialized training, business size and maturity as well as the cost of mounting the hardware and software (Cartildge, 2002). Oyediran and Odusanmi (2005), in emphasizing the issue of cost as a major influencing factor for the adoption of IT and software usage, group the cost factors into the high cost of original software, the high cost of ancillary hardware and the supporting systems. Usman *et al.* (2012) group the inhibitors to the full deployment of information and technology in the delivery of QSSs into human and organizational culture factors. Awolesi (2015) identified seven specialized software used by quantity surveyors to include QS Bill, Snape, Cat Pro, Win-QS System, Master Bill, In-house and QS Elite. Previous studies have

found that the Nigerian construction industry is lagging in digital tools usage in the delivery of construction-related professional services (Oyediran and Odusanmi, 2005; Oladapo, 2007). In the last two decades, the construction industry has witnessed a surge in the development of software to enhance the performance and delivery of construction projects. Professionals in the construction industry have deployed software in project design, e.g. computer-aided drafting, AutoCAD, Arch CAD, etc. in project planning, project evaluation and cost management. Several computer-aided software have been developed to facilitate easy project delivery; some of such software includes Microsoft Project, Cost Planner, Microsoft Excel, etc. In recent years, some construction professionals have automated their services by deploying digital tools in delivering their services. Examples of such professionals are architects and engineers. It is nearly impossible nowadays to see architectural or structural drawings manually produced. However, it is commonly observed that several Quantity Surveyors still partly or completely use the manual method in the delivery of QSSs. Oyediran and Odusanmi (2005) examined computer usage by Nigerian quantity surveyors and found that there is an increasing yearly rate of adoption of computers for quantity surveying services among young Quantity Surveyors. Ojo *et al.* (2019) studied the pedagogy of quantity surveying software and found that collaboration with organizations that can train professionals in software usage and developing information and telecommunication policy will enhance the pedagogy of Quantity Surveying software. This study is advancing on Oyediran and Odusanmi (2005), which majorly concentrated on computer usage and not on awareness and usage of specialized software in the delivery of QSSs. The research questions posed by this study were: what is the awareness level of quantity surveyors to the existence of the identified specialized software? To what extent do the quantity surveyors deploy the identified specialized software in project administration? And what are the factors influencing the usage of this software in delivering QSSs?

Literature review

The construction industry and the quantity surveying services

The economic development of developing nations is significantly enhanced by the construction industry, which plays a crucial role in driving infrastructure development and economic growth (Onyeagam *et al.*, 2019; Ramlee *et al.*, 2015; Onyejeakor *et al.*, 2020). The provision of Quantity Surveying Services (QSS) is essential for the success and sustainability of the construction industry. In this sector, Quantity Surveyors (QS) play a critical role in ensuring efficient cost management, project control and overall project success (Moyanga *et al.*, 2023). However, the industry faces various challenges, such as the necessity to adapt work practices, focus more on client needs and enhance productivity. These challenges arise from factors like economic globalization, rising client expectations, increased competition and the ongoing need to restructure work practices and industrial relationships (Ataei, 2021). This globalization has added complexity to projects, requiring Quantity Surveyors to navigate diverse regulatory environments and different project delivery methods. Many industries have enhanced their operational efficiency and productivity in the last five decades by incorporating innovative technologies and processes (McCoy and Yeganeh, 2021). Present-day construction project managers possess both new technical competencies and soft skills. These new innovations equip them to foresee emerging trends, make precise observations and act accordingly to identify market opportunities, assess inherent risks and capitalize on novel prospects (Ataei, 2021).

Recognizing these developments, the construction industry acknowledges the necessity of implementing strategies to improve the performance of construction activities and achieve strategic objectives. Oke *et al.* (2018) emphasized the global transformation brought about by emerging technologies, affecting various aspects of life, including the Architecture, Engineering and Construction (AEC) industry. The global landscape of construction and infrastructure development has been significantly transformed by the effective use of specialized software tools for quantity surveying services (Jahanger, 2024). Quantity Surveying, a crucial discipline in the construction industry, offers expertise in cost estimation, procurement and financial management

throughout the project life cycle (Ashworth and Perera, 2015). Quantity Surveyors collaborate closely with both design and construction teams, playing a crucial role in optimizing the utilization of resources for optimal results. Their responsibilities encompass delivering financial and cost consultancy services to the project's client, designers and contractors in terms of the preparation of preliminary budgets, final estimates, contract documentation, procurements, contract administration and cost modeling. Initially recognized for proficiency in building work, the quantity surveying profession, dating back to the 17th century, has evolved significantly over time (Jagboro, 1991; Mac-Barango, 2017). The traditional responsibilities of measuring and valuing construction projects through bills of quantities have undergone substantial changes. This transformation includes an expansion into new fields such as engineering, marking a notable evolution in the profession (Opawole *et al.*, 2012).

The quantity surveying software and its extent of usage in Nigeria

Ikediashi and Ogwueleka (2016) asserted that the integration of ICT, also referred to as IT, has become indispensable in various aspects of the construction industry, including design, project planning, cost control, and facilities management. This integration has opened up opportunities for more efficient project execution. Computer software is now extensively used by quantity surveyors for a range of tasks, such as calculations, document preparation (e.g. Bill of Quantities, valuation and tender documents) and measurement of construction works (Oforeh, 1989; Braimoh, 2006; Ye *et al.*, 2020; Nguyen *et al.*, 2024). This is in line with Ibem and Laryea (2014), who opined that the adoption of specialized software, promoting communication and automation among construction professionals, is a widespread concept globally. However, the Quantity Surveying Profession faces significant challenges due to the dynamic and complex nature of the construction environment, impacting traditional roles and services (Mac-Barango, 2017).

The surge in software adoption has led to the development of various specialized packages, such as MasterBill, CatoPro, Digitizers, Planswift, AutoCAD, Eclipse, Super Project, QS Elite, Win QS EVEREST, Estimator Pro, among others, introducing a new paradigm in Quantity Surveying task performance (Oyediran and Odusanmi, 2005). Microsoft Excel is highlighted as the most widely used software for tasks like bill preparation, rate calculations, valuation and variation claims (Akinnagbe and Adelakun, 2014). Recent studies underscore a growing trend in Nigeria, where quantity surveyors are increasingly embracing specialized software tools (Amusan *et al.*, 2021). This shift is attributed to factors such as globalization, technological advancements and the demand for more efficient project delivery.

The Quantity Surveyors involved in various essential tasks throughout the project life cycle seem to be among the few professionals who have not fully adopted innovative technology (Luu and Nguyen, 2020); particularly in Nigeria, and their limited embrace of digitization is attributed to factors such as insufficient management support, funding challenges, resistance to innovation and change, lack of knowledge and inadequate training in digitization, among other issues (Eze and Ugulu, 2021). This is in accordance with the study conducted by Amusan *et al.* (2021), which revealed that approximately 70% of surveyed quantity surveyors in Nigeria employ specialized software, primarily for cost estimation, project management and data analysis. The globalization phenomenon has influenced the construction sector in Nigeria, compelling professionals to align with international standards. To remain competitive, quantity surveyors are to fully adopt technology and software tools widely used on the global stage. While the utilization of specialized software in quantity surveying services in Nigeria is gaining momentum, there remain significant challenges that need to be addressed to maximize the benefits.

Challenges in the use of specialized software in the delivery of quantity surveying services

Amusan *et al.* (2021) outlined two key obstacles hindering the widespread usage of ICT in the context of Nigeria's struggling economy. These challenges stem from inefficiencies in

the national electricity supply system and the high costs associated with computer hardware and software. The authors underscored the significant impact of these challenges on professional prospects in the country. Although the potential benefits of digitalization in the construction industry have been recognized, Oke *et al.* (2018) observed constraints in its application. Despite increased software utilization, persistent challenges and constraints have been noted. According to Oladapo (2007), limited awareness among Quantity surveyors about available software tools, their functionalities and potential benefits poses a substantial obstacle. Insufficient training and the high costs of software acquisition, including initial investment, license renewal fee and recurrent expenses like maintenance, licensing fees, discourage many quantity surveying firms, especially smaller or emerging practices, from using these tools (Oke *et al.*, 2018). These challenges are reiterated by Amusan *et al.* (2021) as significant barriers to the widespread adoption of ICT in the construction industry. Additionally, concerns about software compatibility with local project requirements and the complexity of certain tools impede their seamless integration into quantity surveying practices.

In a different context, Eastman *et al.* (2011) argued that a major obstacle in digital collaboration within the AEC industry is interoperability. Interoperability refers to the ability of associations and professions to exchange, share or integrate data and business processes across information systems or organizational practices. The lack of interoperability is considered a failure of diverse systems to connect effectively. Many institutes do not provide specific modules for digital training, requiring companies to offer additional training to their members. This absence of structured training modules could potentially hinder the implementation of digital technologies in the construction industries. Sacks and Barak (2010) suggested that the absence of well-trained technological staff is a significant requirement preventing the effective utilization and adoption of technological innovations in the construction sector. This highlights the necessity for comprehensive training programs to equip professionals with the skills needed to overcome technological challenges in the industry.

Impact of specialized software on quantity surveying service delivery

The impact of specialized software on service delivery in the context of quantity surveying in Nigeria has garnered considerable attention. In the realm of professional practice, the influence of ICT has primarily manifested in streamlining tasks for practitioners, expediting decision-making processes and generating cost savings, among other outcomes (Amusan *et al.*, 2021). The substantial impact of specialized software on quantity surveying service delivery is evident, as it transforms traditional practices and contributes to enhanced efficiency, accuracy and collaboration. The automation of routine tasks, such as measurement and cost estimation, not only speeds up project timelines but also reduces overall operational costs while significantly improving accuracy in cost estimation (Oladapo, 2006; Wuni *et al.*, 2024). Specialized software tools play a central role in enhancing precision in cost estimation and quantity take-off within the Nigerian quantity surveying context (Ibironke *et al.*, 2011a, b). These tools facilitate the automation of complex calculations and enable prompt adjustments in response to evolving project dynamics.

Research methodology

The study investigated the extent of specialized software usage in the delivery of QSSs in Southwest Nigeria. To achieve the objectives of the study, a quantitative research approach was adopted for data collection using a questionnaire survey. The study considered the choice of the quantitative research approach as the most appropriate in this research because the nature of the study made the numerical result more important than the depth of the research, which is the superior argument for the adoption of the qualitative research method (Tan, 2011; Kaushal and Srivastava, 2021). The

questionnaire designed for the survey was segmented into two sections. The first section asked questions regarding the attributes of the respondents, while the second section inquired about the objectives of the study.

The respondents for the questionnaire survey were selected from Quantity Surveyors in Ekiti and Osun State, Southwest Nigeria. The choice of the two states was basically because they have similar characteristics (Dadamola *et al.*, 2021; Olatunde, 2019) and because of their proximity to the researchers, as this enhanced data collection (Olatunde, 2024).

Respondents from Ekiti State were captured in a workshop between November 30th and December 2nd, 2022, at the State capital – Ado Ekiti, while questionnaires were distributed individually by the researchers to the selected respondents from Osun State. Of the 146 questionnaires that were randomly distributed through a convenient sampling technique, only 114 were retrieved from the field; however, only 109 were screened to be fit and used for the analysis, as the respondents did not completely answer all the questions on the remaining five questionnaires, as such were not fit to be used for analysis. For data analysis, both descriptive and inferential data analysis tools were employed for the study. While frequency, percentile and mean score were used for the descriptive analysis, Cronbach's alpha coefficient and ANOVA were the inferential statistics employed for the study. While the mean item score was used to address objectives one and two of the study, the mean item score and Principal Component Analysis (PCA) was used to address objective three, and the test of hypotheses were done with the use of ANOVA. The PCA was used to reduce the dimensionality of the data into a smaller set while still maintaining significant partners and trends, that is, the PCA was used to reduce the factors influencing usage of specialized software to a more manageable size. The result of the Cronbach's alpha coefficient statistics was used to validate the reliability and validity of the data collected. A Cronbach's alpha coefficient of 0.898 (Table 1) was obtained for the extent of awareness, 0.940 for the extent of usage of specialized software in the delivery of QSSs and 0.853 was obtained for the coefficient of factors influencing usage of specialized software in the delivery of QSSs. These results, in contrast to the benchmark of 0.7 set by DeVellis (2003), showed that the data collected was accurate and the result was reliable.

Research hypothesis

The objectives of the study were to examine the extent of awareness, the extent of usage and factors influencing the usage of specialized software in the delivery of QSSs in Nigeria. To further examine this research's objectives in quantitative terms, three null hypotheses were formulated:

H1. There is no significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on the extent of awareness of specialized software in the delivery of QSSs in Nigeria.

Table 1. Reliability statistics for extent of awareness, extent of usage and factors influencing usage of specialized software in the delivery of quantity surveying services

Extent of awareness of specialized software in delivery of QSSs		Extent of usage of specialized software in delivery of QSSs		Factors influencing usage of specialized software in delivery of QSSs	
Cronbach's alpha	No of item	Cronbach's alpha	No of item	Cronbach's alpha	No of item
0.898	27	0.940	27	0.853	10

Source(s): Authors' own work

H2. There is no significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on the extent of usage of specialized software in the delivery of QSSs in Nigeria.

H3. There is no significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on factors influencing the usage of specialized software in the delivery of QSSs in Nigeria.

The alternate hypotheses formulated for the study were:

H01. There is a significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on the extent of awareness of specialized software in the delivery of QSSs in Nigeria.

H02. There is a significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on the extent of usage of specialized software in the delivery of QSSs in Nigeria.

H03. There is a significant difference in the opinion of quantity surveyors working as academics, in contracting, in consulting and in public organizations on factors influencing the usage of specialized software in the delivery of QSSs in Nigeria.

Results and discussion of findings

Attributes of respondents to the questionnaire

Table 2 shows the attributes of the respondents to the questionnaire (see Table 1). All the respondents were Quantity Surveyors. This was purposive as the study targeted Quantity surveyors to be the population of the study. The analysis of the major area of work of the respondents shows that the respondents' work area cuts across academic (33.0%), contracting (32.1%), public works (20.3%) and consulting organizations (14.7%). This implied a complete mix of the area where Quantity Surveyors are employed; hence, a comparison of opinions from a wide perspective was engendered. As per the year of experience in the construction industry, the analysis shows that 90% of the respondents have more than five years of experience in the construction industry; as such, they were adjudged to have garnered the required experience to be able to supply the information required of them. The highest academic qualification of the respondents ranges from a higher national diploma (26.6%) to a doctor of philosophy (12.8%). All the respondents were members of the Nigerian Institute of Quantity Surveyors (NIQS). However, analysis of the membership type shows that the majority (56.9%) were corporate or associate members, while only 1.8% were fellows in their membership type. The analysis of the number of projects executed yearly by the respondent shows that 80.7% of the respondents execute between three and ten projects yearly. Assessing the respondents in all their attributes, it could be said that they were eminently qualified to supply the information required of them, as they have the required academic, professional as well as work experience needed; as such, the information they supplied could be relied on.

The results depicted in Table 3 show that the specialized software that Quantity Surveyors are mostly aware of and ranked 1st is Microsoft Excel (MS) = 4.28. Other important specialized software that Quantity Surveyors are aware of for the delivery of QSSs and ranked 2nd, 3rd and 4th, respectively, are AutoCAD (MS = 3.93), QS-CAD (MS = 3.71) and Microsoft Project (MS = 3.66). On the contrary, the specialized software that Quantity Surveyors in the study area are least aware of and ranked 27th is Snape (MS = 1.99). Other specialized software with a low extent of awareness among Quantity Surveyors are Vico office takeoff manager (MS = 2.22) ranked 26th, Dimension X (MS = 2.27), ranked 25th and Prism (MS = 2.29) ranked 24th. The average awareness level of quantity surveyors of specialized software for the delivery of QSSs is low (MS = 2.83). The result of the ANOVA shows that

Table 2. Attributes of respondents to questionnaire

Category	Classification	Frequency	Percentage
Profession of respondent major area of work	Quantity Surveying	109	100
	Academic	36	33.0
	Contracting	35	32.1
	Public works	22	20.2
	Consulting	16	14.7
	Total	*109*	*100.0*
Years of experience	1–5	11	10.1
	5–10	24	22.0
	11–15	25	22.9
	16–20	18	16.5
	21–25	31	28.4
	Total	*109*	*100.0*
Highest academic qualification	HND	29	26.6
	PGD	16	14.7
	B.Sc/B.Tech	22	20.2
	M.Sc/M.Tech	28	25.7
	Ph.D.	14	12.8
	Total	*109*	*100.0*
Membership of professional body type of membership	NIQS	109	100.0
	Graduate	12	11.0
	Probationer	33	30.3
	Corporate/Associate	62	56.9
	Fellow	2	1.8
	Total	*109*	*100.0*
Number of project executed yearly	1–2	21	19.3
	3–4	33	30.3
	5–6	25	22.9
	7–8	10	9.2
	9–10	20	18.3
	Total	*109*	*100.0*

Source(s): Authors' own work

respondents were unanimous in their rating of the extent of awareness of Quantity Surveyors about specialized software for the delivery of QSSs, except on two software – Workmate 5.0 ($p = 0.020$) and Oracle primavera ($p = 0.010$). The divergence in the opinion of the respondents on this software that accounts for a significant difference in their opinion on them could be because they were not among the digital tools that the respondents have a high awareness level.

Table 4 shows the extent of usage of specialized softwares in the delivery of QSSs. The results, as obvious from the table, indicate that Microsoft Excel has the highest level of usage (MS = 3.89) for the delivery of QSSs in the study area. Other specialized software that has high usage levels among quantity surveyors in the study area are AutoCAD (MS = 3.25) and Micro Project (MS = 3.03). On the converse, the specialized software that Quantity Surveyors least use in the delivery of QSSs is Vector 8 (MS = 1.87). Other specialized software that the respondents do not use frequently in the delivery of QSSs are: e take off (MS = 1.88), Vico Office takeoff manager (MS = 1.92) and cost planner (MS = 1.95). On average, the extent to which quantity surveyors use specialized software for the delivery of QSSs is low (MS = 2.34). The result of the ANOVA shows that the respondents were almost unanimous (89% agreement) in their rating of the extent of usage of specialized software in the study area.

Table 5 shows the result of the survey on the factors that are influencing the usage of specialized software in the delivery of QSSs in the study area. It could be seen from the result

Table 3. Extent of awareness of specialized software for the delivery of quantity surveying services

S/N	Digital tools	Mean score	Rank	F-stat	*p*-value
1	Microsoft Excel	4.28	1	0.834	0.478
2	AutoCAD	3.93	2	0.372	0.773
3	QS-CAD	3.71	3	0.546	0.652
4	Microsoft Project	3.66	4	2.584	0.057
5	Master Bill	3.30	5	0.398	0.755
6	QS Bill	3.28	6	1.471	0.227
7	Revit	3.17	7	1.582	0.198
8	Estimator	3.05	8	0.449	0.719
9	Workmate 5.0	2.98	9	3.438	0.020*
10	Work plan enterprise	2.87	10	1.115	0.347
11	Cost planner	2.85	11	1.033	0.381
12	Pro-estimate	2.83	12	0.207	0.891
13	In-house	2.66	13	1.774	0.157
14	QS-Plus	2.63	14	0.890	0.449
15	Oracle primavera	2.59	15	3.969	0.010*
16	Cost X	2.53	16	1.248	0.296
17	Cat pro	2.53	17	0.597	0.618
18	Primus takeoff	2.51	18	1.012	0.391
19	e take off	2.51	19	1.828	0.147
20	Vector 8	2.50	20	0.323	0.809
21	Plan swift	2.46	21	4.054	0.009*
22	Win QS	2.46	22	1.162	0.328
23	QS elite	2.44	23	0.827	0.482
24	Prism	2.29	24	2.101	0.104
25	Dimension X	2.27	25	1.643	0.184
26	Vico office takeoff manager	2.22	26	0.690	0.560
27	Snape	1.99	27	0.691	0.560
		Avg = *2.83*			

Source(s): Authors' own work

that the most important factor influencing the usage of specialized software in the delivery of QSSs is the lack of accessibility (MS = 4.17). Other important factors included the high initial cost of mounting the software (MS = 4.05), poor software education (MS = 3.85) and proficiency and knowledge of the software (MS = 3.84). On the contrary, the rate at which software becomes outdated and requires updating (MS = 3.42) has the least influence on the usage of specialized software in the area. The result of the ANOVA shows that there is 80% agreement in the ranking of the various categories of respondents on factors influencing the usage of specialized software in the delivery of QSSs in the study area.

The ten factors that are influencing the usage of specialized software in the delivery of QSSs in the study area were subjected to PCA to identify a relatively small number of factor groupings that can be used to represent relationships among the factors. The Bartlett's test of sphericity was significant ($p = 0.00$) (Table 6), and the value of the KMO index was 0.77, well above the recommended minimum value (0.6). Therefore, the results of these tests confirmed that the data set was appropriate for PCA in all ramifications. The PCA (Table 7) produced a 3-component solution. The Eigenvalue of the three-component factor groupings being greater than 1.00 explains 67.80% of the variance. Each of the factors belonged to only one of the groupings, with the value of factor loading exceeding or being equal to 0.50. The factors influencing the usage of specialized software in the delivery of QSSs were grouped into three principal components, and the corresponding importance ranking of the extracted components is cost-related, education issues and ease of use factors (see Table 8).

Table 4. Extent of usage of specialized software in the delivery of Quantity Surveying services

S/N	Software	Mean score	Rank	F-stat	*p*-value
1	Microsoft Excel	3.89	1	0.834	0.478
2	AutoCAD	3.45	2	0.372	0.773
3	Micro Project	3.03	3	2.584	0.057
4	Master Bill	2.79	4	0.398	0.755
5	Qs CAD	2.68	5	0.546	0.652
6	Revit	2.65	6	1.582	0.198
7	Plan swift	2.58	7	4.054	0.009*
8	QS Bill	2.35	8	1.471	0.227
9	Cost X	2.31	9	1.248	0.296
10	Estimator	2.27	10	0.449	0.719
11	Primus takeoff	2.23	11	2.101	0.104
12	Work plan enterprise	2.20	12	1.115	0.347
13	QS Plus	2.19	13	0.890	0.449
14	Cat Pro	2.17	14	0.597	0.618
15	Win QS System	2.16	15	1.162	0.328
16	Oracle	2.15	16	3.969	0.010*
17	Dimension X	2.12	17	1.643	0.184
18	QS Elite	2.12	18	0.827	0.482
19	Workmate 5.0	2.11	19	3.438	0.020*
20	Snape (vector)	2.07	20	0.691	0.560
21	In-house	2.07	21	1.774	0.157
22	Pro-Estimate	2.06	22	0.207	0.891
23	Prism	2.04	23	1.012	0.391
24	Cost planner	1.95	24	1.033	0.381
25	Vico office takeoff manager	1.92	25	0.690	0.560
26	e Takeoff	1.88	26	1.828	0.147
27	Vector 8	1.87	27	0.323	0.809
		Avg. = 2.34			

Source(s): Authors' own work

Table 5. Factors influencing usage of specialized software in the delivering of quantity surveying services

S/N	Factors	Mean score	Rank	F-stat	*p*-value
1	Lack of accessibility	4.17	1	1.588	0.197
2	High initial cost of mounting the software	4.05	2	1.777	0.156
3	Poor Software education	3.85	3	4.505	0.005*
4	Proficiency and knowledge of software	3.84	4	1.743	0.163
5	Software flexibility	3.71	5	1.129	0.341
6	Complexity of the software application	3.65	6	0.064	0.979
7	Absent of tailor-made QS training by private computer school trainers	3.60	7	5.219	0.002*
8	Inadequate job order to encourage investment in software	3.53	8	0.090	0.965
9	User friendliness of the software	3.51	9	1.204	0.312
10	The rate at which software becomes outdated and require up dating	3.42	10	2.372	0.075

Source(s): Authors' own work

Discussion

As found in this study, Quantity Surveyors' awareness of many specialized software is still low; this could be said to be a major attribute peculiar to developing economies. However, the finding of Shen *et al.* (2003), which found that information and technology applications in QS

Table 6. KMO and Bartlett's test of factors influencing the usage of specialized software in the delivering of quantity surveying services

KMO measure of sampling adequacy		0.77
Bartlett's test of sphericity	Approx. Chi-Square	1389.00
	df	280.00
	Sig.	0.00

Source(s): Authors' own work

companies in Hong Kong are very limited, agrees with the finding of this study. Although a time lag of two decades between the two studies could be interpreted to mean that the position of Hong Kong Quantity surveyors two decades ago is the present reality in the awareness of software in the delivery of QSSs in Nigeria. Just like the finding of Shen *et al.* (2003) in Hong Kong two decades ago, the extent to which Quantity surveyors used specialized software is still low. This finding could be said to be in tandem with Ibironke *et al.* (2011a, b), which found that only 27% of Quantity Surveyors frequently use software for estimating and tender analysis. Similarly, the foremost awareness and use of Microsoft Excel among quantity surveyors for the delivery of QSSs in Nigeria agrees with Shen *et al.* (2003), who found that Quantity surveyors in Hong Kong predominantly use Microsoft Excel for many of their services.

Oyediran and Odusanmi (2005) also found a similar result that the proficiency of the Nigerian Quantity surveyors is high in the use of Microsoft Excel in comparison to other specialized software for the delivery of QSSs. The awareness and use of Microsoft Excel as the most predominant software in the delivery of QSSs were confirmed in a study by Awolesi (2015), as such quantity surveyors in Nigeria have not significantly improved themselves in the use of specialized software in the delivery of QSSs. This could be the main reason why the findings of Oyediran and Odusanmi (2005) and Awolesi (2015) could still be the same as those of this study after a time lag of almost two decades and a decade, respectively.

Comparing this study with Awolesi (2015), which found that Car Pro, Master Bill and QS Bill are the top three most used specialized software, this study, on the contrary, found Microsoft Excel, AutoCAD and Micro Project, respectively, as the most frequently used specialized software in the delivery of QSSs. Although, based on the average rating, it appears there is an observable increase in the way Quantity Surveyors rate their average use of the identified software in Awolesi (2015) with an average mean score of 1.1 as compared to 2.34 for this study. This could imply an upward trend in the use of specialized software in the delivery of QSSs within the decade (Oyediran and Odusanmi, 2005).

In the opinion of Usman *et al.* (2012), one of the major barriers to the usage of specialized software among quantity surveyors in Nigeria is their negative perception and fraudulent activities. This study, however, did not find any alignment with such a position; rather, the lack of accessibility to the specialized software is a main factor influencing the usage of specialized software for the delivery of QSSs in Nigeria. Although this study found lack of accessibility as the most important factor influencing the use of specialized software for the delivery of QSSs in Nigeria, the issue of the high initial cost of mounting the software is still an important issue second to accessibility. As such, this study could be said to agree with Oyediran and Odusanmi (2005), which found the high cost of software as a major factor influencing the use of specialized software for the delivery of QSSs, as well as Rasheed (2018), which found the cost of mounting software as one of the major factors affecting the use of planning software in construction project delivery in Nigeria.

The cost-related factors as emanated from the PCA include lack of accessibility, high initial cost of mounting the software and inadequate job order to encourage investment in software. This resonates with the findings of previous studies (Rathnayaka *et al.*, 2024). Amusan *et al.* (2021) and Rasheed (2018) also found cost-related factors to be the major inhibitors to the use of specialized software for the delivery of QSSs. Therefore, this finding could be said to be in tandem with Rasheed (2018) as well as Amusan *et al.* (2021).

Table 7. Total variance explained of factors influencing the usage of specialized software in the delivering of quantity surveying services

Component	Initial eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	9.90	39.59	39.59	9.90	39.59	39.59	7.44	28.81	28.81
2	3.54	16.18	55.77	3.54	16.18	55.77	5.98	23.02	51.83
3	2.74	12.03	67.80	2.74	12.03	67.80	3.74	15.97	67.80
4	0.98	5.85	72.65						
5	0.96	5.59	78.24						
6	0.91	5.32	83.56						
7	0.87	4.57	88.13						
8	0.77	4.20	92.33						
9	0.73	4.02	96.35						
10	0.64	3.65	100.00						

Note(s): Extraction Method: Principal Component Analysis
Source(s): Authors' own work

Table 8. Rotated component matrix of factors influencing usage of specialized software

Coding	Factors	Component 1	2	3
FP3	Lack of accessibility	0.786		
FP5	High initial cost of mounting the software	0.765		
FP6	Inadequate job order to encourage investment in software	0.534		
FP7	Proficiency and knowledge of software		0.618	
FP8	Absent of tailor-made QS training by private computer school trainers		0.542	
FP4	Complexity of the software application		0.556	
FP2	Poor Software education		0.712	
FP10	User friendliness of the software			0.521
FP1	Software flexibility			0.578
FP9	The rate at which software becomes outdated and require up dating			0.504

Note(s): Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Source(s): Authors' own work

Other barriers to the use of specialized software in the delivery of QSSs are educationally related. The PCA found poor software education, lack of proficiency and knowledge of software, complexity of the software application and absence of tailor-made QS training by private computer school trainers. All these factors are considered challenges in the use of software because of the deficiency in education and training at the professional level (Nguyen *et al*., 2021). In many instances, the curriculum and training are still analog, while the continuous professional development that is to bridge the gap between theory and practice is often inadequate (Ebekozien and Aigbavboa, 2024).

Ease of use of the specialized software was considered another group of factors impeding the use of specialized software in the delivery of QSSs. The factors in this category are user-friendliness of the software, software flexibility and the rate at which software becomes outdated and requires updating. The challenge of ease of use is often a result of the fact that many of the software are not locally developed (Wuni *et al*., 2024).

Conclusion

The study adopted a quantitative research approach to investigate the extent of specialized software usage in the delivery of quantity surveying services in Nigeria. Arising from the findings of the study, it was concluded that the awareness of quantity surveyors of the identified specialized software is low. It was also concluded that Microsoft Excel, AutoCAD and QS-CAD are the predominant specialized software programs the quantity surveyors are aware of. More conclusions are that the extent to which quantity surveyors generally use specialized software in the delivery of QSSs is low. However, Microsoft Excel, AutoCAD and Micro Project software were found to have a high extent of usage for the delivery of QSSs. The important factors that are influencing the use of specialized software in the delivery of QSSs are lack of accessibility and high initial cost of mounting the software. It was also concluded that the factors influencing the usage of specialized software in the delivery of QSSs in the study area could be grouped into three main categories of cost-related factors, education-related factors and ease-of-use factors. It was finally concluded that the respondents were almost unanimous in their rating of the extent of awareness, the extent of usage and factors influencing usage of specialized software in the delivery of QSSs.

Inferring from the conclusions, the study recommended improved digital education in the form of periodic workshops/seminars for Quantity Surveyors from the Nigerian Institute of Quantity Surveyors (NIQS) and the Quantity Surveyors Registration Board of Nigeria (QSRBN) on new specialized software for the delivery of QSSs and a deliberate policy from

the National Information Technology Development Agency (NITDA) to improve access to specialized software for Quantity Surveyors. The major limitation for the study lies in the fact that data collection was only limited to two southwest states of Nigeria; as such, the finding may not be a complete representation of the whole country. Therefore, generalization of the findings to the whole country is with caution. Moreover, the sampling method employed for data collection may be another limitation to the generalization of the study. Further study could be instituted in other regions of the country so as to compare their findings with this study. In the same way, more study could be launched to compare the extent of specialized software usage across built environment professions.

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