

Assessing the Integration of Information Technology Across Key Areas and Functions in Quantity Surveying Professional Practice

Amadi Alolote Ibim^{1,*}

Abstract

Information Technology (IT) has had an immeasurable impact on business systems and processes, in all spheres of the economy including construction. The study assesses the integration of technology within the construction sector by Quantity Surveying professionals in Nigeria. This is against the backdrop that the integration of technology into the practice of Quantity Surveying has had a profound effect on the profession in Nigeria and globally. Technological revolution has fundamentally transformed the way quantity surveyors perform their roles, influencing precision and efficiency, across the areas and functions. Data collection was carried out via questionnaire surveys, which were administered both physically and digitally. The survey questions were structured to capture the extent of adoption and usage of technology as applied in quantity surveying across different key areas and functions in Quantity Surveying professional practice. The study outcome showed that quantity surveying functions such as cost control and tracking are the most technologically integrated, followed by takeoff and estimations, while data visualization and project scheduling are the least integrated. The findings also show that technology is more integrated in areas such as procurement, followed by contract administration, while technology is least integrated in the areas of sustainable practices, and regulatory compliance. Nonetheless, while these segments may currently experience less pronounced technological integration, it is essential to recognize that the industry is dynamic, and these trends can change over time as awareness, affordability, and the benefits of technology become more evident. The aforementioned array of functions and areas showcases the diverse applicability of technology in quantity surveying, which has the potential to contribute to more streamlined processes and improved project outcomes.

Keywords: Construction industry, information technology, professional practice, quantity surveying

INTRODUCTION

The intense growth of Information and Communication Technology (ICT) has had an immeasurable impact on business systems and processes [1]. In recent times, the construction industry has undergone a substantial transformation, transitioning from its traditional paper-based service

delivery methods to embrace electronic information transmission facilitated by Information Technology (IT), particularly in Nigeria. It is now abundantly clear that the integration of Information Technology has the potential to significantly boost construction productivity and enhance communication, thus facilitating effective decision-making among various parties involved in construction projects [2, 3]. Quantity surveyors (QS) being key players responsible for managing crucial construction project success factors like cost, time, and quality, play a pivotal role in this

*Author for Correspondence

Amadi Alolote Ibim
E-mail: amadi.alolote@yahoo.com

¹Lecturer, Department of Quantity Surveying, Rivers State University, Port Harcourt, Nigeria

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technological evolution.

Particularly, the wide adoption of ICT globally has intensified competition among organizations worldwide and even among construction professionals. The ability of Quantity Surveyors (Qs) to embrace the emerging opportunities brought about by ICT depends on their willingness to adopt new technologies [1, 14]. Computers have promised to be dependable tools in various aspects of human endeavours. Literature has extensively discussed the significance of computing in various industries [2, 31]. Professions that embraced available technological tools witnessed advancements [3, 4]. There have been significant developments in all areas of computer applications in industry, including expert systems, artificial intelligence, knowledge-based systems (KBS), artificial neural networking (ANN), robotics, and computer-aided design (CAD).

Information and Communication Technology (ICT), also known as Information Technology (IT), has profoundly reshaped our way of life, learning, work, and recreation [5, 19]. However, it seems that many companies in the construction industry have not fully recognized the positive changes and advantages that this new technology offers, despite its benefits being evident in other sectors of the economy. This study seeks to assess the level of technology integration across different segments of the quantity surveying practice, It further proposes effective strategies for enhancing technology integration in quantity surveying professional practice.

LITERATURE REVIEW

The Need for Technology Integration in Nigeria's Construction Sector

The need for technology across the construction industry in Nigeria is paramount, driven by a confluence of factors that underline the industry's growth, efficiency, and sustainability. First and foremost, Nigeria's construction sector is experiencing rapid expansion due to urbanization and population growth. To meet the growing demand for housing, infrastructure, and facilities, technology is essential for efficient project management, reducing construction time, and improving resource utilization [6]. Additionally, as the industry faces the challenge of limited skilled labour, technology can fill the gap by automating routine tasks and enhancing productivity [7, 22]. This is crucial in an environment where access to skilled labour remains a challenge.

The construction industry in Nigeria is also characterized by the need for better cost control and transparency. Technology, through tools like Building Information Modeling (BIM), digital project management, and real-time data monitoring, offers greater visibility into project costs, resource allocation, and progress tracking [8]. Improved cost control is particularly significant in Nigeria, where project cost overruns have been a persistent issue [9, 10]. In this context, technology becomes a valuable asset in enhancing financial accountability and project budget adherence.

Furthermore, technology is indispensable for sustainability in the construction industry. Nigeria, like many other nations, is increasingly focusing on eco-friendly and green building practices to minimize environmental impact [11,12]. Sustainable technologies, such as energy-efficient building materials and renewable energy systems, are vital for achieving this objective. Moreover, technology can facilitate waste reduction and resource efficiency, aligning construction practices with the broader goals of environmental conservation [13].

Lastly, the Nigerian construction sector can benefit significantly from technology in terms of project risk management and safety [14, 15]. Real-time data from sensors and IoT devices can enhance worker safety by providing early warnings for potential hazards [16]. Predictive analytics and AI can assist in identifying and mitigating project risks, reducing the likelihood of delays and disputes. In this context, technology ensures a safer working environment and improved project outcomes [10, 17].

Effects of the Integration of Technology in Quantity Surveying Practice

The integration of technology into the practice of quantity surveying has had a profound effect on the profession in Nigeria and globally. This technological revolution has fundamentally transformed the way quantity surveyors perform their roles, influencing aspects such as precision, efficiency, and adaptability [18, 19].

One of the most significant impacts of technology on quantity surveying is the enhancement of precision and accuracy [20]. Building Information Modeling (BIM) is a prime example of this [21, 22]. BIM allows quantity surveyors to work with highly detailed 3D models that not only represent the physical aspects of construction projects but also incorporate cost-related data. This real-time cost analysis and estimation using BIM leads to more precise quantity takeoffs, reducing the margin for error and improving project cost control [21, 23, 24]. Technology has given quantity surveyors the tools to ensure that estimates and budgeting are highly accurate, aligning projects with financial expectations [25].

Efficiency gains through technology are another notable effect on quantity surveying practice. Digital software tools have become indispensable, automating various aspects of the quantity surveyor's work [26]. These tools include digital measurement and estimating software, which speeds up quantity takeoffs and cost estimations, and project management software that optimizes processes and collaboration [12, 27]. Quantity surveyors can prepare bills of quantities and cost reports more rapidly, benefiting both the professionals themselves and their clients. The efficiency provided by technology allows quantity surveyors to handle larger and more complex projects while maintaining a high standard of precision [28].

Moreover, technology has made quantity surveying more adaptable and flexible. As construction practices evolve and new methods and materials emerge, technology aids quantity surveyors in staying current. It enables quantity surveyors to adapt to changing industry requirements, environmental concerns, and sustainability practices [13, 29]. This adaptability positions quantity surveyors as valuable professionals who can provide expertise in cost management, budgeting, and project control across a wide spectrum of construction projects [30].

In conclusion, technology has had a transformative effect on the practice of quantity surveying in Nigeria and globally. The precision and accuracy provided by tools like BIM, the efficiency gains through digital software, and the adaptability to evolving industry needs have all made quantity surveyors more effective professionals. As technology continues to advance, quantity surveyors are poised to play a central role in the construction industry's ongoing development and modernization [31].

Challenges to the Integration of Technology in Quantity Surveying Practice

The adoption of technology in quantity surveying practice in Nigeria presents several challenges that have implications for cost management, project timelines, and labour utilization. While technology offers significant benefits, these challenges must be addressed to maximize its potential.

One of the primary challenges is the initial investment required to implement technology. The cost of acquiring and integrating software, hardware, and training personnel can be substantial. In some cases, smaller firms or projects may struggle to justify these upfront costs, impacting their ability to adopt advanced technologies effectively [14]. The initial expense of technology adoption, if not managed effectively, can have adverse effects on project budgets, particularly in cases where cost overruns are not adequately considered [32].

Furthermore, the learning curve associated with new technology can lead to delays in project timelines. The transition from traditional methods to technology-driven processes may require

additional time for training and adaptation, affecting project schedules [15]. Additionally, integrating technology tools into established workflows can lead to resistance from personnel unfamiliar with these changes, further slowing the adoption process [30].

Labour implications also arise from the adoption of technology in quantity surveying. While technology can enhance productivity and reduce the need for manual calculations and data entry, it may also necessitate upskilling the existing workforce or hiring technologically adept personnel [16]. This transition period can temporarily disrupt labour resources and may require additional investment in workforce development [19].

Addressing these challenges is vital to ensure that the adoption of technology in quantity surveying practice ultimately leads to improved cost management, project timelines, and labour efficiency. Strategic planning, careful budgeting, and comprehensive training programs can mitigate the initial cost challenges, ensuring that technology enhances cost management in the long run [17]. Moreover, well-planned technology implementation strategies can minimize the impact on project timelines [25]. Effective change management programs, including clear communication and support, are essential to ensure a smooth transition. In terms of labour, investing in workforce development and creating a technology-friendly workplace culture is crucial to maximizing the efficiency gains technology can offer [31, 32].

METHOD OF STUDY

This study aims to investigate the level of integration of information technology across key areas in quantity surveying professional practice, as it relates to the Nigerian construction industry. In the pursuit of this research, a comprehensive study design has been developed to collect and analyze data that will shed light on this aim. The population and target population for this study comprise a diverse range of quantity surveyors in different areas of professional practice in Nigeria. The research employs a systematic sampling technique to select a representative sample from this population, ensuring that the data collected is reflective of the broader context. Data collection was carried out via questionnaire surveys, which were administered both physically and digitally. The survey questions were structured to capture the extent of adoption and usage of technology as applied in quantity surveying across different project types and scales.

The sample size and sampling techniques for this study are critical elements in ensuring the research's validity and representativeness. A well-considered sample size and appropriate sampling techniques are fundamental to drawing meaningful conclusions about the extent of technology utilization in quantity surveying in Nigerian construction projects. The sample size was 105 and the study area was Rivers State. The sample size for this research was determined by considering statistical power and the practicality of data collection. The data collated provides a representative cross-section of quantity surveyors in Rivers State, Nigeria, and also reflects various sectors and project sizes. The sample size will be large enough to yield statistically significant results while remaining manageable within the research constraints.

Following the data collection process, the next crucial step was to transform the collected data into valuable insights that can inform decision-making. This process commenced with coding and categorizing the data into distinct groups, enabling the creation of tables and charts. Subsequently, the study advanced to the presentation of statistical findings, including mean analysis via the calculation of the relative importance index. These analytical approaches were employed to extract meaningful information from the data and provide a basis for drawing informed conclusions and recommendations.

RESULTS AND DISCUSSION

Key Functions in Quantity Surveying Practice Impacted By Technology

The respondents were able to rate how technology has influenced quantity surveying through their personal experience. Particularly, the respondents were able to identify the key cost management functions in quantity surveying technology that have strongly impacted (Table 1).

Table 1. Key Functions in Cost Management Impacted by Technology.

Cost management functions	Frequency	Percentage	Rank
Accurate quantity takeoffs	24	22.9%	1ST
Enhance cost control	21	20%	2ND
Streamline cost reporting	19	18.1%	3RD
Integration with procurement	15	14.3%	4TH
Real-time cost tracking	13	12.4%	5TH
Advanced cost estimation models	13	12.4%	6TH

Source: Author's Fieldwork

From the survey carried out, the data shows that technology has impacted every aspect of cost management practices, in certain areas like taking off measured quantities, with technology-accurate. Quantity takeoffs can be done easily and efficiently with less human error. Ranking second is enhanced cost control in quantity surveying, which involves implementing strategies and practices to manage and monitor project costs effectively. Third is streamlining cost reporting. The goal of streamlining processes in quantity surveying is to reduce waste, improve efficiency, and increase productivity. This can help ease workload and stress, which is very important and has proven to be very helpful. Streamlining processes entails identifying and eliminating repetitive and unnecessary steps. For example, a cost report is a vital tool in construction used by Quantity Surveyors to report on expenditures and assess the financial performance of a construction project. Streamline cost reporting helps monitor and control the budget, communicate the financial status, and identify and address any issues or risks. Fourth is integration with procurement. Successful integration of technology with procurement enhances transparency and contributes to effective cost management throughout the project lifecycle. Fifth real cost time tracking overall, real-time cost and time tracking enhance the agility of project management by providing accurate, up-to-date information. This, in turn, enables timely adjustments, and better risk management, and ultimately contributes to the successful completion of construction projects. Sixth is advanced cost estimation models like BIM, Data Analytics, Parametric Estimator etc. For example, BIM is a central component in advanced cost estimation. It allows for the creation of 3D models that integrate various project data, enabling quantity surveyors to extract precise quantities and related cost information, overall these advanced cost estimation models enhance the precision, efficiency, and adaptability of quantity surveying practices, contributing to better-informed decision-making throughout the project life cycle.

Current Level of Technology Integration in the Quantity Surveying Profession

Respondents were asked to rate the current level of technology integration within the quantity surveying profession. The respondents were asked to choose high, medium and low. From the survey, results in Table 2, 50 out of 105 respondents, representing over 47.6%, believe that the current level is medium, 33 which is over 31.4% of the total number of respondents believe that the current level is low, while the remaining 23(21.9%) believe that the current level is high. Comprehensive study of Entanglement Entropy in Quantum Field Theory: Analysis of Conformal Field Theory to Massive Field Extensions and Holographic Entanglement

Table 2. Current Level of Technology Integration

Current level of technology integration	Frequency	Percentage
HIGH	23	21.9%
MEDIUM	50	47.6%

LOW	33	31.4%
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Source: *Author's Fieldwork*

From the results, it is clear that the highest percentage of respondents rated the level of technology integration medium, ranking first (Table 3).

Table 3. Ranking of Current Level of Technology Integration.

Current level of technology integration	Frequency	Percentage	Rank
Medium	50	47.6%	1ST
Low	33	31.4%	2ND
High	23	21.9%	3RD

Source: *Author's Fieldwork*

More Technologically Integrated Functions/Areas of Quantity Surveying

Several areas and functions within quantity surveying have experienced more pronounced and advanced technological integration. These segments leverage technology to streamline processes, enhance accuracy, and improve overall efficiency. The respondents were asked about which areas of technology integration are more pronounced. From the survey, all the functions and areas listed are broadly pronounced and integrated technologically. These functions and areas (Tables 4 and 5) showcase the diverse applications of technology in quantity surveying, each contributing to more streamlined processes and improved project outcomes.

Table 4. More Technologically Integrated Functions.

Functions	Strongly disagree	Disagree	Average	Agree	Strongly agree
Takeoff and estimations	3	2	14	38	48
Project scheduling	2	3	12	41	47
Data visualization	5	3	12	42	44
Cost control and tracking	4	2	10	40	49

Source: *Author's Fieldwork*

While many areas within quantity surveying have seen significant technological integration, there are still segments where adoption may be less pronounced. These areas might face challenges related to industry tradition, resource constraints, or slower acceptance of new technologies. Respondents strongly agree that all the segments aforementioned aren't equally technologically integrated and some are more unpronounced, and integrated. While these segments may currently experience less pronounced technological integration, it's essential to recognize that the industry is dynamic, and these trends can change over time as awareness, affordability, and the benefits of technology become more evident.

Table 5. More Technologically Integrated Areas of Practice

Areas/ segments	Strongly disagree	Disagree	Average	Agree	Strongly agree
Traditional practices	6	7	15	32	45
Sustainable practices	4	6	17	38	40
Contract administration	3	7	17	36	42
Regulatory compliance	4	8	19	29	45
Procurement	3	8	15	34	45

Source: *Author's Fieldwork*

From the survey, Table 6 shows Cost control and tracking are more pronounced with a mean score of 4.22, ranking first on the table followed by Takeoff and Estimations with a mean score of 4.20 ranked second, least on the table. Data visualization and project scheduling with a mean of 4.14 each, respectively ranked third and fourth on the table. These areas showcase the diverse applications of technology in quantity surveying, each contributing to more streamlined processes and improved project outcomes.

Table 6. Ranking of More Technologically Integrated Functions

Areas/ segments	Total no.	Mean score	Rank
Cost control and tracking	105	4.22	1ST
Takeoff and estimations	105	4.20	2ND
Data visualization	105	4.14	3RD
Project scheduling	105	4.14	4TH

Source: Author's Fieldwork

Table 7 shows procurement is technology pronounced with a mean score of 4.11 ranking first on the table. This is followed by contract administration, ranking second on the table with a mean score of 4.01. Ranking third is sustainable practices, with a mean score of 3.99. Traditional practices and Regulatory compliance are the least ranked on the table with mean score 3.98 ranked fourth and fifth. While these segments may currently experience less pronounced technological integration, it's essential to recognize that the industry is dynamic, and these trends can change over time as awareness, affordability, and the benefits of technology become more evident.

Table 7. Ranking Of Technologically Integrated Areas.

Areas/ segments	Total no.	Mean affecting score	Rank
Procurement	105	4.11	1ST
Contract administration	105	4.01	2 ND
Sustainable practices	105	3.99	3 RD
Traditional practices	105	3.98	4 TH
Regulatory compliance	105	3.98	5 TH

Source: Author's Fieldwork

Summary of Findings

- From the survey carried out on this research, it was shown that many quantity surveyors believe that the level of technology integration in the profession is medium. This shows that a good number of quantity surveyors don't believe that technology has fully integrated within the quantity surveying profession. However, there's a general trend toward increased adoption of technology to enhance efficiency and effectiveness. The integration of these technologies not only improves the efficiency of quantity surveying tasks but also enhances collaboration across the entire construction project lifecycle. As technology continues to evolve, quantity surveyors are likely to see further advancements that will contribute to a more interconnected and streamlined profession.
- From the data obtained from the survey, investigation shows that 46.7% strongly agree that cost control and tracking is technologically pronounced and integrated in quantity surveying. Technology has significantly pronounced cost control and tracking in the construction industry, enhancing precision, efficiency, and real-time management. Cost control and tracking in the construction industry, offer sophisticated tools and methodologies that empower stakeholders to manage project finances with precision and agility.
- Also from the investigation 45.8% strongly agree that taking off and estimations are more technologically pronounced, Technological advancements have significantly pronounced the processes of takeoff and estimation in the construction industry Overall, technology has

revolutionized the traditional methods of takeoff and estimation in the construction industry, making these processes more efficient, accurate, and adaptable to the dynamic nature of construction projects.

- Project scheduling has a 44.5 rating from the investigation, project scheduling in the construction industry, introducing advanced tools and methodologies that enhance efficiency, accuracy, and collaboration. Project scheduling contributes to more effective and adaptive construction project management, helping teams meet deadlines, optimize resources, and enhance overall project success.
- Lastly Data visualization from investigation 41.9% strongly agree that it has become technologically pronounced in the construction industry, providing powerful tools to interpret and communicate complex information. Tools like BIM, VR/AR etc. The integration of these technologies in data visualization enhances communication, decision-making, and overall project management efficiency in the construction industry. Visualizing data compellingly and interactively contributes to a better understanding of complex construction projects. In the construction industry, technological advancements have significantly impacted various facets, including project scheduling, cost control and tracking, data visualization, and the integration of technology in quantity surveying practices.

CONCLUSION AND RECOMMENDATIONS

The construction industry in Nigeria is evolving, with quantity surveying playing a pivotal role in cost management, project control, and budget optimization. However, the adoption of technology has become imperative to enhance efficiency and precision. Quantity surveyors are increasingly embracing tools like Building Information Modeling (BIM) and digital software to streamline their practices, resulting in improved cost estimation and control, time management, and labour utilization. Quantity surveyors now can work collaboratively with architects and engineers to achieve cost-effective project designs and ensure that projects remain within budget. Technology has revolutionized the field of quantity surveying, bringing about significant advancements and transformative changes in how quantity surveyors perform their roles. These technological innovations have greatly improved the precision, efficiency, and overall effectiveness of quantity surveying practices in Nigeria and beyond.

The integration of technology into quantity surveying practices contributes to better cost control, precision, and efficiency. As the construction industry continues to evolve, technology will play an increasingly pivotal role in ensuring that quantity surveyors can provide clients with accurate estimates, streamline project cost control, and facilitate improved project management. While the benefits of technology in quantity surveying are evident, challenges in its adoption persist. Resistance to change, a lack of awareness, and the initial costs associated with implementing technology pose hurdles. Nevertheless, technology has brought about significant transformations, with digital tools automating tasks, enabling real-time cost analysis, and optimizing project timelines. In summary, technology is reshaping quantity surveying in Nigeria. It improves cost, time, and labour management, making the industry more efficient and responsive to the demands of modern construction projects. The adoption of technology is not without its challenges, but the potential benefits far outweigh the obstacles, making it a crucial driver for the future of quantity surveying in Nigeria's construction industry.

Based on the findings and conclusions derived from the study, the following recommendations are proposed:

- *Integration of Technology in Quantity Surveying (ITQS) Programs:* The Integration of Technology in Quantity Surveying (ITQS) Program, with these recommendations, aims to equip students with the essential technological skills and knowledge needed for success in the dynamic field of quantity surveying. The proposed Integration of Technology in Quantity Surveying (ITQS) Program aims to revolutionize the education of future quantity surveyors.

The program envisions a curriculum that seamlessly integrates fundamental and advanced technology courses, ensuring that students acquire a robust skill set aligning with the industry's technological demands. Emphasis will be placed on practical applications, allowing students to engage in hands-on projects and case studies that mirror real-world quantity surveying scenarios.

- To bridge the gap between academia and industry, the ITQS Program encourages collaboration with professionals, technology experts, and construction firms. Partnerships with industry stakeholders will not only enrich the curriculum with real-world insights but also provide students with opportunities for internships, workshops, and exposure to cutting-edge technologies. Faculty training will be a cornerstone, ensuring that educators stay abreast of the latest advancements and can effectively impart knowledge to students. The program's success will be gauged through continuous evaluation, with feedback loops involving students, faculty, and industry partners to adapt and enhance its offerings.
- *Educational Reforms*: Collaborate with educational institutions to incorporate technology-focused courses into quantity surveying curricula. Emphasize practical applications to ensure graduates are well-equipped with relevant skills. To achieve meaningful educational reform, it is recommended that educational institutions engage in a dialogue with industry professionals, technology experts, and relevant stakeholders. Establishing advisory boards comprising both academia and industry practitioners can provide valuable insights into current industry needs. Additionally, continuous reviews and updates of the curriculum should be conducted to ensure its alignment with emerging technologies and industry trends. The integration of technology-focused coursework should not only be a requirement but a transformative experience that prepares students for the challenges and opportunities presented by the technological evolution in quantity surveying.
- *Professional Development Programs*: Establish continuous professional development programs for practicing quantity surveyors. Offer workshops, seminars, and certifications focused on the use of technology in quantity surveying practices. Implementing a robust professional development program is imperative to enhance the technological proficiency of practicing quantity surveyors. It is recommended to establish structured workshops, seminars, and certification courses specifically designed to address the evolving technological landscape in the field. Collaborate with industry experts and technology providers to tailor these programs to real-world challenges, ensuring relevance and practical application. Encourage participation in continuous learning initiatives and provide platforms for networking and knowledge exchange. By fostering a culture of ongoing professional development, quantity surveyors can stay abreast of the latest technological advancements, enrich their skill sets, and contribute to the progressive integration of technology within the profession.

REFERENCES

1. Adeoye AA. Computerized Information System for Surveyors. Information Management Consultants, Lagos. 1996.
2. Adetola FO. Quantity surveying and technology development in the next millennium. InNIQS 18th Biannual Conference 1998.
3. Bowden S, Dorr A, Thorpe A, Anumba CJ, Gooding P. Making the case for mobile IT in construction. InComputing in Civil Engineering (2005) 2005 (pp. 1–12).
4. Castle G. New Technology—Opportunity or Threat?. New Aspects of Quantity Surveying Practice. 2012 Sep 10:207–38.
5. Deng ZM, Li H, Tam CM, Shen QP, Love PE. An application of the Internet-based project management system. Automation in construction. 2001 Jan 1;10(2):239–46.
6. Doherty JM. A survey of computer use in the New Zealand building and construction industry. BRANZ; 1997 Dec.
7. Durodola OD. Communicating—An Essential Quantity Surveying Tool. In21st Biennial Conference of the Nigerian Institute of Quantity Surveyors, Ibadan, November 2004 (Vol. 24).

8. Gaith FH, Khalim AR, Ismail A. Usage of information technology in construction firms; Malaysian construction industry. *European Journal of Scientific Research*. 2009;28(3):412–21.
9. Hore AV, West R. Attitudes towards electronic purchasing in the Irish construction industry.
10. Ibidapo OO. Appraisal of the impact of information technology in quantity surveying practice in Nigeria. A B. Tech thesis submitted to the department of Quantity Surveying, Federal University of Technology, Akure. 2000.
11. Isikdag U, Underwood J, Kuruoglu M, Acikalin U. The strategic role of ICT within the Turkish AEC industry. *Building Resilience*. 2008 Feb:1940.
12. Löfgren A. *Making Mobile Meaning: expectations and experiences of mobile computing usefulness in construction site management practice* (Doctoral dissertation, KTH).
13. Li H, Irani Z, Love PE. The IT performance evaluation in the construction industry. In *Proceedings of the 33rd Annual Hawaii International Conference on System Sciences 2000 Jan 7* (pp. 9-pp). IEEE.
14. Becerik B, Pollalis SN. Computer aided collaboration in managing construction. *Meridian Systems*. 2006.
15. Moniem AH. The Role of Project Control Systems in the Integration of the Construction Site Processes. A Case Study Approach. Unpublished MSc, Loughborough: Loughborough University. 2000.
16. Mak S. A model of information management for construction using information technology. *Automation in construction*. 2001 Jan 1;10(2):257–63.
17. Maqsood T, Walker DH, Finegan AD. An investigation of ICT diffusion issues in an Australian construction contractor company using SSM. *Globalisation and Construction*. 2004 Nov 17:485.
18. Mohamed S, Stewart RA. An empirical investigation of users' perceptions of web-based communication on a construction project. *Automation in construction*. 2003 Jan 1;12(1):43–53.
19. Murray M, Nkado R, Lai A. The integrated use of information technology in the construction industry. In *Proceedings of the CIB 78 Conference: IT in Construction in Africa, Pretoria, South Africa 2001* (Vol. 39, pp. 1–13).
20. Musa NA, Oyebisi TO, Babalola MO. A study of the impact of information and communications technology (ICT) on the quality of quantity surveying services in Nigeria. *The Electronic Journal of Information Systems in Developing Countries*. 2010 Jul;42(1):1–9.
21. Odusami KT. A survey of current trends in quantity surveying consultancy practice in Nigeria. *The Quantity Surveyor, Journal of the Nigerian Quantity Surveyor*. 1999:57–62.
22. Oladapo AA. The impact of ICT on professional practice in the Nigerian construction industry. *The Electronic Journal of Information Systems in Developing Countries*. 2006 Apr;24(1):1–9.
23. Oyediran OS, Odusami KT. A study of computer usage by Nigerian quantity surveyors. *Journal of Information Technology in Construction (ITcon)*. 2005 Nov 4;10(20):291–303.
24. Peansupap V. *An exploratory approach to the diffusion of ICT in a project environment* (Doctoral dissertation, RMIT University).
25. Page M, Pearson S, Pryke S. Innovation and current practice in large UK quantity surveying firms. *RICS Foundation Publications*. 2004;4(26).
26. Pereira CS, Soares AL. Improving the quality of collaboration requirements for information management through social networks analysis. *International Journal of Information Management*. 2007 Apr 1;27(2):86–103.
27. Page M, Pearson S, Pryke S. Innovation and current practice in large UK quantity surveying firms. *RICS Foundation Publications*. 2004;4(26).
28. Hannus M, Blasco M, Bourdeau M, Böhms M, Cooper G, Garas F, Hassan T, Kazi A, Leinonen J, Rezgui Y, Soubra S. Construction ICT roadmap. ROADCON project deliverable report D. 2003;52.
29. Samuelson O. IT-Barometer 2000-The use of IT in the Nordic construction industry. *Journal of Information Technology in Construction (ITcon)*. 2002 Jul 8;7(1):1–26.
30. Sarshar M, Isikdag U. A survey of ICT use in the Turkish construction industry. *Engineering, Construction and Architectural Management*. 2004 Aug 1;11(4):238–47.

31. Sekou EA. *Promoting the Use of ICT in the Construction Industry: Assessing the Factors Hindering Usage by Building Contractors in Ghana* (Doctoral dissertation).
32. Smith P. Information technology and the QS practice. *Construction Economics and Building*. 2001;1(1):1-21.