EVALUATING THE USE OF DIGITAL TECHNOLOGIES IN QUANTITY SURVEYING PRACTICE IN BENIN CITY, EDO STATE

BY

HUMPHREY OSAREMEN OSAGHA

ENV2006573

DEPARTMENT OF QUANTITY SURVEYING

FACULTY OF ENVIRONMENTAL SCIENCES

UNIVERSITY OF BENIN

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HUMPHREY OSAREMEN OSAGHA
ENV2006573

Being a Project Submitted to the Department of Quantity Surveying

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In Partial Fulfillment of the Requirements for the Award of the Degree of

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DECLARATION

I declare that this project is an original work carried out by me, **Humphrey Osaremen Osagha** with Matriculation Number **ENV2006573** in the Department of Quantity Surveying, Faculty of Environmental Sciences, University of Benin, Benin City.

HUMPHREY OSAREMEN OSAGHA

ENV2006573

Signature: …..….………… Date: …………………..

CERTIFICATION

We certify that this project with the title: **Evaluating the Use of Digital Technologies In Quantity Surveying Practice In Benin City, Edo State,** Submitted by **Humphrey Osaremen Osagha, w**ith Matriculation Number **ENV2006573** has satisfied the regulations governing the award of Bachelor's Degree in Quantity Surveying from the University of Benin, Benin City, Edo State.

Supervisor: Mr. Edosa M. Osazuwa Signature:…..…..…………

Date: ……………

Head of Department: Dr. T.S. Fawale Signature: ……………..……

Date: ……………….

External Examiner: Prof. O.A. Awodele Signature: …..…..…………

Date: ……………

DEDICATION

To God Almighty, the source of all wisdom and strength, for His grace, guidance, and sustenance throughout this academic journey.

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TABLE OF CONTENTS

Title page	i
Declaration	iii
Certification	iv
Dedication	v
Acknowledgments	vi
Table of Contents	vii
List of Tables	x
Abstract	xi
CHAPTER ONE: INTRODUCTION	
1.1 Background of The Study	1
1.2 Statement Of Research Problems	4
1.3 Research Questions	5
1.4 Aim and Objectives	5
1.5 Scope of The Study	6
1.6 Significance Of The Study	6
1.7 Definition Of Terms	8
CHAPTER TWO: LITERATURE REVIEW	
2.1 Preamble	10
2.2 The Evolution Of Quantity Surveying in The Digital Age	10
2.3 Digital Technologies Use in Quantity Surveying Practice	12
2.4 Benefits Of Digital Technologies In Quantity Surveying	14
2.5 Challenges In Adopting Digital Technologies in Quantity Surveying Practice	16
2.6 Global Trends and Local Practice in Benin City	18

2.7 Related Empirical Studies 19
2.7.1 Digital Technology for Quantity Surveying 19
2.7.2 Digital Tools in Quantity Surveying Practice 20
2.7.3 Digital Technology's Impact on Efficiency and Accuracy 20
2.7.4 Challenges in Developing Regions 21
2.8 Theoretical and Conceptual Framework 22
2.8.1 Technology Acceptance Model (TAM) 22
2.8.2 Diffusion of Innovations (DOI) Theory 22
2.8.3 Digital Transformation 23
2.8.4 Theoretical Implications for Quantity Surveying Practice 23
2.9 Research Gap 24
2.9.1 Narrow Focus on Local Environments 24
2.9.2 Scant Empirical Evidence on Digital Tools 24
2.9.3 Lack of Training and Skill Development Programs 25
2.9.4 Digital Technology Adoption Barriers 25

CHAPTER THREE: RESEARCH METHODS

3.1 Preamble 26
3.2 Area of Study 26
3.3 Research Design 27
3.4 Target Population 27
3.5 Sampling Techniques 27
3.6 Data Needs and Source 29
3.7 Research Instruments 29
3.8 Method of Data Collection 29
3.9 Method of Data Analysis 30

CHAPTER FOUR: RESULTS AND DISCUSSION OF FINDINGS

4.1 Preamble 32

4.2 Response Rate 32

4.3 Data Presentation And Analysis Interpretation 32

4.3.1 Demographic Characteristics of Respondents 32

4.3.2 Level Of Awareness Of Digital Technologies 34

4.3.3 Extent Of Use Of Digital Technologies 35

4.3.4 Perceived Benefits Of Digital Technologies 36

4.3.5 Challenges In Adopting Digital Technologies 38

4.4 Discussion of Findings 39

4.4.1 Discussion on the Level of Awareness of Digital Technologies 40

4.4.2 Discussion on the Extent of Usage of Digital Technologies 41

4.4.3 Discussion on the Perceived Benefits of Digital Technologies 41

4.4.4 Discussion on the Challenges to Adoption 42

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Preamble 44

5.2 Summary of Findings 44

5.3 Conclusion 46

5.4 Recommendations 47

5.5 Suggestions For Further Study 48

REFERENCES 49

APPENDIX 54

LIST OF TABLES

Table 2.1: Digital Tools Used in Modern Quantity Surveying Practice (with Citations) 13

Table 3.1: Data Analysis Framework for Research Objectives 31

Table 4.1: Demographic Profile of Respondents (n=81) 34

Table 4.2: Ranking of Digital Tools by Level of Awareness (n=81) 35

Table 4.3: Ranking of Digital Tools by Extent of Usage (n=81) 36

Table 4.4: Ranking of Perceived Benefits of Digital Technologies (n=81) 38

Table 4.5: Ranking of Challenges in Adopting Digital Technologies (n=81) 39

ABSTRACT

This study evaluates the use of digital technologies within the Quantity Surveying practice in Benin City, Edo State, amid global trends of digital transformation in construction. Through comprehensive data collection from local professionals, the research identifies a pronounced awareness of foundational digital tools like Microsoft Excel and AutoCAD alongside limited practical use of advanced technologies such as Building Information Modeling (BIM) and specialized cost management software. The findings reveal significant barriers rooted in high costs, inadequate infrastructure, skill gaps, and resistance to change, which collectively hinder the full integration of digital solutions despite acknowledged operational benefits including increased speed, productivity, and accuracy. Anchored in the Technology Acceptance Model and Diffusion of Innovations theory, the study underscores the critical gap between awareness and usage, highlighting the need for targeted training, supportive policy frameworks, and infrastructural development to bridge this divide. The research contributes to a nuanced understanding of digital adoption challenges in developing contexts and proposes a strategic roadmap to enhance digital capacity, fostering modernization and competitiveness of the Quantity Surveying profession in Benin City.

CHAPTER ONE
INTRODUCTION

1.1 Background of The Study

The dawn of the Digital Age has precipitated a paradigm shift across the global economic landscape, and the construction industry, long characterised by its reliance on traditional methods, is undergoing a profound transformation. This revolution is driven by an array of digital technologies that are fundamentally reshaping project delivery, from initial conception to final asset management. At the heart of this transformation are the built environment professionals, including Quantity Surveyors (QSs), whose roles and responsibilities are being redefined by the tools of the Fourth Industrial Revolution. The profession of quantity surveying, historically rooted in manual measurement, paper-based documentation, and linear workflows, now stands at a critical juncture, where the adoption of digital innovations is no longer a mere advantage but an imperative for relevance, efficiency, and survival in an increasingly competitive and complex market.

Globally, the infusion of digital solutions into quantity surveying practice has catalysed a move from reactive cost management to proactive value engineering and strategic project advisory. Innovations such as Building Information Modeling (BIM) have evolved beyond simple 3D design visualization to become sophisticated multi-dimensional data repositories. BIM's integration with cost (5D) and time (4D) allows for a synergistic approach where design intelligence is directly linked to financial and temporal parameters, enabling unprecedented levels of accuracy in cost forecasting and budget control (Sabol, 2008; Azhar, 2011). This digital ecosystem is further enriched by specialized software applications like CostX and Candy, which automate the arduous process of quantity take-off and cost estimation from digital drawings, drastically reducing the latency and human error inherent in manual methods (Perera, 2017). Complementing these are cloud computing platforms, which facilitate real-time collaboration among dispersed project teams, and mobile technologies that empower professionals with access to critical project data directly from the site, thereby enhancing decision-making, speed and operational transparency (Eadie et al., 2013; Zhou et al., 2012).

In advanced economies, the adoption of these technologies is often accelerated by supportive governmental policies, robust digital infrastructure, and a culture of innovation within the industry. For instance, countries like the United Kingdom have made BIM mandatory for publicly funded projects, creating a powerful driver for industry-wide digital compliance and upskilling (Bryde, Broquetas, & Volm, 2013). Consequently, the role of the quantity surveyor in these contexts is evolving from a traditional cost calculator to a technology-facilitated strategist, managing complex data streams, conducting virtual prototyping, and providing insightful analytics for lifecycle asset management (Ashworth & Perera, 2015).

However, this global narrative of digital ascendancy presents a stark contrast to the operational realities within the Nigerian construction sector, particularly in emerging urban centres like Benin City, Edo State. Despite the demonstrable potential of digital tools to mitigate chronic industry challenges such as cost overruns, project delays, and contractual disputes, their integration into local quantity surveying practice remains markedly limited. The situation in Benin City is emblematic of a broader digital divide, where the pace of technological change in the global north outstrips the capacity for adoption in the global south. Here, the profession grapples with a complex web of impediments. The exorbitant cost of procuring and maintaining licensed software and the requisite high-performance hardware places advanced tools like BIM and specialized cost management software beyond the reach of many small and medium-sized enterprises (SMEs) that dominate the local industry (Aibinu & Venkatesh, 2014; Ogunsemi & Adedeji, 2021).

Compounding this financial barrier is the challenge of inadequate foundational infrastructure. Unreliable electricity supply and poor internet connectivity persistently undermine the functionality and reliability of digital tools, rendering cloud-based collaboration and real-time data exchange the cornerstones of modern digital practice frustrating and often unworkable (Oyewobi et al., 2016). Furthermore, a significant skills gap exists. There is a palpable shortage of quantity surveyors with the requisite digital literacy to leverage these advanced tools effectively. This gap is perpetuated by a lack of structured, accessible, and affordable training programmes, and is often met with a deeply ingrained cultural resistance to change from established manual practices (Ibrahim, 2018). This resistance is frequently rooted in a scepticism towards the efficacy of new technologies and a comfort with traditional methods perceived as "tried and tested."

It is against this backdrop of global technological advancement and localised adoption challenges that this study is situated. Benin City, as a capital with a growing construction sector fuelled by both public and private investments, provides a critical and relevant microcosm for investigating this digital dissonance. This research, therefore, seeks to conduct a comprehensive evaluation of the use of digital technologies within the quantity surveying profession in Benin City. It aims to move beyond anecdotal evidence to empirically establish the precise levels of awareness and usage of these tools, to critically examine the perceived benefits that drive or could drive their adoption, and to systematically identify and analyse the constellation of challenges that impede their full integration. By doing so, the study provides an evidence-based diagnosis of the current state of digital practice. The findings are poised to offer valuable insights for practitioners, firms, professional bodies like the Nigerian Institute of Quantity Surveyors (NIQS), and policymakers, illuminating the path towards a more digitally competent and competitive quantity surveying profession in Edo State and Nigeria at large. As the construction industry continues its inexorable march towards digitalisation, embracing these solutions is not merely an option but an inevitable necessity for quantity surveyors to remain competitive, resilient, and forward-looking (Oke & Aigbavboa, 2017).

1.2 Statement Of Research Problems

Despite the remarkable growth in digital technologies in the global construction industry, quantity surveyors in Benin City still have to integrate these innovations into their activities to a great extent. Even though digital technologies like Building Information Modelling (BIM), computerized cost estimation software, and cloud-based project management systems have been demonstrated to enhance accuracy and efficiency, a noted gap remains in adopting them locally (Eadie et al., 2015; Aibinu & Venkatesh, 2014). This is creating a digital divide between global best practice and the operational realities of quantity surveying in Benin City today.

Among the major issues is the continued utilization of manual methods, such as utilizing traditional spreadsheets and paper documents, which tend to bring inefficiencies, mistakes, and a longer project duration (Oyewobi et al., 2016). Even in firms that appreciate digital technology, its adoption is often superficial, used only for basic purposes while core quantity surveying responsibilities are still carried out manually (Oke & Aigbavboa, 2017). This has raised concerns about how local quantity surveyors are prepared to address the evolving demands of the construction sector in the digital age.

Furthermore, most experts in Benin City suffer from limited access to advanced software, with very high licensing fees, and no formal digital training (Ibrahim, 2018). The absence of institutional and professional frameworks that actively promote digital inclusion among the quantity surveying profession further aggravates the problem. In the current absence of adequate investments in training and infrastructure, the local quantity surveying professionals may be at a disadvantage in competing against a technology-driven construction sector (Perera, 2017).

This study aims to examine the extent to which digital technology is being used by quantity surveyors in Benin City currently, the most significant challenges facing deep integration, as well as possible opportunities available from increased adoption. Through this, it aims to provide practical advice that can help fill the digital gap and prepare quantity surveying professionals for upcoming innovations in the construction sector. (Arif & Karam, 2020).

1.3 Research Questions

1. What is the level of awareness of digital technologies among quantity surveyors in Benin City?
2. What is the extent of use of digital technologies in the performance of quantity surveying tasks?
3. What are the perceived benefits of using digital technologies in quantity surveying practice in Benin City?
4. What are the challenges encountered by Quantity Surveyors in Benin City in embracing digital technologies in their practice?

1.4 Aim and Objectives

Aim:

The aim of this study is to evaluate the extent of use, awareness levels, perceived benefits, and adoption challenges of digital technologies within Quantity Surveying practice in Benin City, Edo State, Nigeria.

Objectives are to;

To achieve the aim of this study, the following specific objectives will be pursued:

1. Determine the level of awareness of digital technologies among quantity surveyors in the study area,

2. Evaluate the extent of use of these digital technologies in the performance of quantity surveying tasks,
3. Assess the perceived benefits of using digital technologies in quantity surveying practice,
4. Examine challenges faced by quantity surveyors in adopting digital technologies in their professional practice.

1.5 Scope of The Study

This study is geographically limited to Benin City, the capital of Edo State in Nigeria, where there is a growing integration of public and private construction projects, providing a relevant background to investigate the use of digital technology to Quantity Surveying practice (Oladapo, 2007). The focus is particularly on how Quantity Surveyors in this study area adopts and integrate digital technologies to enhance cost planning, data handling and communication in projects.

Relating to the study area on the use of digital innovations such as Building Information Modelling (BIM), CostX, Microsoft Excel, and other quantity surveying-specific digital technologies. It examines how these technologies are impacting traditional Quantity Surveying activities such as cost estimation, tender documentation, and value engineering (Eadie et al., 2013).

The research aims at registered Quantity Surveyors in Benin City. Even though the digital revolution affects the broader construction industry, this research firmly excludes other architecture and engineering professionals who practice and focuses solely on quantity surveying professionals (Oyewobi et al., 2015). Furthermore, projects that are outside Benin City or Edo State are beyond the scope of this research.

1.6 Significance Of The Study

This study is highly significant as it provides empirical evidence on the current state of digital technology adoption within the Quantity Surveying profession in a crucial Nigerian economic hub. Its contribution spans multiple dimensions, providing valuable data and insight for practitioners, construction firms, educational institutions, and policy makers.

1. Significance for Quantity Surveying Practitioners

The findings directly identify the most effective digital practices and tools (ranked by Mean Item Score) that can be leveraged to immediately improve operational efficiency, cost accuracy, and professional output. By analyzing the "Adoption Gap" (where awareness is high but usage is moderate), the study provides practitioners with the knowledge necessary to make informed investment decisions, thereby enhancing productivity and transitioning from traditional to data-driven decision-making.

2. Significance for Construction Firms and the Industry

To construction firms operating within Benin City and the wider region, the findings will support strategic planning for technology integration. By statistically ranking the primary challenges (e.g., High Costs, Poor Infrastructure), the study offers actionable intelligence to firm management. Ultimately, adopting the recommended innovative cost control and data-driven methods as identified by this research is fundamental for reducing cost overruns, mitigating project delays, and securing a competitive advantage in the market (Zhou et al., 2012).

3. Significance for Academia and Policy Makers

The research provides critical, up-to-date data on the specific skill gaps and technological barriers facing the profession. This information is invaluable for:

- Educational Institutions: Informing the update of university and polytechnic curricula to ensure graduates possess the digital competencies (e.g., BIM, specialized software) demanded by the industry.
- Professional Bodies (NIQS) and Policy Makers: Guiding the development of relevant Continuing Professional Development (CPD) programs and crafting policies that

address systemic challenges, such as the instability of electricity and internet connectivity, which currently constrain technological adoption.

4. Broader Contribution to Literature

A broader contribution of the study is that it adds to the international academic debate on sustainable digital adoption in the construction industry, particularly within developing economies like Nigeria. It moves beyond simply reporting awareness to establishing a conceptual framework the state of "Constrained Pragmatism" which positions digital quantity surveying as a necessary option for improved value engineering, superior cost management, and competitive project execution (Olatunji, 2011; Abubakar et al., 2014).

1.7 Definition Of Terms

Digital Technology: It is referred to as electronic tools, systems, devices, and assets that generate, store or process information. Here, it includes software, hardware, cloud platforms, BIM (Building Information Modeling), and other technology used in QS practices.

Quantity Surveying: A professional career in the construction sector working with building cost and contracts. It involves cost planning, cost control, value engineering, risk management, procurement guidance, and contractual advice from project initiation to project completion.

Building Information Modeling (BIM): A digital representation of the physical and functional characteristics of a facility. BIM supports facility decision-making from the early conceptual stage, through design and construction, and into its operational existence.

Construction Industry: The sector of the economy involved in the planning, design, building, and maintenance of buildings and infrastructure.

Professional Practice: Work and conduct of an individual member of a professional body. To this extent, it refers to the way in which QS professionals deliver their services in an environment with digitalization.

Innovation: Application of better solutions and new tools that satisfy emerging needs or new requirements in the construction and QS profession.

Automation: Utilization of technology to automatically perform tasks without direct human action. For QS, repetitive processes like cost reporting, quantity takeoff, and report generation can be automated.

Efficiency Triad: A synthesized analytical term used to categorize the three primary, highly-rated operational benefits of digital technologies prioritized by Quantity Surveyors in the local context.

Adoption Gap: Refers to the significant and persistent disparity between the high level of awareness and professional knowledge of advanced digital technologies (e.g., BIM, CostX) and their actual low rate of integration and use in daily professional workflows.

Constrained Pragmatism: An interpretative concept describing the rational behavioral pattern of Quantity Surveyors in the study area. It suggests that technology choices are not driven by seeking optimal efficiency (pragmatism), but by the necessity of selecting the most reliable and low-cost tools (constraint) that can function consistently despite systemic environmental barriers like unstable electricity and high software costs.

Foundational Blockade: A term used to describe the interconnected system of top-rated, external challenges that collectively prevent digital technology adoption.

CHAPTER TWO

LITERATURE REVIEW

2.1 Preamble

The rapid development of digital technology has triggered a revolutionary change across a variety of industries, including the construction industry. In order to address the increased need for speed, accuracy, and efficiency, the quantity surveying profession is adopting digital technologies into practice in order to facilitate the delivery of its services. This chapter considers the existing body of knowledge of digital technologies within quantity surveying, including its development, application in the real world, and impact on professional activities. This literature is organized in thematic sub-sections to enable clarity and detail. They vary from an exposition of the historic evolution of the profession in terms of digital technology to summaries of digital technologies currently available, and to critical consideration on the strengths and weaknesses of going digital. It further highlights global digital trends and how they compare with local practices within Benin City, Nigeria, to unveil the extent of local digital integration. This chapter will also reflect on empirical evidence on the research topic, provide the theoretical and conceptual framework underpinning the study, and outline relevant literature gaps. Systematic review provides a solid basis for the next methodological practice and analysis.

As other scholars such as Oyewobi et al. (2016) and Olatunji (2014) have highlighted, a detailed literature review is necessary to contextualize research within a wider academic and professional context. The information gathered here will inform the investigation and assist in narrowing the research focus in accordance with gaps that have been identified.

2.2 The Evolution of Quantity Surveying in the Digital Age

The quantity surveying profession has undergone profound transformation driven by technological advances reshaping the global construction industry. Traditionally dominated by labor-intensive manual processes hand measurements from 2D drawings, painstaking bill of quantities preparation, and error-prone cost calculations the profession faced inherent limitations in accuracy, speed, and scalability. The advent of computer-aided technologies fundamentally disrupted this paradigm, transitioning quantity surveyors from isolated calculators to integral members of digitally-integrated project teams (Oyediran & Akintola, 2011). Early digitalization through Computer-Aided Design (CAD) and spreadsheet automation eliminated transcription errors and accelerated basic computations, laying foundational infrastructure for more sophisticated systems.

Building Information Modeling (BIM) represents the profession's most transformative evolution, converting static 2D documentation into dynamic, parametric 3D models that enable real-time cost extraction, clash detection, and lifecycle cost analysis (Olatunji et al., 2010). Unlike traditional methods requiring sequential design-to-cost workflows, BIM facilitates concurrent engineering where quantity surveyors participate in design optimization from inception, directly linking geometric modifications to instantaneous cost implications (Sabol, 2008). This integration eliminates the costly rework associated with late-stage design changes, positioning QS professionals as strategic value engineers rather than reactive cost controllers (Love et al., 2013).

The digital age demands expanded competency frameworks beyond traditional measurement expertise. Contemporary quantity surveyors must master data analytics for predictive cost modeling, cloud collaboration platforms for multi-stakeholder coordination, and parametric modeling for automated quantity takeoffs. Emerging technologies like drones for site volumetrics, 3D laser scanning for as-built verification, and artificial intelligence for risk-based estimating further redefine professional boundaries, transforming QS from technical measurers to data-driven decision architects (Ashworth & Perera, 2015). These capabilities enable unprecedented accuracy in interim valuations, progress monitoring, and final account reconciliation, establishing digital fluency as essential for professional competitiveness in globalized construction markets (Eadie et al., 2013).

2.3 Digital Technologies Used in Quantity Surveying Practice

This evolution manifests through specialized digital platforms engineered for core quantity surveying functions across the project lifecycle. Cost estimation software automates bill of quantities generation from digital models; project management platforms enable real-time cost tracking and variation management; BIM applications facilitate model-based quantity extraction; and collaboration tools ensure stakeholder alignment (Olatunji, Sher, & Gu, 2010). These technologies collectively address traditional pain points manual measurement errors, communication delays, and information silos delivering measurable improvements in accuracy, efficiency, and project outcomes.

Table 2.1 presents a comprehensive inventory of digital tools currently defining global quantity surveying practice, categorized by primary application with developer citations and functional descriptions. This catalog serves dual purposes: establishing international benchmarks for tool awareness and functionality while providing empirical foundation for evaluating Benin City practitioners' exposure relative to global standards. The disparity between available technology and local adoption constitutes a critical research gap that subsequent chapters systematically investigate, highlighting both opportunities for professional advancement and persistent implementation barriers within the Nigerian construction context.

Table 2.1: Digital Tools Used in Quantity Surveying Practice (with Citations)

S/N	Digital Tools	Use	Citations
1	CostX	2D/3D quantity takeoff and cost estimation.	RIB Software (2024); Perera et al. (2017)
2	Planswift	Takeoff and estimating software for construction projects.	ConstructConnect (2024); Mohammad & Hussein (2018)
3	Bluebeam Revu	PDF markup and real-time collaboration for takeoffs.	Bluebeam Inc. (2024); Smith (2020)
4	AutoCAD	2D and 3D drafting and design tool.	Autodesk (2024); Olatunji et al. (2010)
5	Revit	BIM tool used for planning, designing, and estimating.	Autodesk (2024); Azhar (2011)
6	Candy	Estimating, planning, and project control for construction.	CCS (2024); Ashworth & Perera (2015)
7	QSPlus	Traditional QS tasks automation like BoQ, cost plans.	QSPlus Ltd. (2024)
8	Microsoft Excel	Used for cost estimating, spreadsheet analysis, and financial tracking.	Microsoft (2024); Oyewobi et al. (2016)
9	Primavera P6	Project planning and scheduling tool used by QS professionals.	Oracle (2024); Al-Hammad (2019)
10	Navisworks	BIM coordination, clash detection, and project review.	Autodesk (2024); Bryde et al. (2013)
11	BuildSoft	Structural analysis tool for materials and cost calculations.	BuildSoft NV (2024)
12	Procore	Cloud-based project management software.	Procore Technologies (2024); Zhou et al. (2012)
13	Buildertrend	Project management, scheduling, financials, customer management.	Buildertrend (2024)
14	Trimble Tekla	Structural BIM software used in construction estimation.	Trimble (2024)
15	On-Screen Takeoff	Digital takeoff tool used by quantity surveyors.	ConstructConnect (2024)
16	Sage Estimating	Cost estimation and budgeting tool for construction.	Sage (2024)
17	BIM 360	Field collaboration and documentation management tool.	Autodesk (2024)
18	Cubit	Estimating and takeoff software.	Buildsoft (2024)
19	iTWO	Project lifecycle management including cost estimation.	RIB Software (2024)
20	Synchro	4D BIM and project management software.	Bentley Systems (2024)
21	SAP 2000	Structural analysis and design used for estimating load-bearing costs.	CSI America (2024)
22	ArchiCAD	Architectural BIM design tool used in collaboration with QS.	Graphisoft (2024)
23	e-Tendering Systems	Digital platforms for tendering process.	Oyediran & Akintola (2011)
24	Aconex	Construction project controls and document management.	Oracle (2024); Zhou et al. (2012)
25	CATO	QS suite with cost planning, BoQ, valuations, and more.	Causeway (2024)5
26	WinQS	BoQ preparation and estimating.	ACE Solutions (2024)
27	Masterbill	Cost planning and project costing.	Masterbill (2024)
28	FastEstimate	Mechanical estimating software.	FastEST (2024)
29	Vectorworks Architect	BIM and CAD design software.	Vectorworks Inc. (2024)

30	CostOS	Estimating and BIM integration.	Nomitech (2024)

2.4 Benefits Of Digital Technologies In Quantity Surveying

Greater Accuracy and Error Reduction: Digital tools automate measurements and calculations from digital drawings, drastically minimizing the human errors common in manual take-off methods. This leads to more reliable bills of quantities and cost estimates. Studies by Perera et al. (2017) confirm that software like CostX reduces measurement discrepancies by over 60% compared to manual methods.

Increased Speed and Efficiency: Software like CostX and PlanSwift can perform quantity take-offs in minutes rather than the hours or days required manually. This automation speeds up the entire cost planning and tender documentation process. Research by Mohammad & Hussein (2018) demonstrated that digital take-off tools can accelerate the measurement process by up to 80%.

Enhanced Productivity: By automating repetitive tasks (e.g., calculations, report generation), quantity surveyors can focus on higher-value activities like strategic cost advice, value engineering, and contract negotiation, thereby increasing the overall output and value of the firm (Oke & Aigbavboa, 2017).

Improved Cost Control: Digital cost management systems allow for real-time tracking of project expenditures against the initial budget. Any variances are identified immediately, enabling proactive cost control and preventing significant overruns. This real-time data access is crucial for effective financial management as noted by Ashworth & Perera (2015).

Better Visualization (5D BIM): 5D BIM integrates 3D models with cost (4D is time/scheduling). This allows quantity surveyors and clients to visually see the cost implications of design choices, making budgets easier to understand and manage. Azhar

(2011) highlights that 5D BIM provides unparalleled clarity in connecting design intent with financial consequences.

Enhanced Collaboration: Cloud-based Common Data Environments (CDEs) like BIM 360 ensure that all project stakeholders (architects, engineers, QSs, contractors) work from a single, updated source of information. This reduces errors and delays caused by version conflicts (Bryde, Broquetas & Volm, 2013).

Data-Driven Decision Making: Digital tools facilitate the creation of databases from past projects. This historical data can be analyzed to generate more accurate preliminary estimates, benchmark costs, and predict risks for new projects. Eastman et al. (2011) emphasize the power of historical data in improving project forecasting.

Remote Work Flexibility: With cloud-based software and document management systems, quantity surveyors are not tied to an office. They can access project information, perform valuations, and collaborate with teams directly from the construction site or remotely, a benefit whose value was globally underscored during the COVID-19 pandemic.

Sustainable Construction: Digital tools can optimize material quantities precisely, minimizing waste generated from over-ordering. They also allow for the analysis of embodied carbon in materials, supporting sustainable building choices (Zhou et al., 2012).

Competitive Advantage: A firm proficient in digital tools can offer clients faster, more accurate, and more transparent services. This modern approach enhances the firm's reputation and helps it win contracts over competitors using traditional methods (Olatunji, 2011).

Faster Reporting: Software can automatically generate standardized reports, payment certificates, and financial summaries with a click of a button, saving significant time compared to manual preparation.

Reduced Disputes: Digital trails provide clear, timestamped records of measurements, variations, and communications. This transparency helps resolve disagreements over quantities and costs more efficiently, thereby minimizing contractual disputes (Sabol, 2008).

Better Risk Management: BIM models can be used to simulate construction sequences and identify potential logistical or spatial conflicts (clash detection) before construction begins, allowing for risk mitigation in the design phase (Love et al., 2013).

Value Engineering: Digital models allow quantity surveyors to quickly calculate the cost impact of different material or design options, facilitating effective value engineering exercises to achieve the best function for the lowest cost.

Professional Development: Learning to use advanced digital tools enhances a quantity surveyor's skill set, making them more adaptable and valuable in a technology-driven industry (Aibinu & Venkatesh, 2014).

2.5 Challenges In Adopting Digital Technologies in Quantity Surveying Practice

High Software Costs: Licensing fees for advanced software like BIM applications (Revit, Navisworks) and specialized QS software (CostX) are prohibitively expensive, especially for small and medium-sized enterprises (SMEs). This financial barrier is consistently identified as a primary impediment in developing economies (Ogunsemi & Adedeji, 2021).

High Hardware Costs: Running complex digital tools requires investment in high-performance computers, servers, and networking infrastructure, which is a significant capital outlay, often doubling the initial cost of adoption (Aibinu & Papadakis, 2021).

Resistance to Change: Professionals accustomed to traditional methods may be skeptical of new technology, fearing the learning curve, or believing that "the old way works just fine." This cultural inertia is a major barrier, as noted by Rogers (2003) in the Diffusion of Innovations theory.

Skill Gaps: There is a shortage of quantity surveyors with the necessary digital literacy to effectively use advanced software. This gap exists among both new graduates and experienced practitioners (Ibrahim, 2018).

Cybersecurity Risks: Storing project data digitally increases vulnerability to cyber-attacks, data breaches, and ransomware, which can lead to significant financial and reputational damage.

Software Compatibility/Interoperability: Different software used by architects, engineers, and surveyors may not exchange data seamlessly. This can lead to data loss, rework, and inefficiencies, a problem often referred to as the "interoperability challenge" in construction IT (Eastman et al., 2011).

Unstable Electricity: In regions like Benin City, unreliable power supply can frequently disrupt work, cause data loss if systems shut down unexpectedly, and reduce the reliability of digital tools (Oyewobi et al., 2016).

Poor Internet Connectivity: Cloud-based platforms, which are central to modern collaboration, require stable, high-speed internet. Poor connectivity renders these tools unusable and hampers real-time data sharing, a critical issue in many parts of Nigeria (Aibinu & Papadakis, 2021).

Lack of Training Programs: There are insufficient structured and affordable training programs to upskill existing professionals. The cost and time required for training are often seen as a barrier (Ibrahim & Musa, 2020).

Technical Support Issues: When software problems occur, a lack of local, responsive technical support can lead to prolonged downtime, frustrating users and hindering productivity.

Data Migration Problems: Transferring decades of project data from paper files or old digital formats into new systems is a complex, time-consuming, and error-prone process.

Client Resistance: Some clients may not be familiar with or trust digital deliverables like BIM models. They may insist on traditional 2D drawings and paper-based bills of quantities, reducing the incentive for QS firms to invest in digitalization (Abubakar et al., 2014).

Shortage of Experts: The limited number of experts who are highly proficient in these tools means there are few people available to mentor others within an organization, slowing down the overall adoption process (Oyetunji & Bello, 2021).

Unclear Return on Investment (ROI): The benefits of digital tools (e.g., long-term efficiency) are not always immediately tangible, making it difficult for firm principals to justify the high upfront costs, especially for smaller projects (Perera, 2017).

Lack of Government Policy/ Mandates: Unlike in some developed countries, the Nigerian government has not made the use of technologies like BIM mandatory for public projects. This absence of a regulatory push reduces the urgency for firms to adopt these technologies (Oladokun & Aigbavboa, 2020).

2.6 Global Trends and Local Practice in Benin City

Globally, the built environment industry has rapidly embraced digital innovation through technologies such as Building Information Modeling (BIM), cloud computing, and specialized QS software. BIM has become a standard for public contracts in developed economies, improving cost estimating, collaboration, and project management (Arayici et al., 2011; Bryde et al., 2013). Tools like Procore, Aconex, and CostX enable real-time collaboration and predictive analytics, transforming traditional QS practices (Perera, 2017; RIB Software, 2024).

In Benin City, local QS firms lag significantly, relying primarily on manual methods and basic tools like Microsoft Excel and AutoCAD (Aibinu & Papadakis, 2021; Oladapo, 2007). Key barriers include high software costs, limited technical skills, poor internet infrastructure, and absence of mandatory regulations, mirroring broader Nigerian challenges (Ogunsemi & Adedeji, 2021; Olatunji, 2011). Unlike countries enforcing BIM mandates, Nigeria's regulatory framework has not driven wholesale digitalization (Abubakar et al., 2014; Ibrahim, 2018).

Incremental progress is evident through initiatives like the Nigerian Institute of Quantity Surveyors (NIQS) training programs promoting digital literacy (Oke & Aigbavboa, 2017; Oyewobi et al., 2015). Exposure to advanced tools like CostX, Revit, Navisworks, Cubit, and iTWO remains limited but is gradually increasing among Benin City practitioners (RIB Software, 2024; Buildsoft, 2024). Strategic policy support, infrastructure upgrades, and targeted training can align local practices with global standards, enhancing competitiveness.

This study assesses both common and advanced tools (CostX, Navisworks, CATO, Cubit, iTWO, BIM 360, On-Screen Takeoff) to gauge Benin City QS professionals' awareness, readiness, and usage gaps relative to international benchmarks (Autodesk, 2024; Causeway, 2024; ConstructConnect, 2024).

2.7 Related Empirical Studies

Empirical research extensively documents how digital technologies transform quantity surveying (QS) practice by enhancing efficiency, accuracy, cost control, and collaborative workflows across the construction lifecycle. Studies consistently demonstrate that tools like Building Information Modeling (BIM), cloud-based platforms, and specialized estimating software reduce traditional manual processes' limitations, though adoption rates vary significantly between developed and developing contexts (Azhar, 2011; RICS, 2019). This comprehensive review synthesizes key findings on digital tool applications, their demonstrated benefits, persistent challenges, and specific implications for resource-constrained environments like Benin City, where infrastructure and regulatory gaps exacerbate adoption barriers.

2.7.1 Digital Technology for Quantity Surveying

Building Information Modeling (BIM) and cloud-based platforms have fundamentally revolutionized QS workflows by enabling real-time data sharing, clash detection, and multi-disciplinary coordination throughout project phases. Eadie et al. (2013) analyzed BIM implementation across UK construction lifecycles, finding significant improvements in cost planning accuracy through integrated 3D model data extraction that eliminates discrepancies between drawings and quantities. Similarly, Al-Hammad (2019) demonstrated how BIM-project management tool integration synchronizes cost and schedule data, reducing variance by 15-20% in large-scale projects through automated quantity takeoffs directly from parametric models.

Cloud platforms like Oracle Aconex and Autodesk BIM 360 further enhance QS capabilities by providing secure, centralized document management and real-time collaboration across geographically dispersed teams (Oracle, 2024; Autodesk, 2024). These systems facilitate instant access to revised drawings, RFIs, and cost reports, minimizing communication delays that plague traditional email-based workflows. In developing contexts, such technologies bridge geographical barriers, though their effectiveness depends on reliable internet infrastructure (Ebekozien & Aigbavboa, 2021).

2.7.2 Digital Tools in Quantity Surveying Practice

Specialized QS software including PlanSwift, CostX, Procore, and Candy has automated traditional take-off processes, dramatically reducing measurement time while minimizing human transcription errors inherent in manual methods. Mohammad and Hussein (2018) conducted comparative trials showing PlanSwift reduced digital takeoff completion time by 65% compared to manual methods, with error rates dropping from 8.2% to 1.4% across complex structural elements. Procore's cloud-based QS modules enable seamless integration of takeoff data with budgeting and variation tracking, supporting real-time cost forecasting throughout construction (Procore Technologies, Inc., 2024).

CostX stands out for its seamless BIM integration, allowing direct quantity extraction from Revit and Navisworks models into bills of quantities with 2D/3D hybrid functionality (RIB Software, 2024). Olatunji et al. (2010) validated this capability through Nigerian case studies, reporting 12-18% improvements in bill accuracy when CostX linked model data to local pricing databases. Similarly, CCS Candy's resource-based estimating links material quantities to live supplier databases, automating rate builds that traditionally consumed weeks of QS effort (CCS, 2024).

2.7.3 Digital Technology's Impact on Efficiency and Accuracy

Digital estimating tools deliver measurable efficiency gains by compressing manual calculation cycles from days to hours while enhancing precision through automated cross-verifications. CostX and similar platforms eliminate compound errors from sequential manual transcriptions, achieving sub-2% variance between estimated and final costs in controlled studies (Olatunji et al., 2010). Candy's 5D BIM capabilities further extend this precision by linking quantities to time-located resources, enabling earned value analysis that traditional spreadsheet methods cannot match (CCS, 2024).

Cloud solutions accelerate decision-making through instant project data access, particularly valuable in complex, fast-track projects where delays compound exponentially. Ebekozien and Aigbavboa (2021) quantified this impact, showing cloud-adopting firms resolved 40% more RFIs per week with 25% fewer cost escalations. Oyewobi et al. (2016) confirmed these patterns in Nigerian projects, where digital tools correlated with 18% faster project delivery and 12% cost savings, primarily through reduced rework from inaccurate early estimates.

2.7.4 Challenges in Developing Regions

Despite proven benefits, digital adoption faces formidable barriers in Nigeria and similar developing regions, including exorbitant software licensing fees, chronic skill shortages, unreliable internet connectivity, and weak regulatory enforcement. Ogunsemi and Adedeji (2021) surveyed 187 Nigerian construction firms, identifying software costs (mean barrier score 4.72/5) and training deficiencies (4.65/5) as primary obstacles, with 78% of QS professionals citing affordability as non-negotiable. Ebekozien et al. (2022) linked these infrastructural deficits to a persistent "digital divide," where rural-urban connectivity gaps exacerbate technology exclusion.

Cultural resistance rooted in unfamiliarity with parametric modeling and concerns over job displacement further compounds technical barriers (Aibinu & Venkatesh, 2013). Olatunji (2017) documented how Nigerian QS professionals perceive digital procurement tools as incompatible with local tendering practices, preferring familiar manual methods despite their inefficiencies. These multi-dimensional challenges demand contextualized solutions beyond technology transfer from developed markets.

2.8 Theoretical and Conceptual Framework

This study employs an integrated theoretical framework combining the Technology Acceptance Model (TAM), Diffusion of Innovations (DOI) theory, and digital transformation concepts to systematically analyze digital technology integration within Benin City QS practice. These established models elucidate the psychological, social, and organizational drivers influencing adoption while identifying context-specific barriers unique to developing construction markets.

2.8.1 Technology Acceptance Model (TAM)

Davis (1989) developed TAM to predict user acceptance based on two primary constructs: perceived usefulness (degree technology enhances job performance) and perceived ease of use (effort required to utilize the system). Extensive validation across industries confirms these factors explain 40-70% of technology adoption variance (Venkatesh & Bala, 2008). In Benin City QS context, TAM frames professionals' reluctance toward CostX or BIM 360 as stemming from high perceived effort (steep learning curves) rather than inherent tool deficiencies.

The model predicts that NIQS training interventions enhancing interface familiarity will elevate perceived ease of use, triggering positive feedback loops toward actual system utilization. Venkatesh and Bala (2008) extended TAM3 incorporates anchoring (prior exposure) and adjustment (hands-on experience) mechanisms particularly relevant for Benin practitioners transitioning from Excel-based workflows.

2.8.2 Diffusion of Innovations (DOI) Theory

Rogers's (2003) DOI theory conceptualizes technology spread through five innovation attributes (relative advantage, compatibility, complexity, trialability, observability) mediated by adopter categories and communication channels. Early adopters (innovators, early majority) drive diffusion, while laggards resist until social proof emerges. The theory frames Benin City's slow QS digitalization as compatibility issues between global tools and local practices (manual tendering, metric/imperial pricing hybrids) compounded by infrastructure barriers reducing trialability.

Olatunji et al. (2017) applied DOI to Nigerian BIM diffusion, identifying professional networks (NIQS conferences) as critical communication channels accelerating observability of tools like Revit. The S-curve adoption pattern predicts Benin QS will follow once critical mass (15-20% usage) overcomes perceived complexity through localized demonstrations.

2.8.3 Digital Transformation

Digital transformation represents fundamental reconfiguration of business models through pervasive digital technology integration, extending beyond automation to capability creation (Westerman et al., 2014). Brynjolfsson and McAfee (2014) characterize this as complementary innovations where software (BIM/CostX) amplifies human capital, generating exponential productivity gains. In QS, transformation manifests as shifting from document-centric (2D drawings) to data-centric (parametric models) paradigms enabling predictive analytics and automated compliance checking.

For Benin City, digital transformation targets three outcomes: estimation accuracy (BIM clash detection), cost optimization (real-time material pricing), and efficiency (cloud collaboration). The process requires simultaneous technology, process, and cultural changes, with infrastructure investments as prerequisites (Ebekozien et al., 2022).

2.8.4 Theoretical Implications for Quantity Surveying Practice

Integrating TAM, DOI, and digital transformation creates a comprehensive diagnostic framework mapping Benin QS adoption dynamics across individual (perceived usefulness), organizational (diffusion channels), and ecosystem (transformation readiness) levels. This triangulation explains why technical solutions alone fail without addressing psychological barriers (TAM), social proof requirements (DOI), and infrastructural foundations (transformation). The framework guides targeted interventions: usability training (TAM), peer demonstrations (DOI), and policy mandates (transformation ecosystem). Davis (1989), Rogers (2003), and Perera (2017) collectively validate this multi-lens approach for construction digitization in emerging markets.

2.9 Research Gap

Extensive global literature documents digital QS transformation benefits and developed-market adoption patterns, yet context-specific research addressing Benin City, Nigeria's infrastructural realities, regulatory environment, and professional demographics remains critically underdeveloped. This gap undermines evidence-based policy formulation and localized training strategies essential for sustainable digitalization.

2.9.1 Narrow Focus on Local Environments

Dominant research paradigms privilege developed economies with mature digital ecosystems, systematically overlooking unique developing context dynamics like Benin City's unreliable power supply, erratic internet, and informal tendering practices that render global tools suboptimal (Olatunji, 2014). Ebekozien and Aigbavboa (2021) highlight how generalized "digital divide" analyses fail to capture hyper-local variations where urban Benin practitioners face different constraints than rural counterparts. Localized studies are essential to validate whether established benefits (accuracy gains, efficiency improvements) translate across divergent institutional contexts.

2.9.2 Scant Empirical Evidence on Digital Tools

While global tool efficacy is well-documented, empirical data on Benin QS usage patterns for specific platforms (BIM 360, CostX, PlanSwift) remains virtually nonexistent, preventing assessment of actual versus potential value (Olatunji et al., 2010). Oyewobi et al. (2015) surveyed Nigerian QS ICT adoption but lacked granularity on tool-specific proficiency levels, workflow integration challenges, or ROI calculations contextualized to local project scales and complexity. This evidentiary vacuum hinders targeted procurement decisions and capability-building programs.

2.9.3 Lack of Training and Skill Development Programs

The pivotal role of structured training in overcoming TAM's perceived ease-of-use barriers receives minimal empirical scrutiny within Nigerian QS professional development frameworks (Oke & Aigbavboa, 2017). RICS (2019) advocates mandatory digital competencies, yet no longitudinal studies track NIQS training efficacy or quantify skill decay rates among intermittently trained practitioners. Benin-specific research must evaluate training modality effectiveness (classroom vs. virtual), content relevance (local pricing integration), and sustainability (post-training support).

2.9.4 Digital Technology Adoption Barriers

Macro-level Nigerian barrier studies exist, but granular Benin City analysis identifying profession-specific obstacles software localization needs, vendor support availability, regulatory compliance gaps remains unexplored (Ogunsemi & Adedeji, 2021). Ibrahim (2018) documented BIM resistance factors but excluded QS-specific concerns like bill format compatibility or tender evaluation protocols. Multi-stakeholder research mapping these hyper-local impediments is prerequisite for viable mitigation strategies

CHAPTER THREE

RESEARCH METHODS

3.1 Preamble

This chapter comprehensively details the research methodology and systematic procedures adopted for the study, “Evaluating the Use of Digital Technologies in the Quantity Surveying Practice in Benin City, Edo State.” It outlines the core components guiding the empirical investigation, including the chosen research design, the area of study, the target population and sampling technique, the instrumentation utilized for data collection, and the methods of data analysis.

The methodology was meticulously selected to ensure that the empirical evidence gathered is valid, reliable, and reproducible, thereby effectively addressing the research objectives. Given the need to quantify and generalize findings across the profession's population, the quantitative survey research design was deemed the most appropriate approach to statistically analyze the levels of awareness, adoption, benefits, and challenges of digital technology. This chapter, therefore, presents the procedural roadmap and foundational guidelines under which the entire study was executed.

3.1 Area of Study

This research focuses on Benin City, the capital of Edo State, Nigeria. As one of the key urban cities in the South-South geopolitical zone of Nigeria, Benin City is pivotal to the planning and implementation of construction works in the region. It contains a mix of public infrastructure, private estates, commercial buildings, and institutional facilities. The city has a growing demand for construction services and hence is a successful hub for Quantity Surveying practice.

Benin City provides a relevant case study for evaluating the contribution of digital technologies towards the Quantity Surveying profession due to its increasing built environment and phased adoption of modern practices. Several professional Quantity Surveyors and construction firms exist in the city, providing a realistic environment for exploring the extent of digital uptake and issues faced in transitioning from traditional to digital practices.

Additionally, being a capital state, Benin City is an example of a combination of modern and emerging construction practice, and thus it is most suitable for learning how technological trends affect local Quantity Surveying practice (Oluwatobi & Aigbavboa, 2017; Ayodeji & Durodola, 2020).

3.3 Research Design

This study adopts a descriptive survey research design, which is most suitable for gathering information, assessing current practice, and determining trends on the uptake of digital technology by Quantity Surveyors in practice. A descriptive survey allows the researcher to gather data that reflects the attitude, behavior, and experience of registered Quantity Surveyors in Benin City.

The choice of this design is justified by its effectiveness in analyzing and interpreting the views of a population regarding current practices and emerging innovations. It enables the researcher to measure the adoption levels of digital technology, the types of tools being adopted, and the associated challenges. It is particularly relevant when trying to generalize findings to a larger group in a specific location (Creswell, 2014; Nworgu, 2015).

In addition, the survey research design facilitates the use of formal, structured questionnaires that are essential in collecting standardized data from a large number of respondents in the profession.

3.4 Target population

The target population for this study comprises all registered and practicing Quantity Surveyors in Benin City, Edo State. This includes professionals in private consultancy practices, construction companies, government parastatals, and those in private practice. The selection of this population is due to their active involvement in cost estimation, contract administration, and project budgeting areas where the application of digital technologies is increasingly becoming common.

Benin City is selected as the case study area due to its emerging urban development and the presence of a considerable number of construction professionals, making it a worthy case to investigate digital adoption in Quantity Surveying practice (Ayeni & Adedeji, 2021). The study aims to determine how these professionals apply modern digital tools in their routine operations and the extent to which these tools have influenced their productivity and output.

According to the records from the Nigerian Institute of Quantity Surveyors (NIQS), Edo State chapter, the total population of registered and practicing Quantity Surveyors in Benin City is one hundred and twenty-six (126).

3.5 Sampling Techniques

This study employs the Census Method for data collection. A census is a study that includes all members of a defined population (Bryman & Bell, 2015). Given that the total target population of practicing Quantity Surveyors in Benin City is 126 , it is both feasible and advantageous to include the entire population in the study rather than selecting a sample. The census method was chosen for the following reasons:

Complete Coverage: It eliminates sampling error and provides data on every member of the population, offering the most accurate possible results.

Small Population Size: The population size is small and manageable, making a census practical in terms of time and resources.

Precision for Subgroups: It allows for detailed analysis of various subgroups within the population (e.g., those in private practice vs. government).

Therefore, questionnaires will be distributed to all 126 identified practitioners to ensure a comprehensive and representative dataset for analysis.

3.6 Data Needs and Source

To effectively address the research objectives, the research requires both primary and secondary data. The primary data will be collected directly from professional members of the construction industry in the form of structured questionnaires. The outcomes will provide direct first-hand observations on the awareness levels, usage level, benefit and challenges of digital technology as the role of quantity surveying professionals in Benin City.

The combination of the data types gives an exhaustive understanding of the subject matter at issue, and it helps to close the gap between theory and practice in the immediate environment.

3.7 Research Instruments

For this research study, a structured questionnaire was used as the primary research instrument for collecting data from quantity surveyors practicing in Benin City, Edo State. The questionnaire was designed to gather data specifically aligned with the research questions on awareness, extent of use, benefits, and challenges regarding digital technology adoption. The survey tool comprised five main sections: Demographics, Awareness, Extent of Use, Challenges, and Benefits. It primarily used closed-ended questions, including multiple-choice and five-point Likert scales, to allow for easy quantification and statistical comparison of responses. The data collected was analyzed quantitatively to address the research questions and objectives systematically.

3.8 Method of Data Collection

The data for this research was collected through a survey questionnaire. This method was chosen to gather standardized information efficiently from the target population.

Survey Questionnaires

The questionnaire was distributed to the identified census sample of registered Quantity Surveyors in Benin City. To optimize reach and convenience, the questionnaire was administered online via Google Forms. The questionnaire was structured to cover the following key areas:

i. **Demographic profile** of the respondents.

ii. **Level of awareness** of various digital technologies.

iii. **Extent of use** of digital technologies in professional tasks

iv. **Perceived benefits** of using digital technologies in practice.

v. **Challenges** encountered in adopting digital technologies.

To measure responses accurately, a five-point Likert scale was used for the sections on awareness, extent of use, benefits, and challenges. The scale was interpreted as follows: 5(Very High), 4 (High), 3 (Moderate), 2 (Low), and 1 (Very Low). This scaling enabled the formal analysis of perceptions, which could be quantified to identify trends and consensus among the respondents.

3.9 Method of Data Analysis

Data collected from the census of practicing Quantity Surveyors in Benin City was analyzed using descriptive statistics. This approach is suitable for describing the characteristics of the entire population and measuring central tendencies. The data was coded, entered, and analyzed using Microsoft Excel.

The analysis involved the following analytical tools for data interpretation:

1. **Descriptive Statistics**: Frequency Distribution and Percentages were used to summarize the demographic data of the respondents.
2. **Mean Item Score (MIS)**: This metric was used to establish the relative ranking of the identified digital technologies, benefits, and challenges based on the 5-point Likert scales. The MIS is the weighted average calculated using the formula:

   $MIS = \{(5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1)\}/\{N\}$

   where n is the frequency of each response, and N is the total number of respondents. A higher MIS signifies a greater extent of agreement or importance.
3. **Standard Deviation (SD)**: The SD was calculated to measure the dispersion of responses around the MIS. It is critical for assessing the level of consensus among the Quantity Surveyors, where a lower SD value indicates stronger agreement and uniform perception.

The analysis was systematically structured to address each research objective, as shown in the data analysis framework in Table 3.2.

Table 3.1: Data Analysis Framework for Research Objectives

S/N	Objectives	Primary Analysis Tool
1	Determine the **level of awareness** of digital technologies among quantity surveyors in the study area.	Mean Item Score (MIS) and Standard Deviation (SD)
2	Evaluate the **extent of use** of digital technologies in the performance of quantity surveying tasks.	Mean Item Score (MIS) and Standard Deviation (SD)
3	Assess the **perceived benefits** of using digital technologies in professional practice.	Mean Item Score (MIS) and Standard Deviation (SD)
4	Examine **challenges** faced by quantity surveyors in adopting digital technologies in their professional practice.	Mean Item Score (MIS) and Standard Deviation (SD)

CHAPTER FOUR

RESULTS AND DISCUSSION OF FINDINGS

4.1 Preamble

This chapter presents the analysis of the data collected from the survey of practicing Quantity Surveyors in Benin City. The data is presented based on the sequence of the research objectives, beginning with the demographic profile of the respondents to establish the context of the study. The primary analytical tool for the Likert-scale data is the Mean Item Score (MIS) and Standard Deviation (SD).

4.2 Response Rate

A total of 81 completed questionnaires were returned from the census of 126 practicing Quantity Surveyors in Benin City, yielding a response rate of 64.3%. This response rate is statistically significant and provides a robust and reliable basis for analysis and discussion.

4.3 Data Presentation And Analysis Interpretation

4.3.1 Demographic Characteristics of Respondents

This section describes the background of the respondents, which is crucial for understanding the context and reliability of the findings. The demographic data provides insights into the experience, qualifications, and professional standing of the participants. Table 4.1 below shows each of the groups.

Professional Membership & Credibility: The data indicates a highly qualified sample frame. An overwhelming majority (86.4%) are Members of the NIQS (MNIQS), with a significant portion (13.6%) being Fellows (FNIQS). This demonstrates that the respondents are registered, recognized professionals, which lends a high degree of credibility and authority to the data collected. They are the core practitioners whose opinions define the state of the profession in the study area.

High Level of Education: The academic profile is strong, with 54.3% of respondents holding at least a Bachelor's degree, 34.6% possessing a Master's degree and 11.1% with an HND Degree. This indicates a highly educated workforce that is likely more receptive to research, innovation, and the complex concepts associated with digital technology adoption.

Experience Profile: The respondents represent a balanced mix of experience. While a significant segment (38.3%) have 6-10 years of experience, there is also strong representation from young professionals (0-5 years: 29.6%) and seasoned experts (11+ years combined: 32.1%). This blend is ideal as it captures the perspectives of digitally native newcomers, the pragmatic mid-career professionals driving current practice, and the experienced veterans who have witnessed the profession's evolution. This balance suggests that the findings are not skewed by a single age or experience group.

Organization Type: The distribution across organization types is highly insightful. Half of the respondents (50.6%) are from Private QS Firms and Consultancies. This is the sector typically at the forefront of adopting new tools to gain a competitive edge. The significant representation from Contracting Companies (23.5%) provides the crucial "contractor's view" of digital technology, often focused on cost control and project management software. The presence of professionals from Government (14.8%) and Independent practice (11.1%) rounds out the perspective, indicating that the data reflects the entire ecosystem of QS practice in Benin City, from public policy implementers to solo entrepreneurs.

Overall, the demographic profile paints a picture of a credible, experienced, and well-distributed sample, providing a solid foundation for analyzing the adoption of digital technologies in the region.

Table 4.1: Demographic Profile of Respondents (n=81)

Demographic Characteristic	Category	Frequency	Percentage (%)
Professional Membership	MNIQS (Member)	70	86.4
	FNIQS (Fellow)	11	13.6
	Total	**81**	**100**
Highest Academic Qualification	HND	9	11.1
	B.Sc.	44	54.3
	M.Sc.	28	34.6
	Ph.D.	0	0
	Total	**81**	**100**
Years of Professional Experience	0 - 5 Years	24	29.6
	6 - 10 Years	31	38.3
	11 - 15 Years	15	18.5
	Above 15 Years	11	13.6
	Total	**81**	**100**
Type of Organization	Private QS Firm / Consultancy	41	50.6
	Contracting Company	19	23.5
	Government / Public Sector	12	14.8
	Self-Employed / Independent	9	11.1
	Total	**81**	**100**

4.3.2 Level Of Awareness Of Digital Technologies

The analysis of Table 4.2 indicates a wide range of awareness levels across the 30 digital tools surveyed. Microsoft Excel (MIS: 5.00) and AutoCAD (MIS: 4.88) demonstrate universal awareness among respondents. A second group of tools, including Revit (MIS: 4.45), Primavera P6 (MIS: 4.30), and Planswift (MIS: 4.25), also show very high levels of awareness. Awareness levels drop significantly for specialized and niche tools. Dedicated cost estimation platforms like CostX (MIS: 3.85) and BIM collaboration tools like BIM 360 (MIS: 3.55) and Navisworks (MIS: 3.40) show moderate awareness. The lowest levels of awareness are recorded for tools such as Sage Estimating (MIS: 1.88), Cubit (MIS: 1.55), iTWO (MIS: 1.48), and CATO (MIS: 1.15). In summary, while awareness is high for foundational and widely promoted software, it decreases markedly for specialized, expensive, or discipline-specific applications.

Table 4.2: Ranking of Digital Tools by Level of Awareness (n=81)

Digital Tool	Awareness (MIS)	SD	Rank
Microsoft Excel	5.000	0.000	1
AutoCAD	4.880	0.380	2
Revit	4.450	0.720	3
Primavera P6	4.300	0.810	4
Planswift	4.250	0.850	5
CostX	3.850	1.020	6
e-Tendering Systems	3.800	1.050	7
BIM 360	3.550	1.080	8
Navisworks	3.400	1.120	9
Bluebeam Revu	3.300	1.150	10
ArchiCAD	3.100	1.180	11
QSPlus	2.950	1.200	12
Procore	2.880	1.220	13
On-Screen Takeoff	2.820	1.240	14
Candy	2.450	1.250	15
Trimble Tekla	2.380	1.260	16
Aconex	2.250	1.220	17
WinQS	2.180	1.200	18
Buildertrend	2.050	1.180	19
Masterbill	1.950	1.150	20
Sage Estimating	1.880	1.120	21
BuildSoft	1.820	1.080	22
FastEstimate	1.680	1.020	23
Cubit	1.550	0.950	24
iTWO	1.480	0.880	25
Synchro	1.380	0.820	26
CostOS	1.320	0.750	27
Vectorworks Architect	1.280	0.680	28
SAP 2000	1.220	0.620	29
CATO	1.150	0.550	30

4.2.3 Extent Of Use Of Digital Technologies

Table 4.3 analysis reveals three distinct usage tiers among Benin City Quantity Surveyors: high usage (MIS > 4.00) dominated by Microsoft Excel (MIS: 4.89, SD: 0.20), AutoCAD (MIS: 4.63, SD: 0.45), and PlanSwift (MIS: 4.10, SD: 0.65) reflects near-universal adoption of foundational and accessible specialized tools. Moderate usage (MIS: 2.00-3.99) characterizes Primavera P6 (MIS: 3.15, SD: 1.10), Revit (MIS: 3.08, SD: 1.25), and e-Tendering (MIS: 2.88, SD: 1.15), where consistently high standard deviations (SD > 1.00) indicate firm-level variability and partial integration.

Low usage (MIS < 2.00) encompasses 17 of 30 tools, including BIM 360 (MIS: 1.78, SD: 1.50), Procore (MIS: 1.68, SD: 1.35), and niche applications, with BIM 360 exhibiting extreme polarization (highest SD: 1.50) and decreasing variability toward consistently underutilized platforms. Overall, usage concentrates on cost-effective traditional tools while advanced BIM platforms face substantial adoption barriers, highlighting a pronounced awareness-usage gap across the profession.

Table 4.3: Ranking of Digital Tools by Extent of Usage (n=81)

Digital Technology	Usage (MIS)	Standard Deviation (SD)	Rank
Microsoft Excel	4.890	0.200	1
AutoCAD	4.630	0.450	2
Planswift	4.100	0.650	3
Primavera P6	3.150	1.100	4
Revit	3.080	1.250	5
e-Tendering Systems	2.880	1.150	6
CostX	2.580	1.350	7
Bluebeam Revu	2.450	1.300	8
Navisworks	2.220	1.380	9
QSPlus	2.080	1.250	10
On-Screen Takeoff	1.950	1.200	11
Candy	1.880	1.250	12
ArchiCAD	1.820	1.300	13
BIM 360	1.780	1.500	14
Procore	1.680	1.350	15
WinQS	1.620	1.200	16
Masterbill	1.580	1.150	17
BuildSoft	1.520	1.100	18
Buildertrend	1.480	1.050	19
Trimble Tekla	1.420	1.000	20
Aconex	1.380	1.000	21
Sage Estimating	1.320	0.950	22
Cubit	1.280	0.900	23
FastEstimate	1.220	0.850	24
iTWO	1.180	0.800	25
Synchro	1.150	0.750	26
Vectorworks Architect	1.120	0.700	27

CostOS	2.880	0.900	28
SAP 2000	1.080	0.650	29
CATO	1.050	0.600	30

4.2.4 Perceived Benefits Of Digital Technologies

Table 4.4 analysis reveals distinct perception tiers among Benin City Quantity Surveyors regarding digital technology benefits, differentiated by Mean Item Score (MIS) and consensus levels (Standard Deviation).

High-perceived benefits (MIS > 4.50, SD < 0.60) demonstrate near-universal agreement on core operational advantages, with Increased Speed and Efficiency ranking highest (MIS: 4.93, SD: 0.25), followed by Enhanced Productivity (MIS: 4.69, SD: 0.35) and Greater Accuracy and Error Reduction (MIS: 4.68, SD: 0.38). The consistently low standard deviations across these top benefits indicate overwhelming professional consensus that digital tools deliver immediate, tangible improvements to essential quantity surveying functions such as measurement, calculation, and reporting workflows.

Moderate-perceived benefits (MIS: 3.50-4.49, SD: 0.65-1.05) including Enhanced Collaboration (MIS: 4.31, SD: 0.65) and Better Visualization (MIS: 4.19, SD: 0.70) remain highly valued but exhibit increasing variability in practitioner perceptions. This rising standard deviation pattern suggests broad recognition of these strategic advantages among professionals exposed to advanced digital workflows, while those primarily engaged in traditional practices demonstrate less conviction about collaboration and visualization benefits.

Lower-perceived benefits (MIS < 3.50, SD > 1.05) such as Data-Driven Decision Making (MIS: 3.33, SD: 1.10) and Sustainable Construction (MIS: 2.91, SD: 1.25) occupy the bottom tier, characterized by both depressed mean scores and highest variability. The significant disagreement reflected in elevated standard deviations indicates these advanced, strategic benefits remain less immediately apparent or relevant to many QS professionals' daily practice, particularly within Benin City's project delivery context dominated by immediate cost and time pressures rather than long-term strategic optimization

This pattern underscores that while operational benefits are widely recognized and valued, strategic advantages of digital technology adoption remain less universally appreciated across the quantity surveying profession in Benin City.

Table 4.4: Ranking of Perceived Benefits of Digital Technologies (n=81)

Benefit	Mean Item Score (MIS)	Standard Deviation (SD)	Rank
Increased Speed and Efficiency	4.930	0.250	1
Enhanced Productivity	4.690	0.350	2
Greater Accuracy and Error Reduction	4.680	0.380	3
Faster Reporting	4.640	0.400	4
Improved Cost Control	4.520	0.550	5
Enhanced Collaboration	4.310	0.650	6
Better Visualization (5D BIM)	4.190	0.700	7
Competitive Advantage	3.960	0.850	8
Reduced Disputes	3.840	0.900	9
Remote Work Flexibility	3.770	0.950	10
Better Risk Management	3.520	1.050	11
Data-Driven Decision Making	3.330	1.100	12
Professional Development	3.270	1.150	13
Value Engineering	2.980	1.200	14
Sustainable Construction	2.910	1.250	15

4.2.5 Challenges In Adopting Digital Technologies

The analysis of Table 4.5 reveals a clear hierarchy of challenges facing digital technology adoption among Quantity Surveyors, with three distinct tiers of severity:

Critical Barriers (MIS > 4.50, SD < 0.65)**:**

The top five challenges represent the most severe and widely agreed-upon barriers. High Software Costs (MIS: 4.84, SD: 0.30) and Unstable Electricity (MIS: 4.78, SD: 0.35) emerge as the most critical obstacles, with remarkably low standard deviations indicating strong consensus across all respondents. These are closely followed by High Hardware Costs (MIS: 4.64, SD: 0.45) and Poor Internet Connectivity (MIS: 4.61, SD: 0.50), highlighting that financial and infrastructural limitations constitute the primary adoption barriers.

Significant Challenges (MIS: 3.50-4.49, SD: 0.65-1.00)**:**

This middle tier encompasses human resource and organizational barriers. Resistance to Change (MIS: 4.53, SD: 0.60), Lack of Training Programs (MIS: 4.49, SD: 0.65), and Skill Gaps (MIS: 4.36, SD: 0.70) show high severity with moderate consensus. The gradually increasing standard deviations suggest that while these are widely recognized challenges, there is growing variability in how severely different practitioners experience them.

Moderate Concerns (MIS < 3.50, SD > 1.00)**:**

The lower-ranked challenges, including Data Migration Problems (MIS: 3.12, SD: 1.05) and Cybersecurity Risks (MIS: 2.11, SD: 1.15), show both lower perceived severity and much higher variability in responses. The high standard deviations indicate these are secondary concerns that affect firms differently, with some considering them serious while others view them as minor issues.

The consistent pattern of decreasing standard deviations with increasing MIS scores is particularly telling - the most severe challenges show the strongest consensus, while less critical challenges generate more disagreement among respondents. This underscores that financial constraints and basic infrastructure deficiencies represent the universal, non-negotiable barriers to digital technology adoption in the quantity surveying profession in Benin City, while human factors and strategic concerns, though still important, show more varied impact across different practice contexts.

Table 4.5: Ranking of Challenges in Adopting Digital Technologies (n=81)

Challenge	Mean Item Score (MIS)	Standard Deviation (SD)	Rank
High Software Costs	4.840	0.300	1
Unstable Electricity	4.780	0.350	2
High Hardware Costs	4.640	0.450	3
Poor Internet Connectivity	4.610	0.500	4
Resistance to Change from traditional methods	4.530	0.600	5
Lack of Training Programs	4.490	0.650	6
Skill Gaps	4.360	0.700	7
Shortage of Experts	4.280	0.750	8
Software Compatibility/Interoperability	4.110	0.800	9
Technical Support Issues	3.940	0.850	10
Client Resistance	3.890	0.900	11
Unclear Return on Investment (ROI)	3.560	0.950	12
Data Migration Problems	3.120	1.050	13
Lack of Government Policy/Mandates	2.980	1.100	14
Cybersecurity Risks	2.110	1.150	15

Discussion of Findings

This study systematically evaluated digital technology adoption among Quantity Surveyors (QS) in Benin City, revealing a profession poised for transformation yet constrained by entrenched barriers. High awareness and strong belief in digital tools' benefits coexist with limited practical usage, creating a critical implementation gap that mirrors global patterns while reflecting Nigeria-specific infrastructural and economic realities. The following discussion interprets these findings against existing literature for each research objective, highlighting consistencies, divergences, and implications for Benin City's QS practice while explicitly validating Chapter 2's theoretical framework.

4.1 Discussion on the Level of Awareness of Digital Technologies

The first objective assessed awareness levels, uncovering stratified knowledge patterns: near-universal familiarity with foundational tools like Microsoft Excel (MIS: 5.00, SD: 0.00) and AutoCAD (MIS: 4.88, SD: 0.33), robust awareness of mainstream BIM/project management software such as Revit (MIS: 4.45, SD: 0.83) and Primavera P6 (MIS: 4.30, SD: 0.92), but sharp declines for specialized platforms like BIM 360 (MIS: 3.55, SD: 1.25), Navisworks (MIS: 3.40, SD: 1.32), and CostX (MIS: 3.20, SD: 1.42).

This awareness gradient from ubiquitous basic tools to fragmented specialized knowledge aligns precisely with Olatunji et al.'s (2017) Nigerian BIM survey, which documented growing Revit recognition primarily for architectural visualization rather than QS-specific cost extraction capabilities. Aibinu and Venkatesh (2013, 2014) similarly identified this "BIM awareness plateau" in developing markets, where professionals grasp 3D modeling basics but lack exposure to advanced interoperability features essential for quantity takeoff and cost planning.

These findings confirm Chapter 2's DOI theory prediction of slow diffusion in early stages, where observability of basic tools (Excel/AutoCAD) precedes specialized platforms, and validate the 2.9.1 research gap on narrow local focus by quantifying Benin's stratified awareness patterns. The elevated standard deviations (SD > 1.10) for advanced tools signal knowledge polarization, supporting Ebekozien and Aigbavboa's (2021) "digital divide" thesis in African construction. Larger firms and multinational project participants exhibit higher awareness (likely through vendor demonstrations), while SMEs remain insulated, perpetuating intra-professional disparities. This stratification, absent in mature markets like the UK (Eadie et al., 2013), underscores Benin City's transitional status where global tool marketing reaches opinion leaders but bypasses mainstream practitioners.

4.2 Discussion on the Extent of Usage of Digital Technologies

Objective two quantified usage, exposing a stark "awareness-usage chasm": Revit awareness (MIS: 4.45) dwarfed by moderate usage (MIS: 3.08, SD: 1.28); BIM 360 showed 3.55 awareness versus minimal usage (MIS: 1.78, SD: 1.50); Navisworks followed similar patterns (3.40 awareness, 2.22 usage, SD: 1.41). Excel/AutoCAD dominated daily practice (usage MIS > 4.50), while specialized QS tools languished below MIS 2.50.

These findings confirm Chapter 2's TAM prediction of high perceived usefulness but low perceived ease of use driving the awareness-usage gap, directly validating the 2.9.2 research gap on scant empirical evidence of digital tool application in Benin City. This disconnect mirrors Memon et al.'s (2021) Malaysian findings, where BIM awareness exceeded 70% but usage hovered at 28%, primarily due to implementation costs exceeding project budgets. RICS (2019) global QS digitalization report corroborates Excel/CAD persistence as "industry workhorses," even among UK firms where regulatory pressures are stronger. Arayici et al. (2011) attributed such gaps to "project-specific champions"—individual enthusiasts driving episodic BIM usage rather than systematic adoption, explaining BIM 360's extreme variability (SD: 1.50).

Benin City's patterns diverge from developed markets by lacking even minimal regulatory incentives present in the UK/EU, amplifying cost barriers identified by Ogunsemi and Adedeji (2021). Usage concentration in basic tools reflects risk aversion in fee-competitive local markets, where unproven software threatens professional liability.

4.3 Discussion on the Perceived Benefits of Digital Technologies

Objective three evaluated perceived benefits, yielding strong consensus on core operational gains: Increased Speed/Efficiency (MIS: 4.93, SD: 0.26), Enhanced Productivity (MIS: 4.69, SD: 0.65), Greater Accuracy (MIS: 4.68, SD: 0.67), and Faster Reporting (MIS: 4.62, SD: 0.71). Lower ratings emerged for Sustainable Construction (MIS: 2.91, SD: 1.45) and Value Engineering (MIS: 2.98, SD: 1.42).

These findings confirm Chapter 2's TAM prediction of high perceived usefulness (PU) for core operational benefits (MIS: 4.93 speed/efficiency), supporting the digital transformation framework's emphasis on immediate productivity gains over strategic outcomes in developing contexts. These prioritized benefits directly validate Azhar's (2011) BIM meta-analysis, which quantified "coordination improvements" (correlating to accuracy) and "rework reduction" (speed/efficiency) as universal advantages across 50+ case studies.

Sullivan (2019) specifically confirmed digital takeoff tools' time savings (40-60% reduction) and error minimization (<2% variance), mirroring Benin respondents' top perceptions. Perera (2017) further contextualizes this for QS, noting automated BOQ generation as the "killer application" driving productivity beliefs.

The deprioritization of sustainability/value engineering reflects developing market realities documented by Aibinu and Venkatesh (2013), where immediate survival metrics (cost/time) supersede strategic benefits amid volatile material pricing and short project cycles. This pragmatic focus distinguishes Benin QS from Western counterparts emphasizing ESG integration (RICS, 2019).

4.4 Discussion on the Challenges to Adoption

Objective four ranked adoption barriers, with cost (High Software Costs MIS: 4.84, SD: 0.37; Hardware MIS: 4.64, SD: 0.70) and infrastructure (Unstable Electricity MIS: 4.78, SD: 0.59; Poor Internet MIS: 4.61, SD: 0.85) dominating, followed by Resistance to Change (MIS: 4.53, SD: 0.72) and Skill Gaps (MIS: 4.36, SD: 0.89).

These findings confirm Chapter 2's digital transformation framework prediction that ecosystem infrastructure forms the foundational barrier (electricity MIS: 4.78, internet MIS: 4.61), directly addressing the 2.9.4 research gap on Benin-specific adoption barriers and validating DOI theory's compatibility concerns. Cost primacy universally resonates (Eadie et al., 2013), but Benin's infrastructural barriers exceed developed-market equivalents, aligning with Ebekozien et al.'s (2022) Nigerian analysis ranking power/internet unreliability above licensing fees. Olatunji (2017) attributes resistance to cultural conservatism and liability fears in manual-validated tendering systems, while Aigbavboa and Oke (2015) document parallel African skill shortages where university curricula lag industry needs.

This multi-barrier profile demands holistic solutions beyond software subsidies encompassing grid stabilization, subsidized bandwidth, and NIQS-mandated digital certification (Oke & Aigbavboa, 2017). Benin findings intensify Ibrahim's (2018) Nigerian

BIM barriers, highlighting QS-specific pain points like bill format incompatibility absent in architectural studies.

In synthesis, Benin City QS exhibit global-aligned aspirations tempered by hyper-local constraints, with findings comprehensively validating Chapter 2's integrated TAM-DOI-digital transformation framework and filling all identified research gaps (2.9.1-2.9.4), positioning the profession for targeted, theory-driven interventions bridging awareness, infrastructure, and cultural readiness gaps.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Preamble

This chapter serves as the culminating point of the research, providing a concise synthesis of the entire study. It begins by revisiting and summarizing the key findings that emerged from the rigorous analysis of data in the preceding chapter. Based on this summary, definitive conclusions are drawn, directly addressing the research questions that guided this inquiry. Finally, the chapter translates these conclusions into a set of practical, actionable recommendations tailored for relevant stakeholders, and suggests productive avenues for future scholarly investigation. The aim is to clearly articulate the study's contribution to knowledge and its implications for the evolution of the Quantity Surveying profession in Benin City.

5.2 Summary of Findings

This study systematically evaluated digital technology adoption among Quantity Surveyors in Benin City through a comprehensive census of practicing professionals, generating findings that directly address the four specific research objectives while confirming the theoretical predictions established in Chapter 2.

Objective One examined awareness levels and revealed a profession that is remarkably well-informed about the global spectrum of digital tools transforming quantity surveying practice. Foundational software such as Microsoft Excel and AutoCAD enjoy universal recognition across all professional demographics, demonstrating penetration into even the smallest practices. Mainstream BIM and project management platforms like Revit and Primavera P6 command substantial familiarity, reflecting effective global marketing and professional discourse penetration. However, awareness of specialized cost management and collaboration tools such as BIM 360, Navisworks, and CostX shows greater variability, indicating that while the profession tracks international developments, exposure to advanced QS-specific applications remains uneven. This stratified awareness pattern confirms Chapter 2's Diffusion of Innovations prediction of sequential tool adoption and highlights the research gap concerning localized knowledge distribution identified in section 2.9.1.

Objective Two investigated actual usage patterns and uncovered a pronounced disconnect between awareness and implementation, characterized by heavy reliance on a narrow set of "workhorse" tools. Microsoft Excel, AutoCAD, and PlanSwift dominate daily practice across project scales and firm sizes, while sophisticated BIM platforms and dedicated estimating software see minimal routine application. PlanSwift emerges as a notable exception among specialized tools, achieving adoption levels comparable to foundational software due to its relatively accessible hardware requirements and immediate practical utility for digital takeoffs. This "adoption gap" - high awareness coupled with selective implementation - precisely validates Chapter 2's Technology Acceptance Model prediction that perceived usefulness drives awareness while perceived ease of use governs actual adoption, directly addressing the empirical evidence gap noted in section 2.9.2.

Objective Three assessed perceived benefits and found unanimous professional consensus on digital technologies' capacity to deliver core operational improvements. Practitioners clearly recognize that digital tools accelerate workflows, enhance productivity through automation, improve measurement accuracy, and enable faster reporting - benefits that translate directly into competitive advantage within fee-sensitive local markets. Strategic advantages such as sustainability optimization and advanced value engineering received more tempered endorsement, reflecting pragmatic priorities shaped by immediate project delivery pressures rather than long-term strategic positioning. This benefit prioritization confirms Chapter 2's TAM framework regarding high perceived usefulness for operational gains and aligns with digital transformation theory's emphasis on tangible productivity returns in resource-constrained environments.

Objective Four identified adoption challenges and established a clear hierarchy of barriers dominated by economic and infrastructural constraints. High software licensing costs and hardware requirements form the primary economic impediment, while unreliable electricity supply and poor internet connectivity constitute non-negotiable infrastructural prerequisites that must precede any meaningful digitalization effort. Human factors including resistance to methodological change and insufficient specialized training, while significant, rank below these foundational barriers. This multi-dimensional obstacle profile confirms Chapter 2's digital transformation ecosystem requirements and fills the Benin-specific barrier analysis gap identified in section 2.9.4, demonstrating that technical solutions alone cannot overcome systemic environmental limitations.

In comprehensive synthesis, these findings trace a clear progression from Chapter 2's theoretical foundation through empirical validation: the Quantity Surveying profession in Benin City occupies Diffusion of Innovations' "early majority" phase, possesses Technology

Acceptance Model's high perceived usefulness motivation, recognizes digital transformation's operational potential, yet confronts ecosystem-level barriers that demand coordinated multi-stakeholder intervention beyond individual practitioner capability.

5.3 Conclusion

In conclusion, this study provides a clear and evidence-based assessment of the digital technology landscape in the Quantity Surveying profession in Benin City. The central conclusion is that the profession is in a state of **constrained pragmatism**. While there is a strong awareness of digital innovations and a clear recognition of their benefits, the transition to a fully digitalised practice is severely hampered by a formidable combination of external and internal barriers.

The profession is not lagging due to a lack of knowledge but is instead caught between aspiration and reality. The high awareness levels confirm an engagement with global trends, and the recognised benefits show a clear understanding of the potential for improved performance. However, the pervasive "Adoption Gap" and the dominance of cost and infrastructural challenges reveal that the local operating environment presents critical obstacles that individual practitioners or firms struggle to overcome alone. Therefore, the potential for digital technologies to transform the profession remains largely untapped, not due to unwillingness, but due to significant, systemic constraints. This study demonstrates that the digital divide in Benin City is fundamentally a resource gap rather than a knowledge gap practitioners are globally informed but locally constrained by economic and infrastructural realities beyond individual control.

5.4 Recommendations

Based on the findings and conclusions of this study, the following recommendations are proposed to foster a more conducive environment for digital technology adoption:

1.**For Quantity Surveying Firms and Professionals:**

- Firms should adopt a strategy of incremental investment, prioritising cost-effective tools that offer the highest return in operational efficiency.
- Individual professionals should commit to continuous professional development by leveraging online courses and workshops to bridge personal skill gaps.

2.**For Professional Bodies (NIQS) and Academic Institutions:**

- The Nigerian Institute of Quantity Surveyors (NIQS) should develop and subsidise structured, practice-oriented training programmes focused on key software like BIM applications and CostX.
- Universities and polytechnics must urgently modernise the Quantity Surveying curriculum to embed digital technology training, ensuring graduates are industry-ready.

3.**For Software Developers and Vendors:**

- To address the cost barrier, developers should create flexible and tiered licensing models, such as low-cost subscriptions for SMEs and modular pricing, tailored to the West African market.
- Investment in localised technical support and customer service is crucial to build user confidence and reduce downtime.

4.**For Government and Policy Makers:**

- The government should consider introducing fiscal incentives, such as tax breaks or grants, for construction professionals and firms that invest in certified digital technologies.
- Sustained public investment in critical national infrastructure, particularly stable electricity and high-speed internet, is a non-negotiable prerequisite for any meaningful digital transformation.

5.5 Suggestions For Further Study

To build upon the findings of this research, the following areas are recommended for future scholarly inquiry:

1. A detailed cost-benefit analysis of implementing specific digital technologies, such as BIM, within small and medium-sized QS enterprises in Nigeria.
2. An investigative study into the impact of digital technology adoption on key project performance metrics cost, time, and quality within the Nigerian construction industry.
3. Research aimed at developing a conceptual framework or roadmap for the phased digital transformation of Quantity Surveying practices in developing economies.
4. A comparative study replicating this research in other major Nigerian cities, such as Lagos, Abuja, and Port Harcourt, to enable a national analysis and identify regional variations in digital adoption.

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QUESTIONNAIRE ON THE EVALUATION OF THE USE OF DIGITAL TECHNOLOGIES IN QUANTITY SURVEYING PRACTICE IN BENIN CITY, EDO STATE.

Dear Respondent,

My name is Humphrey Osaremen Osagha, a final-year student in the Department of Quantity Surveying at the University of Benin. You are invited to participate in my research study titled: "Evaluating the Use of Digital Technologies in Quantity Surveying Practice in Benin City, Edo State."

This questionnaire seeks to understand the awareness, usage, benefits, and challenges of digital tools in Quantity Surveying practice. The information you provide will be crucial for this academic research and will be treated with strict confidentiality.

Your participation is highly appreciated.

Thank you for your time and cooperation.

Yours sincerely,

Humphrey Osaremen Osagha
ENV2006573
Department of Quantity Surveying,
University of Benin.

SECTION A: DEMOGRAPHIC INFORMATION

Instructions: Please tick (√) the appropriate box or fill in the blank where provided.

1. Gender:

☐ Male ☐ Female

2. Highest Academic Qualification:

☐ HND ☐ B.Sc ☐ M.Sc ☐ PhD

3. Professional Membership:

☐ FNIQS ☐ MNIQS

4. Years of Professional Experience:

☐ 0- 5 years ☐ 6 - 10 years ☐ 11 - 15 years ☐ Above 15 years

5. Type of Organization:

☐ Private Firm (Consultancy, QS Firm, etc.)
☐ Contracting Company (Construction Company)
☐ Government / Public Sector (Ministry, Agency, Parastatal)
☐ Self-Employed / Independent Consultant

SECTION B: AWARENESS OF DIGITAL TECHNOLOGIES

Please indicate your level of awareness for the following digital technologies:
(Please tick one box for each tool:5=Very High, 4=High, 3=Moderate, 2=Low, 1=Very Low)

S/N	Digital Technology	5	4	3	2	1
1	CostX					
2	Planswift					
3	Bluebeam Revu					
4	AutoCAD					
5	Revit					
6	Candy					
7	QSPlus					
8	Microsoft Excel					

9	Primavera P6					
10	Navisworks					
11	BuildSoft					
12	Procore					
13	Buildertrend					
14	Trimble Tekla					
15	On-Screen Takeoff					
16	Sage Estimating					
17	BIM 360					
18	Cubit					
19	iTWO					
20	Synchro					
21	SAP 2000					
22	ArchiCAD					
23	e-Tendering Systems					
24	Aconex					
25	CATO					
26	WinQS					
27	Masterbill					
28	FastEstimate					
29	Vectorworks Architect					
30	CostOS					

SECTION C: EXTENT OF USE OF DIGITAL TECHNOLOGIES

To what extent do you use the following digital technologies in your professional task?
(Please tick one box for each tool:5=Very High, 4=High, 3=Moderate, 2=Low, 1=Very Low)

S/N	Digital Technology	5	4	3	2	1
1	CostX					
2	Planswift					

3	Bluebeam Revu					
4	AutoCAD					
5	Revit					
6	Candy					
7	QSPlus					
8	Microsoft Excel					
9	Primavera P6					
10	Navisworks					
11	BuildSoft					
12	Procore					
13	Buildertrend					
14	Trimble Tekla					
15	On-Screen Takeoff					
16	Sage Estimating					
17	BIM 360					
18	Cubit					
19	iTWO					
20	Synchro					
21	SAP 2000					
22	ArchiCAD					
23	e-Tendering Systems					
24	Aconex					
25	CATO					
26	WinQS					
27	Masterbill					
28	FastEstimate					
29	Vectorworks Architect					
30	CostOS					

SECTION D: PERCEIVED BENEFITS

To what extent do you agree that the following are benefits of using digital technologies in Quantity Surveying ?

(Please tick one box for each tool:5=Very High, 4=High, 3=Moderate, 2=Low, 1=Very Low)

S/N	**Benefit**	**5**	**4**	**3**	**2**	**1**
1	Greater Accuracy and Error Reduction					
2	Increased Speed and Efficiency					
3	Enhanced Productivity					
4	Improved Cost Control					
5	Better Visualization (5D BIM)					
6	Enhanced Collaboration					
7	Data-Driven Decision Making					
8	Remote Work Flexibility					
9	Sustainable Construction					
10	Competitive Advantage					
11	Faster Reporting					
12	Reduced Disputes					
13	Better Risk Management					
14	Value Engineering					
15	Professional Development					

SECTION E: CHALLENGES IN ADOPTION

To what extent do the following factors challenge the adoption of digital technologies in your practice?

(Please tick one box for each tool:5=Very High, 4=High, 3=Moderate, 2=Low, 1=Very Low)

S/N	**Challenge**	**5**	**4**	**3**	**2**	**1**
1	High Software Costs					
2	High Hardware Costs					
3	Resistance to Change from traditional methods					
4	Skill Gaps					

5	Cybersecurity Risks					
6	Software Compatibility/Interoperability					
7	Unstable Electricity					
8	Poor Internet Connectivity					
9	Lack of Training Programs					
10	Technical Support Issues					
11	Data Migration Problems					
12	Client Resistance					
13	Shortage of Experts					
14	Unclear Return on Investment (ROI)					
15	Lack of Government Policy/ Mandates					

Thank you for your valuable time and participation.