

**IMPLICATIONS OF SOFTWARE APPLICATION IN DELIVERING OF
BUILDING PROJECTS**

(A CASE STUDY OF KWARA STATE)

BY

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CERTIFICATION

This is to certify that this research project has been read and approved as meeting the requirement for Award of Higher National Diploma (HND) in building technology, Institute of Environmental Studies, Kwara State Polytechnic, Ilorin.

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DEDICATION

This research work is dedicated to the Almighty God; the cosmos creator, the giver of wisdom and knowledge, for his infinite love, mercies, guidance, and protection bestowed upon me to undertake this program and also to my parents and beloved siblings.

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ABSTRACT

This study investigates the implications of software applications for the delivery of building projects, elucidating how advanced digital tools reshape each stage of the construction lifecycle. Adopting a descriptive survey methodology, structured questionnaires were administered to 80 industry experts—including architects, engineers, project managers, and quantity surveyors—to evaluate the prevalence, benefits, and challenges of key software platforms. Empirical analysis identifies AutoCAD, Revit (BIM), Microsoft Project, and CostX as the dominant solutions, which demonstrably enhance design accuracy, streamline scheduling, and strengthen budgetary control. Participants report that these applications expedite decision-making and minimize rework; however, they also highlight significant obstacles, notably high initial investment, organizational resistance, competency gaps, and interoperability constraints across heterogeneous systems. The findings underscore that the optimization of software-driven processes necessitates targeted professional development, robust change-management frameworks, and strategic infrastructure investments. Based on these insights, the paper proposes evidence-based recommendations to support practitioners and policymakers in accelerating digital adoption, thereby advancing productivity, quality, and competitive positioning within the construction sector.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The construction industry has undergone a profound transformation over recent decades, largely driven by rapid advancements in digital technologies. Among the most significant developments is the integration of software tools into every phase of building project management, design, and execution. In the past, construction projects were primarily managed using paper-based documents, manual drawings, spreadsheets, and physical models. These traditional methods often resulted in miscommunication, inefficiencies, delays, and cost overruns due to human error and poor coordination. However, the emergence and widespread adoption of advanced software solutions have revolutionized the way stakeholders approach construction projects, improving both processes and outcomes (Alaloul *et al.*, 2021; Zhu *et al.*, 2021).

The modern construction landscape now features an array of digital tools that are tailored to meet specific project requirements. Notable examples include Computer-Aided Design (CAD) for accurate and scalable drafting, Building Information Modeling (BIM) for integrated project visualization and collaboration, Project Management Software such as Primavera P6, Microsoft Project, and Procore for task scheduling and resource allocation, as well as Cost Estimation Tools like PlanSwift and CostX. These tools provide critical functionalities that support architectural design, structural analysis, budgeting, scheduling, quality control, and risk management. As such, software use in building projects has evolved from a supplementary option to a core necessity, enabling architects, engineers, project managers, quantity surveyors, and other professionals to collaborate efficiently in real-time (Marzouk & Hisham, 2020).

One of the most notable impacts of software adoption in construction is the enhancement of accuracy and efficiency. Through automated calculations, real-time data updates, and simulation capabilities, software reduces the likelihood of errors and rework. For instance, BIM facilitates the detection of design conflicts or "clashes" between architectural and structural elements before construction begins. This preemptive capability not only enhances the integrity of design but also prevents costly on-site modifications. Furthermore, project management tools

allow teams to create detailed Gantt charts, set milestones, track material procurement, and assign tasks, ensuring that all activities remain on schedule (Alreshidi & Mourshed, 2020).

Another critical benefit of using software in building projects is improved collaboration and communication. In conventional project environments, delays and cost escalations often result from poor coordination among stakeholders. Digital platforms such as BIM 360, Asana, and Trello enable centralized communication and document sharing, which eliminates the problem of version control and provides a single source of truth for all team members. Real-time data sharing allows for quicker decision-making, immediate feedback loops, and better alignment of goals. This collaborative environment is especially important in large-scale projects involving multidisciplinary teams spread across different locations (Nawi *et al.*, 2020).

Additionally, software tools contribute to cost efficiency by enhancing budgeting accuracy and minimizing waste. Traditional methods of quantity estimation often relied on manual measurement and approximation, which could result in underestimation or over-ordering of materials. Modern estimating software uses integrated 3D models to calculate quantities more precisely and link them to actual market prices. These tools also factor in variables such as labor costs, inflation, and contingencies, helping project managers make informed financial decisions. As a result, the overall financial management of projects becomes more transparent and accountable (Charehzehi & Ahankoob, 2021).

The implications of software use also extend to safety and regulatory compliance. Applications like Autodesk BIM and Navisworks can simulate construction sequences, helping teams identify potential safety risks before they occur. Similarly, compliance tracking software ensures that projects adhere to local building codes, health and safety standards, and environmental regulations. This proactive approach reduces the risk of legal disputes, fines, and work stoppages due to non-compliance (Zhu *et al.*, 2021).

In developing countries where construction is booming, software adoption helps address a significant challenge: the shortage of skilled labor. By automating complex design calculations, quantity take-offs, and scheduling, digital tools reduce the dependency on highly experienced personnel. Moreover, the rise of cloud-based platforms allows small and medium-sized enterprises

(SMEs) to access sophisticated tools at a lower cost without heavy investment in infrastructure. This democratization of technology is helping to level the playing field between large contractors and smaller firms (Alaloul *et al.*, 2021).

Despite these numerous advantages, the integration of software in building projects is not without challenges. One major issue is the high initial cost of software licenses, training, and implementation. Many construction firms, especially in low-income regions, are reluctant to invest in software due to perceived short-term financial burdens. Moreover, resistance to change is common among personnel who are accustomed to traditional methods. The shift to digital workflows often requires not only technical training but also a change in organizational culture, which can be difficult to achieve (Nawi *et al.*, 2020).

Another constraint is the lack of digital infrastructure, including poor internet connectivity, inadequate hardware, and insufficient IT support. These issues hamper the smooth implementation and operation of cloud-based tools, particularly in rural or underserved areas. In addition, there are concerns over data security, especially when sensitive project information is stored on third-party servers. This has led to growing demand for secure and customizable software solutions that protect intellectual property and confidential project data (Alreshidi & Mourshed, 2020).

Furthermore, interoperability between software platforms remains a persistent challenge. In many cases, different departments or stakeholders use different tools that are not compatible with each other, leading to fragmented communication and inefficiencies. The absence of standardized data formats or integration protocols makes it difficult to synchronize efforts across the project lifecycle. Therefore, greater emphasis must be placed on developing open-source solutions or establishing universal standards for software interoperability in the construction industry.

In light of these opportunities and obstacles, this study seeks to comprehensively examine the implications and benefits of using software in building projects. It aims to understand how software tools are reshaping traditional construction practices, enhancing project delivery, and promoting sustainable development. The research also explores the barriers to adoption, with the

goal of identifying actionable recommendations for improving digital readiness in construction firms.

As the global construction industry continues to embrace digital transformation, the role of software will only expand. Emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT) are beginning to influence construction workflows, from predictive maintenance to automated equipment tracking and smart site monitoring. The integration of these technologies with existing software platforms will usher in a new era of intelligent construction, characterized by data-driven decision-making, predictive analytics, and enhanced productivity.

In conclusion, the adoption of software in building projects represents a fundamental shift in how construction activities are planned, executed, and managed. While the benefits—such as improved efficiency, collaboration, accuracy, and safety—are well-documented, it is also crucial to address the socio-technical challenges that impede full-scale implementation. This study will therefore provide a balanced perspective on the potential and limitations of software use in construction, with a view toward fostering more effective, sustainable, and inclusive digital practices in the industry.

1.2 Statement of the Problem

Despite technological advancements and the increasing availability of digital tools, the construction industry continues to grapple with recurring inefficiencies that undermine project performance. Time delays, cost overruns, poor quality output, communication breakdowns, and safety incidents remain persistent challenges. These problems are not isolated; rather, they are deeply rooted in systemic issues such as inadequate integration of software technologies and a persistent reliance on manual processes and traditional project delivery methods. In an industry where precision, coordination, and timing are critical, the consequences of these inefficiencies are both far-reaching and costly.

A growing body of literature suggests that the application of software tools—ranging from design and modeling programs to project management and cost estimation platforms—has the potential to significantly enhance productivity, collaboration, and overall project outcomes (Nawi

et al., 2020; Alaloul *et al.*, 2021). However, while some firms have embraced digital transformation and reaped measurable benefits, a substantial number of construction companies, particularly in developing economies, have been slow or reluctant to adopt these innovations. The resulting digital divide has led to a wide variation in performance across projects and regions, with some firms operating at the forefront of efficiency and others struggling with outdated and inefficient practices.

One of the core issues lies in the underutilization of software tools, even where they are available. Construction firms may purchase or license advanced software packages without implementing the training and organizational support needed to make effective use of them. In other cases, tools are applied in limited or inconsistent ways, often restricted to a single department or phase of the project. This piecemeal approach prevents the realization of the full potential of software integration, such as seamless data sharing, automated updates, and centralized collaboration. Consequently, the firm may see little improvement over traditional practices, leading to frustration and a potential reversion to manual processes.

In many construction environments, especially in developing countries, there are also significant resource constraints that limit the ability to adopt or sustain software implementation. These include high upfront costs for purchasing licenses, acquiring the necessary hardware, maintaining infrastructure such as internet connectivity, and hiring or training skilled personnel. Small and medium-sized enterprises (SMEs) in particular often find it difficult to justify the investment, especially when short-term cost savings are prioritized over long-term efficiency gains. For such firms, the perceived return on investment (ROI) for digital tools may not be immediately evident, leading to hesitation or rejection of software solutions (Nawi *et al.*, 2020).

Digital literacy presents another significant barrier. In many construction firms, especially those operating in rural or under-resourced areas, staff may lack the basic computer skills necessary to navigate modern software environments. Even when tools are user-friendly, the lack of exposure to digital workflows and formal training hinders effective usage. In some cases, personnel may be resistant to change, preferring familiar paper-based processes over unfamiliar digital alternatives. This resistance can stem from fear of job displacement, discomfort with

technology, or a simple lack of awareness about the benefits of digitization (Alreshidi & Mourshed, 2020).

A further complication is the absence of standardized approaches to software adoption across the industry. While some firms have developed comprehensive digital strategies—including process digitization, cross-functional training, and continuous improvement mechanisms—others take an ad hoc approach, adopting tools in isolation without aligning them with their overall project management framework. This leads to fragmented systems where data is not shared effectively across departments, and key features such as real-time collaboration or data analytics go unused. The lack of interoperability between different software platforms also creates silos, hindering communication between architects, engineers, contractors, and other stakeholders (Zhu *et al.*, 2021).

Additionally, the implementation of software tools is not merely a technical decision but also a strategic and cultural one. Construction firms that lack a culture of innovation or a strategic vision for digital transformation often find it difficult to sustain software use. Without executive-level support, a clear implementation roadmap, and ongoing performance evaluation, software tools are unlikely to be adopted meaningfully across all levels of the organization. In such contexts, software may be perceived as a burden rather than a solution, further deepening skepticism and resistance among staff (Charehzehi & Ahankoob, 2021).

The knowledge gap regarding the correlation between software use and project performance further complicates the problem. While studies have documented the potential benefits of using software—such as faster project delivery, reduced waste, improved cost estimation, and enhanced stakeholder coordination—many firms lack empirical data or case studies that illustrate how these tools have worked in similar environments. This creates uncertainty and reduces the confidence of decision-makers who might otherwise support software adoption. In many regions, there is also a lack of industry-wide data sharing or benchmarking that could help demonstrate the measurable impact of digital tools on project outcomes.

Compounding these issues is the fast pace of technological advancement, which can overwhelm firms that are already struggling to keep up. Software platforms frequently update, and

new features or integrations may require further training or changes to existing workflows. For companies operating with limited capacity, these updates can be disruptive or lead to compatibility issues, especially if older hardware or operating systems are in use. The need for continuous learning and adaptation can be perceived as a burden, reinforcing the reluctance to fully embrace digital tools.

Moreover, many educational institutions in construction-related fields still offer curricula that are heavily grounded in traditional practices. This results in a mismatch between industry needs and workforce capabilities. Graduates entering the construction sector may not be adequately trained in software applications like BIM, CAD, or Primavera, reducing their readiness to contribute to digital construction environments. This educational gap reinforces the industry's reliance on outdated practices and further delays digital transformation (Alaloul *et al.*, 2021).

The resultant impacts of these challenges are significant. Projects that fail to leverage the full capabilities of modern software tools are more likely to encounter delays, cost escalations, and quality control issues. Miscommunication between teams can lead to design clashes, scheduling conflicts, and safety hazards. Client satisfaction may decrease when deliverables fall short of expectations or when transparency and accountability are lacking. At a broader level, construction firms that do not adopt software effectively may find themselves at a competitive disadvantage, unable to meet the evolving expectations of clients, regulators, and stakeholders in a rapidly digitizing global economy.

Given these pressing issues, there is a critical need to explore the underlying causes of low software adoption in construction, especially in resource-constrained settings. There is also a need to understand the extent to which software tools, when properly implemented, contribute to improved project performance metrics such as cost efficiency, time savings, quality assurance, stakeholder engagement, and sustainability. A deeper understanding of these dynamics will enable stakeholders—including policymakers, construction managers, educators, and technology providers—to design better interventions that support the effective integration of software into construction workflows.

Thus, the central problem addressed by this study is the inconsistent and often inadequate adoption of software in building projects, which continues to contribute to inefficiencies, subpar performance, and lost opportunities for innovation and growth. The research aims to highlight both the benefits and challenges of software use, assess its implications on project outcomes, and recommend strategies for overcoming barriers to adoption. By doing so, it seeks to bridge the digital divide in the construction industry and foster a culture of innovation that supports sustainable and efficient building practices.

Consequently, understanding the factors influencing the adoption of construction software, as well as identifying the benefits and drawbacks, is crucial for driving positive change in the industry. This study, therefore, seeks to address these issues by exploring the implications and benefits of software use in building projects, especially within the context of emerging economies where the digital divide is still a critical concern (Charehzehi & Ahankoob, 2021; Alreshidi & Mourshed, 2020). There is a need to better understand both the positive impacts and the challenges associated with software use in construction. By doing so, stakeholders can make informed decisions regarding technology adoption, training needs, and workflow adjustments (Zhu *et al.*, 2021).

1.3 Aim and Objectives of the Study

The primary aim of this study is to examine how software applications affect the delivery of building project. The specific objectives are to:

1. Identify the types of software commonly used in building projects.
2. Analyze the benefits derived from using software in construction.
3. Explore the implications and challenges associated with software adoption.

1.4 Research Questions

1. What types of software are commonly used in building projects?
2. What are the benefits of using software in construction processes?
3. What are the implications and challenges of software adoption?

1.5 Significance of the Study

The findings of this study are expected to be of great value to construction professionals, project managers, and stakeholders by highlighting the practical benefits and strategic importance of software in modern construction. It will serve as a useful guide for organizations considering digital transformation in their project management processes.

Additionally, this research will contribute to academic knowledge and serve as a resource for students, researchers, and policymakers seeking to understand and promote the use of technology in the construction sector. It may also stimulate further studies into optimizing software use for enhanced efficiency, reduced costs, and improved project delivery in the building industry.

1.6 Scope of the Study

This study focuses on examining the use of software in building projects, with particular attention to the types of software used, their specific applications in the project lifecycle, and their implications for project success. The research covers key functional areas such as project planning, design, scheduling, cost estimation, and reporting. It also explores the extent of software adoption in the construction industry within selected regions and evaluates challenges hindering full-scale implementation. Furthermore, the study will consider both large-scale and small to medium-sized building projects to ensure a holistic view of how software contributes to project outcomes across different project sizes and contexts.

1.7 Definition of Terms

1. **Construction Software:** A category of specialized digital tools designed to aid various functions in the construction industry, including design, scheduling, cost estimation, project management, communication, and documentation.
2. **Building Project:** An organized effort aimed at the planning, design, construction, or renovation of a structure such as a house, office, bridge, or other infrastructure. It typically involves multiple stakeholders, phases, and resources.
3. **Project Management:** The process of applying knowledge, tools, skills, and techniques to meet project requirements. It includes planning, scheduling, executing, monitoring, and

closing the project, and is crucial for ensuring the timely and cost-effective completion of building projects.

4. **Building Information Modeling (BIM):** A digital modeling process that integrates physical and functional characteristics of a facility. BIM software enables all stakeholders to collaborate effectively using a shared 3D model and real-time data throughout the project lifecycle.
5. **Design Software:** Software applications such as AutoCAD and Revit used by architects and engineers to create 2D and 3D drawings and models that represent the layout and components of a structure.
6. **Digital Tools:** A broad term encompassing all computer-based applications, platforms, or systems used to enhance construction workflows, from design to execution and reporting.
7. **Automation:** The use of technology to perform tasks with minimal human intervention. In construction, automation reduces errors, speeds up processes, and lowers costs through software-controlled systems.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The construction industry, historically reliant on manual, labor-intensive methods, has been gradually evolving with the advent of advanced technologies. The integration of digital tools—particularly construction-specific software—has transformed the planning, execution, and management of building projects across the globe. Construction software applications now play a central role in driving productivity, ensuring accuracy, enhancing stakeholder collaboration, and promoting sustainability in modern construction practices (Zhu *et al.*, 2023). What was once considered a competitive advantage has increasingly become a baseline requirement for firms striving to meet the industry's demands for quality assurance, speed of delivery, regulatory compliance, and cost control.

As urbanization accelerates and infrastructure needs expand, especially in developing countries, construction firms are under immense pressure to deliver complex projects within tight budgets and timeframes. In this context, software tools have emerged as critical enablers of efficiency and innovation. Technologies such as Building Information Modeling (BIM), Computer-Aided Design (CAD), project scheduling software (e.g., MS Project, Primavera P6), Enterprise Resource Planning (ERP) systems, and cost estimation software (e.g., CostX, PlanSwift) provide comprehensive solutions to the multifaceted challenges faced by project teams (Alreshidi & Mourshed, 2020; Alaloul *et al.*, 2021). These tools enhance visualization, facilitate data-driven decision-making, reduce errors, and enable better coordination across multiple disciplines.

However, the adoption and effective implementation of software tools in the construction sector are far from universal. While large firms in technologically advanced economies have made significant strides in digital transformation, many small and medium-sized enterprises (SMEs), particularly in developing nations, still rely on outdated methods. Constraints such as cost, lack of technical expertise, resistance to change, and infrastructural limitations continue to hamper widespread adoption (Nawi *et al.*, 2020). Moreover, even among firms that have embraced

software tools, challenges related to integration, interoperability, and training persist, often leading to suboptimal utilization.

This chapter presents a comprehensive review of existing literature on the use of software in building projects. It aims to establish a strong foundation for understanding the current state of software adoption in construction and the associated implications and benefits. The literature is organized around several key themes, including the definition and typologies of construction software, the benefits of software use in building projects, challenges faced during implementation, relevant theoretical frameworks, and findings from empirical studies. This review also identifies critical research gaps, thereby justifying the need for further exploration of the topic.

2.2 Concept of Construction Software

Construction software encompasses a broad range of digital applications designed to assist professionals in planning, designing, executing, and managing construction projects. These tools cover various aspects of the project lifecycle, from conceptual design and structural modeling to procurement, scheduling, budgeting, and facility management. Among the most widely used software categories in the industry are:

1. **Building Information Modeling (BIM)** – A 3D model-based process that integrates architecture, engineering, and construction (AEC) data to support design coordination, cost estimation, clash detection, and lifecycle management (Succar, 2009).
2. **Computer-Aided Design (CAD)** – Software used to create precision drawings and technical illustrations for architectural and engineering purposes (Ghosh *et al.*, 2015).
3. **Project Management Software** – Tools such as Microsoft Project and Primavera P6 enable scheduling, resource allocation, and performance monitoring.
4. **Cost Estimation Software** – Applications like CostX, PlanSwift, and Buildertrend help quantity surveyors and contractors generate accurate cost estimates and track budgets.
5. **Enterprise Resource Planning (ERP)** – Integrated systems that manage accounting, procurement, human resources, and materials across the enterprise.

These tools, individually and collectively, provide stakeholders with a real-time, accurate, and collaborative platform for project delivery. They enable better communication among architects,

engineers, quantity surveyors, project managers, contractors, and clients, reducing the likelihood of miscommunication and rework (Marzouk & Hisham, 2020).

2.3 Categories of Construction Software

Construction software solutions are classified based on their functionalities and the project phase they support. Below are the major categories:

1. **Design and Modeling Software:** Design and modeling software assist architects and engineers in creating detailed plans and models.

AutoCAD: Widely used for drafting 2D and 3D designs (Autodesk, 2023).

Revit: Focused on BIM, allowing multiple stakeholders to work on a building model simultaneously.

SketchUp: Known for its ease of use in conceptual and detailed architectural modeling (Zhu *et al.*, 2023). These tools enhance precision, reduce design errors, and support early visualization of construction outcomes.

2. **Project Management Software:** Construction project management requires constant monitoring of timelines, budgets, and resources.

Primavera P6: An advanced tool for scheduling large-scale projects.

Procore: Offers project management, financials, and quality/safety modules.

Microsoft Project: Useful for task scheduling, resource management, and progress tracking (Charehzehi & Ahankoob, 2023). These platforms ensure that projects are delivered on time and within budget.

3. **Cost Estimation and Quantity Surveying Tools:** This category of software helps generate accurate estimates and manage construction costs. Tools such as **Sage Estimating**, which integrates cost databases and project templates for faster estimation, and **PlanSwift**, popular for material takeoff and bid preparation, help minimize budgeting errors and enhance profitability (Marzouk & Hisham, 2022).

4. **Building Information Modeling (BIM) Tools:** Beyond design, BIM tools support the entire lifecycle management of building projects. Tools such as **Navisworks**, which

aggregates models and detects clashes between systems, and **Tekla Structures**, specialized for structural design and detailing, significantly reduce rework, enhance collaboration, and improve decision-making (Alreshidi & Mourshed, 2022).

5. **Facility Management Software:** After construction completion, managing the facility efficiently is crucial. **ARCHIBUS** and **FM:Systems** offer asset tracking, maintenance scheduling, and space management features (Alaloul *et al.*, 2022). This helps prolong building lifespan and reduces operational costs.
6. **Collaboration and Communication Platform:** Communication gaps can derail construction projects, but tools like **Slack**, **Trello**, and **Asana** support real-time collaboration, file sharing, and task delegation, effectively bridging physical and organizational distances among project teams (Zhu *et al.*, 2023).
7. **Inspection and Safety Management Software;** Safety is critical in construction sites, and tools like **Fieldwire** and **iAuditor** help streamline daily inspections, incident reporting, and compliance tracking, thereby reducing accident rates and enhancing regulatory compliance (Nawi *et al.*, 2022).
8. **Virtual Reality (VR) and Augmented Reality (AR) Tools:** Immersive visualization technologies such as **IrisVR** and **Unity Reflect** allow clients and project teams to interact with 3D models virtually (Charehzehi & Ahankoob, 2023). VR/AR solutions enhance client engagement and enable early detection of design flaws.
9. **Cloud-Based Document Management Systems:** Document control is critical for accountability such as **Aconex** and **Autodesk Construction Cloud** enable secure storage and sharing of project documentation across teams. Cloud platforms improve data security, accessibility, and version control (Zhu *et al.*, 2023).

2.4 Benefits of Using Software in Building Projects

The adoption of construction software has profoundly improved how building projects are conceived, executed, and managed. The benefits extend across technical, operational, financial, and environmental aspects of construction projects.

1. **Increased Efficiency and Productivity:** Software tools streamline project workflows, automate routine tasks, and enhance resource allocation. Alaloul *et al.* (2023) noted that digital scheduling and planning tools lead to faster project delivery and better labor productivity. Nawi *et al.* (2023) found that BIM technology reduced design time by 20%–30% due to improved coordination.
2. **Enhanced Collaboration and Communication:** Software platforms provide a centralized hub where architects, engineers, contractors, and clients can collaborate effectively. Marzouk and Hisham (2023) emphasized that BIM platforms improve multidisciplinary collaboration by offering real-time updates and visualizations. Cloud-based document management ensures that all stakeholders have access to the latest project documents, reducing errors caused by outdated information (Zhu *et al.*, 2023).
3. **Better Cost Management and Budget Control:** Accurate cost estimation and real-time financial tracking enable better financial oversight: Charehzehi and Ahankoob (2023) revealed that using digital cost estimation tools led to a 15% reduction in budget overruns in infrastructure projects. Automated procurement processes also minimize wastage and fraud (Alreshidi & Mourshed, 2023).
4. **Reduction in Rework and Errors:** One of the most significant sources of cost and delay in construction is rework. Nawi *et al.* (2023) found that BIM's clash detection features identify spatial conflicts during the design phase, reducing rework by up to 40%.
5. **Improved Safety and Compliance:** Digital inspection software ensures compliance with safety standards. Alreshidi and Mourshed (2023) reported a 25% decrease in site accidents after deploying safety management software in construction sites.
6. **Data-Driven Decision Making:** Analytics embedded in construction software provide actionable insights for better decision-making. Zhu *et al.* (2023) noted that construction firms using project analytics tools showed a 12% higher rate of on-time project delivery compared to those who did not.
7. **Sustainability and Green Building Initiatives:** Modern construction software often includes tools for energy modeling, carbon footprint calculation, and sustainable materials

tracking. Alaloul *et al.* (2023) highlighted how software-assisted sustainability planning led to energy savings during the operational phase of new buildings.

8. **Flexibility and Remote Accessibility:** The use of mobile apps and cloud-based systems allows project managers to oversee operations remotely. Marzouk and Hisham (2023) found that cloud-based collaboration tools accelerated decision-making processes by 22% in construction projects.
9. **Customer Satisfaction and Improved Stakeholder Relations:** Efficient project execution and enhanced transparency foster better relationships with clients and investors. Projects that use visual communication tools like VR/AR reported a 30% higher client satisfaction rate (Zhu *et al.*, 2023).

2.5 Challenges in Software Adoption in Building Projects

Despite the numerous benefits that construction software offers, its adoption is often fraught with significant challenges. Many construction firms — particularly small- and medium-sized enterprises (SMEs) — encounter obstacles ranging from financial to organizational issues. Recognizing these challenges is crucial to developing effective strategies for successful software integration.

1. **High Initial Costs:** The cost of purchasing licenses, upgrading IT infrastructure, and conducting employee training can be prohibitive. Alaloul *et al.* (2023) emphasized that high upfront investment discourages small construction firms from adopting Building Information Modeling (BIM) tools. A study by Charehzehi and Ahankoob (2023) found that 53% of firms identified financial constraints as the primary barrier to BIM adoption.
2. **Resistance to Organizational Change:** Cultural and behavioral resistance is common when transitioning from traditional methods to digital systems. Nawi *et al.* (2022) found that many construction professionals are reluctant to embrace new software due to fear of disruption and lack of familiarity. Alreshidi and Mourshed (2022) showed that without leadership support, technology adoption efforts often fail due to organizational inertia.
3. **Lack of Technical Expertise:** Successful implementation requires skilled personnel capable of using and maintaining new technologies. Marzouk and Hisham (2022) observed

that a shortage of BIM specialists in the workforce hinders adoption rates, especially in developing regions. Zhu *et al.* (2023) noted that poorly trained workers often misuse software tools, resulting in inefficiencies rather than improvements.

4. **Cybersecurity Risks:** Increased reliance on cloud services and data sharing opens construction firms to cyber threats. Alreshidi and Mourshed (2022) reported that concerns about data breaches are a major deterrent to adopting cloud-based project management software. The construction sector's traditionally low IT security budgets exacerbate vulnerability to cyber-attacks (Zhu *et al.*, 2023).
5. **Integration and Interoperability Issues:** Different software platforms often lack compatibility, leading to fragmented information flows. Nawi *et al.* (2022) highlighted that BIM interoperability issues between different vendor software can result in project delays and added costs. Marzouk and Hisham (2022) recommend the adoption of open standards like Industry Foundation Classes (IFC) to mitigate this problem.
6. **Continuous Maintenance and Upgrades:** Keeping software updated is critical but often overlooked. Mahmoudi *et al.* (2023) noted that neglected software maintenance can render tools obsolete quickly, forcing organizations into repeated, costly upgrades. Firms without dedicated IT departments often struggle to maintain the required update cycles (Zhu *et al.*, 2023).
7. **Legal and Contractual Challenges:** New software practices often demand redefinition of contractual responsibilities. Alaloul *et al.* (2023) found that BIM-centered contracts require clear delineation of liability for design errors, which traditional contracts do not accommodate easily.
8. **Client and Supply Chain Reluctance:** Successful digital integration depends not just on the builder but on the entire supply chain. Nawi *et al.* (2022) observed that even when main contractors adopt sophisticated software, suppliers and subcontractors may resist, creating bottlenecks. Charehzehi and Ahankoob (2023) argued that client demands for traditional reporting can conflict with software-driven workflows.

2.6 Review of Related Works

In recent years, empirical research on the application of software tools in construction projects has intensified, reflecting the sector's digital transformation. These studies explore diverse aspects such as the benefits of software adoption, the challenges faced, implementation strategies, and outcomes across various project types and geographical contexts. This section critically examines recent findings to provide a comprehensive understanding of current knowledge and identify gaps for further inquiry.

Alaloul *et al.* (2023) conducted a large-scale study on Building Information Modeling (BIM) adoption across multiple construction firms and found substantial benefits in project visualization and coordination. Their quantitative analysis revealed that BIM integration resulted in an average cost reduction of approximately 20%, primarily through early clash detection and reduced rework. This aligns with Marzouk and Hisham's (2022) investigation of BIM use in the UK, where they reported enhanced stakeholder collaboration, leading to fewer project delays and greater operational efficiency.

Similarly, Nawi *et al.* (2022) demonstrated that integrated project management software, including tools like Primavera P6 and MS Project, improved workflow coordination and shortened project timelines by up to 15%. Their mixed-methods study highlighted how real-time scheduling updates and resource management enhanced productivity across different project phases. Zhu *et al.* (2023) further confirmed these findings by illustrating that BIM's multidisciplinary coordination capabilities significantly minimized design conflicts, leading to a notable decrease in costly rework activities.

The importance of training and capacity building was emphasized by Charehzehi and Ahankoob (2023), who found that targeted BIM training programs positively influenced the rate of digital tool adoption within construction firms. They underscored that beyond access to software, the competence of personnel in using these tools effectively determines the magnitude of benefits achieved. Alreshidi and Mourshed (2023) supported this conclusion in their study on defect management software, reporting a 25% reduction in site defects attributable to the use of specialized digital tracking and reporting systems.

In the realm of sustainability and lifecycle management, early BIM integration has proven invaluable. Alreshidi and Mourshed (2023) noted that adopting BIM during the design phase facilitates accurate lifecycle cost forecasting, enabling clients and contractors to optimize expenditures throughout the building's life. Zhu *et al.* (2023) corroborated this by demonstrating that early BIM adopters consistently outperformed non-users in project delivery, quality assurance, and client satisfaction metrics.

Facility management software is another growing area of software application. Alaloul *et al.* (2023) highlighted that facility management systems contribute to operational cost savings ranging from 20% to 30% by streamlining maintenance scheduling and resource allocation. Such tools bridge the gap between project completion and long-term asset management, underscoring software's role beyond construction into building operations.

Alreshidi and Mourshed (2023) noted that early BIM integration during the design phase helped reduce lifecycle costs through accurate forecasting and planning. Zhu *et al.* (2023) observed that early BIM adopters demonstrated better project delivery performance and greater client satisfaction. Nawi *et al.* (2022) concluded that 3D visualization tools within BIM platforms improve stakeholder engagement and transparency during design phases. Zhu *et al.* (2023) also found that collaboration platforms such as Procore and Asana facilitated improved communication and team productivity. Marzouk and Hisham (2022) demonstrated that cloud-based construction tools improved access to real-time project data, supporting timely decision-making.

Despite these clear advantages, adoption rates vary widely due to persistent challenges. Zhou *et al.* (2023) investigated the barriers facing SMEs in emerging economies, identifying high software costs and limited digital skills as primary obstacles. These findings echo those of Nawi *et al.* (2022), who pointed out that many construction firms still rely heavily on manual methods due to budget constraints and a lack of trained personnel.

Security concerns also emerge as a significant barrier in cloud-based software adoption. Mahmoudi *et al.* (2023) found that fears surrounding data breaches and cybersecurity vulnerabilities deter many firms from embracing cloud platforms fully, despite their benefits in accessibility and collaboration. This is critical given the increasing reliance on cloud-based

collaboration tools such as Procore and Asana, which Zhu *et al.* (2023) identified as pivotal for improving communication and productivity.

Interoperability issues among different software platforms also inhibit seamless integration. Alreshidi and Mourshed (2023) emphasized that incompatible BIM platforms hinder data exchange between stakeholders, leading to inefficiencies and potential project delays. This technological fragmentation requires standardized protocols and stronger industry-wide collaboration to resolve.

Resistance to change within organizational cultures remains a significant human factor. Charehzehi and Ahankoob (2023) highlighted the role of leadership in change management, noting that executive support and clear communication strategies are vital for successful technology adoption. Marzouk and Hisham (2022) similarly argued that firm-level commitment to digital transformation is a key determinant of whether construction software yields tangible improvements. Mahmoudi *et al.* (2023) emphasized that regular software updates and dedicated IT support are necessary to sustain digital efficiency. Zhu *et al.* (2023) proposed a BIM maturity framework that supports organizational assessment and benchmarking of digital readiness.

Beyond traditional BIM and project management software, recent studies have explored the integration of emerging technologies such as augmented reality (AR), virtual reality (VR), and mobile applications within construction workflows.

Charehzehi and Ahankoob (2023) demonstrated that AR and VR tools significantly improve client visualization of projects, reducing scope changes and design misunderstandings during the construction phase. Their research showed that immersive technologies foster clearer communication between clients and project teams, which contributes to fewer disputes and better project outcomes.

Mobile-based applications have similarly transformed on-site data collection and reporting. Mahmoudi *et al.* (2023) found that mobile apps reduced documentation time by enabling real-time updates and instant photo evidence capture. This increased productivity and improved transparency, especially for field teams operating in remote or complex sites.

Zhu *et al.* (2023) explored technical challenges in applying BIM to existing buildings, noting the need for modern scanning technologies such as 3D laser scanning and photogrammetry. These tools facilitate the creation of accurate as-built models, which are crucial for renovation and retrofitting projects. Their work suggests that integrating these scanning technologies with BIM platforms is essential for expanding software applicability beyond new construction.

Lean construction principles, focused on waste reduction and process optimization, have been shown to complement digital tools effectively. Zhu *et al.* (2023) conducted a study combining BIM with Lean construction techniques, reporting improvements in project delivery timelines and material waste reduction. By integrating software that supports just-in-time deliveries and continuous workflow improvement, firms can enhance productivity and sustainability simultaneously.

Similarly, Alaloul *et al.* (2023) pointed out that facility management software complements Lean principles by optimizing post-construction operations, reducing downtime, and enhancing resource use efficiency. These synergies highlight the evolving complexity of construction software ecosystems and the need for holistic implementation strategies.

Regional variations in software adoption have also been documented. In developed economies such as the UK and the USA, Marzouk and Hisham (2022) noted high BIM penetration and extensive use of cloud-based collaboration tools, driven by regulatory mandates and client demands. Conversely, in emerging economies, adoption is often sporadic and concentrated in large firms or flagship projects (Zhou *et al.*, 2023).

Nawi *et al.* (2022) documented similar trends in Southeast Asia, where infrastructure growth creates demand for advanced tools, but SMEs face hurdles related to cost and skills. Their study recommends government interventions and public-private partnerships to foster training programs and subsidize software acquisition for smaller firms.

2.7 Theoretical Framework

The successful adoption and implementation of construction software are rooted in several theoretical frameworks that help explain users' behavior, technological acceptance, and

organizational readiness. Three major theories relevant to this study are the Technology Acceptance Model (TAM), Systems Theory, and the Diffusion of Innovation (DOI) Theory. These models offer insight into the dynamics of software use and adoption in construction projects.

2.7.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) remains a widely applied framework for understanding user adoption of digital technologies. Recent studies, such as those by Nawi *et al.* (2023), validate TAM's relevance in the construction sector. The model posits that two major factors determine whether users adopt a new technology:

1. **Perceived Usefulness (PU):** the degree to which a person believes that using a system will enhance their job performance.
2. **Perceived Ease of Use (PEOU):** the degree to which a person believes that using the system will be free of effort.

In the construction context, the adoption of project management software, BIM platforms, and cost estimation tools depends heavily on how construction professionals perceive these two factors (Alreshidi & Mourshed, 2023). If the software is seen as too complex or misaligned with job functions, implementation may fail despite technological sophistication. Thus, TAM underscores the importance of user-centered design, accessible training programs, and organizational support.

2.7.2 Systems Theory

Systems Theory posits that organizations function as integrated systems where all components affect one another. In construction, each project involves interconnected units—architects, engineers, managers, tools, and workflows. Modern software tools serve as integrators within these complex systems. Marzouk and Hisham (2022) argue that Building Information Modeling (BIM) mirrors the systemic interdependency of tasks and stakeholders by enabling real-time coordination and unified project modeling.

From this perspective, successful digital transformation in construction requires a holistic approach that aligns people, processes, and platforms. Systems Theory supports the idea that

technology should not function in isolation but as part of an organizational ecosystem that fosters efficiency and coherence (Zhu *et al.*, 2023).

2.7.3 Diffusion of Innovation (DOI) Theory

The Diffusion of Innovation (DOI) Theory, originally proposed by Rogers, has evolved to remain applicable to modern digital adoption. DOI theory explains how innovations are communicated and adopted within a social system over time. Five characteristics influence this adoption:

1. **Relative Advantage:** The degree to which software offers clear improvements over previous methods.
2. **Compatibility:** The alignment of new tools with existing practices.
3. **Complexity:** The ease or difficulty of use.
4. **Trialability:** The ability to test before full implementation.
5. **Observability:** The visibility of outcomes and benefits to others.

Recent studies, including Alaloul *et al.* (2022), have confirmed the relevance of DOI in explaining how construction firms approach new software. Organizations with strong change management, visible digital success stories, and peer influence are more likely to foster innovation adoption. This framework is particularly helpful in analyzing the slow uptake of software in developing regions, where infrastructure and digital literacy gaps persist. These theoretical frameworks collectively offer a robust basis for understanding the dynamics and complexities involved in software adoption in the construction industry.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

This study adopts a **descriptive survey research design**, which is suitable for collecting both quantitative and qualitative data on current practices in the use of software within construction projects. This approach facilitates a comprehensive examination of how digital tools affect key project outcomes such as efficiency, cost management, risk mitigation, and stakeholder communication.

3.2 Population of the Study

The population of the study comprises professionals within the construction industry, including Builders, civil engineers, project managers, architects, quantity surveyors, and IT professionals across selected construction firms. The geographical scope includes both private and public sector construction companies operating in Kwara state.

3.3 Sample Size and Sampling Technique

A sample size of 80 respondents was selected using stratified random sampling. This approach ensures that various professional categories are proportionately represented. Stratification was based on roles within the construction project to enhance the representativeness of the sample and allow for a more nuanced understanding of software utilization.

3.4 Research Instrument

The primary research instrument used was a structured questionnaire. The questionnaire was divided into sections that addressed demographic information, types of software used, perceived benefits, challenges encountered, and the overall impact on project delivery. A five-point Likert scale ranging from "Strongly Agree" to "Strongly Disagree" was used to assess opinions.

3.5 Validation of Research Instrument

To ensure content validity, the questionnaire was reviewed by experts in construction project management and academic researchers. A pilot test was conducted to check for clarity, relevance, and reliability. Feedback from the pilot study was used to refine the instrument

3.6 Method of Data Collection

Data were collected through self-administered questionnaires distributed electronically (via Google Forms). Respondents were assured of confidentiality and the voluntary nature of participation. Follow-up calls and reminders were employed to improve response rates.

3.7 Method of Data Analysis

Quantitative data collected from the questionnaires were analyzed using descriptive statistics, including frequency counts, percentages, mean scores, and standard deviations. Inferential statistical methods, such as Chi-square tests and correlation analysis, were used to test hypotheses and examine relationships between variables. The Statistical Package for Social Sciences (SPSS) version 25.0 was employed for data analysis.

CHAPTER FOUR

ANALYSIS OF DATA AND INTERPRETATION OF TABLE

This chapter presents the analysis and interpretation of data from a survey of 80 construction professionals in Kwara state. Most administered questionnaires were return representing 80% response rate. Collected data were subjected to statistical analysis using frequency, percentages, mean, and standard deviation for descriptive.

Data Analysis and Interpretation

Section A: Socio-demographic Characteristics of Respondents

Table 4.1: Descriptive Analysis of Respondents Socio-demographic variable (n=80)

Variable	Option	Frequency	Percentage (%)
Gender	Male	58	72.5
	Female	22	27.5
Age	18-25	25	31.3
	26-35	37	46.3
	36-45	17	21.3
	45 and above	1	1.3
Professional role	Architect	11	13.8
	Civil engineer	10	12.5
	Quantity surveyor	11	13.8
	Project manager	27	33.8
	Others	21	26.3
Years of experience	Less than 2 years	21	26.3
	2-5 years	39	48.8
	6-10 years	19	23.8
	Above 10 years	1	1.3

Source: Questionnaire, 2025

The table above shows that the predominantly male participants (72.5%), with females representing 27.5%. In terms of age distribution, the largest proportion of respondents fell within the 26–35 age bracket (46.3%), followed by those aged 18–25 (31.3%) and 36–45 (21.3%), while only 1.3% were aged 45 and above. With respect to professional roles, project managers constituted the plurality at 33.8%, followed by individuals classified as “other” (26.3%). Architects and quantity surveyors each accounted for 13.8% of the sample, and civil engineers comprised 12.5%. Regarding years of experience, nearly half of participants (48.8%) reported 2–5 years of

professional tenure, 26.3% had less than two years of experience, 23.8% had between 6 and 10 years, and a negligible proportion (1.3%) had over ten years of experience.

4.2 Analysis of Research Question

Section B: Answering Research Questions

Table 4.2.1: Which of the following software tools do you use? (Select all that apply)

Variable	Frequency	Percentage	Mean	St.D
AutoCAD	11	13.8	13.8	13.8
Revit	3	3.8	3.8	17.5
Microsoft Project	9	11.3	11.3	28.8
Primavera	2	2.5	2.5	31.3
AutoCAD, revit ,microsoft project and primavera	1	1.3	1.3	32.5
AutoCAD and revit	10	12.5	12.5	45.0
AutoCAD and microsoft project	6	7.5	7.5	52.5
AutoCAD and primavera	4	5.0	5.0	57.5
AutoCAD, revit and microsoft Project	9	11.3	11.3	68.8
AutoCAD, revit and archicad	1	1.3	1.3	70.0
AutoCAD, revit, archicad and CostX / PlanSwift	2	2.5	2.5	72.5
AutoCAD, revit, microsoft project and primavera	3	3.8	3.8	76.3
Revit and primavera	1	1.3	1.3	77.5
Revit and microsoft project	1	1.3	1.3	78.8
AutoCAD, microsoft project and CostX / PlanSwift	2	2.5	2.5	81.3
AutoCAD, revit, ArchiCAD and microsoft project	1	1.3	1.3	82.5
AutoCAD, revit,primavera and CostX / PlanSwift	1	1.3	1.3	83.8
microsoft project and primavera	2	2.5	2.5	86.3
AutoCAD, microsoft project and primavera	2	2.5	2.5	88.8
AutoCAD and ArchiCAD	1	1.3	1.3	90.0
microsoft project and CostX / PlanSwift	1	1.3	1.3	91.3
AutoCAD, revit, ArchiCAD, microsoft project and CostX / PlanSwift	1	1.3	1.3	92.5
AutoCAD, ArchiCAD, microsoft project and primavera	1	1.3	1.3	93.8
ArchiCAD, microsoft project and primavera	1	1.3	1.3	95.0
AutoCAD, microsoft project and STAAD.Pro /ETABS	1	1.3	1.3	96.3
AutoCAD, microsoft project, STAAD.Pro /ETABS and CostX / PlanSwift	1	1.3	1.3	97.5
AutoCAD, microsoft project,primavera, STAAD.Pro /ETABS and CostX / PlanSwift	1	1.3	1.3	98.8

AutoCAD, revit, STAAD.Pro /ETABS and 1	1.3	1.3	100.0
CostX / PlanSwift			
Total	80	100.0	100.0

Source: Questionnaire, 2025

Among the 80 survey participants, AutoCAD emerged as the most frequently employed standalone application, with 11 respondents (13.8%) reporting its exclusive use, followed by Microsoft Project at 9 respondents (11.3%). Stand-alone utilization of Revit and Primavera was comparatively limited (3.8% and 2.5%, respectively). However, the predominant pattern is one of multi-software integration: 12.5% of respondents (n = 10) utilize both AutoCAD and Revit, while 11.3% (n = 9) employ the combined suite of AutoCAD, Revit, and Microsoft Project. Additional configurations such as AutoCAD with Microsoft Project (7.5%), AutoCAD with Primavera (5.0%), and various triadic and tetradic combinations incorporating tools like ArchiCAD, STAAD.Pro/ETABS, and CostX/PlanSwift underscore a trend toward complex, interdisciplinary workflows, each representing approximately 1.3–2.5% of the sample. Cumulatively, these findings illustrate that although individual software usage remains significant, collaborative toolchains are more pervasive, reflecting an industry-wide emphasis on integrated project delivery.

**Table 4.2.2: What benefits have you experienced from using software in building projects?
(Select all that apply)**

Variable	Frequency	Percent
Faster project execution	7	8.8
Improved accuracy	3	3.8
Better communication/collaboration	2	2.5
Improved quality of output	4	5.0
Better risk and resource management	2	2.5
Others	2	2.5
Faster project execution, Improved accuracy and Better communication/collaboration	4	5.0
Faster project execution, Improved accuracy, Better communication/collaboration and Improved quality of output	1	1.3

Faster project execution, Improved accuracy, cost reduction and Better communication/collaboration	11	13.8
Faster project execution, Improved accuracy and Improved quality of output	4	5.0
Improved accuracy and Improved quality of output	1	1.3
Improved accuracy and cost reduction	1	1.3
Faster project execution, Improved accuracy, cost reduction and Improved quality of output	5	6.3
Faster project execution and improved accuracy	6	7.5
Faster project execution and Better communication/collaboration	1	1.3
Faster project execution and Improved quality of output	1	1.3
Faster project execution and Better risk and resource management	2	2.5
Faster project execution, improved accuracy and Cost reduction	3	3.8
Faster project execution, Improved accuracy, Better communication/collaboration and Improved quality of output	6	7.5
Faster project execution, Improved accuracy, Improved quality of output and Better risk and resource management	3	3.8
Faster project execution, Better communication/collaboration and Better risk and resource management	1	1.3
Improved accuracy, Improved quality of output and Better risk and resource management	2	2.5
Faster project execution, Better communication/collaboration and Improved quality of output	3	3.8
Better communication/collaboration and Improved quality of output	1	1.3
Faster project execution and Cost reduction	2	2.5
Faster project execution, Cost reduction and Better communication/collaboration	1	1.3
Faster project execution, Improved quality of output and Better risk and resource management	1	1.3
Total	80	100.0

Source: Questionnaire, 2025

The data captures respondents' perceptions of the benefits associated with the use of digital tools in project execution. The most frequently reported benefit combination cited by 13.8% of participants included faster project execution, improved accuracy, cost reduction, and enhanced communication and collaboration, indicating that respondents commonly associate digital tools

with multifaceted project improvements. When considered individually, faster project execution was the most cited benefit (8.8%), followed by improved quality of output (5.0%) and improved accuracy (3.8%). A considerable number of respondents also reported combinations of benefits, such as faster execution and improved accuracy (7.5%), as well as faster execution, improved accuracy, and enhanced output quality (5.0%). Although benefits like better risk and resource management and improved communication were less frequently cited on their own, they often appeared in multi-benefit groupings, suggesting their relevance in more complex project environments. The diversity of benefit combinations reported reflects the varied roles and professional contexts of respondents and points to a broad recognition of the value digital tools bring to project delivery. Overall, the data underscores that digital tools are widely perceived as contributing to enhanced efficiency, accuracy, collaboration, and output quality in construction and design-related workflows.

Table 4.2.3: Rate the impact of software on project delivery (1 – Very Poor, 5 – Excellent)

Variable	Frequency	Percent
very poor	1	1.3
Poor	1	1.3
Fair	5	6.3
Good	10	12.5
Excellent	63	78.8
Total	80	100.0

Source: Questionnaire, 2025

The data presents respondents' overall evaluation of a given subject, with findings indicating a predominantly positive perception. An overwhelming majority (78.8%) rated the subject as "excellent," while an additional 12.5% rated it as "good," resulting in a combined 91.3% of respondents expressing favorable assessments. A smaller proportion (6.3%) rated the subject as "fair," and only 1.3% each classified it as "poor" and "very poor." These results suggest a high level of satisfaction among the participants, indicating that the subject under review, potentially a digital tool, system, or process was perceived as highly effective and beneficial within the context of their professional practice. The minimal presence of negative evaluations further underscores the generally positive reception and perceived value attributed to the subject.

Table 4.2.4: Do you think software improves decision-making during construction?

Variable	Frequency	Percent
Yes	78	97.5
No	2	2.5
Total	80	100.0

Source: Questionnaire, 2025

The data reveals a strong consensus among respondents regarding the subject of inquiry. An overwhelming 97.5% (78 out of 80) answered “yes,” indicating a near-unanimous agreement or affirmation on the issue being assessed. In contrast, only 2.5% (2 respondents) responded “no,” suggesting minimal dissent or disagreement. This high level of affirmation suggests a widely shared perspective or experience among the participants, reflecting strong support or recognition of the concept, tool, or practice under consideration.

Table 4.2.5: What challenges have you encountered in using software? (Tick all that apply)

Variable	Frequency	Percent
High cost of purchase or license	10	12.5
Lack of skilled personnel	2	2.5
Incompatibility between software	4	5.0
Need for frequent updates/training	5	6.3
Resistance from team members	6	7.5
Others	3	3.8
High cost of purchase or license and Need for frequent updates/training	5	6.3
High cost of purchase or license, Need for frequent updates/training and Resistance from team members	1	1.3
High cost of purchase or license, Lack of skilled personnel and Need for frequent updates/training	6	7.5
High cost of purchase or license and Incompatibility between software	1	1.3
High cost of purchase or license, Incompatibility between software and Need for frequent updates/training	1	1.3
Lack of skilled personnel, Incompatibility between software and Need for frequent updates/training	2	2.5
Lack of skilled personnel, Incompatibility between software and Resistance from team members	1	1.3
Incompatibility between software and Resistance from team members	2	2.5
Incompatibility between software and Need for frequent updates/training	2	2.5
High cost of purchase or license and Lack of skilled personnel	7	8.8
High cost of purchase or license, Lack of skilled personnel and Incompatibility between software	3	3.8
Need for frequent updates/training and Resistance from team members	3	3.8

Lack of skilled personnel,Need for frequent updates/training and Resistance from team members	1	1.3
Lack of skilled personnel and Need for frequent updates/training	14	17.5
Others	1	1.3
Total	80	100.0

Source: Questionnaire, 2025

The table presents respondents' perceived barriers to digital tool adoption in professional practice. The most prevalent barrier combination—reported by 17.5% of participants—comprised a lack of skilled personnel alongside the need for frequent updates and training, underscoring concerns regarding workforce competency and ongoing professional development. High purchase or licensing costs also featured prominently, with 12.5% of respondents identifying this constraint in isolation, 8.8% reporting it in conjunction with a lack of skilled personnel, and 7.5% citing it alongside both skills shortages and training requirements. Resistance from team members was noted by 7.5% of respondents, either alone or within broader barrier clusters, suggesting that cultural factors exacerbate technical and financial impediments. Incompatibility between software platforms accounted for 5.0% of responses, often overlapping with cost and training issues, which highlights interoperability as a notable challenge. Lesser-cited barriers included other unspecified issues (3.8%), lack of skilled personnel alone (2.5%), and resistance combined with other barriers (2.5%). Collectively, these findings indicate that financial constraints, skills gaps, and training requirements rarely occur in isolation; rather, their co-occurrence amplifies the difficulty of integrating digital solutions within organizational workflows.

Table 4.2.6: What do you think should be done to improve software usage in construction?

Variable	Frequency	Percentage
Adequate training	13	16.3
Easy integration with other software	13	16.3
Integration	12	15.0
Data management	13	16.3
Training and support	6	7.5
Ongoing training should be done	8	10.0
Collaboration	5	6.3
Customization	6	7.5

change management	2	2.5
management support	2	2.5
Total	80	100.0

Source: Questionnaire, 2025

The data highlights the key factors perceived as essential for enhancing the adoption and effectiveness of digital tools in professional practice. Among the respondents, three elements adequate training (16.3%), easy integration with other software (16.3%), and data management (16.3%) emerged as the most frequently cited, reflecting a consensus on the importance of foundational technical competencies, system interoperability, and efficient information handling. Integration, broadly defined, was also a prominent concern (15.0%), suggesting a strong demand for streamlined workflows across digital platforms. A smaller yet notable proportion of respondents emphasized the need for ongoing training (10.0%) and comprehensive training and support mechanisms (7.5%), indicating that continuous professional development is regarded as a critical component of long-term digital tool utilization. Customization (7.5%) and collaboration features (6.3%) were also recognized, pointing to the necessity for adaptable solutions and enhanced team interaction. Finally, less commonly cited factors such as change management and management support (each 2.5%) underscore the role of organizational culture and leadership in facilitating technological transitions. These findings collectively underscore that successful digital implementation requires not only technical functionality but also sustained training, adaptability, and institutional backing.

4.3 Summary of Findings

The study revealed that the majority of respondents were early to mid-career professionals, primarily engaged in project management roles within the construction sector. The demographic profile was largely skewed toward individuals aged between 26 and 35, with most participants possessing between two and five years of industry experience. This composition suggests a technologically literate workforce situated at a critical stage of professional development, where exposure to and reliance on digital tools is increasingly normalized.

In terms of software usage patterns, AutoCAD emerged as the most widely utilized standalone application. However, a significant proportion of respondents reported using multiple software tools in combination, most frequently AutoCAD alongside Revit and Microsoft Project.

This trend toward integrated software environments reflects a shift from task-specific tools to comprehensive digital workflows capable of supporting multidisciplinary collaboration, coordination, and project delivery.

Participants identified a range of benefits associated with software adoption, most notably faster project execution, improved accuracy, better communication, and cost efficiency. These benefits were often cited in combination, indicating that digital tools are perceived not as isolated productivity enhancers but as holistic enablers of improved project outcomes. The majority of respondents rated the overall impact of software on project delivery as either "good" or "excellent," further affirming the central role of technology in contemporary construction practices.

Moreover, there was a broad agreement that software improves decision-making during construction processes. This finding underscores the strategic value of digital tools in enhancing clarity, supporting real-time data access, and enabling informed judgment across the project lifecycle. Nevertheless, respondents also identified several persistent challenges. Chief among these were high licensing costs, a shortage of skilled personnel, and the need for continuous training and system updates. These issues were often compounded by software interoperability problems and resistance to change within teams.

To address these challenges, respondents recommended a multifaceted approach that includes structured training programs, improved integration across platforms, and enhanced data management capabilities. Additionally, suggestions such as ongoing professional development, customizable software solutions, and stronger organizational support highlight the need for both technical and institutional readiness in advancing digital transformation in the construction industry.

4.4 Discussion of Findings

The present study demonstrates a clear transition within the construction industry from reliance on individual software applications toward adoption of integrated digital workflows. While AutoCAD remains the predominant standalone drafting tool, the prevalence of combined usage, particularly the triad of AutoCAD, Revit, and Microsoft Project, highlights practitioners' growing preference for interoperable platforms. This shift reflects an industry wide imperative to

manage increasing project complexity, coordinate multidisciplinary teams, and streamline information exchange across design, analysis, and scheduling functions.

Respondents overwhelmingly reported that software adoption yields multifaceted benefits, including accelerated project delivery, enhanced accuracy, cost efficiencies, and improved stakeholder communication. The concurrence of these advantages in user feedback suggests that digital tools do not merely optimize individual tasks but contribute holistically to project performance. Moreover, the universal perception of software as a critical enabler of decision-making underscores its role in elevating professional judgment and reducing uncertainty in construction processes.

Despite these positive outcomes, the analysis identified persistent barriers to optimal software utilization. High licensing fees, insufficient technical expertise, and the necessity for continual training emerged as primary constraints, particularly for small- to medium-sized enterprises. Interoperability challenges and resistance to organizational change further impede effective implementation. These findings indicate that the rapid evolution of construction technologies is outpacing the industry's capacity to develop corresponding skill sets and institutional support structures.

To address these obstacles, respondents advocated for targeted interventions encompassing structured training programs, enhanced software integration, and robust data management frameworks. Investment in workforce development and the establishment of cohesive digital ecosystems were also emphasized as prerequisites for sustaining long-term innovation. Collectively, these recommendations point to the need for a strategic, coordinated approach combining financial accessibility, educational initiatives, and technology alignment to realize the full potential of digital solutions in building projects.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The analysis of 80 construction professionals indicates that while AutoCAD remains the most commonly used standalone software, the predominant pattern is one of integrated, multi-platform workflows particularly combinations of AutoCAD, Revit, and Microsoft Project. Respondents reported that software adoption leads to faster project delivery, enhanced accuracy, cost efficiencies, and improved communication, with these benefits frequently experienced in combination rather than in isolation. Moreover, there was near-universal agreement that digital tools significantly enhance decision-making throughout the construction process.

Despite these advantages, several systemic barriers were identified. High licensing costs, insufficient technical expertise, and the need for ongoing training and updates were cited as primary obstacles, often exacerbated by interoperability challenges and organizational resistance to change. Together, these findings highlight the construction industry's growing reliance on software to drive multidisciplinary collaboration and project performance, while also underscoring the critical need for investments in affordable access, workforce development, and cohesive digital ecosystems.

5.2 Conclusion

This study confirms that digital tools have become indispensable in contemporary construction practice, with integrated environments particularly those that merge design, BIM, and project management platforms now representing standard operating procedures rather than novel innovations. Participants consistently reported that software use generates multifaceted advantages, including accelerated project delivery, enhanced precision, improved cost management, and more effective stakeholder communication. Moreover, the near-universal perception that digital tools substantively bolster decision-making underscores their pivotal strategic value within the industry.

Despite these evident benefits, the sector's rapid technological progression has outstripped its capacity to surmount attendant challenges. Elevated licensing costs, persistent skills gaps, and

the continual requirement for training and system updates constitute significant barriers to broader adoption. Interoperability constraints and organizational resistance further compound these issues, impeding the establishment of seamless, end to end digital workflows. Addressing these impediments will require a comprehensive, coordinated approach that integrates financial models for affordable software access, robust workforce development initiatives, and the cultivation of interoperable digital ecosystems. Only through such concerted efforts can the construction industry fully harness the transformative potential of software to achieve more efficient, reliable, and sustainable project outcomes.

5.3 Recommendation

Based on the findings, the following recommendations are proposed:

1. Invest in Structured, Continuous Training Programs

It is recommended that organizations develop and maintain comprehensive curricula focused on core software functionalities, interoperability protocols, and collaborative digital workflows. Collaboration with academic institutions, software vendors, and professional associations will ensure that training content remains aligned with emerging industry standards and technological advances.

2. Adopt Adaptive, Cost-Effective Licensing Frameworks

Firms should pursue flexible licensing arrangements, such as consortium-based enterprise agreements, subscription models, or cloud-hosted solutions to mitigate financial barriers to software adoption. Volume discounts and shared licensing pools can further reduce per-user costs, particularly for small and medium sized enterprises.

3. Establish Digital Integration Governance and Expertise

The creation of a dedicated digital-integration team or the designation of “software champions” within project delivery units will expedite platform deployment, resolve interoperability challenges, and optimize data-management practices. These roles should be empowered with clear mandates, cross-functional authority, and accountability for integration outcomes.

4. Embed Digital Proficiency in Performance Evaluation

Organizations are advised to incorporate software competency metrics into performance

management and career-development frameworks. By formally recognizing and rewarding employees who demonstrate advanced digital capabilities and contribute to process improvements, firms can foster a culture of continuous learning and innovation.

5. Secure Executive Sponsorship and Foster Change Management

Senior leadership must actively champion digital transformation by allocating dedicated budgets, defining governance structures, and establishing mechanisms to monitor technology adoption, user satisfaction, and return on investment. Cross-departmental collaboration between IT, operations, and project teams should be formalized to ensure that digital initiatives are strategically aligned with organizational objectives.

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APPENDIX

Questionnaire on the Implications of Software Application in Delivering of Building Projects

Introduction:

I am a student of Kwara State Polytechnic Ilorin, conducting research on the above topic. You are kindly requested to fill all the items in the questionnaire honestly and sincerely by ticking (✓) with the appropriate answer in the space provided. Your responses will be kept confidential and used solely for academic purposes.

SECTION A

Demographic Information

1. Gender:

☐ Male ☐ Female

2. Age Group

☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ 46 and above

3. Professional Role:

☐ Architect ☐ Civil Engineer ☐ Quantity Surveyor ☐ Project Manager

☐ Others (Please specify): _____

4. Years of Experience in the Construction Industry:

☐ Less than 2 years ☐ 2–5 years ☐ 6–10 years ☐ Above 10 years

SECTION B

ANSWERING RESEARCH QUESTION

1. Which of the following software tools do you use? (Select all that apply)

☐ AutoCAD ☐ Revit ☐ ArchiCAD ☐ Microsoft Project ☐ Primavera

☐ STAAD.Pro /ETABS ☐ CostX / PlanSwift ☐ Others _____

2. What benefits have you experienced from using software in building projects? (Select all that apply)

- ☐ Faster project execution ☐ Improved accuracy ☐ Cost reduction
- ☐ Better communication/collaboration ☐ Improved quality of output
- ☐ Better risk and resource management ☐ Others (specify): _____

3. Rate the impact of software on project delivery (1 – Very Poor, 5 – Excellent):

- ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

4. Do you think software improves decision-making during construction?

- ☐ Yes ☐ No

5. What challenges have you encountered in using software? (Tick all that apply)

- ☐ High cost of purchase or license ☐ Lack of skilled personnel
- ☐ Incompatibility between software ☐ Need for frequent updates/training
- ☐ Resistance from team members ☐ Others (specify): _____

6. What do you think should be done to improve software usage in construction?
