# Application of Building Information Modelling Software on Project Supervisionin Building Construction Sitesin Sokoto State

by

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**Abstract**

*The study determined the application of Building Information Modelling (BIM) Software on Project Supervision in Building Construction sites in Sokoto State. Three research questions guided the study. A descriptive survey design was adopted. The population for the study was 56 Building construction workers. No sampling was made because of the relatively small size of the population. Instrument for data collection was structured questionnaire. The instrument was validated by three experts. The internal consistency of the questionnaire items was determined by using Cronbach alpha reliability method and 0.86 reliability coefficient was obtained. Data were analyzed using mean and standard deviation. The study revealed that respondents agreed that BIM is impacting on collaboration, error reduction and project outcome, also building construction workers do associate advantages with using BIM in building construction project. It was recommended that Building Information Modelling approach be adopted in project workflow.*

**Keywords:** Building Information Modelling (BIM), Software, Supervision, Control, Construction Sites.

## Introduction

Building Information Modelling (BIM) is a transformative approach in the construction industry, offering a digital representation of the physical and functional characteristics of a facility. In Nigeria, however, the adoption of BIM has been relatively slow compared to other countries (Babatunde, Ekundayo, Adekunle, & Bello 2020). BIM according to Cao, Xu, Aziz, & Kamaruzzaman (2023) is a comprehensive process that involves generating and managing digital representations of physical and functional characteristics of places. It enhances collaboration among stakeholders in the Architecture, Engineering, and Construction (AEC) sectors by providing a shared resource for information about a facility, facilitating improved decision-making throughout the project lifecycle. Research indicates that awareness and utilization of BIM within the Nigerian AEC community are significantly low (Toyin & Mewomo, 2023). Many professionals are unfamiliar with the term "Building Information Modelling," although they may recognize some of its associated tools like AutoCAD and Revit. Key challenges hindering the widespread adoption of BIM in Nigeria include inadequate infrastructure, lack of skilled personnel,

insufficient training programs, and a general lack of awareness about the benefits of BIM.

Additionally, there is a notable absence of legislative frameworks or incentives to promote BIM usage (Elhendawi, Omar, Elbeltagi, & Smith, 2020). Despite the challenges, BIM software has shown potential to improve project management in Eko Atlantic City and certain public-sector initiatives in Port Harcourt, Nigeria,by enhancing communication, reducing conflicts, and increasing efficiency during construction (Muhammad, Ahmed, &Yakasai 2017).

BIM software can lead to better client satisfaction, improved quality of work, and more effective supervision of projects (Aluko, Idoro, & Ajayi 2022). Integrating BIM into academic curricula and establishing training centers for professionals can help build a skilled workforce familiar with BIM technologies. Professional bodies should conduct awareness campaigns to educate stakeholders about the benefits of BIM software potentials to improve project outcomes. BIM software has the potential to revolutionize the construction industry by improving collaboration and efficiency, significant barriers must be addressed to realize its full benefits. Increased awareness, education, and government support are crucial for fostering a culture of innovation within the industry in Sokoto State.

Sokoto State, like many other regions in Nigeria, faces unique challenges that hinder the effective implementation of BIM. The construction sector in Sokoto is crucial for the region's economic development, as it supports infrastructure projects that are essential for improving living standards and fostering economic growth. However, the slow adoption of BIM and other emerging technologies has resulted in suboptimal project delivery and inefficiencies in the construction sites. Hence the need to determine the level of application of BIM in the building construction sites

Construction site is a crucial sector that plays a significant role in the country's economic development. It encompasses a wide range of activities, including the construction of infrastructure such as roads, bridges, buildings, and other facilities (Lee & Yoon 2021). This industry is vital for job creation, economic growth, and improving living conditions. Construction industry significantly contributes to Nigeria's Gross Domestic Product (GDP), accounting for a substantial portion of capital investment (Saka 2022). It is a major driver of economic activity, providing employment opportunities and supporting various related sectors. Abosede, Opawole, Olubola, Ojo, &Kajimo-Shakantu (2019) stated that Construction site is characterized by a mix of small and medium-sized local contractors, with many focusing on residential projects. In recent years, there has been a growing trend towards the adoption of technology in construction processes. Technologies such as Building Information Modelling (BIM), prefabrication, and drones are being integrated to enhance efficiency, safety, and quality in construction projects.

Construction industry faces numerous challenges, including inadequate funding, lack of skilled labor, poor project supervision practices, and a significant deficit on control mechanism (Moore 2019). These issues often result in delays, cost overruns, and safety concerns, such as building collapses due to unregistered contractors entering the market. It is on this note Azolibe, Okonkwo, &Adigwe, (2020) stated that the Nigerian government has recognized the importance of the construction sector and is taking steps to improve infrastructure and attract foreign investment. These initiatives aim to stimulate growth and address the existing challenges within the industry through the integration of Building Information Modelling (BIM) for effective supervision practices.

Supervision practices using Building Information Modeling (BIM) in the building construction sites focuses on enhancing the quality and efficiency of construction project management. BIM enhances quality supervision by allowing for better inspection processes (Babatunde, Ekundayo, Adekunle & Bello 2020). It enables supervisors to visualize the project in a 3D environment, facilitating more accurate inspections and compliance with relevant standards. Supervision practices help in identifying potential issues early in the construction process as against the traditional supervision methods which often suffer from inefficiencies due to manual data entry and the complexity of tracking numerous inspection items. BIM software fosters better collaboration among project stakeholders, including architects, engineers, contractors, and inspectors (Ebenezer2024). This collaborative environment ensures that all parties have access to the same information, leading to improved decision-making and coordination throughout the construction process. Supervisors can monitor construction progress in real-time through BIM models, allowing them to make informed decisions without needing to be physically present on-site. According to Okonta, Vukovic, Segovia & Akinola (2023), BIM integrates various data types, including construction schedules, quality standards, and inspection reports. This integration helps supervisors manage and analyze project data more effectively, leading to better quality control. Project supervision practices in the building construction industry significantly enhances efficiency, collaboration and project quality control mechanism among stakeholders.

Control mechanisms using Building Information Modeling (BIM) in the building construction site focuses on enhancing the efficiency and effectiveness of project management by integrating BIM tools and processes. Control mechanism using BIM facilitates better cost control by enabling accurate quantity takeoffs, cost estimation, and cost tracking (Owusu, Wong & Chan 2024). The integration of 5D BIM (cost dimension) allows for real-time cost monitoring and forecasting, helping project teams stay within budget, also, 4D BIM (time dimension) links the 3D model with construction schedules, enabling better visualization and control of project timelines (Tochukwu 2018). It helps identify potential risks, such as design conflicts or constructability issues, early in the project lifecycle. This control mechanism helps identify potential scheduling conflicts, optimize construction sequences among project stakeholders by providing a common data environment for sharing information. Project teams can monitor construction progress in real-time by comparing the BIM model with actual site conditions, enabling better decision-making. Ja'far, (2021) stated that control mechanism as BIM models can automatically generate accurate quantities of materials, reducing the risk of errors and improving cost control. Integration of control mechanisms in the building construction industry enhances cost, schedule, and quality management. By leveraging BIM technology, construction projects can achieve better control over project outcomes and improve overall project performance.

**Statement of the Problem**

Construction site is projected to experience growth driven by increased public and private investment in infrastructure projects. Building Information Modelling (BIM) is an innovation with the potential to reshape construction industries and improve quality supervision and control practice. construction industry is one that has fully integrated Building Information Modelling (BIM) into its practices, leading to enhanced efficiency, collaboration, and project outcomes. Construction professionals have strong understanding of BIM principles and its potential benefits. Construction workers need to adapt and update various BIM technologies,

such as 3D modeling, clash detection, and project management software. These tools facilitate project supervision and control workflow, enabling better visualization, coordination, and decision-making. Information is shared efficiently, reducing conflicts and enabling better decision-making.

However, construction site in Sokoto State, Nigeria, faces significant challenges in adopting innovative practices, particularly Building Information Modelling (BIM). Despite the global shift towards digital transformation in construction, the integration of project supervision practices remains limited in this region. This study aims to determine application of Building Information Modelling Software on Project Supervision in Building Construction sites in Sokoto State. This study will explore these issues to provide a comprehensive understanding of the current state of BIM adoption in Sokoto State and propose actionable recommendations to improve its implementation in the local construction site.

**Purpose of the Study**

The general purpose of the study was to determine the Application of Building Information Modelling Software on Project Supervision in Building Construction Sites in Sokoto State, specifically, the study sought to determine level of:

1. Adoption on Building Information Modelling software in building construction sites
2. Supervision practices on Building Information Modelling software in construction sites
3. Control mechanism on Building Information Modelling software in construction sites

**Research Questions**

1. What is the level of Adoption on Building Information Modelling software in construction sites?
2. What is the level of Supervision practices on Building Information Modelling software in construction sites?
3. What is level of Control mechanism on Building Information Modelling software in construction sites?

**Hypotheses**

1. There is no significance difference in the mean responses of Building Construction Site Engineers and contractors on the level of Adoption on Building Information Modelling software in construction sites
2. There is no significance difference in the mean responses of Building Construction Site Engineers and contractors on the level of Supervision practices on Building Information Modelling software in construction sites
3. There is no significance difference in the mean responses ofBuilding Construction Site Engineers and contractorson the level of Control mechanism on Building Information Modelling software in construction sites

**Methodology**

This study employed survey research design. A survey research design is a systematic research design that seeks information to characterize a phenomenon, situation or population. More specifically, it assists in addressing the what, when where and how questions of the study topic rather than the why (Siedlecki, 2020). Survey research design was considered appropriate for the study since it elicit information from site engineers and construction contractors.

The study was carried out in Sokoto State. Sokoto State is presently experiencing traditional industries and practices, presenting both conflict and risks in construction sector. The research work will enhance awareness which is needed to improve adoption of BIM in the construction industry to foster supervision and control practices.

The population for the study was 47 which comprised of Building Construction Site Engineers and contractorsspread across construction sites in Sokoto state. There was no sampling, since the entire population size is manageable. A structured questionnaire was used as the instrument for data collection. The questionnaire contained 34 items and was structured in line with research questions. The questionnaire was divided into two; section A and B. Section A was used to obtain personal information of the respondents. Section B contains three clusters A-C. cluster A of the instrument dealt with research question one, the cluster covers items 1-10 to source for information on level of adoption of Building Information Modelling (BIM) software in building construction industries. Cluster B dealt with research question two, the cluster covers items 1-12 to source for information on Supervision practices on Building Information Modelling software in construction industry while cluster C dealt with research question three and the cluster covers items 1-12, which was used to elicit information on Control mechanism on Building Information Modelling software in building construction site. The respond options attached to questionnaire items are as follows: Very Often (VO) - 5, Often (O) - 4, Sometimes (ST) - 3, Rarely (R) - 2, and Never (N) -1.

The instrument was subjected to face validation by three Lecturers in the Department of Industrial Technical Education, University of Nigeria, Nsukka. The experts were asked to read the items statements one by one and their suggestions were incorporated to the final draft of the questionnaire.The reliability coefficient of the instrument was determined by using Cronbach alpha reliability method. Copies of the structured questionnaire were administered on 10 site engineers and construction contractors in relevant construction Industries in Zamfara State and Statistical Package for Social Science (SPSS version 25) was used in computing the overall reliability coefficient and 0.82 was obtained.

Forty-seven copies of the questionnaire were administered on the respondents at different construction industries with the help of a research assistants who knew the terrain of the study area. This research assistant was instructed on how the copies of the questionnaire should be administered on the respondents considered for the study. the research assistants and the researcher administer copies of the questionnaire on site engineers and construction contractors in different construction sites. After a week, 47 copies of the administered instrument were collected back from the respondents which represent 100 percent return rate.

The data collected for the study were analyzed using *Mean* and standard deviation. The *Mean* and standard deviation were used to answer three research questions. Any item with the *Mean* value of 3.50 or above was considered asagree while any item with the *Mean* value of less than 3.50 was considered disagree.

**Results**

The results of the data analyses are presented below in accordance with the research questions.

**Table 1: Mean Responses of the Respondents on level of Adoption on Building Information Modelling software in construction site**

| Item Statements | Mean | Std. D | Decision |
|---|---|---|---|
| 1. The need for streamlined project information has been a key factor influencing my decision to implement BIM software in construction projects. | 3.87 | .44 | Accept |
| 2. BIM software is regularly utilized across my organization and construction projects to enhance project execution. | 3.51 | .58 | Accept |
| 3. The adoption of BIM software has significantly improved workflow efficiency, project scheduling, and overall timeline management. | 3.82 | .56 | Accept |
| 4. I have encountered various challenges in the adoption and implementation of BIM software within construction processes. | 4.04 | .65 | Accept |
| 5. My team and I demonstrate a strong commitment to effectively utilizing BIM software in construction projects. | 4.08 | .61 | Accept |
| 6. I actively develop and implement strategies to promote BIM software adoption among project stakeholders. | 3.51 | .50 | Accept |
| 7. I evaluate the return on investment (ROI) after integrating BIM software into construction projects to assess its effectiveness. | 3.61 | .49 | Accept |
| 8. Training programs and support systems are established within my organization to facilitate the successful adoption and application of BIM software. | 3.61 | .49 | Accept |
| 9. Efforts are made to ensure BIM software is seamlessly integrated with existing project management workflows and systems. | 3.57 | .49 | Accept |
| 10. I have an optimistic perspective on the continuous evolution and increasing adoption of BIM software in the construction industry. | 4.27 | .92 | Accept |

Data in Table I revealed that all the items have their mean value ranged from 3.51 to 4.25 and this shows that the *mean* value of each item was above cutoff point of 3.50, indicating that the items are the extendlevel of Adoption on Building Information Modelling software in construction industry. Similarly, the standard deviation of these items ranged 0.44 to 0.92 indicating that the respondents were close to one another in their opinion.

**Table 2: Mean Responses of the Respondents on level of Supervision practices on Building Information Modelling software in construction sites**

| Item Statements | Mean | | Std. D | Decision |
|---|---|---|---|---|
| 1. I understand the role of supervision practices when utilizing BIM software in construction projects | 3.78 | | .41 | Accept |
| 2. I rely on data within BIM software for supervising project progress and activities | 4.14 | | .69 | Accept |
| 3. I ensure that project team members are effectively trained to use BIM software for supervision purposes | 3.85 | | .46 | Accept |
| 4. I encounter challenges in supervising construction projects using BIM software. | 3.76 | | .42 | Accept |
| 6. Supervision through BIM software impact the quality control and assurance processes during construction projects | 4.10 | | .69 | Accept |
| 7. I monitor and track project timelines and milestones using supervision practices facilitated by BIM software | 3.87 | | .33 | Accepted |
| 8. Does supervision through BIM software enhance communication and coordination among project stakeholders | 3.65 | | .56 | Accept |
| 9. I often conduct reviews or audits of supervision practices implemented through BIM software to ensure project alignment with goals | 3.80 | | .82 | Accept |
| 10. I integrate feedback from on-site inspections and observations into the supervision practices supported by BIM software | 3.63 | | .56 | Accept |
| 11. Data management and analysis optimize supervision practices within BIM software for construction projects | 3.80 | | .82 | Accept |
| 12. I often experience limitations or constraints in the current supervision practices offered by existing BIM software solutions | 3.65 | | .56 | Accept |

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|---|---|---|---|
| 13. I measure the effectiveness and impact of supervision practices conducted through BIM software on project outcomes and performance | 3.61 | .49 | Accept |

Data in Table II, revealed that all the items have their *mean* value ranged from 3.61 to 4.14 and this shows that the *mean* value of each was above cutoff point of 3.50, indicating that the items are the extendlevel of Supervision practices on Building Information Modelling software in construction industry. Similarly, the standard deviation of these items ranged from 0.33 to 0.82 indicating that the respondents were close to one another in their opinion.

**Mean Responses of the Respondents onlevel of Control mechanism on Building Information Modelling software in construction sites**

| Item Statements | Mean | Std. D | Decision |
|---|---|---|---|
| 1. I believe that implementing BIM software enhances the overall control mechanism in construction projects | 3.61 | .49 | Accept |
| 2. I update or revise the control mechanisms within BIM software throughout a construction project | 3.74 | .64 | Accept |
| 3. Data control is what i find most crucial when using BIM software for project management in construction | 3.65 | .47 | Accept |
| 4. I ensure that the data and information inputted into the BIM software are accurate and reliable for maintaining control over the project | 3.53 | .68 | Accept |
| 5. In my experience, the level of control mechanism in BIM software impacts the coordination and collaboration among project stakeholders | 3.74 | .44 | Accept |
| 6. I encounter challenges in maintaining control mechanisms within BIM software. | 3.70 | .46 | Accept |
| 7. I involve external stakeholders (e.g., clients, subcontractors) in the control processes facilitated by BIM software. | 3.70 | .54 | Accept |
| 8. I integrate change management processes within the control mechanisms of BIM software to adapt to project modifications | 3.63 | .87 | Accept |
| 9. I consider training and education in enhancing the effectiveness of control mechanisms within BIM software for construction projects | 3.78 | .50 | Accept |
| 10. I ensure that the control mechanisms within BIM software align with the project's overall objectives and milestones | 3.97 | .73 | Accept |
| 11. I often experience limitations or constraints in the current control mechanisms offered by existing BIM software solutions | 3.70 | .46 | Accept |
| 12. I evaluate the success and effectiveness of the control mechanisms implemented through BIM software at the conclusion of a construction project | 3.55 | .50 | Accept |

Data in Table III, revealed that all the items have their *mean* value ranged from 3.53 to 3.97 and this shows that the *mean* value of each was above cutoff point of 3.50, indicating that the items are the extendlevel of Control mechanism on Building Information Modelling software in construction industry. Similarly, the standard deviation of these items ranged from 0.44 to 0.87 indicating that the respondents were close to one another in their opinion.

**Discussion**

The findings of this study revealed 10 level of Adoption on Building Information Modelling software in construction industry, 10level of Supervision practices on Building Information Modelling software in construction industry and 10 level of Control mechanism on Building Information Modelling software in construction industry.

The findings of the study were in consonance with the findings of Babatunde,

Ekundayo, Adekunle & Bello (2020 who carried out a study onComparative analysis of drivers to BIM adoption among AEC firms in developing countries: A case of Nigeria and found outfrom factor analysis identified major drivers that modify BIM adoption, supervision practices and control to include cost and time savings, improved communication, and BIM awareness and government supports. Also, the findings are in agreement with the study carried out by Elhendawi, Omar, Elbeltagi& Smith (2020) conducted a study onPractical approach for paving the way to motivate BIM non-users to adopt BIM. It was found that the key findings that deterred the implementation of BIM were personal correlated issues such as resistance to change and lack of appropriate awareness of BIM. The findings of this study also agreed with the findings of Okonta, Vukovic, Segovia & Akinola (2023) conducted a study onBuilding Information Modelling (BIM)-Based Quality Management System (QMS) for Mitigating Building Failures and Collapse: A Case Study of Nigeria. The findings revealedfindings suggest that there is a significant need for greater implementation of QMS practices in Nigeria'sArchitecture, Engineering, Construction, and Operations (AECO) industry, particularly in the context of building collapses. The potential use of BIM as a tool for QMS represents a promising avenue for mitigating building failures and collapses in Nigeria and other developing countries.

The adoption of Building Information Modeling (BIM), effective supervision practices, and control mechanisms play crucial roles in the construction industry. providing a comprehensive digital representation of the project, BIM helps in identifying clashes and errors early on, reducing rework and cost overruns. Effective supervision practices ensures that construction activities meet quality standards and specifications, resulting in a high-quality end product. Safety Supervision practices help monitor and enforce safety protocols on-site, reducing the risk of accidents and injuries. Control Mechanisms help identify, assess, and mitigate risks associated with the construction project, ensuring its successful completion, effective control mechanisms monitor project costs, track expenses, and implement cost-saving measures to keep the project within budget. By integrating BIM adoption, effective supervision practices, and robust control mechanisms, construction projects can benefit from improved efficiency, quality, safety, and overall project success.

**Recommendations**

Based on the findings of this, the following recommendations were made:

1. Construction Site professional should have periodic training on BIM and other allied emerging technologies to become updated.
2. There should be a regulatory body to enforce anddevelop industry-specific standards and guidelines for BIM adoption, supervision practices, and control mechanisms to ensure consistency and quality across projects.
3. There should be professional and innovative collaboration among project teams, including architects, engineers, contractors, and subcontractors, to leverage the benefits of BIM technology.

**Conclusion**

The following conclusions were drawn from the findings of the study:

The study determinedlevel of applicationof Building Information Modelling Software on Project Supervision in Building Construction Sites

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