BIM-AI Adoption in Philippine Public Sector Construction: A Study on Efficiency Gains and Implementation Challenges

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Abstract: - This study investigates the Building Information Modelling (BIM) with Artificial Intelligence (AI) integration adoption in the Philippine public sector construction. It is also the aim of this study to determine the benefits that the government gain from integrating it and identify the challenges encountered by the operators. A survey questionnaire and semi-structured interview was utilized by this study to reveal the efficiency gained by the users in terms of cost, time, and quality. The data collected was also analyzed to identify the implementation challenges encountered. IBM SPSS Statistics 27.0.1 and NVivo software was used to analyze the data. Results showed that BIM-AI projects achieved cost reductions of 10% to 20%, while a reduction of 15% to 25% was attained in terms of time savings. In terms of quality, a substantial boost in BIM-AI projects was observed compared to traditional approach. Moreover, data collected showed that lack of training, lack of budget to buy subscriptions, and insufficiency of provided seminars were among the challenges encountered by the BIM-AI operators. Inadequate inter-agency coordination and the lack of standardized digital protocols hinder the scalable implementation of BIM-AI across government infrastructure projects.

Key Words — BIM, Building Information Modelling, AI, Artificial Intelligence, Philippine Construction Industry, DPWH, Efficiency Gains, Implementation Challenges

I. INTRODUCTION

The Philippine construction industry, particularly in the public sector, is undergoing rapid modernization. One of the key innovations gaining global traction is the integration of Building Information Modeling (BIM) with Artificial Intelligence (AI) to enhance efficiency, accuracy, and decision-making in infrastructure development.

While BIM is already being adopted in various countries for its ability to manage building data in a digital format, AI integration further enhances predictive analytics, automation, and project optimization.

In the Philippines, however, the adoption of BIM-AI technologies remains limited and uneven, especially in government-funded projects. Understanding how BIM-AI impacts efficiency and what barriers exist to its wider implementation can guide more strategic and informed decisions for future infrastructure programs.

1.1 Literature Review

Building Information Modeling (BIM) has revolutionized the construction industry by providing a digital representation of the physical and functional characteristics of a facility. According to Eastman et al. (2018), BIM supports decision-making throughout a building's lifecycle, from planning and design to construction and operation. The integration of Artificial Intelligence (AI) into BIM introduces enhanced capabilities such as automation, predictive analytics, and real-time monitoring, thereby increasing project efficiency.

Numerous studies have examined the impact of BIM-AI integration on construction outcomes. Zhang, Wang, and Liu (2022) emphasize that AI enhances BIM's capabilities through automated clash detection, risk identification, and optimized scheduling, significantly reducing project delays and cost overruns. Similarly, Lin and Gao (2021) argue that AI-enabled BIM systems can predict material demand and labor requirements, resulting in improved resource allocation and sustainability.

In a global context, McKinsey & Company (2021) reports that digital transformation through BIM and AI can reduce construction project costs by 10–20% and cut project time by up to 30%. These findings align with the experience of developed countries like Singapore and the UK, where BIM has been mandated in public projects, and AI is increasingly embedded in construction technologies.

The Philippine government has recognized the potential of BIM through the Department of Public Works and Highways (DPWH), which launched a roadmap for BIM implementation in 2020. However, BIM-AI integration remains at an early stage. According to Reyes and Santos (2023), challenges such as inadequate digital infrastructure, limited technical expertise, and unclear policy frameworks hinder widespread adoption.

Moreover, local case studies suggest that pilot projects using BIM alone have shown improvements in coordination and cost control (DPWH, 2021). However, there is minimal documentation on projects using both BIM and AI. This gap highlights the need for empirical research to assess the real-world efficiency gains of BIM-AI adoption in public infrastructure development.

In summary, while international literature confirms the efficiency benefits of BIM-AI integration, its application in the Philippine public sector remains underexplored. This study aims to bridge that gap by evaluating existing projects and identifying key enablers and barriers to adoption.

1.2 Conceptual Framework

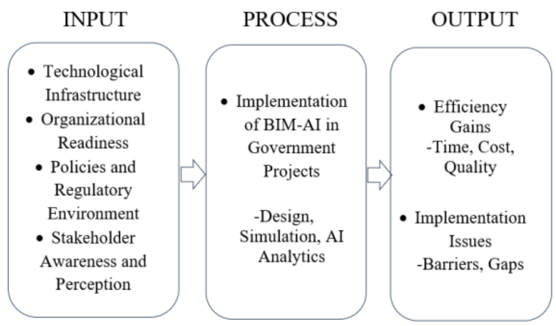

Fig. 1. Conceptual Framework

Fig. 1 shows the Input-Process-Output (IPO) model framework of the study. The conceptual framework illustrates how key inputs—technological infrastructure, organizational readiness, policies, and stakeholder awareness—influence the implementation of BIM-AI in government construction projects. Through processes such as digital design, simulation, and AI analytics, these inputs lead to outcomes including efficiency gains (in time, cost, and quality) and the identification of implementation barriers. This framework guides the study in examining both the benefits and challenges of BIM-AI adoption in the Philippine public sector.

1.3 Objectives

- To compare the efficiency (in terms of cost, time, and quality) between BIM-AI integrated and traditional public sector projects.
- To identify the technological, organizational, and policy-related challenges in implementing BIM-AI in government infrastructure projects.
- To assess the current level of awareness, readiness, and capacity of government stakeholders to adopt BIM-AI.
- To propose recommendations to enhance BIM-AI adoption in the public sector.

1.4 Significance of the Study

This research will benefit various stakeholders, including government agencies such as the DPWH and LGUs by providing insights for developing BIM-AI policies and capacity-building programs; construction professionals by offering a clearer understanding of the practical benefits and challenges of BIM-AI integration; policy makers through data-driven recommendations to guide national construction and digitalization strategies; and academic institutions by serving as a reference for future studies on smart construction technologies.

II. METHODS

2.1 Research Design

This study employed a mixed-methods research design, specifically using a convergent parallel approach. Both quantitative and qualitative data were collected simultaneously, analyzed separately, and then merged during interpretation.

Quantitative data provided measurable comparisons between BIM-AI, BIM-only, and traditional construction methods in terms of cost efficiency, time performance, and quality. Qualitative data offered in-depth insights into implementation challenges, stakeholder perceptions, and organizational readiness.

This approach ensured a more comprehensive understanding of how BIM-AI impacted project performance in the public sector and the challenges in its implementation.

2.2 Samples and Sampling Procedures

The study focused on government completed and ongoing infrastructure projects (including DPWH flagship projects) in the Philippines which uses BIM-AI. Stakeholders involved in these projects included project managers, engineers, BIM coordinators, contractors, and government decision-makers from agencies such as the Department of Public Works and Highways (DPWH), Bases Conversion and Development Authority (BCDA), Department of Transportation (DOTr) and Local Government Units (LGUs).

Purposive sampling was also used to select the project that implemented BIM-only, BIM with AI integration, and traditional construction methods. Additionally, survey and interview samples include project programmers, engineers, and project implementors involved in either BIM-AI and traditional projects or both.

2.3 Research Instrument

For quantitative data, a survey questionnaire was used to obtain information from professionals working in the government specifically those involved in the planning and implementation of the projects about their experience using BIM-AI in terms of project efficiency, challenges, and satisfaction.

For qualitative data, a semi-structured interview guide and a survey questionnaire were employed. These included Likert-scale items and open-ended questions. The instruments were validated by experts and were pilot-tested with a small sample prior to full deployment.

2.4 Data Gathering Procedure

Document analysis was conducted by reviewing project reports obtained from various government, and BIM-AI software websites. Secondary data on project cost, time, and quality outcomes were gathered.

The questionnaire used was developed using Google Forms, selected for its cost-free accessibility and its capability to automatically record responses in an organized spreadsheet format, as supported by Vasantha Raju et al. (2016). The survey link was distributed to participants through email and Facebook Messenger. Prior to participation, respondents were briefed on the study's objectives and assured of the confidentiality and anonymity of their responses. Upon achieving the target number of responses, the collected data were systematically compiled, reviewed, and subjected to detailed quantitative analysis.

Key informant interviews were conducted with project programmers, designers, and BIM/AI practitioners either via video conferencing or in person, depending on availability. Interviews were recorded and transcribed with the consent of participants.

2.5 Data Analysis and Technique

Quantitative data were analyzed using descriptive statistics such as means, percentages, and standard deviations to summarize project performance metrics. Simulation using IBM SPSS Statistics 27.0.1 was used.

Qualitative data were subjected to thematic analysis. Transcripts and written responses were coded and categorized under major themes such as technical barriers, organizational resistance, and policy gaps. NVivo software was used for qualitative analysis.
The findings from both datasets were triangulated to ensure validity and presented narrative summaries.

III. RESULTS AND DISCUSSIONS

Efficiency

The comparative study between BIM-AI integrated construction projects and traditional public sector methods revealed notable improvements in cost, time, and quality performance. BIM-AI projects achieved cost reductions of 10% to 20%, mainly due to precise quantity take-offs, automated data integration, and early detection of design clashes, which reduce costly rework. Furthermore, the study of Tran et al. (2024) showed that BIM's capacity to offer precise visualizations and foster enhanced coordination among stakeholders proves essential in addressing complex project challenges and mitigating risks. AI further contributes by forecasting resource needs, leading to better allocation and minimized waste. These innovations streamline financial planning and cut unnecessary expenditures that are often unavoidable in conventional construction workflows.

In terms of scheduling, BIM-AI implementations showed time savings of 15% to 25%. This improvement is driven by 4D modeling that visualizes project timelines and highlights potential delays before they occur. AI supports this by analyzing patterns and suggesting preventive strategies, unlike traditional approaches that rely on manual coordination and reactive decision-making. Quality also sees a substantial boost in BIM-AI projects, with more accurate as-built documentation, fewer construction defects, and improved adherence to design standards. Real-time monitoring and AI-powered issue detection ensure continuous quality assurance and support efficient asset management throughout a project's lifecycle.

Implementation Challenges

Despite the clear advantages of BIM-AI integration, several challenges hinder its widespread adoption, particularly in public sector projects. This study identified the challenges encountered while using BIM-AI software. This includes lack of training, lack of budget to buy subscriptions, and provided trainings are not enough to understand the software fully. Technological barriers remain significant, with high upfront costs for software licenses and hardware limiting access, especially for smaller contractors. Interoperability issues between different BIM tools further complicate data integration throughout the project lifecycle. Mata et al. (2024) mentioned in their study that addressing usability concerns is crucial for effective BIM tool utilization, particularly in developing countries like the Philippines, where adoption faces challenges. Additionally, limited digital infrastructure and unstable internet connectivity in some regions obstruct the smooth sharing of models and real-time collaboration among project stakeholders. It is revealed in the study of Raqqad (2024) that 50% of the database indicates negligence of integrating BIM-AI in modern construction projects.

Organizational and regulatory challenges also play a major role. Many government personnel, especially field supervisors and mid-level managers, lack digital proficiency, with less than a quarter of professionals trained in BIM. Resistance to change, limited training programs, and inconsistent leadership support slow the cultural shift toward digital workflows. Data security concerns further dampen adoption, as stakeholders express unease over the protection and ownership of sensitive project data. Moreover, while agencies like DPWH have issued BIM guidelines, a lack of mandatory procurement policies and uneven enforcement contribute to fragmented implementation. Weak inter-agency coordination and the absence of standardized digital protocols further limit the scalability of BIM-AI across government infrastructure projects.

Despite the challenges identified, over 90% of the respondents expressed support for the adoption of BIM-AI in the construction industry, recognizing its potential to enhance work efficiency and contribute significantly to the advancement of the Philippine construction sector. This was consistent with the result of the study of Dimaculangan (2023) which shows that majority of their respondents feel that the direction of BIM is towards the adoption of BIM technology.

Stakeholder Awareness and Readiness

The study revealed significant gaps in stakeholder awareness and readiness for BIM-AI adoption, with only about 21% of surveyed professionals expressing strong confidence in their organization's digital capabilities. In the study of Dimaculangan (2023), the results showed that the majority of the industry does not implement BIM in their current construction processes and is currently still using traditional methods such as CADD-based drawing and spreadsheets. This suggests a widespread lack of preparedness across the sector, highlighting the uneven understanding and adoption of digital tools necessary for successful BIM-AI integration.

Furthermore, 75% of the respondents indicated that they had not received any formal training in BIM or AI tools. The majority of users reported being self-taught, which limits their ability to fully utilize the software's capabilities. As a result, most BIM-AI operators are only familiar with the basic functionalities of these tools.

To address this, respondents stressed the importance of structured capacity-building initiatives, including formal training, professional certification, and peer learning platforms. Institutional backing, particularly from senior leadership, was seen as crucial in fostering a culture of innovation and overcoming internal resistance. Successful examples like the NLEX-SLEX Connector Road Project were identified as valuable case studies that could inspire confidence and guide other public sector projects toward broader digital transformation. Moreover, Khan et al. (2024) highlighted that addressing these barriers necessitates a concerted effort from industry stakeholders to realign strategic objectives with the technological advancements of BIM-AI, as well as to implement targeted interventions aimed at overcoming these critical impediments.

This study confirms the transformative impact of BIM-AI integration in improving cost efficiency, project timelines, and construction quality within the Philippine public sector. The observed benefits align with global findings, offering strong evidence to support the acceleration of digital adoption in infrastructure delivery. Yet, despite these advantages, the adoption of BIM-AI remains uneven due to a mix of technological limitations, skill gaps, policy ambiguities, and organizational resistance. These findings are consistent with the study by Santos et al. (2024), which also highlighted a promising yet varied landscape of AI integration, driven by the need for improved cost management, enhanced decision-making, and higher quality standards.

To move forward, a holistic approach is essential. One that includes robust investments in digital infrastructure, standardized training programs, enforceable procurement policies, and strong cybersecurity frameworks. Encouraging signs of progress, such as increased government interest and successful pilot projects, indicate momentum toward digital transformation. A strategic, phased implementation, starting with high-impact flagship projects and gradually scaling to regional initiatives, can help institutionalize BIM-AI practices. By learning from early adopters and tailoring strategies to local needs, the Philippine construction sector can significantly enhance infrastructure performance, sustainability, and public value.

IV. CONCLUSION

This study aimed to evaluate the efficiency gains and identify the implementation challenges of adopting BIM-AI in Philippine public sector construction projects. The findings revealed that BIM-AI integration in Philippine public sector construction presents clear advantages in improving cost efficiency, project timelines, and overall quality. However, its widespread adoption is hindered by systemic barriers, including limited digital infrastructure, fragmented policies, and varying levels of stakeholder readiness. While awareness is gradually increasing, inconsistent digital capabilities across agencies and a lack of formal training continue to slow progress. To address these challenges, investments in capacity building, the establishment of clear and enforceable policy guidelines, and stronger inter-agency collaboration are essential.

Accelerating digital transformation requires a strategic, phased approach tailored to local conditions and informed by successful global practices. Flagship projects can serve as models to build momentum and institutional support, while standardized procurement policies and robust cybersecurity frameworks will reinforce adoption. With coordinated efforts across government, industry, and academia, the Philippines can mainstream BIM-AI and deliver resilient, efficient, and future-ready public infrastructure that maximizes both economic value and long-term sustainability.

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