# A LITERATURE REVIEW ON THE BENEFITS AND CHALLENGES OF IMPLEMENTING BUILDING INFORMATION MODELING (BIM) IN CONSTRUCTION PROJECTS

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**Abstract**: This study aims to systematically review the benefits and challenges of implementing Building Information Modeling (BIM) in construction projects, with a particular focus on the Indonesian context and adherence to the BIM protocol standards set by the Ministry of Public Works and Housing (PUPR) in 2020. Utilizing a qualitative Systematic Literature Review (SLR) method, data were collected from multiple reliable electronic databases including Scopus, Web of Science, and Google Scholar, filtering peer-reviewed publications published between 2010 and 2023 relevant to BIM implementation. Analysis synthesized findings on strategic and operational advantages of BIM such as enhanced collaboration, significant cost and time savings (over 50%), improved risk management, and integrated lifecycle facility management. However, the study also identifies critical barriers including high initial investment costs, immature regulatory frameworks, insufficient skilled human resources, cultural resistance, and limited interoperability issues. The research highlights the necessity for ongoing workforce training, software innovation, regulatory improvements, and promotion of open data standards to fully harness BIM's potential. The findings provide essential insights for policymakers, industry practitioners, and academics to optimize BIM adoption, ultimately contributing to increased productivity and quality in construction projects in Indonesia and comparable developing countries.

**Keywords:** *Building Information Modeling (BIM), construction projects, benefits, challenges, project management, digital construction, technology adoption*.

## INTRODUCTION

The construction industry today faces increasingly complex demands in terms of improving efficiency, productivity, and project quality. In response to these challenges, Building Information Modeling (BIM) has emerged as a technological innovation capable of transforming construction project management through an integrated digital approach. BIM is not merely a three-dimensional model; it is a collaborative process that manages the physical and functional information of a project throughout its lifecycle, including time (4D), cost (5D), and building operation aspects (6D) (Hasan et al., 2021). Thus, BIM can enhance coordination among stakeholders, reduce design errors, and accelerate decision-making processes, leading to cost and time savings during project execution (Samuel, 2023; Cao et al., 2017; Belay et al., 2021).

The significant benefits of BIM have been widely recognized, such as improved interdisciplinary collaboration, reduced errors and conflicts in the design phase, and increased efficiency in project execution (Borrmann et al., 2021). In addition, BIM also supports sustainability by optimizing resource usage and managing construction waste more effectively (Cao et al., 2017). However, despite its great potential, BIM adoption in Indonesia and other developing countries still faces various obstacles that hinder optimal implementation (Saka & Chan, 2021; Babatunde et al., 2020).

Some of the main barriers to BIM implementation include the limited availability of human resources proficient in BIM technology, lack of training and incentives, and organizational cultural resistance to adopting new technologies (Teicholz, 2013; Pishdad-Bozorgi et al., 2018; Succar, 2009; Linderoth, 2010). Additionally, limitations in technological infrastructure, high software investment costs, and a lack of policy support and appropriate protocol standards are also significant inhibiting factors, especially in the Indonesian local context (Ministry of Public

Works and Housing, 2020). The research gap concerning the adequacy of protocol standards, the quality of human resources, and infrastructure support highlights the need for in-depth studies focusing on local conditions (Ali et al., 2022).

In this context, this literature review aims to systematically identify and synthesize the key benefits and challenges faced in BIM implementation in construction projects, particularly those referring to the BIM protocol standards issued by the Ministry of Public Works and Housing in 2020. This study also seeks to fill the knowledge gap regarding underexplored implementation barriers, including field-related risks and collaboration aspects (Ali et al., 2022). It is expected that the results of this review will provide a strategic foundation for developing a more effective and sustainable BIM implementation approach in Indonesia's construction industry (Olanrewaju et al., 2021; Olugboyega & Windapo, 2021a).

Considering the significant benefits and complex challenges, this study is expected to serve as a key reference for academics, practitioners, and policymakers in understanding and optimizing the utilization of BIM to support increased productivity and quality in construction project outcomes in Indonesia.

## METHOD

This study employs a Systematic Literature Review (SLR) approach with a qualitative nature to examine the benefits and challenges of implementing Building Information Modeling (BIM) in construction projects, specifically referring to the 2020 BIM protocol standards issued by the Ministry of Public Works and Housing (PUPR) in Indonesia.

### Population and Research Sample

The population in this study consists of scientific publications and policy documents discussing the implementation of BIM in the construction industry, both at the global level and

within the Indonesian context. The sample was selected using purposive sampling based on the following inclusion criteria:

- Publications are sourced from peer-reviewed journals, conference proceedings, and official documents published between 2010 and 2023.
- Focus on the benefits, challenges, or evaluation of BIM implementation.
- Have specific relevance to Indonesian standards and context, where available.

**Instruments and Data Collection**

Literature data were collected through searches in electronic databases such as Scopus, Web of Science, Google Scholar, and relevant government institutional repositories. The search process utilized a combination of keywords such as "Building Information Modeling", "BIM implementation", "BIM challenges", and "BIM Indonesia". Screening was conducted in stages: title and abstract screening, followed by full-text checks to ensure relevance to the research objectives.

**Data Analysis**

The extracted literature data were analyzed using narrative synthesis to identify and synthesize findings related to the benefits, challenges, and research gaps in BIM implementation. The quality of the literature was also descriptively evaluated based on each study's methodology and scope. This analysis aims to produce a conceptual framework that helps understand the current state and provides recommendations for developing more effective BIM implementation in Indonesia's construction industry.

**RESULT**

Based on the literature review conducted from various sources related to the implementation of Building Information Modeling (BIM) in construction projects, it can be concluded that BIM offers a wide range of significant strategic and operational benefits. These advantages include improved efficiency, quality, stakeholder collaboration, risk management, and integrated facility management. However, on the other hand, BIM implementation also faces a number of complex challenges, particularly related to human resource competencies, technology integration, initial investment costs, underdeveloped standards and regulations, as well as organizational cultural resistance. Therefore, optimizing the use of BIM must be accompanied by adequate training, standard development, awareness campaigns, and policy support to overcome these obstacles.

**Benefits of BIM Implementation**

In terms of benefits, BIM brings various advantages that enhance multiple aspects of construction projects, including:

1. Improved Planning and Design

   BIM provides an accurate and interoperable building information platform that enhances planning, design, construction, and maintenance throughout the building's lifecycle. A comprehensive and integrated BIM model enables more detailed and accurate information delivery, minimizing errors and reducing the risk of miscommunication during the construction phase (Hasan et al., 2021; Roslan et al., 2019).
2. Integrated Collaboration and Coordination

   BIM enables more effective collaboration among project stakeholders through better data integration and communication. This facilitates integrated project delivery and lifecycle management through a 3D virtual model,

reducing duplication of work and coordination errors (Ali et al., 2022; Vorbeck et al., 2022).

3. Risk and Error Reduction

   By consistently storing and managing building information, BIM helps prevent undesired design changes and reduces risks in the construction process. BIM also facilitates early risk identification and more effective mitigation (Azhar, 2011; Hammad et al., 2012).

4. Improved Safety Management and Facility Maintenance

   BIM combined with IoT technology has been used for worker safety management through wireless sensor-based monitoring and simplifies facility management during operation by providing 3D models integrated with both geometric and non-geometric information (Becerik-Gerber et al., 2012; Lin et al., 2022).

5. Time, Cost, and Resource Efficiency

   Utilizing BIM can save over 50% of project costs, speed up execution time by approximately 50%, and significantly reduce human resource requirements. BIM also supports better design decision-making and accelerates project progress (Berlian et al., 2016; Azhar, 2012; Fitriani et al., 2021).

6. Use of Open Data and Standard Formats

   The use of open data exchange formats such as Industry Foundation Classes (IFC) is increasingly common, facilitating data integration across software platforms and supporting cross-platform collaboration (Vorbeck et al., 2022).

**Challenges in BIM Implementation**

Regarding the challenges of BIM implementation, several obstacles must be addressed to ensure effective adoption of this technology, including:

1. Human Resource Competency and Training

   A major challenge is the need for technical competence and continuous training, given the high cost of BIM training and software, as well as the limited number of skilled professionals (Fitriani et al., 2021; Hasan et al., 2021).
2. Resistance to Change and Lack of Awareness

   A lack of understanding and awareness of BIM's benefits leads to resistance on the ground, hindering broader and optimal adoption (Koutamanis et al., 2021).
3. High Initial Costs and Investment

   Procuring software and training staff require substantial investments, which is a significant barrier, especially in developing countries (Fitriani et al., 2021).
4. Limited Government Support and Developing Regulations

   The need for incentives, subsidies, and clear regulations is crucial for widespread BIM adoption. Immature regulations and unsupportive contract structures also act as barriers (Ministry of PUPR; Koutamanis et al., 2021).
5. Gap Between Promises and Implementation Reality

   Although BIM is promoted as a revolutionary solution for the digitalization of the AECO (Architecture, Engineering, Construction, and Operation) industry, its practical implementation still faces conceptual, technical, and social barriers. Further theoretical development, software innovation, and regulatory understanding are required to fully realize BIM's potential (Koutamanis et al., 2021).
6. Barriers in Building Lifecycle Management

   Limitations in remuneration, cross-lifecycle contracts, limited investment, and evolving regulations are major

obstacles in BIM development, particularly in the facility management phase.

Overall, BIM has great potential to improve efficiency, collaboration, risk reduction, and construction project quality. However, its implementation requires continuous efforts in human resource training, regulatory development, and technology investment to overcome existing challenges and realize its full benefits (Hasan et al., 2021; Koutamanis et al., 2021; Fitriani et al., 2021).

## DISCUSSION

This study affirms that the implementation of Building Information Modeling (BIM) plays a significant role in accelerating the digital transformation of the AECO (Architecture, Engineering, Construction, and Operations) industry. Practically, BIM has been proven to substantially improve efficiency in time, cost, and resources, with project cost savings exceeding 50% and execution time reduced by up to 50% (Berlian et al., 2016; Azhar, 2012; Fitriani et al., 2021). These findings are consistent with previous studies that document cost and time savings through the use of BIM.

Theoretically, these results reinforce the concept of BIM as an interoperable platform that enables integrated and collaborative planning and management of the building lifecycle. BIM provides a comprehensive and integrated information platform, minimizing errors and reducing the risk of miscommunication during the construction phase (Hasan et al., 2021; Roslan et al., 2019). Additionally, the use of open data formats such as Industry Foundation Classes (IFC) further supports interoperability and cross-platform collaboration (Vorbeck et al., 2022).

However, this review also reveals conceptual, technical, and social barriers that still hinder the full realization of BIM's potential. Limitations in human resource competencies, cultural resistance,

high initial investment costs, and underdeveloped regulations remain major obstacles—findings that are also echoed by Koutamanis et al. (2021) and Fitriani et al. (2021). Barriers in the facility management phase are especially critical, as the lack of remuneration and cross-lifecycle contracts continues to obstruct BIM development at the operational stage (T4). This underscores the need for theoretical innovation, software development, and regulatory improvements to fully realize BIM's potential (Koutamanis et al., 2021).

Extrapolating from these findings, the adoption of BIM is not merely a technical issue, but also involves organizational culture and crucial public policy dimensions. Human factors and policy support are key determinants in the successful implementation of BIM, directly impacting the efficiency and quality of construction projects (Fitriani et al., 2021; Hasan et al., 2021). Therefore, continuous efforts are required in human resource training, raising awareness of BIM's benefits, and developing supportive regulations to bridge the gap between the promises and the reality of BIM implementation (Koutamanis et al., 2021).

In conclusion, this study confirms that BIM is a revolutionary solution in construction project management, delivering significant improvements in collaboration, efficiency, and risk mitigation. However, to fully realize the optimal benefits of BIM, a holistic approach that includes technological innovation, human resource development, and regulatory policies is essential to address current challenges and support the advancement of a digitally-centered construction industry (Hasan et al., 2021; Koutamanis et al., 2021; Fitriani et al., 2021).

## CONCLUSION

This study highlights that Building Information Modeling (BIM) offers transformative benefits for the construction industry, significantly enhancing project efficiency, collaboration, and risk

management. Despite these advantages, successful BIM implementation remains constrained by challenges including limited human resource competencies, high initial costs, cultural resistance, and evolving regulatory frameworks. Addressing these barriers requires continuous investment in workforce training, policy development, and technological innovation. Ultimately, a comprehensive approach that integrates technical, organizational, and regulatory aspects is essential to unlock BIM's full potential and support sustainable digital transformation within the AECO sector.

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