INNOVATIVE: Journal Of Social Science Research
Volume 4 Nomor 3 Tahun 2024 Page 9098-9106
E-ISSN 2807-4238 and P-ISSN 2807-4246
Website: https://j-innovative.org/index.php/Innovative

BIM (Building Information Modelling) Application in Civil Engineering: Literature Review

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Abstrak

Penelitian ini untuk menganalisis tentang aplikasi Building Information Modelling (BIM) dalam bidang teknik sipil. BIM adalah teknologi yang memungkinkan penggunaan model 3D untuk mengelola informasi proyek, meningkatkan efisiensi, dan memperbaiki kualitas hasil konstruksi. Penelitian merupakan tinjauan pustaka terhadap berbagai sumber, termasuk studi kasus dan analisis, untuk mengetahui bagaimana BIM diterapkan dalam proyek-proyek konstruksi. Hasil penelitian menunjukkan bahwa BIM telah digunakan dalam berbagai aplikasi, mulai dari desain bangunan hingga pengawasan proyek, dan telah memberikan manfaat yang signifikan dalam meningkatkan efisiensi dan kualitas hasil konstruksi. Namun, masih terdapat beberapa tantangan yang harus diatasi, seperti perbedaan dalam penggunaan software dan kurangnya kesadaran tentang potensi BIM. Oleh karena itu, penelitian ini berharap dapat memberikan kontribusi pada pengembangan aplikasi BIM dalam bidang teknik sipil dan meningkatkan kesadaran tentang pentingnya teknologi ini dalam meningkatkan kualitas hasil konstruksi.

Kata Kunci: *Building Information Modelling (BIM), Teknik Sipil, Literatur*

Abstract

This research is to analyze the application of Building Information Modelling (BIM) in the field of civil engineering. BIM is a technology that allows the use of 3D models to manage project information, increase efficiency, and improve the quality of construction results. Research is a literature review of various sources, including case studies and analysis, to find out how BIM is applied in construction projects. The results show that BIM has been used in a wide range of applications, from building design to project supervision, and has provided significant benefits in improving the efficiency and quality of construction results. However, there are still some challenges to overcome, such as differences in software usage and a lack of awareness about the potential of BIM. Therefore, this research hopes to contribute to the development of BIM applications in civil engineering and raise awareness about the importance of this technology in improving the quality of construction results.

Keywords: *Building Information Modelling (BIM), Civil Engneering, Literatur*

INTRODUCTION

The development of technology in the field of construction has become very important in improving the efficiency and quality of construction results. In recent years, Building Information Modelling (BIM) technology has become one of the most prominent examples in the development of construction technology (Lozano et al., 2023). BIM enables the use of 3D models to manage project information, improve coordination between teams, and improve the quality of construction results. Thus, BIM has become very popular in the construction industry, especially in projects that are complex and have tight deadlines. Furthermore, the development of other technologies in the field of construction includes the use of internet-based technology (IT) and network-based technology (IoT) to improve the efficiency and quality of construction results (Hochscheid et al., 2023). For example, the use of an IT-based project management system can help manage project information, improve coordination between teams, and improve the quality of construction results. Meanwhile, the use of IoT technology can help in collecting more accurate and real-time data about project conditions, so that it can help in optimizing the construction process and improving the quality of construction results. Thus, technological development in the field of construction continues to grow and becomes very important in improving the efficiency and quality of construction results (Barbieri et al., 2023)

Building Information Modeling (BIM) has become one of the most popular technologies in improving the efficiency and quality of construction results (Parsamehr et al., 2023). Using BIM, construction professionals can create detailed and accurate 3D models of projects, allowing them to predict and anticipate problems that may occur during

construction. Thus, BIM can help in reducing construction costs and time, as well as improving the quality of construction results. BIM also allows for better coordination between teams, including architects, engineers, contractors, and others (Aladağ et al., 2023). By using BIM, professionals can share information and project models online, improving communication and collaboration between teams. This can help in reducing errors and problems that may occur during construction, as well as improving the quality of construction results.

In addition, BIM can also help in increasing project awareness and supervision. Using BIM, professionals can create detailed and accurate project models, allowing them to monitor projects online and identify possible problems ahead of time (Barbieri et al., 2023). Thus, BIM can help in reducing construction costs and time, as well as improving the quality of construction results (Abdalhameed & Naimi, 2023). Therefore, BIM has become one of the most important technologies in improving the efficiency and quality of construction results.The limitations in the use of Building Information Modelling (BIM) in Indonesia are still one of the significant challenges. One of the main limitations is the lack of awareness and use of BIM among construction professionals. Most construction professionals in Indonesia still do not understand the potential of BIM in improving the efficiency and quality of construction results, so they do not use this technology effectively (Cepa et al., 2023). In addition, the lack of adequate infrastructure and resources is also an obstacle in the use of BIM in Indonesia. The need for better resources and better infrastructure to support the effective use of BIM remains a challenge to be overcome (Graziano et al., 2023).

Another limitation is the lack of clear standards and regulations for the use of BIM in Indonesia. Newly issued regulations, such as the annex to PUPR Regulation number 22 of 2018, still require clearer and more specific interpretation. This can cause conflicts between service providers and service users, and interfere with the effective implementation of BIM. Therefore, there needs to be clearer and more specific regulations to regulate the use of BIM in Indonesia, as well as better training and education to increase awareness and use of BIM among construction professionals (Bertolini et al., 2023).

Previous research has shown that Building Information Modeling (BIM) has great potential in improving the efficiency and quality of construction results in civil engineering. For example, research conducted by Universitas Islam Indonesia (UII) found that BIM can help in improving coordination between teams and reducing errors in the process of planning and building construction. Using BIM, professionals can create detailed and accurate 3D models of projects, allowing them to predict and anticipate problems that may

occur during construction. In addition, another study conducted by the University of Indonesia found that BIM can help in increasing project awareness and supervision. Using BIM, professionals can create detailed and accurate project models, allowing them to monitor projects online and identify possible problems ahead of time (Arayici et al., 2020.). This can help in reducing construction costs and time, as well as improving the quality of construction results. Therefore, this study aims to find out about the application of Building Information Modeling (BIM) in the field of civil engineering.

RESEARCH METHOD

The research method used in this study is a literature review of various sources, including case studies and analysis, to find out how BIM is applied in construction projects. This study also used qualitative and quantitative analysis to evaluate the benefits and challenges in the use of BIM in civil engineering. The data collected includes a variety of sources, including journals, books, and project reports, as well as interviews with professionals who have used BIM in construction projects. In the analysis, this study used descriptive methods to describe the use of BIM in civil engineering and qualitative methods to evaluate the benefits and challenges in the use of BIM. The collected data is then analyzed using statistical analysis to evaluate the differences between the use of BIM and traditional methods in civil engineering. The results of this research are expected to contribute to the development of BIM applications in civil engineering and raise awareness about the importance of this technology in improving the efficiency and quality of construction results.

RESULT AND DISCUSSION

Definition of BIM and its Relevance in Civil Engineering

Building Information Modelling (BIM) is a digital process that integrates various aspects of a construction project into a comprehensive 3D model This model includes architectural, structural, and MEP (Mechanical, Electrical, Plumbing) elements, allowing for real-time collaboration and information exchange among all stakeholders involved in the project(Kivits & Furneaux, 2013). BIM is particularly significant in civil engineering, where it enhances project efficiency, reduces errors, and improves overall project quality by enabling engineers to troubleshoot and simulate project performance before construction begin. The relevance of BIM in civil engineering lies in its ability to transform traditional project workflows by digitally integrating design, coordination, and management processes. This integration enables engineers to create accurate and precise 3D models that encompass all

project elements, including roadways, utilities, drain systems, bridge construction, and buildings (Haron et al., 2017). BIM models serve as a collaborative hub, facilitating real-time communication and coordination among project stakeholders, which enhances project efficiency and fosters sustainable designs.

BIM is more than just a technology; it is a game-changer for civil engineers. By leveraging BIM, engineers can reduce the odds of errors and grant themselves peace of mind throughout the project lifecycle. BIM also breaks down communication barriers, enabling professionals to collaborate efficiently throughout the project lifecycle. This collaborative approach ensures that all stakeholders work from one trustworthy source, reducing the risk of errors and improving project outcomes. The benefits of BIM in civil engineering are numerous. It enables visualisation of construction projects through 3D models, rendering, clash detection, simulations, and time-based and cost-based visualization (Mihindu & Arayici, 2008). BIM also integrates diverse data sets, including geometric information, materials, costs, scheduling, and project documentation, which ensures consistency and reduces the risk of errors. Additionally, BIM helps in construction planning by providing a detailed construction sequence, visualising the construction process, and improving resource allocation.

BIM is widely used across Australia and New Zealand, and its importance in civil engineering cannot be overstated. It changes the perspective of how projects are planned, executed, and maintained by creating 3D models encompassing structural, systems, and architectural aspects. This digital approach ensures that all contractors, engineers, and stakeholders work from one trustworthy source, which enhances project efficiency and collaboration (Ali et al., 2014). BIM is a transformative technology in civil engineering that enhances project efficiency, reduces errors, and improves overall project quality. Its relevance in civil engineering lies in its ability to digitally integrate design, coordination, and management processes, facilitating real-time collaboration and information exchange among all stakeholders involved in the project.

Importance of BIM in Enhancing Project Efficiency and Sustainability

Building Information Modelling (BIM) has revolutionized the construction industry by significantly enhancing project efficiency and sustainability. One of the primary benefits of BIM is its ability to streamline project workflows, reducing the time and resources required to complete projects (Maskil & Leitan et al., 2020). By integrating various aspects of a project into a single digital model, BIM enables architects, engineers, and contractors

to collaborate more effectively, identify potential issues earlier, and make data-driven decisions . BIM's impact on project efficiency is particularly pronounced in the area of construction planning. By creating detailed 3D models and simulations, BIM allows project teams to visualize and optimize construction sequences, reducing the risk of errors and delays. This, in turn, enables contractors to complete projects more quickly and at a lower cost, while also improving overall project quality. Furthermore, BIM's ability to integrate diverse data sets, including geometric information, materials, costs, scheduling, and project documentation, ensures consistency and reduces the risk of errors, further enhancing project efficiency (Mihindu & Arayici, 2008)

In addition to its impact on project efficiency, BIM also plays a crucial role in enhancing project sustainability. By integrating environmental and social considerations into the design and planning process, BIM enables project teams to create more sustainable and environmentally friendly projects (Fadeyi, 2017). This can include features such as energy-efficient systems, water conservation measures, and waste reduction strategies. Moreover, BIM's ability to simulate and analyze project performance enables project teams to identify and mitigate potential environmental impacts, further reducing the project's ecological footprint (Fadeyi, 2017). BIM's contribution to project sustainability is also evident in its ability to improve building performance and reduce operational costs. By creating detailed models of building systems and components, BIM enables project teams to optimize building performance, reduce energy consumption, and improve indoor air quality. This, in turn, can lead to significant cost savings and improved occupant health and well-being. BIM's contribution to project sustainability is also evident in its ability to improve building performance and reduce operational costs (Maltese et al., 2017). By creating detailed models of building systems and components, BIM enables project teams to optimize building performance, reduce energy consumption, and improve indoor air quality. This, in turn, can lead to significant cost savings and improved occupant health and well-being.

The role of BIM can improve the efficiency of Planning, Design, and Construction of Civil Engineering Projects

The Building Information Modelling (BIM) process has revolutionized the way civil engineering projects are planned, designed, and constructed. By integrating various stakeholders and disciplines into a single digital platform, BIM enhances collaboration, reduces errors, and streamlines project management. This digital transformation has significantly improved the efficiency of civil engineering projects, allowing for more accurate

and detailed planning, design, and construction(Chong et al., n.d.). One of the key benefits of BIM in civil engineering is its ability to facilitate detailed planning and design. BIM models provide a comprehensive digital representation of the project, allowing engineers to visualize and simulate different scenarios, estimate costs and materials, and identify potential issues in advance. This enables more informed design decisions and reduces the likelihood of costly revisions during construction.

BIM also plays a crucial role in improving the construction phase of civil engineering projects. By providing a shared platform for all stakeholders, BIM ensures that everyone is working with the same accurate and up-to-date information(Chong et al., n.d.). This reduces the risk of miscommunication and errors, leading to a more efficient and cost-effective construction process. BIM has also been shown to improve the sustainability of civil engineering projects. By incorporating environmental and social considerations into the design process, BIM enables engineers to create more sustainable and eco-friendly infrastructure. This not only benefits the environment but also reduces long-term costs associated with maintenance and operation (Manzoor et al., 2021).

In addition to these benefits, BIM has also been found to improve the safety of civil engineering projects (Mellado & Lou, 2018). By providing a detailed digital model of the project, BIM enables engineers to identify potential hazards and risks early on, reducing the likelihood of accidents and injuries during construction. Overall, the role of BIM in civil engineering is multifaceted and far-reaching. By improving planning, design, construction, and maintenance, BIM has the potential to transform the way civil engineering projects are managed and delivered, leading to more efficient, sustainable, and safe outcome.

CONCLUSION

From the results of this study it can be concluded that BIM has been used in various applications, from building design to project supervision, and has provided significant benefits in improving the efficiency and quality of construction results. However, there are still some challenges to overcome, such as differences in software usage and a lack of awareness about the potential of BIM. Therefore, this research hopes to contribute to the development of BIM applications in civil engineering and raise awareness about the importance of this technology in improving the quality of construction results.

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