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A Review on the Application of BIM Dimensions to a Building

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A B S T R A C T :

The newest technology in the construction sector was BIM (Building Information Modelling), which contains several layers of dimensions, including 2D, 3D, 4D, 5D, 6D, and 7D. The dimensions include lowering human labor and improving accuracy, time-saving, overspending, mistakes, etc. These days, BIM serves as an intermediary between architects, engineers, and clients. The BIM dimension is similar to 3D in terms of effective visualization, coordination, and clash detection; 4D and 5D are digital representations of construction job scheduling and cost estimation. We can easily coordinate with others as a result. The largest issue facing the construction sector was carbon emissions; tons of carbon were released daily as a result of construction activity. By utilizing additional high-carbon-emission materials, BIM 6D provided a way to lower carbon emissions. Insight 360, GBS (Green Building Studio), One Click LCA, and other tools like Revit, Navisworks Manage, and STAAD.pro are all connected with the BIM workflow.

Keywords: BIM Dimensions (2D, 3D, 4D, 5D), One click LCA, GBS (Green Building Studio), Navisworks Manage, STAAD.pro

INTRODUCTION

BIM (Building Information Modelling) is a workflow that integrates many software's to promote interoperability. BIM use in the construction business is increasing on a daily basis. BIM is being used in all types of construction projects, from large too small. BIM was used in a variety of applications, including construction work modeling and scheduling, construction work estimating, construction work sustainability and energy efficiency, and operation and maintenance, among others. BIM usage resulted in lower construction costs, fewer problems such as mechanical electrical plumbing clashes (MEP), and easier communication with engineers, architects, and clients. Based on numerous research, BIM increases construction efficiency when compared to traditional construction processes. Nowadays, there are numerous BIM (Building Information Modelling) software options on the market, such as STAAD.Pro for construction design, Revit software for structural modeling, material quantity take-off, and Navisworks Manage for construction scheduling and estimate, as well as digital representation. Green Building Studio, Insight 360, and One Click LCA are the plugins and software's used for energy analysis and carbon emissions estimates, respectively. Each BIM Dimension (2D, 3D, 4D, 5D, 6D, and 7D) has a specialty, and when all of the BIM Dimensions are combined, the construction process is optimized.

Literature Review

- **Pierre Diaz (2016) et al.** [1]. "This paper examines the benefits, advantages, and challenges of Building Information Modelling (BIM) in the construction industry." According to the study's literature evaluation and analysis of existing frameworks and methodologies, BIM improves information quality for important design decisions and facilitates a single language among project partners. It also shows the inherent challenges and practical issues connected with BIM.
- **Sakdirat Kaewunruen et al. (2024**) [2]. "This article investigates the use of 6D Building Information Modelling (BIM) to improve circular value chains and increase stakeholder participation in built settings. The study delves into the problems, limitations, benefits, and overall effectiveness of 6D-BIM practices using a thorough literature analysis and focused interviews. The authors also use a snowball sampling strategy to delve more into the topic of valorization. The findings show that 6D-BIM enables real-time tracking of sequence, cost, and carbon footprint, hence reducing unexpected consumption and material waste. Furthermore, the study underlines the importance of BIM's interoperable architecture in facilitating life-cycle assessments and fostering circularity in building construction and operation, making it an essential instrument for advancing sustainable development in the built environment.
- **Muhammad Wardani et al. (2025)** [3]. "This study looks at the use of 3D, 4D, and 5D BIM in the layout and integration of the IHM dock access road. The research uses BIM-based data analysis to model alignment and profile plans, integrate cost data, and schedule work durations in a unified BIM model. The findings show that 3D BIM provides a clear visual representation of the road's physical layout, 4D BIM provides insight into construction sequencing, and 5D BIM incorporates cost-related data. Together, these dimensions improve project coordination by making cost, time, and quality estimates more clear, methodical, and manageable throughout the infrastructure development cycle.
- **O. Yashchenko et al. (2016)** [4]. "The purpose of this study is to define the theoretical and methodological underpinnings for using BIM technology in construction organizations. The study examines alternative BIM definitions and compares them to traditional design approaches. It also looks at the short-term and long-term benefits of using BIM. The study discovers that BIM enables the production of not just 3D models,

but also advanced dimensions such as 4D, 5D, 6D, and even 7D models. The use of these multidimensional BIM systems can considerably improve project efficiency. Cost savings, greater economic outcomes, and increased safety and quality throughout the construction lifecycle are all significant advantages. This study underlines BIM's transformative potential for improving construction project results and business operations.

- **Carlos Alberto Andrade Bomfim et al. (2016)** [5]. "This study looks at how the design process has evolved in order to achieve efficient building methods, correct budgets, and trustworthy timetables. It is based on a literature analysis, topic interviews, and insights from a major BIM enterprise in Brazil. The findings show that upgrading the design process entails planning, engineering, constructability, rationalization, and integration. BIM goes beyond 3D modeling to include extra dimensions including 4D (time), 5D (cost), and 6D (operation), which improves project coordination and efficiency.
- **Chang-Su Shim et al. (2011)** [6]. "In this work, we look at how 3D Bridge Information Modeling (BIM) can be used in bridge design and construction. The authors emphasize the usage of extensible standards for bridges to provide interoperability across the many processes involved in bridge construction. The process consists of digital mock-ups, parametric modeling, and 4D/5D simulation. The findings demonstrate that 3D models may accurately depict numerical drawings derived from structural designs, boosting the quality of construction through better accuracy, constructability, and cooperation. The study underlines the importance of process transformation in properly implementing BIM in bridge projects to get better outcomes.
- **Lancine Doumbouya et al. (2017)** [7]. "This article examines the value of Building Information Modeling (BIM) in the development of a pharmaceutical industrial base, focusing on its larger importance. The study examines BIM standards, the IFC (Industry Foundation Classes) data standard, and essential ideas including 4D-BIM and 5D-BIM. Technologies such as parameterization, visualization, and geographic systems are also investigated. The findings emphasize BIM's importance in integrating project data and enabling comprehensive building life-cycle management. BIM has been demonstrated to have a significant impact on project design, construction, operation, management, and maintenance, establishing it as a revolutionary tool in modern construction.
- **M. L. Lee et al. (2020)** [8]. "This research looks into the integration of various dimensions of Building Information Modeling (BIM), notably 3D modeling paired with 4D scheduling and 5D cost prediction, to simulate a complete 5D BIM process. The research is based on a case study of a commercial initiative at University Tunku Abdul Rahman (UTAR)'s Sungai Long City Campus. It assesses the process by comparing virtual data to actual construction results to determine its benefits and drawbacks. According to the findings, Virtual Design and Construction (VDC) assists stakeholders in visualizing buildability sequences, resulting in faster and more cost-effective project delivery. However, effective implementation is contingent upon effort, interoperability, and data output limits.
- **Huimin Li et al. (2020)** [9]. "This study proposes a systematic approach for improving prefabricated construction projects by combining Building Information Modeling (BIM) and 3D laser scanning technology. A complete literature analysis and crucial procedure identification were carried out, with BIM dimensions serving as tolerance benchmarks and point cloud data obtained via 3D scanning. The findings indicate that this integrated strategy increased efficiency control and built a foundational framework, indicating its great potential for future use in prefabricated projects.
- **Eva Quevedo-Martinez et al. (2022)** [10]. "This study investigates the digitalization of infrastructure inventory using Building Information Modeling (BIM) combined with LiDAR, based on geolocation and bio parameters of cypress species." It seeks to examine the environmental implications of allergenicity. The methodology entails employing LiDAR to capture geo-referenced 3D environments and measuring the aerobiological index (IUGZA) with BIM models expanded to 6 dimensions. The findings indicate that building 6D environments aids in the prevention of construction-related issues and demonstrates that combining aerobiological data with BIM using LiDAR is feasible for construction engineering.
- **K. Whitlock et al. (2021)** [11]. "This study looks at how Building Information Modeling (BIM) can be applied to Construction Logistics Management (CLM). The study uses in-depth qualitative interviews with six professionals to document practical experiences with BIM for CLM. The findings show that BIM's primary contributions to CLM are the generation of 3D site layout plans, 4D coordination processes, dynamic updates to 4D plans as projects progress, and improved collaboration in BIM-based coordination.
- **Fernanda Rodrigues et al. (2022)** [12]. "This study investigates the integration of BIM methodology with new technologies in the design phase of site management. The primary goal is to determine how BIM can be strategically deployed in phases to improve planning and execution processes, notably in reducing safety dangers such as falls from heights. Through a literature analysis and a 4D BIM-based simulation case study, the paper demonstrates how time-based visualization enables stakeholders—including technicians, designers, and site managers to successfully monitor and assess each project phase. The study emphasizes BIM's capacity to facilitate informed decision-making by determining the best timing and implementation of safety measures. This proactive strategy improves planning accuracy and management efficiency, making the construction process safer and more manageable. The results show that 4D BIM not only enhances coordination.
- **L. Inzerillo et al. (2024)** [13]. "This paper focuses on using BIM for time-cost analysis (4D/5D BIM) in a major infrastructure project the North-South railway station in Riyadh." The goal is to see how BIM may improve project planning and execution by combining scheduling and cost estimation. The study looks at BIM models with automation elements that allow for exact control over timetables and budgets. These capabilities enable stakeholders to view the status and financial implications of each project phase in real time. The findings show that BIM serves as a single hub for project data management, providing a structured and data-driven strategy that improves overall product quality, lowers risks, and simplifies construction processes. Furthermore, by reducing unexpected changes and associated cos
- **Zoran Puko et al. (2017)** [14]. "This paper presents a case study on the use of 6D Building Information Modelling (BIM) in a real-world business storage facility in Slovenia." The goal was to include maintenance, cost, and lifetime statistics into the BIM process to better long-term facility management. The methodology involves adhering to Slovenian legislation and describing tasks such as element maintenance, lifetime service projection, and time-cost modeling. The study used Vico Office software to perform 5D analysis, linking cost data to 3D models, whereas Excel was used for 4D scheduling without model connection. The findings provide a novel approach that combines linked

and non-linked data settings. The integrated approach increased operational clarity by assisting facility managers in making proactive decisions through improved visualization and lifecycle tracking.

CONCLUSION

Building Information Modelling (BIM) improves construction efficiency. 3D BIM (3-Dimensional Modelling of Building Structures) provides improved visualization and reduces mechanical, electrical, and plumbing clashes in the building. We can also provide visualized reinforcement direction and placement utilizing 3D modeling.4D BIM (Scheduling of construction activities) provides a digital depiction of the workflow of the construction works. Previously, we utilized CPM and Gantt charts to communicate the construction works, but it was difficult to identify the sequence of works. 5D BIM (Cost Estimation) provides cost estimates based on construction activities, allowing for easy understanding and communication of work progress. Using BIM (Building Information Modelling), we can detect high carbon released materials with one click LCA and insight 360, thereby reducing carbon emissions and meeting sustainability criteria. Based on this, we may determine the most energy-efficient measures, such as window wall ratio and building orientation, among others.

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