



A Review on Effects of BIM Integration with Lean Construction Practices

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ABSTRACT

Growing interest in Building Information Modeling (BIM) and associated technologies like Integrated Project Delivery (IPD) and Lean Construction underscores the need for advanced education in rapidly evolving construction-related disciplines. This study addresses the gap by introducing a novel university BIM-IPD-Lean Masters-level degree course. The four-phase development involved a comprehensive literature review, industry consultation, program structuring, and launch. The construction industry faces challenges of high costs and slow excavation, leading to inefficient use of human resources. This study proposes a solution by incorporating prefabricated components and integrating BIM and Lean methodologies for controlling pipe-rack modules in industrial facilities. paper explores the beneficial integration of BIM and Lean practices to identify and reduce waste in construction. Analyzing the relationship between Lean Design Management practices and BIM uses reveals a positive correlation, emphasizing the impact of BIM on lean management practices during the design phase. The study contributes empirical evidence of improved efficiency through increased BIM adoption. The paper highlights the challenges faced by Operations and Maintenance (O&M) departments in adopting BIM for efficient maintenance. paper establishes a linkage between Lean techniques and knowledge management through the SECI mode, demonstrating the positive impact of Lean tools on knowledge creation and overall Lean performance. Finally, a systematic literature review identifies hot topics in scientific studies related to Lean construction and BIM, including benefits, challenges, simultaneous implementation issues, supporting instruments, and potential future applications.

Keywords: Lean construction and Building information modelling (BIM), Design management, Construction projects

INTRODUCTION

1) Building Information Modeling (BIM) as a digital platform that can improve project performance by facilitating better information-sharing among project teams. In addition to being a major contributor to many countries' GDP, the construction industry is essential to the socioeconomic development of any country. A country's physical structure count and size usually give the first clue as to how quickly it is developing. By using building information modelling to achieve lean principles for improving efficiency of work in construction projects. The construction industry focused on a interaction between two transformation methodologies of lean construction and BIM. Identify the lean principles that can be used as a guideline for firms and building surveyors who wish to implement BIM. BIM helped to achieve Lean principles by reducing waste

2) It developments that are effecting fundamental change in the architecture/engineering/construction industry: lean construction and building information modeling (BIM). It explores the potential synergies between these two paradigms and how they can be used to improve construction processes. The introduction also raises questions about the impact and effectiveness of BIM and its potential to eliminate dominant wastes in construction.

3)The Building Information Modeling (BIM) and Lean Construction (LC) has brought about a revolutionary change in project management techniques within the construction industry. BIM, or building information modeling, is a digital depiction of the construction process that promotes improved communication and cooperation. Numerous case studies have examined its integration with LC, a management philosophy that emphasizes waste reduction and process efficiency, and have shown that the two have a symbiotic relationship. This article explores the complex relationships that exist between BIM and LC, highlighting how these relationships can work together to increase project efficiency. Although BIM offers technological strength, organizational processes will hinder its successful deployment. Conversely, LC, which is based on production theory, gives processes and people priority. In order to address the, the two must work in concert.

Literature Review

- Yongqi wang Et Al (2022) reported that; The study on how the combination of lean construction and Building Information Modeling (BIM) can enhance the precast design process. The authors propose a new workflow that combines lean construction and BIM based on the Plan-Do-Check-Act (PDCA) framework to improve the precast design process. They also develop an automatic precast element design

engine (APEDE) to facilitate the precast design process. The outcomes of this study show that the proposed framework can significantly improve the time efficiency and total man-hours of the precast design process.

- Rodrigo F. Herrera Et Al (2021) study that; Study that analyzes the relationship between Lean Design Management practices and the use of Building Information Modeling (BIM) in the early stages of construction projects, specifically during the planning and design phases. The study found that there is a positive correlation between the level of implementation of Lean Design Management practices. The study also identified specific Lean Design Management practices that are more closely associated with BIM uses, and continuous improvement. The study provides insights into the challenges and opportunities of implementing BIM and Lean Design Management practices in the construction
- Ashwin Mahalingam Et Al (2015) explained that; The study demonstrates that the successful alignment of BIM technology with work processes and willingness to coordinate among project participants are critical factors for successful BIM adoption. We also validate the framework through simulations of the hospital construction process using 4D modeling techniques, which show significant improvements in project performance compared to traditional construction methods. The study concludes that the integration of lean practices and BIM technology can significantly improve project performance in the construction industry.
- Rafael sacks Et Al (2012) study that; It explores the potential synergies between two transformative technologies in the construction industry: Building Information Modeling (BIM) and lean construction. The paper proposes a conceptual framework for analyzing the interaction between these two technologies and identifies 56 issues that could impact their effectiveness. The paper also presents evidence from practice and research to support the argument that there is a significant synergy between BIM and lean construction. Finally, the paper suggests several areas for further research and extension of the work presented.
- Wenchi Shou Et Al (2014) investigated that; The integration of Building Information Modeling (BIM) and Lean concepts for maintenance management. The PDF provides a theoretical framework for analyzing the limitations of existing maintenance activities and proposes an integrated approach that combines BIM, Lean, and maintenance management. The PDF also presents a case study that demonstrates the effectiveness of the integrated approach in improving productivity and efficiency in the Oil & Gas industry. Additionally, the PDF discusses the potential benefits and challenges of using BIM and Lean concepts in maintenance management and provides recommendations for successful implementation
- John Deeney Et Al (2014) reported that; The study discusses the potential benefits of using Building Information Modelling (BIM) methodologies in Public Works Contracts (PWCs) in Ireland. The authors argue that the use of BIM can help to align with the stated aims of the Construction Contracts Bill and the Construction Procurement Reform Strategy in achieving greater efficiency and cost certainty in PWCs. The authors report on two recent simulated pilot projects involving PWC teams, in order to gauge the level of use and capability of the Irish AEC sector to embrace BIM technologies on public works projects. The authors conclude that the use of BIM methodologies can help to align with the stated aims of the Construction Contracts Bill and the Construction Procurement Reform Strategy in achieving greater efficiency and cost certainty in PWCs in Ireland.
- David Riley, Ph.D. Et Al (2012) investigated that; The paper presents a conceptual model for a unified process approach to healthcare project delivery that incorporates green strategies, lean principles, and Building Information Modeling (BIM). The paper also provides three case studies of LEED Gold certified hospitals that incorporate green, BIM, and lean strategies, respectively, to illustrate the potential benefits of the proposed approach. The paper concludes that by adopting this framework, healthcare facilities can be delivered fast, effectively, and efficiently to enhance healing.
- Mansooreh Moghadam Et Al (2012) focused that; This paper proposes an integrated BIM/lean model for production line schedule of modular construction manufacturing. The authors expanded the MCM Pro computer tool for drafting in the MCM process to generate building components' schedule. Finally, a simulation model was generated to explore the proposed VSM. The results showed that the proposed model can significantly improve the efficiency and productivity of the modular construction manufacturing process by reducing waste, time, and resource usage.
- Mughees Aslam Et Al (2020) reported that; A framework has been proposed for selecting the most appropriate lean tool and also it improves the decision making capability of construction in selecting tools reduce the variability in planning design and process maintaining continuous flow of work and better visualisation of customers.
- Igwe Et Al (2020) study that; Reduce the occurrence of these wastes in developing countries such as Nigeria. The adoption of better management practices such as Total Quality Management (TQM) will help construction practitioners to continuously monitor the quality of construction activities to reduce the occurrence of defects and reworks and extra processing significantly. Adoption of technologies such as Building Information Modelling (BIM),and also last Planner System (LPS) would help reduce the waste of making do, lead to more collaborative planning (Javanmardi et al. 2018) and is expected to help reduce the waste of waiting due to more collaboration, communication and commitment by stakeholders to improve both the technical and managerial skills of construction personnel to improve their skills and competencies and help reduce the waste on non-utilized talent.

CONCLUSION

Lean principles play a pivotal role in optimizing space conditions, emphasizing Waste reduction, Pull, Flow, and zero errors. Building Information Modelling (BIM) is identified as a key enabler, particularly in building surveying, deconstruction projects, and undergraduate construction management education. The integration of Lean construction, Sustainability, and BIM is highlighted as essential for collaborative and sustainable project development. The research underscores the potential synergies between Lean principles and digital technologies like BIM and IoT in construction projects. The study on clash management in highway design showcases the ongoing exploration of Lean principles within the BIM process, identifying opportunities for improvement in clash detection and resolution. Overall, the findings emphasize the significance of cross-disciplinary collaboration, systematic planning, and the continuous improvement of processes to enhance efficiency and sustainability in construction projects.

The integration of Building Information Modeling (BIM) with existing frameworks, such as the Capital Works Management Framework (CWMF), demonstrates substantial potential for enhancing value, risk management, and overall project outcomes in publicly funded projects without compromising core principles. This paper contributes significantly by proposing a unified process approach for healthcare project delivery that incorporates green strategies, lean principles, and BIM. It identifies key factors influencing the use of these strategies and explores their relationships in the early stages of facility design. Additionally, the practical application of BIM and lean concepts in modular construction processes and oil & gas maintenance has shown remarkable improvements in efficiency and productivity. The proposed frameworks and models provide valuable insights for project teams, emphasizing the synergy between BIM and lean principles to streamline processes, reduce costs, and enhance project coordination across various industries.

To Developing a tool to perform Eurocode-compliant precast element design. To investigate the role of lean practices in enabling Building Information Modeling (BIM) adoption in construction projects. The study explores how lean practices can improve coordination within project teams and enable successful BIM adoption. To explore the potential synergy between lean construction and building information modeling (BIM) and how they can be used to improve construction processes. It focuses on productivity improvement activities at an Oil & Gas company and aims to identify primary problems related to the maintenance process

To investigate the association between Lean Design Management practices and Building Information Modeling (BIM) uses in the design of construction projects.

The investigation also emphasised federation strategy as an essential fundament at the beginning of the design process. It should consider clash detection prerequisites, tolerances, rules, and frequency of cycles; and how the resolution of clashes will be carried out, considering the stakeholders, actions, and root causes. The key root causes identified in this exploration represent a first step in the improvement of the existing taxonomies. Also, the identification of “intentional clashes” in practice is worth mentioning and calls for further investigation. The findings indicate that Lean can contribute to BIM processes, beyond BIM capabilities and features, supporting BIM process improvements. Until BIM and Lean (particularly considering Lean support for BIM) are implemented jointly as a standard practice in the sector, researchers and practitioners are encouraged to disseminate lessons learned and case studies, demonstrating how Lean techniques can improve BIM processes and providing evidence for higher quality outputs. For the Lean community to have a firmer place in the BIM community and discussions, and to be able to claim a mutual synergy between Lean and BIM, the wide range of intervention opportunities in BIM processes from a Lean perspective should be investigated further through a more systematic approach.

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