

Integration of Project Management Professional (PMP) and Building Information Modeling (BIM) in the Construction Industry: Systematic Review

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Abstraction

Infrastructure and economic growth depend heavily on the building sector. Using Building Information Modeling (BIM) and Project Management Professional (PMP) techniques together improves planning and execution, increases project quality and risk management, and improves performance while cutting expenses and time. The advantages of BIM-PMP integration, including better project execution, lower costs and risks, and greater team communication, are examined in this study. It also tackles organizational, cultural, and technological issues. Based on expert interviews, the research examines the links between BIM, PMP, and factors including cost, time, and quality using statistical analysis using IBM SPSS and AMOS. The results emphasize the importance of BIM in attaining timely, high-quality, and cost-effective project completions as well as the need of a BIM-PMP framework to optimize processes and accomplish project objectives. In order to increase project success, future approaches include creating new tools, improving training, and encouraging creativity.

Introduction

The construction sector is essential to economic expansion and infrastructural development, propelling global societal progress. Advanced approaches and technologies are becoming more and more necessary as projects become more complicated in order to improve project performance and efficiency. In this setting, Project Management Professional (PMP) and Building Information Modelling (BIM) approaches have become revolutionary tools. Better planning, design, and execution are made possible by BIM's full view of project data, which includes accurate 3D modeling and central database capabilities [1] [2]. With its structured project management methodology, PMP guarantees that projects are planned, carried out, and closed in a methodical manner while conforming to established standards and goals. [3] By using the advantages of both systems, integrating BIM and PMP processes promises to significantly enhance the

building sector. [4] The objectives of this integration are to increase communication and cooperation among project stakeholders, lower expenses, handle risks more skillfully, and improve overall project performance. [5] Despite the obvious advantages, organizational, cultural, and technological barriers prevent the construction sector from achieving the full potential of BIM and PMP integration. The purpose of this analysis is to examine how project management professional (PMP) and building information modeling (BIM) methods are integrated in the construction sector. [6] The main goals are to assess how combining BIM and PMP might enhance

construction project results and to examine how this integration affects project management, specifically with regard to coordination, communication, transparency, and risk management. [7] By comparing projects that use BIM and PMP with those that don't, the evaluation also aims to evaluate how these technologies affect project quality. Creating a

framework that outlines precise procedures, best practices, and recommendations for using BIM and PMP in the construction sector is another objective. The perspective concludes by identifying and analyzing the difficulties and barriers that businesses have while using BIM and PMP techniques and by providing suggestions for resolving these issues. [8] The theoretical and practical aspects of using BIM and PMP in building projects are covered in this study. It contains a thorough assessment of the advantages and difficulties of this integration, backed by expert interviews and statistical research. [9] Project planning and execution, risk and cost management, teamwork and communication, and overall project quality are important areas of concentration. However, the review may not cover all potential situations and uses of BIM and PMP integration since it is restricted to studies and instances that are accessible in the literature. [10] By tackling these goals within the parameters of the study, it hopes to provide insightful analysis and useful suggestions for improving project performance in the construction sector by integrating BIM and PMP.

2. Review of Literature Construction Sector The construction sector, which includes a broad variety of operations from planning, designing, and building to maintaining buildings and infrastructure, plays a crucial role in the economic growth and development of countries. [11] Despite its importance, the sector confronts several obstacles, including as complicated building technologies, high costs, constrained timelines, many stakeholders, and extensive information management. To overcome these obstacles, Building Information Modelling (BIM) has become a game-changing technology that significantly improves building processes and increases their efficiency. Building Information Modeling (BIM) BI [12] By enabling conflict detection and detailed visualization of the construction process, BIM, a digital technology that integrates various data and information throughout a project's lifecycle and provides a detailed and interactive 3D model of the project [13], facilitates improved coordination among stakeholders, increases productivity, and lowers errors and rework. [14] Because it facilitates efficient project scheduling, precise cost estimate, and effective communication, this technology is especially beneficial in big and complicated projects with many participants [1]. Benefits of BIM in the Construction Sector The construction sector has benefited greatly from the introduction of Building Information Modelling (BIM), which has changed how projects are carried out. The improved cooperation and communication that BIM promotes is among the biggest advantages. BIM facilitates better collaboration between architects,

engineers, contractors, and other stakeholders by offering a single platform for information exchange. Project execution becomes more effective as a result of this simplified communication, which lowers the possibility of misunderstandings. [15] BIM provides accurate cost estimation and budgeting in addition to enhancing communication. Precise quantity take-offs and cost calculations are made possible by the comprehensive information about construction materials and components that BIM models provide. This degree of detail ensures that financial resources are handled precisely throughout the project lifetime by assisting in the preparation of trustworthy project budgets and the efficient management of expenditures. [16] Additionally, project planning and visualization are greatly improved by BIM's 3D modeling capabilities. Project teams may use these features to model different situations and see the full building process. The capacity to see the project in a virtual setting facilitates better project scheduling, resource allocation, and early detection of any problems. Project management runs more smoothly and effectively when BIM is used to anticipate and handle issues before they develop. [17] The benefits of BIM in the construction sector are many and include better project planning, accurate cost management, and greater teamwork. These advantages highlight the revolutionary influence of BIM on building methods, opening the door to more successful and efficient project management. [18] Difficulties with BIM Implementation Implementing Building Information Modelling (BIM) in the building business is difficult despite its many advantages. The hefty upfront cost of adopting it is one of the main obstacles. It is necessary to make a significant investment in technology, software, and training, which may be costly, particularly for smaller businesses that could find it difficult to cover these up-front costs. [19] The development of skills and training is another difficulty. Because BIM requires a certain set of abilities and in-depth knowledge, it is necessary to either educate current employees or hire new BIM-proficient individuals. This procedure may be expensive and time-consuming, which makes deployment even more difficult. [20] Another major barrier is change management. It is often necessary to modify current workflows and procedures in order to implement BIM. The effective implementation of BIM may be hampered by resistance from staff members used to older approaches. It is crucial yet difficult to overcome this reluctance and guarantee a seamless transition to new working methods. Interoperability and data sharing also provide persistent challenges. It might be challenging to guarantee smooth data interchange across diverse software systems and among different stakeholders.

Potential data loss or mistakes might result from this difficulty, making the deployment process more difficult and weakening the efficiency improvements that BIM offers. These difficulties demonstrate how difficult it is to use BIM in the building sector. Even while the advantages are obvious, effective adoption demands meticulous preparation, financial commitment, and a readiness to adapt. [21] Construction project management may be greatly improved by combining Project Management Professional (PMP) techniques with BIM. While BIM gives extensive project visualization and data management capabilities, PMP delivers a defined set of skills and knowledge areas necessary for efficient project management. [22] By combining these two frameworks, project planning and execution can be streamlined, teamwork can be improved, and overall project efficiency can be raised. [23] Better risk management, precise cost control, and enhanced project lifecycle management are made possible by this synergy, which eventually results in effective project outcomes. [19] In conclusion, despite the many obstacles the construction industry encounters, the use of BIM, aided by PMP techniques, offers a viable solution. By improving stakeholder participation, cutting costs, and increasing project efficiency, this integration opens the door for more creative and prosperous building projects. [24] 3. Approach Bibliometric Data Collection Gathering academic literature from important databases like Web of Science and Scopus was part of the bibliometric data collecting process for this systematic review. These databases were chosen due to their extensive coverage of peer-reviewed publications in the domains of building information modeling (BIM), construction management, and project management. Particular keywords associated with "Project Management Professional (PMP)," [25] "Building Information Modelling (BIM)," and their incorporation into the construction sector were part of the search strategy. Advanced search searches were

run using Web of Science and Scopus, which combined keywords and Boolean operators to hone search results. To find highly referenced papers that provide insights into key works in the subject, citation analysis was used. The influence and applicability of individual papers and publications were evaluated using metrics including citation counts, h-index, and journal impact factors. [26] Content Analysis Data Gathering Articles chosen from the bibliometric data were examined in further detail using inclusion and exclusion criteria for the content analysis stage. Relevance to the construction industry's integration of PMP and BIM, publishing in peer-reviewed publications, and the availability of full-text English papers were among the inclusion criteria. [27] To find possibly relevant papers, titles and abstracts were first examined. Following their retrieval, full-text articles that satisfied the inclusion requirements underwent a thorough content analysis. In order to uncover recurrent themes, methodology used, important discoveries, and practical consequences of the integration of PMP and BIM, this includes qualitative evaluation approaches including thematic coding. [27] Articles were arranged according to They concentrate on collaborative techniques, BIM applications in building projects, project management methodologies (including PMP concepts), and technical advances. A thorough grasp of current trends, obstacles, and possibilities in integrating PMP and BIM in the construction sector was synthesized via this exacting selection and analysis process. [28] Overall, strong methodological criteria were followed in the data collecting procedure for both the bibliometric and content analysis components of the systematic review, guaranteeing the validity and trustworthiness of the results. The methodical approach made it easier to synthesize the body of information already in existence and offered suggestions for future lines of inquiry and useful applications in building project management. Analyzing Data Analysis of Bibliometrics

Table 1: The most cited researchers in previous studies

Cites	Authors
91	KChen, GFang
89	TANguyen, TANguyen
61	YRui, LYaik-Wah, TCSiang
51	APCChan, XMa, WYi, XZhou, F Xiong
19	AWaqar, IOthman, NShafiq, ADeifalla, AERagab, M Khan
15	MFSiu, REkyalimpa, MLu, SAbourizk

The most referenced scholars in earlier works are K. Chen and G. Fang, who have 91 citations each, closely followed by TA Nguyen, who has 89 citations. APC Chan, X. Ma, W. Yi, X. Zhou, and F. Xiong earned 51 citations, while Y. Rui, L. Yaik-Wah, and TC Siang received 61. MFSiu, R.Ekyalimpa, M. Lu, and S. Abourizk acquired 15 citations, while A. Waqar, I. Othman, N. Shafiq, A. Deifalla, AERagab, and M. Khan gathered 19 citations further down the list. As a result of their effect and influence in the subject, these scholars have made major contributions to the literature. [27]

Table2:Themostcitedresearchersinpreviousstudies

A.Count	Authors
21	KChen,GFang
18	TANguyen,TANguyen
15	YRui,LYaik-Wah,TCSiang
14	APCChan,XMa,WYi,XZhou,F Xiong
13	AWaqar,IOthman,NShafiq,ADeifalla,AERagab,M Khan

In terms of output, the most active researchers found in the literature are K. Chen and G. Fang, who have 21 publications each, closely followed by Tanguyen and Tanguyen, who have 18 publications each. With 15 publications, Y. Rui, L. Yaik-Wah, and TCSiang are renowned for their output. With 14 articles, APCChan, X. Ma, W. Yi, X. Zhou, and F. Xiong have made a substantial contribution. With 13 publications, A. Waqar, I. Ottman, N. Shafiq, A. Deifalla, AE Ragab, and M. Khan have also produced fruitful work. In their particular fields of expertise, these scholars have continuously advanced our understanding of the subject. [26]

Table3:Themostcitedresearchersinpreviousstudies

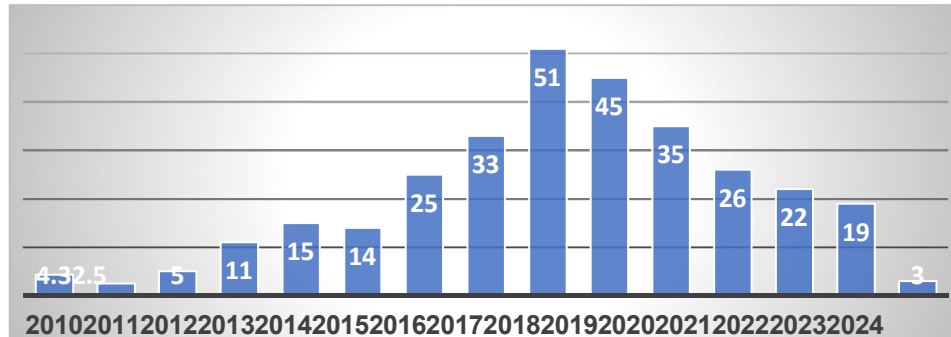
Cites	Publisher
33	Elsevier
32	e3s-conferences.org
29	etasr
26	eprints
25	polyu.edu.hk
25	ascelibrary.org

Elsevier is one of the top publications found in the study, with 33 citations, closely followed by e3s-conferences.org, with 32 citations. Eprints and polyu.edu.hk both have 26 citations, compared to 29 for the journal etasr. Furthermore, with 25 citations, ascelibrary.org is very noteworthy. These publications have contributed to the academic conversation in this area by helping to disseminate research results about the integration of Building Information Modeling (BIM) and Project Management Professional (PMP) in the construction industry. [28]

Table4:Keyreferencedstudies

Cites	Title	Year
51	Criticalreviewofstudiesonbuildinginformationmodeling(BIM) inprojectmanagement	2018
19	ImpedimentsinBIMimplementationfortheriskmanagementof tallbuildings:	2023
16	ConstructionProjectManagementBasedonBuildingInformation Modeling(BIM)	2021
11	Applyingregressionanalysistopredictandclassifyconstruction cycle.	2013
3	BuildingInformationModeling(BIM)forConstructionProject ScheduleManagement:AReview	2024
1	Analysisofthecurrentstatusandcomprehensiveapplication researchonBIMtechnologyinconstructioncost management	2024

The study on the integration of Building Information Modeling (BIM) and Project Management Professional (PMP) in the construction sector has heavily cited a number of important publications. The 2018 research "Critical review of studies on building information modeling (BIM) in project management" has the most citations (51). The article "Impediments in BIM implementation for the risk management of tall buildings" from 2023 comes next, and it has received 19 citations. While "Applying regression analysis to predict and classify construction cycle" from 2013 has earned 11 citations, "Construction Project Management Based on Building Information Modeling (BIM)" from 2021



has received 16 citations. Furthermore, the papers "Analysis of the current status and comprehensive application research on BIM technology in construction cost management" and "Building Information Modeling (BIM) for Construction Project Schedule Management: A Review" have been referenced three and one times, respectively, demonstrating their importance to the subject. Together, these studies provide insightful information on the use and difficulties of BIM in building project management.

Figure 1. Articles count per year

The "Articles count per year" bar chart shows the number of articles produced annually between 2010 and 2024. Research on the integration of Building Information Modeling (BIM) and Project Management Professional (PMP) in the construction sector has exhibited variable publication rates since 2010. There have been considerable increases in the number of papers published annually in 2017 and 2018, with maxima of 33 and 51 publications, respectively. The number of publications has gradually decreased in subsequent years, with 2024 displaying the fewest publications at three articles to date. Analysis of Content

Table 5: Main findings from previous studies

Count	S. Results
1	According to all of the above, determine the main search results
3	Recommend integrating BIM training into educational curricula.
2	Emphasize the need for widespread availability of BIM resources.
1	BIM tools (3D, 4D, 5D) improve project management efficiency.
2	Benefits include conflict detection, scheduling optimization, and cost management.
5	Reduces rework and enhances construction quality.
6	Identifies emerging trends in BIM application across project stages and disciplines.
5	Advocates for standardized BIM practices to enhance project development and management.
1	Discusses challenges in using BIM for risk management in tall buildings.
4	Proposes comprehensive BIM-based risk management frameworks.
2	Introduces regression analysis techniques for predicting construction cycle times.
1	Enhances efficiency and productivity in construction operations.
1	Provides a comprehensive approach to applying BIM in cost management.
4	Focuses on enhancing decision-making and automating processes.

1	.IntroducesBIM5Danddigitaltwintechnologiesforprojectcostcontrol and management.
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For each individual sustainable practice (S. Practice), the table shows how many times each sustainable practice (Count) has been used. The figures show how often each sustainable activity occurs, giving information about how popular and extensively each practice is in the sustainability space. Use sustainable and local resources, for instance: It is the most often used practice, having been used 15 times.

Table6:Detailedandsub-resultsandtheirdefinitions

Category	Definition	DetailedPractices	Nu
Integration of BIM into project scheduling enhances efficiency.	BuildingInformationModeling(BIM) is a digital representation of physical and functional characteristics of a facility,servingasasharedknowledge resourceforinformeddecision-making throughoutitslifecycle.[29]	1. Visualization 2. Simulation 3. Real-time Tracking	4 3 3
Recommends integrating BIM training into educational curricula.	BuildingInformationModeling(BIM) refers to the process of creating and managing digital representations of physical and functional characteristics of a built asset.[24]	1. Educational Integration 2. Skill Development: Curriculum Enhancement:	6 5 3
Benefits include conflict detection, scheduling optimization,and cost management.	BuildingInformationModeling(BIM) refers to a digital representation of physical and functional characteristics of a facility. It's used to facilitate efficientmanagementthroughoutits lifecycle.[30]	1. Conflict Detection 2. Scheduling Optimization Cost Management [31]	5 4 2
Advocates for standardizedBIM practices to enhanceproject development and management.	BuildingInformationModeling(BIM) is a process that involves creating and managing digital representations of physical and functional characteristics of a building or infrastructure.[32]	1. Streamlines ProjectDevelopment 2. Improves Collaboration EnsuresConsistency	5 4 2
Proposes comprehensive BIM-based risk management frameworks.	BuildingInformationModeling(BIM) is an advanced digital process that involvescreatingandmanagingvirtual models of construction projects, integratingvariousdatapointsand elements to enhance project planning, execution, and management.[33]	1. EffectiveRisk Identification 2. HolisticRisk Assessment Integrated Mitigation Strategies:	4 5 4

In the field of building project management, Building Information Modelling (BIM) develops as a revolutionary digital approach based on the synthesis of current research and academic ideas. BIM is an advanced technology for producing, maintaining, and disseminating digital representations of the functional and physical attributes of constructed assets [34]. By offering a common information base that facilitates informed decision-making over a facility's full lifespan, its incorporation into project scheduling greatly improves operational efficiency. [35]

The results also highlight how important it is to include BIM training into school curriculum. This calculated action is recommended in order to provide aspiring professionals the necessary tools to use BIM efficiently. By incorporating BIM into education, schools want to develop the skills required to use its capabilities in actual construction project situations, improving industry preparedness and competency overall. [36] Furthermore, the advantages of BIM are many and include crucial elements like accurate cost management, schedule optimization, and conflict identification. BIM technologies make it possible to

proactively identify conflicts, model building sequences to maximize scheduling effectiveness, and offer precise cost projections. These features not only make project operations more efficient, but they also greatly reduce risks and improve the overall quality of the project. [37]

Another important issue in the literature is support for standardized BIM procedures. Standardization is seen to be essential for bringing industry-wide procedures into harmony, which would enhance cooperation between many stakeholders and guarantee consistency in project results. [38] By creating uniform standards and processes that improve productivity and effectiveness, BIM has the ability to completely transform project development and management methods, as this demand for standardization highlights. [33]

Last but not least, the thorough frameworks for BIM-based risk management that have been suggested emphasize the strategic significance that this approach plays in anticipating and mitigating project risks. Throughout the course of a project, these frameworks support methodical methods to risk identification, assessment, and mitigation. Organizations may improve project resilience, overcome risks, and maximize project delivery by incorporating BIM into risk management processes. [39]

In conclusion, the integration of various academic viewpoints highlights the critical role that BIM plays in contemporary building project management. It develops educational curriculum, standard practices, and risk management techniques to drive the construction industry toward more innovation and sustainability, in addition to improving operational efficiency and project results.

1. Conversation The combination of results from both bibliometric analysis and content assessment indicates a comprehensive knowledge of the interaction between Project Management Professionals (PMP) and Building Information Modeling (BIM) in the construction sector, according to discrepancies from other research. The content analysis explored the qualitative elements, clarifying important findings and practical suggestions, while the bibliometric analysis offered a quantitative summary, emphasizing recurring themes and research patterns.

It has been shown that integrating PMP and BIM significantly improves project results, highlighting their complimentary responsibilities rather than a synergistic connection. Effective management techniques across quality, cost, and time dimensions are supported by PMP principles, while BIM

improves efficiency via sophisticated visualization, simulation, and real-time tracking in project scheduling. The separate but cumulative advantages of using both approaches in building project management are shown by this additive relationship. Implications

The theoretical ramifications highlight how project management techniques in the construction industry are changing and how integrating new technologies like BIM necessitates conforming to pre-existing frameworks like PMP. This calls for a paradigm change in educational curriculum and professional development programs toward multidisciplinary cooperation and skill integration. [40]

Practically speaking, construction companies are urged to plan the integration of PMP and BIM by coordinating with organizational objectives, improving staff preparedness, and cultivating cooperative procedures.

This method reduces the risks related to technology installation and change management while simultaneously increasing project efficiency and stakeholder satisfaction. [41]

It is recommended that future studies look at moderating variables that affect the link between PMP, BIM, and project performance that go beyond conventional measurements. Deeper understanding of the generalizability and scalability of integrated techniques in various construction settings will also be possible by broadening the scope to include other geographic, sectoral, or organizational contexts. [42] Restrictions by emphasizing a few important elements, such as:

The review notes a number of limitations present in the existing research, such as possible biases in data sources, methodological restrictions in statistical analyses, and differences in how PMP and BIM conceptions are operationalized across studies. These drawbacks highlight the need of thorough empirical verification and contextual modification of integrated frameworks in practical contexts. [43]

Several constraints are highlighted when examining how Project Management Professional (PMP) concepts and Building Information Modeling (BIM) may be integrated in building projects. First off, the study mostly summarized research from the construction sector, which would limit more general findings that might be applied to other industries or settings where PMP and BIM integration can show up in various ways. [44]

Second, possible biases are introduced by

methodological discrepancies across the examined research, such as changes in sample sizes and data collecting methods. These differences may have an impact on how solid the analysis's conclusions are, which would reduce the overall dependability of the combined results. [45]

Furthermore, the view's dependence on literature up to a certain date restricts its capacity to absorb subsequent developments or shifting patterns in PMP-BIM integration. Recent advancements in BIM applications or changes in project management techniques could not be completely represented in the synthesis results due to the quick pace of technical innovation. [46]

Last but not least, another limitation is the variation in the caliber and rigor of individual studies included in the view. The validity and generalizability of the results drawn from these research may be impacted by variations in the standards and methodology used. Therefore, these limitations highlight the need for careful assessment and interpretation of its results in both research and practical applications, even if the perspective offers useful insights into the present status of PMP-BIM integration in construction.

References

- [1] Ahmed, S., et al., BIM performance improvement framework for Syrian AEC companies. International Journal of BIM and Engineering Science, 2018. 1(1): p. 21-41.
- [2] Raza, M.S., et al., Potential features of building information modeling (BIM) for application of project management knowledge areas in the construction industry. Heliyon, 2023. 9(9).
- [3] Elgendi, A.F., et al., The vulnerability of the construction economic to COVID-19 and its probability impact in combating the virus. International Journal of BIM and Engineering Science, 2021. 4(1): p. 01-17.
- [4] Elhendawi, A., et al., Practical approach for paving the way to motivate BIM non-users to adopt BIM. International Journal of BIM and Engineering Science, 2020. 2(2).
- [5] Elhendawi, A.I.N., Methodology for BIM Implementation in KSA in AEC Industry. Master of Science MSc in Construction Project Management, Edinburgh Napier University, UK, 2018.
- [6] Evans, M., et al., Influence of partnering agreements associated with BIM adoption on stakeholder's behaviour in construction mega-projects. International Journal of BIM and Engineering Science, 2020. 3(1): p. 1-20.
- [7] Kalajian, K., S. Ahmed, and W. Youssef, BIM in infrastructure projects. International Journal of BIM and Engineering Science, 2023. 6(2): p. 74-87.
- [8] Shaban, M.H., and A. Elhendawi, Building Information Modeling in Syria: Obstacles and requirements for implementation. International Journal of BIM and Engineering Science, 2018. 1(1): p. 42-64.
- [9] Saleh, F., et al., A Framework for Leveraging the Incorporation of AI, BIM, and IoT to Achieve Smart Sustainable Cities. Journal of Intelligent Systems and Internet of Things, 2024. 11(2): p. 75-84.
- [10] Saleh, F., et al., An ICT-based Framework for Innovative Integration between BIM and Lean Practices Obtaining Smart Sustainable Cities. Journal of Intelligent Systems and Internet of Things, 2024. 14(2): p. 68-75.
- [11] Ahmed, S., et al., Possibility of applying BIM in Syrian building projects. Engineering for Rural Development, 2018. 17: p. 524-530.
- [12] Ahmed, S., et al., Analyzing the change orders impact on building projects. Journal of Engineering and Applied Sciences, 2016. 11(7): p. 1532-1537.
- [13] Roman, A., et al., Integration of data flows of the construction project life cycle to create a digital enterprise based on building information modeling. International Journal of Emerging Technology and Advanced Engineering, 2022. 12(1): p. 40-50.
- [14] Al Hammoud, E., Comparing BIM Adoption Around the World, Syria's Current Status and Future. International Journal of BIM and Engineering Science, 2021. 4(2): p. 64-78.
- [15] Alchoufi, S. and M. Shaaban, Proposal for a Project Management Office "PMO" in the Public Establishment of Housing in Syria. International Journal of BIM and Engineering Science, 2023. 7(1): p. 28-42.
- [16] Lepkova, N., et al., BIM implementation maturity level and proposed approach for the upgrade in Lithuania. International Journal of BIM and Engineering Science, 2019. 2(1): p. 22-38.

- [17] Rudwan, D.Y., R. Maya, and N. Lepkova, Quality Assurance of Construction Design and Contractual Phases in Syria Within BIM Environment: A Case study. *International Journal of BIM and Engineering Science*, 2023. 6(2): p. 55-73.
- [18] Farnsworth, C.B., et al., Application, advantages, and methods associated with using BIM in commercial construction. *International Journal of Construction Education and Research*, 2015. 11(3): p. 218-236.
- [19] Shker, Y. and L. Saoud, The Integration between Building Information Modelling and Scrumban. Case Study: FD3 Commercial Building in Damascus. *International Journal of BIM and Engineering Science*, 2023.
- [20] Safour, R., S. Ahmed, and B. Zaarour, BIM Adoption around the World. *International Journal of BIM and Engineering Science*, 2021. 4(2): p. 49-63.
- [21] Criminale, A. and S. Langar, Challenges with BIM implementation: a review of literature. in 53rd ASC annual international conference proceedings. 2017.
- [22] Sheina, S., et al., Integration of BIM and GIS technologies for sustainable development of the construction industry, in *International School on Neural Networks*, Initiated by IIASS and EMFCSC. 2022, Springer. p. 1303-1311.
- [23] Salman, N. and M. Hamadeh, The Integration of Virtual Design and Construction (VDC) with the Fourth Dimension of Building Information Modeling (4DBIM). *International Journal of BIM and Engineering Science (IJBES)*, 2023. 7(1): p. 08-27.
- [24] Abbas, A., Z.U. Din, and R. Farooqui, Integration of BIM in construction management education: an overview of Pakistani Engineering universities. *Procedia Engineering*, 2016. 145: p. 151-157.
- [25] Arslan, V., The Role of Certification on Project Management: Perspective of PMP Certified Project Managers. *Karaelmas Fen ve Mühendislik Dergisi*, 2024. 14(1): p. 36-47.
- [26] Abrabba, S.A., et al., A Bibliometric Systematic Analysis of Factors Affecting the Compliance of Residential Planning Standards and Regulations: A Conceptual Framework. *Civil Engineering and Architecture*, 2021. 9(3): p. 646-655.
- [27] Amrouni, K. and R.A. Arshah, Bibliometric analysis of the E-government studies with (UTAUT). in *Proceedings of the FGIC 2nd Conference on Governance and Integrity*, Kuantan, Malaysia. 2019.
- [28] Almutairia, F.L., et al., Bibliometric Study of E-Government in Kuwait.
- [29] Edirisinghe, R. and K. London, Comparative analysis of international and national level BIM standardization efforts and BIM adoption. in *Proceedings of the 32nd CIB W78 Conference*. 2015.
- [30] Barlish, K. and K. Sullivan, How to measure the benefits of BIM—A case study approach. *Automation in construction*, 2012. 24: p. 149-159.
- [31] Smith, P., BIM & the 5D project cost manager. *Procedia-Social and Behavioral Sciences*, 2014. 119: p. 475-484.
- [32] Teo Ai Lin, E., et al., Framework for productivity and safety enhancement system using BIM in Singapore. *Engineering, Construction and Architectural Management*, 2017. 24(6): p. 1350-1371.
- [33] Banawi, A., O. Aljobaly, and C. Ahiabale, A comparative review of building information modeling frameworks. *International Journal of BIM and Engineering Science*, 2019. 2(2): p. 23-49.
- [34] Kadi, A.J., et al., The Effect of Innovation Barriers on Construction Firms' Innovation Orientation. *European Proceedings of Social and Behavioural Sciences*.
- [35] Becker, R., et al., BIM—Towards the entire lifecycle. *International Journal of Sustainable Development and Planning*, 2018. 13(1): p. 84-95.
- [36] Younes, M., Achieving optimal lighting to improve the functional performance of the museum using computer simulation case study: Lattakia Museum in Syria. *International Journal of BIM and Engineering Science*, 2022. 5(2): p. 19-37.
- [37] Hammoud, E.A., Comparing BIM adoption around the world, Syria's current status and future. *International Journal of BIM and Engineering Science*, 2021. 4(2): p. 64-78.
- [38] Ahmed, S. and P. Dlask, The Gradual Transition to BIM in Syrian Companies. in *Creative Construction Conference 2018, CCC 2018*, 30 June-3 July 2018, Ljubljana, Slovenia. 2018.

- [39] Saada, M. and H. Aslan, The effectiveness of applying BIM in increasing the accuracy of estimating quantities for public facilities rehabilitation projects in Syria after the war. *International Journal of BIM and Engineering Science*, 2022. 5(2): p. 08-18.
- [40] Mashali, A., El tantawi, A. (2022). BIM-based stakeholder information exchange (IE) during the planning phase in smart construction megaprojects (SCMPs). *International Journal of BIM and Engineering Science*. 5(1): p. 08-19.
- [41] Raad, L., R. Maya, and P. Dlask, Incorporating BIM into the Academic Curricula of Faculties of Architecture within the Framework of Standards for Engineering Education. *International Journal of BIM and Engineering Science (IJBES)*, 2023. 6: p. 08-28.
- [42] Ahmed, S., Inovace stavebních procesů v Sýrii pomocí BIM. 2018.
- [43] Raad, L., Maya, R., Dlask, P., 2023. Incorporating BIM into the Academic Curricula of Faculties of Architecture within the Framework of Standards for Engineering Education. *International Journal of BIM and Engineering Science*. 6(2): p. 08-280168730.
- [44] Elhendawi, A., A. Smith, and E. Elbeltagi, Methodology for BIM implementation in the Kingdom of Saudi Arabia. *International Journal of BIM and Engineering Science*, 2019. 2(1).
- [45] Mrad, R., D. Jdeed, and S. Ahmed, Net-zero energy building using solar photovoltaic energy and modeling within BIM environment: Case study of Al-Ajrafe elementary school in Quneitra. *International Journal of BIM and Engineering Science*, 2023. 7(1): p. 58-71.
- [46] Dalloul, F. and L. Saoud, Proposing a framework for introducing the concept of engineering digitization to develop curricula: case study - Tishreen University, Faculty of Civil Engineering. *International Journal of BIM and Engineering Science*, 2023. 6(1): p. 34-51.
- [47]