engineering proceedings

Proceeding Paper

A Systematic Review of Client Satisfaction and Success Factors in BIM-Enabled Projects †

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† Presented at the 1st International Conference on Industrial, Manufacturing, and Process Engineering (ICIMP-2024), Regina, Canada, 27–29 June 2024.

Abstract: The adoption of building information modelling in construction projects has a transformative impact, driving improvements in collaboration, efficiency, quality, sustainability, and regulatory compliance throughout the project lifecycle. This systematic review examines client satisfaction and success factors in BIM-enabled projects. Building information has emerged as a transformative technology in the construction industry, promising enhanced collaboration, efficiency, and project outcomes. Understanding client satisfaction and the factors contributing to project success in BIM-enabled projects is crucial for stakeholders aiming to maximise the benefits of BIM adoption. Through a comprehensive analysis of existing literature, this review synthesises key findings related to client satisfaction levels, as well as the critical success factors influencing project outcomes in BIM-enabled environments. The review highlights the importance of effective communication, collaboration, stakeholder engagement, and technological infrastructure in ensuring client satisfaction and project success. Additionally, it identifies gaps in current research and offers recommendations for future studies to further advance our understanding of client satisfaction and success factors in BIM-enabled projects.

Keywords: building information modelling; collaboration; construction stakeholders; construction clients; technological infrastructure

Citation: Bamgbose, O.A.; Ogunbayo, B.F.; Aigbavboa, C.O.; Ogundipe, K.E. A Systematic Review of Client Satisfaction and Success Factors in BIM-Enabled Projects. *Eng. Proc.* **2024**, *76*, 33. https://doi.org/10.3390/engproc2024076033

Academic Editors: Golam Kabir, Sharfuddin Khan, Mohammad Khondoker and Hussameldin Ibrahim

Published: 21 October 2024

1. Introduction

The need to simplify construction complexity enabled adoption of building information modelling in various construction stages [1,2]. Building information modelling has revolutionised the construction industry in recent years by offering advanced digital tools for project planning, design, construction, and management [3]. As BIM adoption becomes increasingly prevalent worldwide, understanding its impact on client satisfaction has become a subject of significant interest among researchers, practitioners, and industry stakeholders [4]. Recently, there has been an increasing demand for integrated information databases in construction operations [5]. BIM-enabled projects facilitate stakeholders to contribute to a shared BIM platform, thus enhancing collaboration and value creation throughout the building life-cycle [4,5].

Building information modelling has emerged as a revolutionary technology in the construction industry, promising enhanced collaboration, efficiency, and project outcomes [3]. With its advanced digital tools for project planning, design, construction, and management, BIM has transformed traditional construction practices and paved the way for more integrated and streamlined project delivery processes [6–8]. Adopting BIM in construction projects introduces novel collaboration, visualisation, and data management approaches, potentially enhancing project outcomes and client experiences [9]. The adoption of BIM promotes integrated collaboration and communication among project stakeholders, creating a collaborative environment where multiple parties contribute to a shared model [10]. However, while numerous studies have examined the technical benefits of BIM, relatively few have focused specifically on its influence on client satisfaction metrics. By systematic findings from a wide range of studies, this review offers a comprehensive understanding of how BIM adoption impacts client satisfaction across various project phases and stakeholder perspectives.

2. Research Method

Through systematic findings from a wide range of studies, this review offers a comprehensive understanding of how BIM adoption impacts client satisfaction across various project phases. The insights gained from this review can inform industry practitioners, policymakers, and academics seeking to optimise project delivery processes, improve client relationships, and promote the broader adoption of BIM in the construction sector. Therefore, this review seeks to consolidate existing research findings, identify gaps in knowledge, and propose avenues for future research in this domain. Primary emphasis was placed on secondary data, mostly from online databases, including Google Scholar, ResearchGate, and ScienceDirect. Keywords relevant to the study's objectives, such as building information modelling adoption, BIM-enabled projects, stakeholders' contributions to BIM, and client satisfaction in BIM-enabled projects, were used to search for literature relevant to this study.

The initial search yielded fifty-four articles focusing on client satisfaction with BIM-enabled projects. After meticulously analysing these articles, thirty-five were found to address client and stakeholders' perspectives regarding BIM-enabled projects. The remaining seventeen articles offered a broader, global perspective on BIM adoption within the construction industry. Subsequently, the data extracted from these selected articles underwent a detailed content analysis, with the findings elaborated upon in the subsequent sections of this study.

3. Overview of Digital Construction Technologies

The advancement of technology within the construction sector has opened substantial avenues for enhancing project delivery [11]. The advantages offered by BIM have spurred numerous construction firms to invest in this innovative technology [12]. Implementing digital tools, processes, and methodologies in various construction operations to enhance construction planning, design, and management is becoming a trend in modern construction practices [13,14]. Building information modelling is one of the digital construction tools that has changed the traditional concept to a more complex approach via its robust tools for visualisation [3,15]. Also, it is a modern construction technology that deals with the design process [15,16]. It uses a system of three-dimensional (3D) models to coordinate construction activities from inception to completion instead of separate drawings. Its robust tool has also made it beneficial in the facilities management of properties [17]. Furthermore, BIM's collaborative way of storing, sharing, exchanging, and managing multidisciplinary information through the entire project lifecycle has improved communication processes between the project sponsors and other stakeholders in the entire phase of the construction [18]. The ability to visualise projects before actual construction has improved how stakeholders contribute their ideas and intentions at all stages of the construction, thus enabling proper project review when necessary [19]. Other digital construction tools are virtual design and construction, using digital simulation and virtual reality technologies to plan, simulate, and optimise construction processes [20]. Digital twins, virtual replicas of physical assets or systems that enable real-time monitoring, analysis, and infrastructure performance optimisation, are another modern trend in the construction industry [20,21]. Drones, augmented reality, and artificial intelligence are modern digital tools to improve everyday construction processes, especially on large construction sites [22].

3.1. Building Information Modelling-Integrated Projects

BIM-enabled projects leverage digital technologies to improve collaboration, efficiency, and decision-making across all stages of the project lifecycle, from conceptual design to operation and maintenance [23]. The BIM-based models are comprehensive databases containing vast information about a building's construction and performance [24]. BIM-enabled projects harness digital technologies to foster collaboration, streamline workflows, and support informed decision-making at every stage of the project lifecycle, ultimately delivering projects more efficiently, cost-effectively, and sustainably [25]. At the design stage, BIM allows stakeholders to create a digital representation of the project [26,27]. This enables architects, engineers, and other construction team members to collaborate more effectively, visualising and refining design concepts in a virtual environment [26]. This collaborative process allows stakeholders to explore various design options and make informed decisions to meet project objectives [27]. Furthermore, BIM implementation in engineering projects facilitates coordination among multidisciplinary teams, integrating architectural, structural, and MEP (mechanical, electrical, and plumbing) aspects into a single model [28,29]. This enables early identification and resolution of component clashes or conflict, thus minimising errors, and rework [28]. BIM has further played a lead role during the construction phase, using the robust digital model to prepare comprehensive construction planning and planning [30]. However, maintenance of BIM-implemented projects is easier by transitioning the BIM model into an asset for facility management [31]. Also, homeowners and facility users can leverage BIM data for maintenance planning, space management, and asset tracking, which can prolong the lifespan of the infrastructure and reduce operational costs [32].

3.2. Influence of BIM Usage in Construction Projects

The adoption of BIM in construction operations is seen as a solution to a number of inefficiencies in the construction sector such as improved collaboration among project stakeholders, thus enhancing communication and coordination of project information [33]. This often reduces misunderstandings and conflicts between the owner client and construction team members or other stakeholders on the project [34]. The BIM robust tool for visualisation aids in conveying design intent more effectively, improving communication between project teams and clients [35]. It can further aid stakeholders in exploring design alternatives and making informed decisions with respect to the visual project representation [35]. In addition, improved coordination, including clash detection through the BIM tool on construction projects, has contributed to cost and time savings in various construction projects [36]. Also, stakeholders in the construction sector observed that BIM adoption can improve project efficiency and streamline workflow, reducing project duration and costs [36].

Furthermore, implementing BIM in construction projects supports a comprehensive sustainability and lifecycle management strategy by integrating environmental analysis tools like energy simulation and lifecycle assessment [37]. This integration aids in designing more sustainable buildings and infrastructure. Moreover, BIM data can be utilised for facility management, supporting ongoing operations, maintenance, and renovations throughout the lifespan of the construction [38]. Finally, adopting BIM in construction projects helps to streamline regulatory compliance by providing accurate and up-to-date project information [39].

3.3. Stakeholders' Contribution to BIM-Based Projects

Implementing BIM in construction projects provides an arena for stakeholders to contribute their unique expertise and ideas at different stages of construction works, thus improving collaboration to achieve project objectives efficiently [40]. It further enhances decision-making and delivers a high-quality environment. The robust data from the BIM model informs every stakeholder in construction operations of what to do and how to do it, simplifying construction workflows [41]. According to [42], BIM is a centralised platform for project information, allowing stakeholders to access and share data in real time. This ensures that all team members and project sponsors can access the latest project information, reducing the risk of errors and miscommunication [42].

The ability of the BIM model to analyse energy simulations, detect clashes in components, plan and sequence projects, and estimate project costs enables construction project stakeholders to analyse design alternatives, assess performance criteria, and optimise design solutions to achieve project objectives more efficiently [43]. In addition, facility managers can make informed decisions in the maintenance, renovations, and modification of an existing structure using BIM data prepared for such infrastructure [44].

3.4. Evaluation of Client Satisfaction Level and Success Factors in BIM-Enabled Projects

According to [45], the most significant success factors in BIM adoption relating to the client's acceptance of BIM implementation in construction projects are successful project delivery and improved coordination and collaboration in the design, construction, and management phases of project development [46]. Mounting concerns over global environmental degradation have catalysed the predominant objective of integrating sustainable design principles in contemporary architectural discourse, with heightened significance attributed to sustainable development imperatives due to the escalating urgency of global climate change, thereby driving the adoption of building information modelling (BIM) in modern construction projects as stakeholders pursue innovative solutions to address environmental impacts and promote sustainable practices within the built environment [46]. Meanwhile, [47] identified major success factors of BIM as effective management of projects, leadership, and improved coordination among project stakeholders. Furthermore, project stakeholders perceived several human-related BIM implementation factors, such as improved teamwork, collaboration, and early involvement of contractors, as critical success factors for BIM-enabled projects [48]. According to [8], the adoption of BIM in construction projects has improved client satisfaction through improved quality output, effective management of limited resources, and realistic cost estimating.

Moreover, the project success and client satisfaction measures are anchored in the iron triangle: time, quality, and cost. Numerous clients perceive BIM-enabled projects to adhere more closely to schedules and budgets while delivering higher-quality project outcomes than non-BIM-implemented constructions [49]. The adoption of BIM in construction projects has been observed to foster trust, thereby enhancing collaborative relationships between clients and consultants. This is achieved through demonstrated commitment, teamwork, and effective communication, all of which play integral roles in contributing to the project's success [50]. Also, BIM facilitates an easy understanding of clients' requirements [50]. Clients' satisfaction becomes critical since the client defines the responsibility of the contractor and sometimes specifies the level of BIM to be used to execute the proposed projects [51]. Integrating BIM in construction projects enables project owners to select their choice of BIM contractor based on their capabilities tailored to the project's complexity [45]. Choosing contractors with higher information integration and multifunctional advantages for complex projects and focusing on executive support and contractor capabilities for simpler projects facilitate project accuracy and higher-quality output [52]. Table 1 below summarised the client satisfaction and success factor in BIM-enabled projects.

Table 1. A review of client satisfaction and success factors in BIM-enabled projects.

SN	BIM Client Satisfaction and Success Factors	Authors
1	Improved coordination and collaboration	[8,45,46,50]
2	Improved project quality	[8,46]
3	Sustainable design	[38,43]
4	Effective project management	[47]
5	Early engagement of stakeholders	[48]
6	Resource management	[8,49]
7	Cost management	[8,49]

Table 1. *Cont.*

SN	BIM Client Satisfaction and Success Factors	Authors
8	Quality management	[49]
9	Cost management	[49]
10	Enhanced confidence	[50]
11	Enhanced work breakdown structure	[51]
12	Selection of project contractor	[51]

4. Implication of the Study

The research represents a comprehensive literature review focused on client satisfaction levels and success factors associated with BIM-enabled projects. BIM adoption is a pivotal factor with significant implications for diverse construction projects. The study underscores the transformative potential of BIM across the construction industry, particularly emphasizing its capacity to enhance project outcomes. By delving into the findings of this research, stakeholders can gain valuable insights into optimizing BIM adoption in various construction projects, with a particular emphasis on its application in developing countries. The identification of success factors, including but not limited to improved communication, robust collaboration among project stakeholders, and the establishment of clear project objectives, underscores the positive impact of BIM implementation on client satisfaction levels. A crucial aspect highlighted by the study is the importance of clearly understanding project objectives. This clarity facilitates streamlined workflows and minimises project rework while improving project cost and time management. Such enhancements elevate client satisfaction and increase profitability and return on investment for both clients and small-to-medium construction enterprises. Furthermore, the research underscores the broader significance of digital construction practices in modern construction methodologies. The findings emphasise the increasingly indispensable role of BIM in shaping the future of construction projects, offering a pathway towards greater efficiency, sustainability, and client satisfaction. This study serves as a clarion call for stakeholders to recognise and harness the potential of BIM-enabled projects. By implementing the insights gleaned from this research, stakeholders can propel their projects towards greater success, driving positive outcomes and advancements in the field of construction.

5. Conclusions and Further Research

The research conducted provides a thorough examination of the literature surrounding client satisfaction levels and success factors in BIM-enabled projects. As the construction industry evolves, the adoption of BIM has become integral to project success. This study highlights the transformative impact of BIM on construction practices, emphasising its ability to enhance project outcomes and client satisfaction. BIM adoption introduces innovative digital tools and methodologies that streamline project planning, design, construction, and management processes. By synthesizing findings from a wide range of studies, this review offers valuable insights into how BIM adoption influences client satisfaction across various project phases and stakeholder perspectives. These insights are particularly relevant for industry practitioners, policymakers, and academics seeking to optimise project delivery processes and promote broader BIM adoption. Key findings from the review underscore the importance of clear project objectives, effective communication, and robust collaboration among project stakeholders. These factors contribute significantly to client satisfaction and overall project success in BIM-enabled projects. Furthermore, the review identifies success factors such as improved teamwork, early contractor involvement, and the availability of trained professionals using BIM tools, all of which play crucial roles in driving project success. Importantly, the study suggests that BIM adoption is not limited to complex projects but can also benefit simpler projects, promoting widespread adoption across different project types. By leveraging the insights gained from this research, stakeholders can enhance project accuracy, streamline workflows, and ultimately achieve greater profitability and return on investment.

This research underscores the transformative potential of BIM-enabled projects in the construction industry. By embracing BIM and implementing the insights gleaned from this study, stakeholders can drive positive outcomes, improve client satisfaction, and advance the construction field towards greater efficiency and sustainability. Further research can be carried out in selected geographical settings to ascertain the success factors and satisfaction of clients in BIM-enabled projects.

Author Contributions: Conceptualization, O.A.B.; methodology, O.A.B., B.F.O., C.O.A. and K.E.O.; validation, B.F.O. and C.O.A.; investigation, O.A.B.; resources, O.A.B. and K.E.O.; data curation, O.A.B.; writing—original draft preparation, O.A.B.; writing—review and editing, B.F.O. and C.O.A.; visualization, C.O.A.; supervision, B.F.O. and C.O.A.; project administration, B.F.O. and C.O.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: No new data were created.

Conflicts of Interest: The authors declare no conflicts of interest.

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