A Conceptual Framework for BIMxCHAIN Application to Reduce Construction Disputes

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Abstract. Construction disputes, which are a result of miscommunication, poor coordination, lack of transparency, and ineffective resource management, particularly in complex public sector projects, continue to pose persistent challenges for the construction industry. This conceptual article suggests a conceptual framework for BIMxCHAIN, a digital solution that integrates Supply Chain Management (SCM) principles and Building Information Modelling (BIM) to reduce these challenges. Stakeholder engagement, transparency, real-time information sharing, visual communication, and efficient resource allocation are all promoted by the framework, which is founded on collaborative working principles and systems theory. The novelty of BIMxCHAIN lies in its multi-phase, traceable process that distinctly integrates BIM with SCM, unlike previous models which treated them as separate domains. BIMxCHAIN enhances transparency, real-time collaboration, and integrated stakeholder planning through a structured and digitalised workflow that addresses persistent implementation bottlenecks in public projects. The framework advances smart infrastructure in the construction sector by supporting Malaysia's Twelfth Plan (RMK-12) and harmonising with Sustainable Development Goal 9. Ultimately, this study establishes the foundation for future empirical validation and practical application in the Malaysian public construction environment by bridging BIM and SCM practices in dispute reduction.

Keywords: BIMxCHAIN, Construction Disputes, Building Information Modelling (BIM), Supply Chain Management (SCM), Public Infrastructure Projects

1 Introduction

Particularly on public sector projects that necessitate a substantial number of collaborators, construction disputes maintain their prevalence. In Malaysia, the demand for integrated project delivery systems has increased due to the complexity of government

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infrastructure projects [1]. Supply Chain Management (SCM) and Building Information Modelling (BIM) are underutilised, despite their potential to enhance communication and reduce waste [2]. The objective of this study was to ascertain the necessity for a digital solution that integrates BIM and SCM to reduce disputes during project delivery.

In the Malaysian public sector, infrastructure development is often characterised by complex, multi- layered regulations, fragmented workflows, and the need for coordination among diverse stakeholders [3]. These conditions frequently trigger construction disputes, which stem from communication breakdowns, uncoordinated deliverables, and misaligned project expectations [4]. The consequences often include contractual friction, financial losses, and project overruns [5].

The public construction sector in Malaysia persists in experiencing insufficient resource allocation planning, a lack of transparency, and poor communication, resulting in disputes, cost overruns, and project delays [6]. Despite the existence of digital tools such as SCM and BIM, they are unable to reduce disputes due to their incompatibility [7]. Coordination, clarity, and decreased disputes can only be achieved by integrating these technologies into a digital framework. Therefore, this investigation proposes a conceptual framework to address the deficiencies of the BIMxCHAIN application.

This study aims to determine the type of digital framework that can reduce disputes in Malaysian public construction projects by integrating BIM and SCM. In addition, it is intrigued by the potential of this framework to address substantial challenges that may arise during project delivery, including inadequate coordination, inefficient resource utilisation, and poor communication. This study aims to reduce disputes in Malaysian public sector construction projects by creating a conceptual framework for the BIMxCHAIN application that integrates BIM and SCM principles.

This research concentrates on construction projects within the public sector of Malaysia, with a particular emphasis on government organisations such as the Public Works Department (PWD). Given that these projects frequently encounter issues and that the Twelfth Malaysia Plan (RMK-12) promotes increased transparency and digitisation, the scope is justified [8].

There is an increasing interest in the construction industry in adopting digital technologies; however, there is a lack of research that has identified a method to integrate BIM and SCM in order to reduce disputes. The purpose of this study is to bridge the gap and lay the groundwork for the development of digital tools, including BIMxCHAIN, that will be beneficial to both theory and practice. Policymakers, project managers, technology developers, and clients in the public sector who seek to improve the coordination, accountability, and delivery results of construction projects are among the beneficiaries.

2 Challenges in Implementing BIMxCHAIN in Construction Projects

Construction projects operate more efficiently as a result of the BIMxCHAIN software, which incorporates the principles of Supply Chain Management (SCM) and

Construction Information Modelling (BIM). The construction industry is of the opinion that dispute can be alleviated by promoting honesty, resource management, and effective communication.

While employing BIM, it is easier to collaborate in real time and observe objects. It also makes communication between individuals easier. According to [9], SCM effectively manages data, materials, and decisions throughout the project. Together, these components allow the BIMxCHAIN platform to monitor project progress, resolve issues before they worsen, and make the requisite adjustments. This is particularly beneficial for public sector initiatives that are considered complex, necessitate strict adherence to the law, and involve multiple individuals.

Figure 1 illustrates that the operation of the BIMxCHAIN application consists of six interrelated activities: identifying the root cause, defining the subcategory, recommending an SCM tool, formulating an action plan, monitoring and evaluating, and delivering ongoing feedback. The digital elements and user behaviours linked to each phase signify the principal causes of disputes arising in construction projects. Miscommunication, insufficient coordination, and inadequate resource planning are systematically addressed through targeted digital interventions.

Fig. 1. The BIMxCHAIN App Workflow.

BIM-SCM solutions that are integrated have significant potential; however, prior research has suggested that certain issues must be addressed prior to their implementation. Construction workers are resistant to change, there are no common protocols, and the software systems do not function together [10]. Some of the issues are as follows. Integrated products are difficult to use due to internal company issues such as inadequate technical expertise, inadequate training, and inadequately designed processes. Furthermore, the adopting of digital technologies and the completion of projects are further complicated by the public sector's numerous issues and bureaucratic red tape. In numerous studies, there is no apparent mechanism for BIM and SCM to collaborate in order to resolve issues. Ensuring that a model such as BIMxCHAIN is utilised appropriately and functions properly is essential.

3 Enhancing BIMxCHAIN Effectiveness through SCM Integration

According to [11], supply chain management (SCM) is the strategic coordination of all the resources and procedures necessary to transport a good or service from the site of sale to the point of delivery. [12] assert that supply chain management (SCM) guarantees that all stakeholders involved in a construction project, such as contractors, suppliers, and clients, reach a consensus regarding the manner in which tasks will be completed, the information that will be exchanged, and the necessary supplies. This is particularly crucial for large public initiatives, as they are frequently The implementation of SCM principles can reduce plagued by issues and delays [13]. Delays, enhance cost management, and increase stakeholder accountability in construction projects [14]. Real-time monitoring and process improvement are made practicable by SCM. In order to integrate digital technologies like BIMxCHAIN into the construction industry, this is necessary.

BIMxCHAIN's efficacy is substantially improved by SCM, which offers the logistical support necessary to capitalise on BIM insights. In accordance with [15], BIM offers designers an abundance of information that simplifies the coordination and visualisation of design. This data is supplied on schedule and utilised at the designated location, as guaranteed by SCM. [16] posits that SCM enables BIMxCHAIN to effectively manage material flow, assign tasks to employees, and adjust to schedule changes without causing future concerns. A platform that integrates BIM and SCM, BIMxCHAIN enables technical teams and supply partners to communicate more effectively and resolve issues before they occur. In the public sector, this integration assists in the expeditious resolution of disputes and the completion of projects.

4 Theoretical Foundation

This investigation is primarily guided by two primary concepts: systems theory and collaborative working theory. Building projects are intricate systems composed of interconnected components, such as teams, responsibilities, and tools, as prescribed by

systems theory. The appropriate coordination of these components is essential for the system's operation [17]. BIMxCHAIN aims to unite individuals and processes that are typically disjointed. In contrast, [18] argue that the collaborative working theory is ineffective unless all project participants possess mutual trust, are capable of communicating, and share similar objectives. The development of a digital infrastructure that enables real- time communication and collaboration among project participants is facilitated by this concept. Both theories could be employed to investigate the potential of digital technology to ensure that construction projects are relatively trouble-free.

A single issue, such as the acquisition of supplies or the interaction with others, could potentially halt the entire process in the constantly evolving construction industry. Therefore, this endeavour implements systems theory [19]. BIMxCHAIN offers a centralised digital infrastructure that enables the coordination of efforts to resolve these issues. In addition, the collaborative ethic is crucial because it reduces the likelihood of dispute by facilitating effective communication among all stakeholders [20]. The principles of this technique are upheld by the visualisation tools, communication interfaces, and shared data environments of BIMxCHAIN. The conceptual framework is founded on these two concepts, which enhance construction projects by merging technology and altering behaviour.

Systems theory was chosen over alternatives such as lean construction or socio-technical systems theory because it provides a holistic view of the construction project as a dynamic and interdependent network, where disruption in one area can destabilise the entire system [21]. Collaborative working theory, in contrast, better captures the human-centric aspects of trust, communication, and shared goals, making it more effective than contract-centric or transactional models in addressing stakeholder misalignment [22]. While lean construction emphasises waste reduction and continuous improvement [23], it often lacks the systems-level abstraction needed to manage large-scale public sector complexity. Similarly, socio-technical systems theory accounts for the interaction between people and technology [24], but it tends to fall short in guiding inter-organisational collaboration. Therefore, the selected theories better align with BIMxCHAIN's dual emphasis on technological integration and stakeholder collaboration.

5 Constructs and Issue Connection

Numerous factors that are interconnected may constitute complications on construction locations. A few of the issues include fragmented knowledge sharing, poor communication, disorganised resource planning, and a lack of openness [25]. In public sector structures, these issues are more severe due to the mandatory compliance of numerous employees with stringent regulations, as per [26]. When no unified system is in place, it is common for expectations to be misaligned, modification orders to be postponed, and materials to be delivered late [27]. Because there is no integrated digital technology, stakeholders are more likely to experience miscommunication and dispute when they are required to implement disparate processes [28]. To enhance the efficacy

of the building environment and its dispute resolution capabilities, it is imperative to address these fundamental issues.

All of the subjects that were addressed, such as transparency, cooperation, communication, and anticipated resources, formed the basis for the BIMxCHAIN concept. The framework includes shared data environments to tackle communication issues, resource monitoring systems to guarantee that tasks are completed on time, and visual displays to provide clarity [28]. A targeted solution is provided by the framework, which distinguishes it from a generic digital solution by connecting each of these issues to the specific causes of their occurrences.

As illustrated in Figure 2, several components such as miscommunication, poor coordination, and ineffective resource management are deliberately positioned outside the core system boundary to denote their status as overarching problem dimensions. These elements represent systemic challenges that, while not directly controlled by the digital tools within the framework, exert significant influence on construction outcomes. The demarcation of this boundary conceptually distinguishes internal operational features from externalised issues. These external issues are addressed through internal BIMxCHAIN functionalities such as real-time modelling and workflow synchronisation, which serve as targeted interventions. Furthermore, the inclusion of directional arrows elucidates the interdependencies between external challenges and internal mechanisms, thereby reinforcing the framework's adaptive capacity in mitigating the root causes of construction disputes.

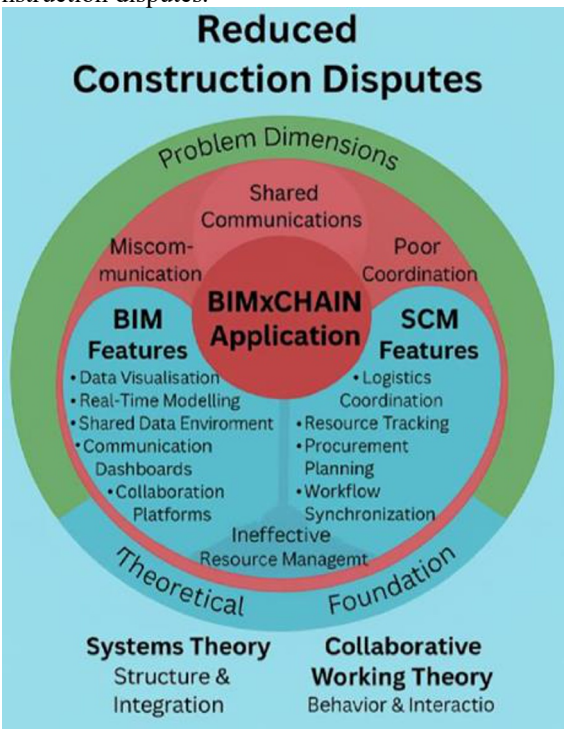

Fig. 2. Conceptual Integration of BIM and SCM Attributes to Address Dimensions of Construction Disputes.

Given that the conceptual paradigm is susceptible to change, it is both practical and efficient. In a planned manner, this approach enables Malaysian government construction projects to expedite project completion and reduce disputes. The BIMxCHAIN conceptual framework, seen in Figure 2, amalgamates components of Supply Chain Management (SCM) and Building Information Modelling (BIM) to tackle three principal challenges: insufficient resource management, suboptimal coordination, and miscommunications. The program, based on collaboration and systems theory, allows users to share information, monitor resources, and coordinate actions. The theoretical basis of the proposed framework is reinforced by the direct relationship between these features and the underlying causes of problems in the Malaysian public construction sector.

6 Conclusion

One of the primary objectives of this investigation was to establish a conceptual framework for the BIMxCHAIN software. Supply Chain Management (SCM) and Building Information Modelling (BIM) are integrated in this program to help the Malaysian public sector prevent construction-related disputes. To ascertain the primary causes of the discrepancies and to verify that the framework is consistent with the responsibilities of SCM and BIM, we conducted a thorough review of the literature. The foundation of the framework is based on the concept of collaboration and systems theory. Stakeholder communication tools, shared data environments, and real-time monitoring are all essential components of the system's approach. Potential issues are intended to be addressed by all of these following the project's completion.

Since the issue is so theoretical, it is difficult to make generalisations from real-world facts. We are uncertain about the efficacy of the proposed structure, as it has not yet been implemented. The study's conclusions may not be applicable to other types of structures, as it exclusively examined public sector buildings in Malaysia. A comprehensive understanding of numerous real-world issues and the perspectives of users may not be achieved through the sole use of secondary data.

In the absence of empirical validation, the operational effectiveness of the proposed conceptual framework for the BIMxCHAIN application to reduce construction disputes remains theoretical. Accordingly, future research should prioritise implementation-based pilot testing involving key public sector agencies to assess its real-world applicability. A mixed-method research design that integrates simulations, system log analyses, and stakeholder interviews is recommended to obtain a comprehensive understanding of implementation dynamics. Particular emphasis should be placed on evaluating the framework’s capability to pre-emptively identify dispute signals, coordinate inter- organisational logistics, and support adaptive governance within complex construction environments. Future research that incorporates stakeholder-driven validation, such as real-time simulations or pilot studies, will be more effective because they will receive feedback on the system's implementation and demonstrate its potential in the real world.

Further investigation is required to explore the potential implementations of the BIMxCHAIN architecture in a variety of domains and project types. Significant distinctions may exist between the implementation of new technology in commercial endeavours and public initiatives. In order to enhance implementation strategies, it may be beneficial to take into account human-centered attributes, including a collaborative culture, trust, and a desire to resist digitalisation. In addition, you may wish to investigate more advanced alternatives, such as the AI-powered analytics provided by BIMxCHAIN, which can help you anticipate potential problems.

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