Permission Blockchain-BIM Framework For Construction Dispute Prevention

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Abstract

Construction projects frequently face disputes caused by unclear documentation, conflicting design versions, and accountability gaps among stakeholders. While Building Information Modeling (BIM) enhances collaboration, it currently lacks the immutable audit trails necessary for legal evidence. This paper explores the integration of blockchain technology with BIM to create transparent, tamper-proof systems for dispute administration. This study proposes a Blockchain-Enabled BIM Dispute Resolution (B-BIM-DR) architecture using Hyperledger Fabric. The framework maps contractual dispute clauses to smart contract logic and defines a three-stage data flow Pre-construction, Construction, and Closeout compliant with ISO 19650 information management standards. Two illustrative scenarios, analyzing dispute contexts from the Dubai Creek Tower and Hong Kong International Airport, are utilized to verify the logical consistency of the framework. The proposed architecture demonstrates how automating the "Initial Decision Maker" and "Mediation" phases via smart contracts provides a legally robust mechanism for data-driven conflict management, theoretically reducing the time required for evidence assembly and arbitration.

Keywords –

Keywords: Blockchain, BIM, Dispute Resolution, Smart Contracts, Transparency

1 Introduction

The construction industry is undergoing rapid digital transformation, with Building Information Modeling (BIM) emerging as a central technology for collaboration, visualization, and project coordination. BIM enhances data integration across disciplines, enabling improved design accuracy and real-time decision-making [1]. However, despite these technological benefits, construction disputes remain a persistent challenge, often stemming from unclear documentation, conflicting design versions, and accountability gaps among stakeholders [2]. Globally, construction disputes significantly erode project value. According to the Arcadis Global Construction Disputes Report [3], the average dispute costs approximately USD 42 million and lasts over a year, emphasizing the critical need for transparent and tamper-proof information management systems. While BIM facilitates information flow, it lacks the inherent mechanisms to ensure that project data are immutable, legally verifiable, and traceable across multiple stakeholders [4]. Blockchain Technology (BCT), a decentralized and immutable digital ledger, offers a potential solution to this critical trust deficit. When integrated with BIM (B-BIM), blockchain can record every transaction, design change, and approval as a time-stamped, tamper-proof entry [5], [1]. This integration can revolutionize how project records are managed and how disputes are prevented or resolved [6].

2 Literature Review

The integration of blockchain with BIM, often referred to as B-BIM, is gaining recognition as a transformative approach for achieving transparency, data integrity, and accountability in construction project management. Blockchain's core properties, decentralization, immutability, and distributed consensus, make it ideal for ensuring that data shared across project participants cannot be altered retroactively [7].

In addition to transparency and immutability, various researchers argue that blockchain can be viewed as a trust infrastructure between BIM based collaboration, thus replacing traditional central authorities with cryptographic consensus developed among distributed nodes. As an example, [8] show that specifically, multiparty transactions, accountability requirements, and information asymmetries inherent in construction projects are the areas where a distributed ledger architecture fits best and, therefore, blockchain is a logical way to handle BIM-related data transfer through the building life cycle.

The latest systematic reviews expand the theoretical framework in the field of BIM-blockchain integration. [12] enter this conversation in the Journal of Construction Engineering and Management with an article in the form of a review that is an introduction to the field of mixed method, called When BIM Meets Blockchain, identifying the main themes of integrations, i.e., information management, payment and procurement, contract administration, and collaboration. According to their findings, BIM and blockchain interaction is not a simple tool convergence, but rather the essential restatement of responsibilities, approval procedures and records keeping, where the latter are encoded as tamper-free transactions pinned on model-based directories.

The view is further supported by [9], who investigate the idea of blockchain integration into the construction sector in a systematic survey of blockchain use and blockchain implementation barriers, discovering that BIM-inspired scenarios can be seen as a specific type, especially in the environment where trust, traceability, and coordination among many stakeholders are essential.

2.1 Early Conceptual and Review Studies on B-BIM

The conceptual and review studies of B-BIM will be presented in the very first chapter of the work. The possibilities of blockchain to enhance the reliability of data and the confidence of stakeholders in construction management were initially described in the early conceptual research by [8]. Later on, [10] conducted a review of its development.

Based on the previous works, [11] provide one of the first systematic reviews of available literature on the adaptation of Building Information Modelling (BIM) and blockchain technology in the conditions of project delivery. Their trajectory of analysis shows that there is a spectrum of application cases, such as smart contracts, supply chain traceability, and records of immutable models, with much conceptual potential, but with a significant lack of standardization and actual application. [12] elaborate on this discussion with the introduction of bibliometric techniques with the help of qualitative analysis, showing that the discourse has shifted, leaving the theoretical to the applications fields that include payments, procurement, and digital twins, but most of the studies are in the proof-of-concept phase.

[13] presented an extensive overview of the implementation of blockchain in the BIM processes and highlights that despite the current academic interest, the prevalent adoption of it in the industry is impeded by legal, organizational and technical concerns. All such initial conceptual and review works provide the theoretical basis of Building-Blockchain Integration Modelling (B-BIM). They thus highlight the need to create more action oriented, dispute resolution-oriented frameworks, including the one presented herein.

2.2 Empirical Applications: Traceability, Procurement, Claims and Payments

More recent empirical studies have given importance to the role of blockchain in terms of enhancing project traceability and automation. As an example, [14] created a document tracking system that uses a blockchain to automatically document any changes in the construction documents and thereby verify any claim. In China, Xiong’an New Area, [15] presented a fund management model, which utilizes blockchain. Their work showed that this model improves financial transparency and auditability. In a similar effort, [16] designed a Blockchain-BIM Automated Procurement System (BBAPS) that eliminates procurement bias by recording every transaction immutably.

The note of the present study is particularly relevant since a corresponding model is the Block-Based Automated Procurement System (BBAPS) proposed by [16] according to which Building Information Modelling (BIM) elements are used to designate procurement items and then utilize blockchain technology and smart contracts to independently assess and award contracts. Every single decision is stored in the blockchain and thus provides a clear and immutable history of purchase operations. The latter is an example of the potential of B-BIM to eliminate conflicts based on the perceived unfairness or vagueness of the awarding criteria.

At the same time, blockchain-based claims and dispute management tools have been developed by the Korea Society of Civil Engineers (KSCE). In the journal of civil engineering, [14] presented an automated construction documentation tracker and extraction based on blockchain with a specific focus on claim and dispute solutions. The system tracks the document transfers via email, creates engine blockchain transactions associated with every relevant event and supports the historical tracking and the authenticity verification. With this contribution, it is represented that blockchain can provide chronological, tamper-evident records that directly help in resolving disputes and legal complaints.

Empirical studies on the automation of payments further highlight the potential of blockchain in the field of BIM to reduce the amount of dispute. [7] presented payment schemes that depend upon smart-contracts to activate payments upon certified progress measurements using BIM and reality-capture data. These processes reduce one of the most typical bases of building arguments consisting of delayed or contracted payments, by dispensing funds dependent on objectively verifiable computer manifestations.

2.3 Governance, Distributed Common Data Environments (CDEs) and City-Scale Applications

From a governance perspective, [17] proposed blockchain-based frameworks for City Information Modelling (CIM) to enhance data reliability in urban development. [18] further demonstrated blockchain's role in Hong Kong's infrastructure projects, identifying significant opportunities in automated payments and contract enforcement.

[19] suggested a decentralized CDE architecture, which incorporates blockchain and IPFS in the domain of Common Data Environments (CDE). The infrastructure is structured so that storing voluminous BIM files that are controlled by IPFS is separated into the storage of a transaction log on the blockchain, establishing a scalable infrastructure where every model revision and the metadata associated with it can be tracked without unnecessarily burdening the blockchain. Such a strategy is particularly relevant to Building-BIM (B-BIM) dispute resolution since it provides a powerful platform of maintaining the historical record on design modification and approvals on a large scale.

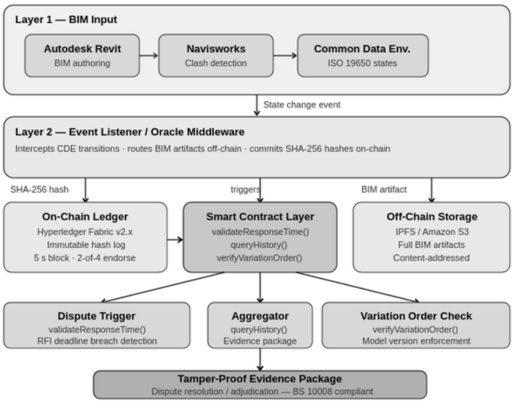

Figure 1. B-BIM-DR System Architecture

The diagram illustrates the three-layer structure: (1) As shown in Figure 1, BIM Input Layer (Autodesk Revit/Navisworks → CDE); (2) Event Listener/Oracle middleware routing large BIM artifacts to off-chain IPFS/S3 while committing SHA-256 hashes to the on-chain Hyperledger Fabric ledger; (3) Smart Contract Layer containing the Dispute Trigger Contract (*validateResponseTime()*), Evidence Aggregator Contract (*queryHistory()*), and Variation Order Verification Contract (*verifyVariationOrder()*), each operating on the immutable distributed ledger.

Besides that, [20] explore the concepts of using blockchain-based documentation systems and Common Data Environment (CDE) solutions to streamline design collaboration and contract administration. They claim that a distributed register can provide security as to the authenticity of the records of transactions carried out in the CDE operations. These architectures come in especially handy with large, multi-party projects, where ownership of data and the necessity to update information is often the source of controversy.

Blockchain-based City Information Modelling (CIM) frameworks at the municipal level can be used to show how these principles can be extended past the projects. According to [17], even a blockchain-based CIM can be used to create an immutable urban history, where approval of regulatory measures, maintenance work, and transfers of property are recorded safely. This type of structure provides a higher level of governance to project level B-BIM systems, especially where there is a dispute with government and long-life infrastructure ownership.

2.4 Dispute-Resolution–Oriented Frameworks and Remaining Gaps

With these developments, blockchain-based BIM is underdeveloped when it comes to resolving construction disputes. Most of the available research focuses on the technical viability, but there is no systematic approach of application. To improve the full potential of blockchain in solving construction disputes, [13] observes that the frameworks between technological capability and the legal and managerial practice do not exists.

Both [11] and [12] claimed that most of the studies on BIM-blockchain are based on the view that, instead of focusing on the dispute and claims workflows, the focus is on digital collaboration on the-large, payment systems, or integrating a supply-chain based solution, but not developing end-to-end workflows designed to serve this purpose. [9] also indicated that in most cases, validation of empirical validations is restricted and those based on piloting or lab-based, and with little information regarding the practical application of blockchain-authenticated records as a subset of arbitration, adjudication or negotiation.

In addition, works like [14], [16], and [19] provided strong backbone elements, which are document tracking underpinnings, automated procurement, and distributed common data ecosystems. However, these are usually provided to isolated functions rather than come up with a comprehensive dispute-resolution framework. Therefore, it is observed that there still is a very discernible lack of Building-Information-Model-based (BBIM) systems that explicitly:

- Map BIM transaction, and document against legal contracts (marks of notices, instructions and variations).
- Contractual structure Blockchain records in compliance with traditional templates of contracts and dispute-resolution; and
- Prescribe transparent, reproducible workflow, which the project teams can replicate throughout the identification of a problem up to its solution.

Consequently, the academic discourse is narrowed down to the need of dispute-oriented, workflow-oriented B-BIM systems, situated beyond primitive technical prototyping. The Blockchain-Based BIM Dispute Resolution (B-BIMDR) paradigm developed in this project aims at filling this gap by incorporating the principles of BIM, blockchain, smart contracts, and common-data-environment into a consistent, logical approach to ensuring the transparent and impeccable prevention and resolution of disputes associated with actual construction scenarios.

3 Methodology

The proposed Blockchain-Enabled BIM Dispute Resolution (B-BIM-DR) framework is developed using a Design Science Research (DSR) methodology, operationalized through three interlocking DSR cycles: (1) the Relevance Cycle, which grounds the research in the construction industry's identified need for tamper-proof dispute evidence administration; (2) the Design Cycle, which iteratively specifies and refines the B-BIM-DR architecture artifact through conceptual design and logical evaluation; and (3) the Rigor Cycle, which ensures the design builds upon and contributes to the established knowledge base of BIM-blockchain integration [12][21]. This structured DSR approach ensures that the resulting artifact is both practically motivated and theoretically grounded. This section details the system's architectural design, its three-stage implementation model, the logical mapping of contractual rules to automated smart contract code, the technical network specification, and the conceptual validity boundaries of the framework.

3.1 Research Design and Framework Foundation

This study employs a conceptual framework development methodology, rigorously structured to align with the architectural specification protocols used by [21]. The conceptual approach is justified by the current state of the field, which recommends design specification following comprehensive reviews of BIM-Blockchain integration [12].

3.2 Framework Implementation Stages:

To ensure systematic management across the project duration, the B-BIM-DR architecture is structured into three discrete, chronologically linked stages, directly adapting the modular model proposed by [22]:

- **Stage 1:** Pre-construction (Rules Definition): The core contractual rules and project-specific Endorsement Policies are parameterized and translated into the initial smart contracts (chain code). This stage codifies the consensus mechanisms and establishes deterministic thresholds (e.g., RFI response deadlines) that will programmatically trigger potential breach events.
- **Stage 2:** Construction (Immutable Data Provenance): The B-BIM system operates as a secure logger for the Common Data Environment (CDE). Every critical transaction (RFI submission, Change Order, Model Version Update) is processed, hashed, and anchored to the ledger. This process ensures all digital artifacts adhere to the data transition states required by ISO 19650.
- **Stage 3:** Closeout and Dispute Resolution (Automated Adjudication): If a formal claim is initiated, the system automatically triggers the Evidence Aggregator Contract. This function instantaneously assembles the complete, timestamped, and tamper-proof evidentiary package from the ledger history, by passing the manual discovery process.

3.3 Architectural Components and Logic Mapping

The B-BIM-DR framework is built upon a hybrid on chain/off-chain data strategy to resolve the conflict between the large file size of BIM models and the scalability limitations of blockchain, while strictly adhering to legal admissibility standards.

3.3.1 Hybrid Data Flow Architecture (BIM Layer & Blockchain Layer)

The BIM layer (Input) leverages tools like Autodesk Revit and Navisworks as the data source. When information transitions within the CDE (Input), an Event Listener/Oracle intercepts the change. The Blockchain Layer (Processing and Immutability) then performs the following:

- Heavy BIM artifacts are sent to **Off-Chain Object**

Storage (e.g., IPFS/S3).

- The resulting **cryptographic hash (SHA-256)**, file Content ID, and minimal metadata (Timestamp, User ID) are committed to the **On-Chain Ledger**.

This system ensures that the hash acts as an immutable anchor, guaranteeing the file's integrity and authenticity [19].

3.3.2 Smart Contract Layer (Automation Logic)

The smart contract layer facilitates proactive dispute prevention by programmatically enforcing contractual clauses following the mapping methodology established by Faraji et al. [21]. This approach enables advanced automated functions similar to those demonstrated in automated procurement systems [16].The key functions within this layer include:

- Dispute Trigger Contract

(*validateResponseTime()*): Automatically creates a formal dispute record if an RFI response exceeds a contractual deadline. The function accepts three inputs: *RFI_ID* (string), *IssueDate* (Unix timestamp), and *ContractualDeadline* (integer, days; default = 7 per FIDIC Red Book Clause 4.20) [25]. Processing logic: the function computes elapsed time by subtracting *IssueDate* from the current block timestamp. If elapsed time > *ContractualDeadline*, the function (1) writes a *BreachEvent* record to the ledger containing {*RFI_ID*, *IssueDate*, *BreachTimestamp*, *ContractorID*}; (2) sets the RFI status flag to '*DISPUTED*'; and (3) returns the *BreachTimestamp* as cryptographically immutable evidence. Given the assumed 5-second block time, breach events are anchored within one block interval, reducing evidentiary latency from days of manual discovery to seconds.

- Evidence Aggregator Contract

(*queryHistory()*): Upon dispute initiation, the function accepts *DocumentHash* (SHA-256 string) as its sole input and returns an ordered array of all on-chain transactions linked to that hash. Each record includes: *BlockHeight*, Timestamp (Unix), *UserID*, *EventType* (e.g., RFI_SUBMITTED, BREACH_FLAGGED, MODEL_APPROVED), and the IPFS Content Identifier (CID) linking to the full off-chain BIM artifact. The resulting output constitutes a tamper-proof, court-admissible evidentiary package meeting BS 10008 authenticity requirement. With a 10 MB block size and 32-byte SHA-256 hash, the system can anchor approximately 327,680 document hashes per block, eliminating throughput bottlenecks on large projects [26].

Table 1 details the core Chain code modules designed to monitor and flag common construction challenges, establishing the necessary technical link to legal and information standards:

Table 1: Mapping Construction Challenges to Blockchain BIM Logic and Standards

Challenge	Contractual Role	Chaincode Function	Data Fields	Evidence Artifact	Legal/Evidence Standard
Late RFI Responses	Response required within 7 days (e.g., FIDIC Red Book).	validateResponseTime()	RFI_ID, IssueDate, RespondedID, Due_Date	Time-stamped 'Bench' Transaction Hash	ISO 19650-2 (Information Delivery Cycle)
Unverified Design Changes	Variations must be formally approved by the Project Engineer.	verify(VariationOrder)	ElementGUID, Status:APPROVED, SignerKey	Digitally Signed Block Header	BS 10008 (Evidential Integrity & Authenticity)
Tampered Audit Logs	Project records must remain unaltered for liability periods.	commitAnchorHash()	MerkleRoot, PreviousHash, Timestamp	Cryptographic Receipt (SHA-256)	BS 10008 (Electronic Identity & Integrity)

3.4 Technical Specification and Test Network Assumptions

To contextualize the B-BIM-DR framework, a permissioned blockchain environment simulating a Hyperledger Fabric deployment is assumed. The assumed network parameters and their logical implications are as follows. Platform: Hyperledger Fabric v2.x. Participants: four primary organizations (Owner, Engineer, Contractor, Subcontractor), each operating a peer node. Channels and Policies: a single Dispute Resolution Channel governed by a 2-of-4 endorsement policy, requiring signatures from at least two organizations before any transaction is committed. Performance Assumptions: 10MB maximum block size, 5-second block creation time. Chain code/SDK: Node.js SDK. These parameters support the following quantitative logical inferences.

- Evidentiary latency: breach events flagged by *validateResponseTime()* are anchored to the immutable ledger within 5 seconds (one block interval), compared to days or weeks of conventional manual discovery that is a reduction of at least four orders of magnitude.
- • Throughput capacity: a 10 MB block can anchor ~327,680 SHA-256 document hashes per block, confirming zero throughput bottleneck even on large, document-intensive projects such as the HKIA Expansion [23][26].
- Consensus integrity: a 2-of-4 endorsement policy ensures no single participant can unilaterally alter ledger state, satisfying the multi-party authentication requirements of BS 10008.

These inferences are grounded in the specified network parameters (platform: Hyperledger Fabric v2.x; block size: 10 MB; block time: 5 s; endorsement: 2-of-4;

SDK: Node.js) and are clearly labelled as assumed rather than measured, preserving scientific integrity.

3.5 Threats to Conceptual Validity

While the B-BIM-DR framework offers a detailed conceptual model, three specific threats to its conceptual validity are acknowledged. First, the Threat of Non-Empirical Data: the framework's efficacy is validated through illustrative scenarios rather than live deployments. Future work should pursue pilot implementations on actual projects to generate empirical performance data. Second, the Threat of Technical Simplification: the framework is intentionally scoped to objective, quantifiable contract clauses such as deadline-triggered RFI responses and model version endorsements. However, many construction contract clauses involve inherently subjective assessments, including judgements of "reasonable time", "fitness for purpose", or force majeure conditions, which cannot be encoded into deterministic smart contract logic without significant interpretive ambiguity. To address this, the B-BIM-DR framework adopts a hybrid governance model: clauses that are objectively quantifiable are enforced autonomously by the smart contract, while clauses requiring subjective interpretation are flagged by the contract and escalated to a designated human adjudicator within the Hyperledger Fabric channel, preserving legal oversight where automation is insufficient. Third, the Threat of Generalization: the framework is specified for a permissioned Hyperledger Fabric environment; adaptation to public blockchains or alternative DLT platforms would require re-evaluation of the endorsement policy model and confidentiality controls

4 Illustrative Scenarios and Conceptual Evaluation

4.1 Scenario 1: Dubai Creek Tower – Reactive Verification

The Dubai Creek Tower project, a complex, multi-billion dollar collaboration, frequently encountered high-stakes disputes related to the sequencing of design approval signoffs and resultant schedule delays. In a conventional CDE environment, proving accountability for these delays requires significant effort. The need for a robust blockchain solution for verifiable document tracking for claims is reinforced in literature.

1. Conventional Workflow Challenge

In a conventional CDE, when a contractor files a delay claim alleging a late RFI response, the legal process involves:

- **Manual Discovery:** Legal teams search through months of emails, server logs, and CDE audit trails (often weeks of effort).
- **Data Fragility:** Logs can be edited or lack cryptographic certainty. Establishing the exact moment the RFI was submitted and the exact moment the deadline was breached requires relying on human testimony or potentially inconclusive metadata.
- **Cost:** The preparation of evidence for arbitration typically costs tens of thousands of dollars and significantly extends the dispute resolution cycle.

2. Theoretical Application and Solution

The B-BIM-DR framework is conceptually applied to the RFI process. When the contractor submits an RFI, the Event Listener captures the action. The Blockchain Layer performs the following immutable transaction:

- **Transaction Data:** The transaction committed to Hyperledger Fabric includes the RFI document's hash (*H1*), the User ID, and the *IssueDate*.
- **Smart Contract Action:** The Dispute Trigger Contract (the function *validateResponseTime()* from Table 1) is activated. It creates a secondary ledger entry defining the immutable *Due_Date* (e.g., *IssueDate* + 7 days, as per the FIDIC Red Book standard).

3. Outcome: Post-Dispute Verification

- **Resolution:** When the dispute is formalized, the Evidence Aggregator Contract is triggered. Instead of launching a manual search, the contract instantaneously queries the ledger for all transactions linked to *H1*.
- **Admissibility:** The system provides an irrefutable package containing the initial RFI hash, the immutable *IssueDate*, and the automated "*Breach Event*" transaction timestamped after the *Due_Date*. Because every event is cryptographically anchored, the evidence satisfies the evidential integrity and authenticity requirements of BS 10008.
- **Impact:** This mechanism bypasses manual discovery, theoretically reducing the dispute resolution cycle from weeks to minutes [8]. The evidence is ready for adjudication, demonstrating the framework's superior reactive evidence verification capability.

4.2 Scenario 2: Hong Kong International Airport (HKIA) Expansion – Proactive Prevention

The $18 billion HKIA Expansion involves numerous contractors and complex digital twin requirements, creating a chronic risk of "conflicting version" disputes where parties rely on outdated BIM models for execution and claims [23]. The goal is to enforce the Single Source of Truth (SSOT) proactively. The concept of using smart contracts for automated workflow validation is a key trend, including systems for automatic procurement [16].

1. Conventional Workflow Challenge

A contractor performs work based on an unverified or outdated BIM model (e.g., Model Version 5), then submits a payment claim.

- **Rework Risk:** When the engineer discovers the discrepancy against the official Model Version 6, the contractor is forced into costly rework, leading to a high-value Variation Order dispute.
- **Verification Time:** The verification process requires multiple stakeholders to manually compare model versions, which severely impacts the payment and project delivery schedules.

2. Theoretical Application and Solution

The B-BIM-DR framework operates as a unified, trust-based CDE. All model version updates must pass an Endorsement Policy (e.g., approval from the Design Manager and Project Engineer) before the new hash (*H6*) is anchored as *Status:PUBLISHED*.

- **Smart Contract Enforcement:** The system employs the Smart Contract Layer to enforce the ISO 19650 information delivery cycle. The contract includes the function *verifyVariationOrder()* (from Table 1), which is designed to prevent noncompliant transactions.
- **Proactive Veto:** When the contractor attempts to submit a claim referencing the outdated Model Version 5 (Hash *H5*), the smart contract automatically checks the ledger's state. It discovers that *H5* lacks the necessary *Status:PUBLISHED* endorsement.

3. Outcome: Risk Mitigation and Workflow Acceleration

- **Dispute** Prevention: Instead of allowing the claim to proceed to a dispute, the smart contract instantaneously rejects the transaction at the point of submission. The system informs the contractor that the reference hash is invalid for payment calculation. This action forces immediate compliance with the SSOT defined by the ledger.
- **Impact**: This demonstrates the system’s shift from reactive dispute resolution to preventive governance. By programmatically enforcing the contractual requirement for the most current, verified data, the framework eliminates the opportunity for conflicting claims, resulting in a measurable acceleration of both verification and automated payment processes [18].

5 Discussion

The primary academic contribution is the detailed Conceptual Framework Specification (Section 4), particularly the Smart Contract Logic Mapping (Table 1). This mapping programmatically links contractual obligations to technical enforcement functions (e.g., *validateResponseTime()*), providing a rigorous model for digitalizing contract administration [21]. The resulting integration produces an unquestionable audit trail of time-stamped, unchangeable documentation of design modifications and milestone confirmations [1].

The conceptual evaluation via illustrative scenarios (Section 5) validated the framework's core utility: enabling a necessary shift from reactive, expensive evidence discovery to proactive governance. The framework was shown to enable near-instantaneous evidence verification in reactive scenarios (Dubai Creek Tower, supported by specialized claims tracking research, [24]. Furthermore, the integration of smart contract-based automated compliance procedures for claims and payment verification [16] was demonstrated to proactively avert disputes by enforcing the Single Source of Truth (HKIA Expansion, [23].

5.1 Compliance and Digital Governance Implications

The B-BIM-DR framework provides a critical mechanism for achieving compliance with international digital governance standards. By leveraging the ledger's immutable state, the system effectively maps the BIM workflow to the ISO 19650 information states: data only transitions from Work in Progress (WIP) to Shared/Published when its hash is immutably anchored and endorsed on the blockchain. Furthermore, blockchain features such as hashing, time-stamping, and non-repudiation ensure audit entries meet BS 10008 standards for integrity and authenticity, establishing B-BIM-DR as a trusted digital mechanism.

6 Conclusion

This study addresses data fragility and lack of transparency in construction dispute resolution by proposing the Blockchain-Enabled BIM Dispute Resolution (B-BIM-DR) framework. Using a Design Science Research approach, it introduces a three-stage architecture based on Hyperledger Fabric, with a hybrid on-chain/off-chain strategy that securely stores cryptographic hashes of BIM data to ensure tamper-proof evidence while maintaining scalability.

The framework’s key contribution is mapping FIDIC contract clauses into smart contract logic, demonstrated through scenarios of dispute verification and prevention. Results suggest significant efficiency gains, such as reducing breach detection time to seconds and supporting large-scale data handling. Limitations include its conceptual nature and focus on quantifiable clauses, with future work aimed at real-world testing and expanding contract coverage.

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