

Blockchain-Enabled Solutions in Construction Dispute Resolution: A Bibliometric and Thematic Analysis

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Abstract

This study systematically investigates blockchain-enabled dispute resolution within the construction domain. Notably, a gap still exists in systematic quantification and thematic mapping that directly addresses construction disputes. Thus, the study examines the key constructs, research directions, and theme development in blockchain-based approaches to construction dispute resolution, using a combined bibliometric and thematic analysis. The study employs a quantitative bibliometric design, based on peer-reviewed publications from the Scopus database, spanning 2017 to 2025. It also includes qualitative thematic interpretation of keyword clusters and key publications to support the bibliometric results. The search string TITLE-ABS-KEY (blockchain AND (construction OR "built environment") AND ("dispute resolution" OR claims OR arbitration OR litigation OR "smart contracts")). This study is limited to English-language publications indexed in Scopus, excluding industry and legal reports. A total of 147 documents were analysed for the study using VOSviewer software. The results show a steady increase in scholarly publications over time. The network visualisation demonstrates that four thematic pillars emanated from bibliometric analysis: decentralised digital governance for dispute prevention, blockchain-enabled supply chain and lifecycle accountability, smart contract-driven contractual automation in construction projects, and BIM-based information modelling. The study hereby concludes that integrating decentralised ledgers, automated contracts, secure information management, and lifecycle modelling, blockchain research in construction is increasingly positioned not merely as a technological innovation, but as a systemic mechanism for dispute prevention and resolution.

Keywords: Blockchain technology, Claims, Construction disputes, Dispute resolution, Smart contracts

Introduction

The construction industry is widely recognised as one of the most dispute-prone sectors due to its inherent complexity, fragmented delivery systems, multiplicity of stakeholders, and recurring contractual ambiguities (Kalogeraki & Antoniou, 2024). Disputes commonly arise from delayed payments, time overruns, scope variations, inconsistent records and disagreements over performance obligations (Kalogeraki & Antoniou, 2024). These conflicts generate significant economic and operational consequences, including cost overruns, project delays, reduced productivity, and deteriorating professional relationships (Nanayakkara *et al.*, 2021). Conventional mechanisms such as litigation, arbitration, and adjudication are often adversarial, time-consuming, and costly, thereby reinforcing inefficiencies rather than resolving them effectively (Kalogeraki & Antoniou, 2024). Consequently, there is a growing demand for digital solutions that enhance transparency, accountability, and enforcement in the construction contract administration.

Blockchain technology has emerged as a promising innovation capable of transforming contract

management and dispute resolution practices (Celik *et al.*, 2024). As a decentralised and immutable ledger, blockchain enables secure and tamper-resistant recording of transactions, strengthening transparency and trust among stakeholders (Celik *et al.*, 2024). Smart contracts self-executing agreements embedded within blockchain networks extend this functionality by automatically enforcing predefined conditions when specified requirements are met (Wu *et al.*, 2022). Accordingly, scholars suggest that blockchain-enabled systems may decrease both the frequency and severity of disputes while reinforcing inter-organisational trust (Kalogeraki & Antoniou, 2024).

Despite this potential, existing reviews largely address blockchain applications from broader perspectives, focusing on supply chain management, payment efficiency, and data traceability rather than dispute resolution as a distinct domain (Celik *et al.*, 2024). Although Saygılı *et al.* (2021) proposed a decentralised online dispute resolution model, related research remains fragmented across empirical, conceptual, and legal strands.

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There is no integrated bibliometric and thematic review dedicated specifically to blockchain-enabled dispute resolution in the construction contract. Existing studies identify technological potentials and barriers (Wu *et al.*, 2022) but do not systematically map the research evolution, dominant themes, or influential contributors in this niche area. Addressing this gap, the present study employs a combined bibliometric and thematic approach to map publication trends, citation impact, thematic clusters, and emerging research directions. By integrating quantitative mapping with qualitative interpretations, the study consolidates dispersed knowledge and clarifies the blockchain's evolving role in dispute prevention, adjudication, and governance.

Blockchain-Enabled Dispute Resolution in Construction

The construction industry has increasingly adopted digital technologies to address persistent inefficiencies arising from fragmented information, contractual ambiguity, and coordination failures, conditions that frequently generate claims and disputes. Blockchain technology has emerged as a decentralised, tamper-resistant ledger that records transactions transparently and securely, fostering trust in environments often characterised by adversarial contracting and opportunistic behaviour (Perera *et al.*, 2020; Mahmudnia *et al.*, 2022). Early built environment research framed blockchain not as a speculative financial instrument but as a governance infrastructure providing a shared, verifiable source of truth across project stakeholders (Mahmudnia *et al.*, 2022). Since 2019, scholarly attention has expanded to explore its capacity to enhance collaboration, accountability, and dispute mitigation through improved data integrity and lifecycle auditability (Celik *et al.*, 2024).

Blockchain's principal contribution lies in establishing a shared, immutable data environment that strengthens governance over contractual and performance information (Ye *et al.*, 2022; Celik *et al.*, 2024). Although consensus exists regarding benefits such as traceability and transparency, much of the literature conceptualises blockchain primarily as a preventive mechanism rather than a direct dispute resolution tool, indicating the need for focused synthesis on its role in dispute dynamics.

In construction, smart contracts are associated with milestone verification, progress certification, and payment release processes that traditionally generate contention (Hamledari & Fischer, 2021). Studies suggest automation reduces human error, discretionary delays, and information asymmetry, addressing common conflict triggers (Mahmudnia *et al.*, 2022). However, limitations persist, including legal enforceability, jurisdictional variation, rigidity of coded logic, and tensions between deterministic systems and the interpretive nature of construction

practice (Kalogeraki & Antoniou, 2024). Smart contracts should therefore be viewed as components of broader socio-technical governance systems.

Beyond automation, blockchain-enabled contract administration shows potential to improve transparency and traceability in variation management and certification (Kalogeraki & Antoniou, 2024). Payment automation, particularly when integrated with BIM verification, may reduce administrative delays (Hamledari & Fischer, 2021). Yet empirical studies directly measuring dispute outcomes remain limited. Existing gaps include the absence of dedicated bibliometric synthesis, insufficient outcome-based evaluations, and underexamined legal and institutional dimensions (Kalogeraki & Antoniou, 2024), justifying a focused thematic consolidation.

2.2 Theoretical Lens

Transaction Cost Economics (TCE) provides a theoretical foundation for understanding the relevance of blockchain-enabled solutions in dispute resolution. It argues that firms aim to minimise transaction costs arising from opportunism, uncertainty, bounded rationality, and asset specificity (Williamson, 1985).

Through TCE, blockchain provides a shift in contractual governance from centralization to decentralization. This lowers transaction costs and removes slow, opaque, and expensive traditional dispute resolution protocols. By providing a shared, immutable ledger, it mitigates opportunistic behaviours such as information withholding and delayed payments, aligning with TCE's emphasis on safeguarding transactions (Saber *et al.*, 2019). The technological protocol substitutes centralized trust with cryptographic verification, automated monitoring, and code-based enforcement. This process lowers costs, eliminates opportunistic behaviour, and enhances speedy transactions. However, TCE might be limited in highly nuanced disputes where subjective judgement is required; human courts may be more cost-effective.

Research Methodology

Given its reliance on bibliometric indicators and qualitative thematic interpretation, this study adopts a post-positivist and pragmatic research paradigm (Celik *et al.*, 2024). This paradigm is appropriate because it recognises objective patterns in publication data while allowing interpretive analysis of themes and research directions. The paradigm supports methodological pluralism and aligns with established practices in construction management and information systems research. A Post-positivist orientation is operationalized using quantitative and replicable metrics.

Scopus was selected for its broad, structured metadata needed for co-occurrence and citation analysis, and its

established use in prior construction-management bibliometric studies that support comparability with the existing literature. The search string TITLE-ABS-KEY (blockchain AND (construction OR "built environment")) AND ("dispute resolution" OR claims OR arbitration OR litigation OR "smart contracts"). The authors searched the database on January 18, 2026, and found 842 relevant documents. 366 documents were found after using engineering and environmental science as subject areas, document type limited to articles and conference papers, final publication stage, document sources are journal publications and conference proceedings. Scopus indexes legal journals and professional articles were also considered. Only documents written in the English language were considered. Documents were further filtered by considering the relevance of the titles and abstracts to exclude irrelevant ones, thereby reducing them to 147 documents. This number is considered suitable because bibliometric reviews perform best with 50-200 articles. A very small dataset may limit the network analysis, thematic mapping, and trend detection. VOSviewer software was applied to visualise bibliometric mapping on 147 documents (Van Eck & Waltman, 2010). The study considered documents published spanning 2017 to 2025, reflecting the period during which blockchain applications in construction began to gain traction. Bibliometric analysis is particularly suitable because it systematically captures the intellectual structure and evolution of the domain. Bibliometric techniques provide a quantitative and reproducible approach to mapping scholarly output, identifying influential

publications, and detecting thematic convergence over time (Donthu *et al.*, 2021).

Findings and Discussion

4.1 Publications Per Year

Out of the total 147 documents that were analysed, 98 were journal articles while 49 were conference proceedings. Figure 1 shows the publication trends from 2017-2025. It was obvious that between 2017 and 2018, there were no publications related to blockchain-enabled solutions in dispute resolution. However, a notable paradigm shifts in publications in this subject area began in 2019 with (7 documents), in 2020, it was increased to (11 documents), (16 documents) recorded in 2021, (28 documents) in 2022 and (30 documents) were produced in 2023. There was a sharp decline in 2024 with 21 documents and later rose again in 2025 to (34 documents). Though the reason for decline in the number of publications could not be ascertained, Figure 1 shows multiple peaks which portend an increase in the researchers interests in digitalizing dispute resolutions because of the inherent benefits.

4.2 Network Analysis of Publications per Country

The analysis of the network of publications per country, with a minimum of three documents and two citations per country, which eliminates possible overlapping where articles have more than one country's affiliation. Out of the thirty-six countries, twenty-one met the threshold. Figure 2 shows the network visualization of

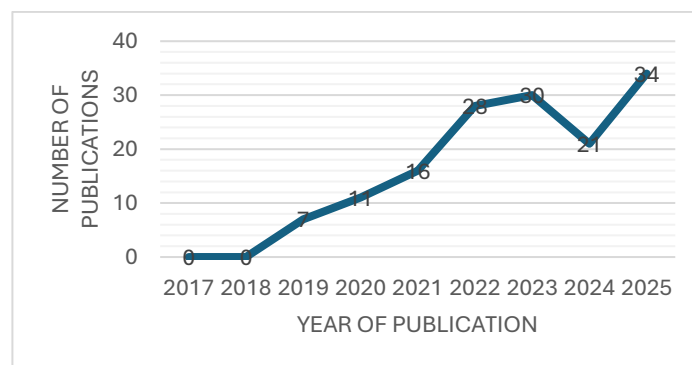


Figure 1: Publication Per Year (2017-2025)

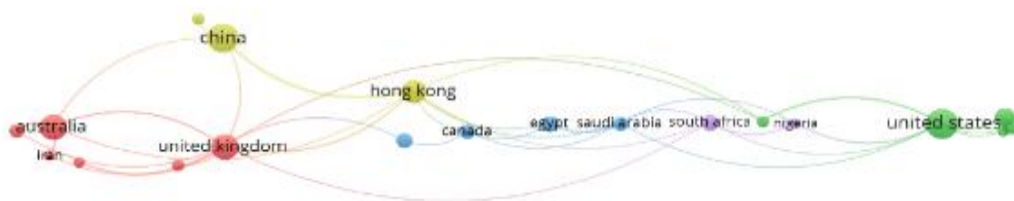


Figure 2: Network Visualisation of the number of publications per country

the number of documents per country. Twenty-one leading countries in Blockchain-enabled solutions in dispute resolution are listed in Table 1. It shows six leading countries in the subject area. United States (23 documents, 806 citations), China (22 documents, 494), Australia (17 documents, 1133 citations), United Kingdom (17 documents, 589 citations), Hong Kong (14 documents, 628 citations), and Turkey (10 documents, 478 citations). This is a testament that these countries have made notable contributions to the subject. The total link strength of countries reveals that the study conceptualizes the framework of blockchain application in dispute resolution is gaining acceptance. The network visualization reveals an international collaboration among the authors who have worked in this area. South Africa has collaborated with five countries (UK, USA, Hong Kong, Saudi-Arabia and

Nigeria). The United Kingdom has the highest collaboration index with nine countries (China, Malaysia, Sweden, Australia, South Korea, Hong Kong, South Africa, Iran, and Singapore).

4.3 Publication per Document Source

A threshold of 3 publications per source was set for 13 publication sources as shown in Table 2. Automation in construction has published 22 documents (2248 citations). This revealed that this journal has published more blockchain technology than any other journal outlet. This is followed by Buildings 7 documents (189 citations), Engineering, Construction and Architectural Management with 5 documents (107 citations). The publication trend suggests that Automation in Construction dominates the field, with most documents and citations, indicating a strong technological

Table 1: Publications per Country

Country	Document	Citation	Total link Strength
United States	23	806	10
China	22	494	7
Australia	17	1133	9
United Kingdom	17	589	13
Hong Kong	14	628	12
Turkey	10	478	1
Italy	9	133	1
India	8	99	0
Egypt	7	105	5
South Africa	7	83	6
South Korea	6	83	2
Canada	6	11	4
Sri Lanka	5	69	4
Saudi Arabia	5	32	8
Germany	4	148	1
Malaysia	4	144	1
Singapore	4	76	5
Iran	3	146	4
Netherlands	3	73	1
Sweden	3	32	3
Nigeria	3	14	5

Table 2: Publication per Document Source

Source	Document	Citation	Impact Factor
Automation in Construction	22	2248	11.5
Buildings	7	189	3.1
Engineering, Construction and Architectural Management	5	107	3.9
Journal of Information Technology in Construction	4	167	3.8
World Construction Symposium	4	50	-
Proceedings of International Structural Engineering and Construction	4	31	-
IOP Conference Series: Earth and Environmental Science	4	10	0.402
Journal of Legal Affairs and Dispute Resolution in Engineering and Construction	3	145	1.5
Journal of Construction Engineering and Management	3	73	5.1
Journal Management in Engineering	3	68	5.3
Journal of Engineering, Design and Technology	3	33	2.7
IEEE Access	3	78	3.6
Proceedings of the European Conference on Computing in Construction	3	7	-

emphasis and scholarly contribution. Other journals, such as *Buildings*, *Engineering, Construction, and Architectural Management*, and the *Journal of Information Technology in Construction*, make moderate contributions, indicating consistent interdisciplinary interaction. Conference proceedings, such as the *World Construction Symposium* and the *European Conference on Computing in Construction*, have low citations, indicating that emergent research is still being consolidated into journal publications. In general, the area is technologically based but becoming more interdisciplinary, encompassing fields such as building innovation, management, legal, and digital engineering.

4.4 Co-authorship (Bibliographic Coupling) analysis per Country

The bibliographic coupling map reveals a globally interconnected research network structured into three main clusters as shown in Figure 3. The first (red cluster) is dominated by the United States and China, which exhibit the largest nodes and strongest coupling strength, indicating high publication output and substantial shared reference bases with countries such

as Hong Kong, Italy, India, Singapore, Germany, Turkey, and South Korea. The second (green cluster) is anchored by the United Kingdom and Australia, closely linked with Malaysia, the Netherlands, Sweden, Sri Lanka, and Iran, reflecting a cohesive and regionally aligned intellectual grouping. The third (blue cluster) comprises South Africa, Nigeria, Saudi Arabia, Egypt, and Canada, with South Africa emerging as a central node within this grouping. Cross-cluster linkages involving the United States, the United Kingdom, China, and Australia demonstrate strong bridging roles and high intellectual centrality, indicating that the field shares a common global knowledge base despite regional clustering.

4.5 Thematic Analysis

A pragmatic orientation informs the cluster and themes inductively. Analysis of the keyword network (32 items, 338 links, total link strength = 1405) reveals four coherent and interrelated research themes for the study. While the clusters were algorithmically generated using VOSviewer (Van Eck & Waltman, 2010) as shown in Figure 4, the following themes represent an interpretive synthesis of their conceptual meaning. Four pillars are

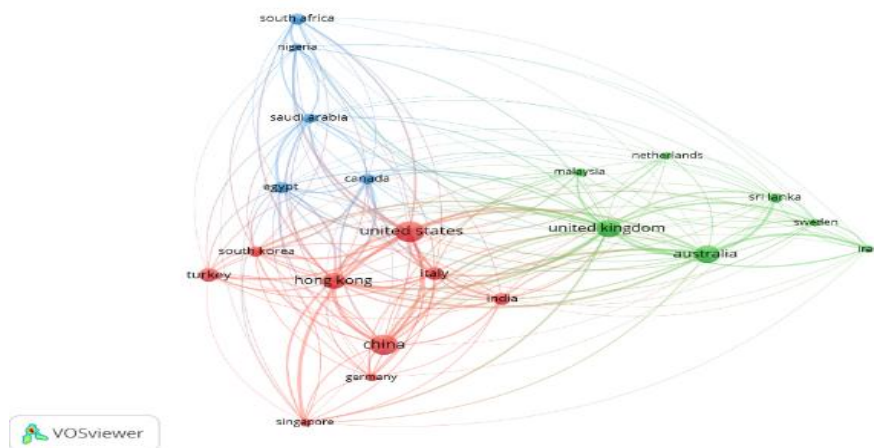


Figure 3: Network visualisation Co-authorship per country

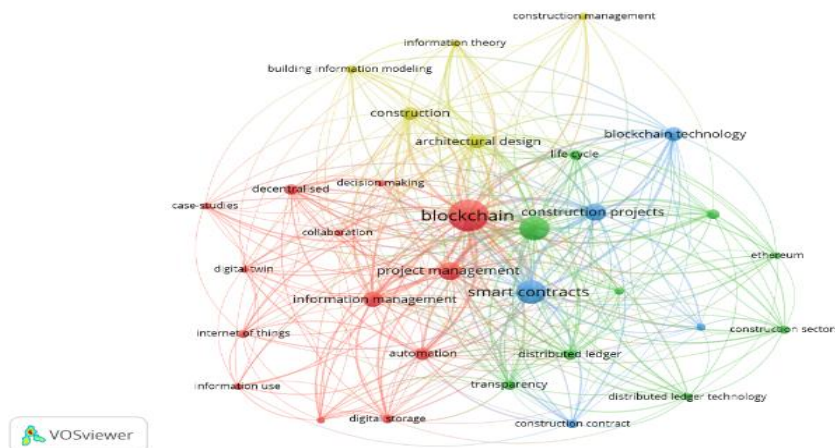


Figure 4: Network Visualisation Keyword Co-occurrence

explicitly empirically derived clusters groupings that emerged from keyword co-occurrence frequency in the retrieved literature rather than as validated theoretical constructs with defined boundaries, measurement properties, or causal relationships to one another.

Theme 1: Decentralised Digital Governance for Dispute Prevention

Theme 1 contains 13 keywords (automation, blockchain, case studies, collaboration, decentralised, decision-making, digital storage, digital twin, information management, information use, Internet of Things, network security, project management) that reflect the managerial and technological governance of construction processes. This theme reflects blockchain as a governance infrastructure for improving transparency, coordination, and accountability in construction projects. The co-occurrence of decentralised, collaboration, and decision-making suggests a shift from central control structures toward distributed trust architectures. Blockchain's decentralised ledger enhances tamper resistance and data integrity, which are essential in evidentiary contexts during disputes (Casino et al., 2019).

The presence of digital twin and IoT indicates integration with real-time monitoring systems, enabling objective verification of project performance. Such integration supports proactive dispute avoidance by reducing information asymmetry among stakeholders (Pan & Zhang, 2021). Information management and network security further reinforce the importance of reliable digital records in mitigating claims related to miscommunication, data manipulation, or incomplete documentation.

Theme 2: Blockchain-Enabled Supply Chain and Lifecycle Accountability

The following keywords are items in theme 2 (construction industry, construction sectors, construction supply chain, distributed ledger technology, Ethereum, lifecycle, supply chain management, transparency) with a focus on distributed ledger technology (DLT) as an infrastructural solution for lifecycle transparency. The presence of Ethereum indicates practical deployment platforms for smart contract execution. Blockchain's immutability has been widely associated with supply chain transparency (Sabeti et al., 2019). In construction, lifecycle integration is critical because disputes frequently arise from fragmented information flows across project stages (Nawari & Ravindran, 2019). The co-location of transparency and supply chain management demonstrates that this stream positions blockchain as a tool for traceable procurement, payment flows, and material verification mechanisms directly linked to dispute prevention.

Theme 3: Smart Contract-Driven Contractual Automation in Construction Projects

Blockchain technology, construction contracts, construction projects, project participants and smart contracts form the contractual core of the network in theme 3. Smart contracts are self-executing code deployed on blockchain platforms that automate contractual obligations when predefined conditions are met (Szabo, 1997). In construction, they have been proposed to automate progress payments and reduce opportunistic behaviour among project participants (Hamledari & Fischer, 2021). The theme of construction contracts and project participants indicates strong thematic alignment with dispute resolution, as payment delays and contractual ambiguities are leading causes of construction disputes (Titus et al., 2023). This theme hereby represents the legal-technological interface where blockchain directly addresses contractual enforcement and payment security.

Theme 4: BIM-Based Information Modelling

Architectural design, building information modelling, construction management, and information theory reflect the informational and theoretical foundation of blockchain integration. Building Information Modelling (BIM) provides structured digital representations of project data, enabling interoperability and lifecycle information management (Succar, 2009). Prior research has identified the complementary relationship between BIM and blockchain for enhancing data reliability and process transparency (Nawari & Ravindran, 2019). The presence of information theory suggests a conceptual grounding in data transmission, integrity, and system coordination principles. This theme thus anchors blockchain-enabled dispute resolution within robust digital information ecosystems.

Conclusion and Further Research

A bibliometric review was conducted to visualise and map the research trends of blockchain and dispute resolution. Data mined from the Scopus database was mapped using VOSviewer software. A total of 147 documents were eventually used for the study after the initially mined documents had been filtered based on exclusion and inclusion criteria. The study mapped publications per country, documents per source, bibliographic coupling, co-authorship, and keyword co-occurrence. The network visualisation demonstrates that blockchain-enabled solutions in construction dispute resolution are organised around four interdependent pillars: (1) decentralised digital governance for dispute prevention, (2) blockchain-enabled supply chain and lifecycle accountability, (3) smart contract-driven contractual automation in construction projects, and (4) BIM-based information modelling. The density of connections and high total

link strength indicate a maturing research domain characterised by conceptual convergence rather than fragmentation. Crucially, the thematic core of the network aligns with known dispute drivers such as payment delays, contractual ambiguity, fragmented information, and lack of transparency. The study thus concludes that integrating decentralised ledgers, automated contracts, secure information management, and lifecycle modelling, blockchain research in construction is increasingly positioned not merely as a technological innovation, but as a systemic mechanism for dispute prevention and resolution.

This study advances knowledge by systematically mapping the intellectual structure, trends, and thematic evolution, integrating fragmented prior studies, identifying critical gaps in terms of legal enforceability and smart contracts limitations, and providing a theory-

informed foundation to guide future empirical research, policy development, and industry adoption strategies

The study's scope is limited, given that it leverages only the Scopus library. Scopus, a database from Elsevier, is one of the largest and most inclusive databases that thoroughly records abstracts and citations of peer-reviewed literature as well as quality web sources covering various academic disciplines. Future work should supplement Scopus with a legal-domain database.

This approach can guide further research by identifying thematic gaps in legal enforcement, governance strategies, and practical implementation problems

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