

Drivers of blockchain technology adoption in construction supply chains: a systematic literature review and scientometric synthesis

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Abstract

Purpose – Blockchain technology (BT) has attracted growing attention in construction supply chain management (CSCM), yet existing research predominantly emphasises applications, technical architectures and barriers, providing limited understanding of the pressures motivating adoption. This study, therefore, systematically identifies and synthesises the drivers of BT adoption in construction supply chains (CSCs).

Design/methodology/approach – A systematic literature review, conducted using the Scopus database, yielded 493 records. Following screening, 145 publications were retained for scientometric analysis, with 40 subsequently selected for qualitative content analysis.

Findings – The findings identify five interrelated driver themes: information governance; transactional and operational pressures; digital integration; sustainability and institutional pressures; and strategic and contextual pressures. Information fragmentation, limited visibility, trust and accountability deficits, coordination inefficiencies and unreliable provenance emerged as the most prominent motivations. However, driver salience varies across clients, contractors, subcontractors, suppliers, regulators and other supply-chain actors, demonstrating that adoption is a negotiated network-level decision rather than a uniform organisational response.

Originality/value – The findings provide a theoretically grounded basis for empirical research and help practitioners and policymakers align BT investments, governance arrangements and procurement interventions with clearly defined supply-chain problems rather than technology-led experimentation.

Keywords Blockchain technology, Construction supply chain management, Adoption drivers, Stakeholder alignment, Digital transformation, Digital integration

Paper type Literature review

1. Introduction

The construction industry is widely recognised as one of the least digitalised and most fragmented industrial sectors, characterised by adversarial contracting practices, information silos, low transparency and persistent inefficiencies across its supply chains (Pittri *et al.*, 2026a; Hamledari and Fischer, 2021). Construction supply chains (CSCs) typically involve multiple tiers of suppliers, subcontractors, logistics providers, consultants and clients, operating under temporary project organisations with misaligned incentives and limited trust (Tezel *et al.*, 2021). These structural characteristics have long undermined coordination, data reliability, payment efficiency and accountability, contributing to cost overruns, delays, disputes and sustainability underperformance (Pittri *et al.*, 2026a; Kifokeris and Tezel, 2025).

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Reddy and Tyagi (2022), Studer and De Brito (2021) and Okafor *et al.* (2022) postulated that the construction supply chain (CSC) remains among the least automated industries hindered by persistent challenges, including limited trust and transparency, inefficient data exchange and communication, and weak stakeholder coordination, with corruption further exacerbating these issues. Collectively, these constraints continue to undermine overall industry performance (Chen *et al.*, 2018).

In recent years, blockchain technology (BT) has emerged as a promising digital infrastructure capable of addressing many of these long-standing supply chain challenges. BT is a decentralised and immutable distributed ledger that enables secure peer-to-peer transactions, tamper-resistant data storage and programmable automation through smart contracts (Pittri *et al.*, 2026b). Within CSCs, BT has been proposed as an enabling mechanism for transparent information sharing, provenance tracking, trustless collaboration, automated payments and auditable compliance across organisational boundaries (Li *et al.*, 2021).

Driven by these perceived capabilities, academic and industry interest in BT for construction supply chain management (CSCM) has grown rapidly since the mid-2010s. Existing studies have explored BT applications in procurement, material logistics, off-site manufacturing, payment administration, sustainability reporting, contract management and lifecycle data governance (Li *et al.*, 2021; Celik *et al.*, 2023; Xu *et al.*, 2023; Pittri *et al.*, 2026b). More recently, research has also emphasised BT's role as a complementary technology, integrated with building information modelling (BIM), the Internet of things (IoT) and artificial intelligence (AI) to enhance real-time visibility, traceability and decision-making across CSCs (Li *et al.*, 2021; Sarkar *et al.*, 2023; Pittri *et al.*, 2026b).

Despite the expanding literature on BT in construction, a comparative examination of existing reviews (see Table S1 in supplementary file) reveals that scholarship has predominantly concentrated on technological applications, benefits, implementation barriers, technical integration and the broader evolution of the research field. Existing reviews have examined blockchain applications in CSCM (Yoon and Pishdad-Bozorgi, 2022), construction contract management (Zhang *et al.*, 2023), procurement (Kim and Kim, 2024) and the wider AEC/AECO context (Li and Kassem, 2021; Xu *et al.*, 2022; Celik *et al.*, 2024). Bibliometric and scientometric studies have further mapped publication trends, intellectual structures, thematic clusters and research networks (Shishehgharkhaneh *et al.*, 2023; Saah and Choi, 2023). Although these reviews provide important insights into factors such as transparency, traceability, trust, automation, efficiency and sustainability, their principal concern has generally been what blockchain can do, where it can be applied, or what constrains its implementation, rather than systematically explaining the underlying problems and pressures that motivate its adoption across CSCs.

Consequently, an important conceptual gap remains between blockchain capabilities and the motivations underlying adoption decisions. Factors such as transparency, trust, traceability and efficiency are frequently discussed interchangeably as benefits, technological attributes, adoption motivations or expected outcomes, making it difficult to distinguish why organisations adopt BT from how the technology responds to identified supply-chain problems and what outcomes subsequently result. Moreover, existing reviews provide limited synthesis of how adoption motivations differ among heterogeneous CSC actors, including clients, contractors, subcontractors, suppliers and technology providers, whose responsibilities, risks and incentives vary considerably. The relationships and potential interdependencies among organisational, transactional, institutional, sustainability and digital-integration pressures also remain insufficiently theorised. Thus, the research gap concerns not simply the identification of additional adoption factors, but the absence of a consolidated, theoretically informed and stakeholder-sensitive explanation of BT adoption drivers within CSCs.

Addressing this gap is important because understanding adoption drivers provides the basis for determining whether BT responds to genuine supply-chain needs rather than being pursued primarily through technology-led experimentation. In fragmented CSCs characterised by

information asymmetry, low inter-organisational trust, contractual complexity, payment inefficiencies and uneven digital maturity, the motivations for adoption can shape investment priorities, technology configuration, stakeholder participation and ultimately value realisation. A clearer understanding of these drivers can therefore help organisations prioritise appropriate BT use cases, enable policymakers and clients to design more targeted institutional and procurement interventions, and provide researchers with theoretically meaningful constructs for subsequent empirical testing. Crucially, distinguishing adoption drivers from blockchain-enabled mechanisms and subsequent outcomes also reduces the conceptual conflation evident in the existing literature and provides a more robust basis for explaining how and under what conditions BT adoption may generate value in CSCs.

Against this backdrop, this study aims to (1) map the intellectual structure and evolution of BT research in CSCM; (2) systematically identify and classify the key drivers motivating BT adoption in CSCs; (3) examine how adoption motivations vary across CSC stakeholders and synthesise their relationships within a theoretically informed conceptual framework and (4) identify research gaps and propose directions for future empirical and theoretical development.

The study is theoretically positioned through the complementary lenses of Institutional Theory, the Technology–Organisation–Environment (TOE) framework, the Resource-Based View (RBV) and inter-organisational governance. Together, these perspectives explain how external pressures, organisational capabilities, technological conditions and network-governance arrangements shape BT adoption across CSCs.

The remainder of this paper is structured as follows. The next section outlines the research methodology, detailing the systematic literature review (SLR) process, including data collection, screening, and analytical techniques. This is followed by the results and discussion, where findings from the scientometric and qualitative content analyses are presented and synthesised. The subsequent section discusses the key research gaps and proposes directions for future studies. A conceptual framework is developed in the subsequent section following the findings of the study. Finally, the paper concludes by summarising the main contributions, theoretical and practical implications, and limitations of the study.

2. Research methodology

This study adopted an SLR, integrating scientometric mapping and qualitative content analysis to investigate BT drivers and future research directions in CSCM. The mixed-method design provided both a macro-level overview of research trends and micro-level thematic insights that enhanced the robustness of the findings (Pittri *et al.*, 2026b).

2.1 Identification and screening of publications

The Scopus database was selected for literature retrieval because of its broad multidisciplinary coverage and consistent bibliographic metadata, which support systematic retrieval and science-mapping analyses using tools such as VOSviewer (Pittri *et al.*, 2026b). A structured Boolean search was conducted across the title, abstract and keyword fields using terms related to BT, supply chains and construction (Figure 1). The search terms were informed by relevant review studies (Yoon and Pishdad-Bozorgi, 2022; Kim and Kim, 2024) and refined through discussions among the research team. The search was conducted on 27 June 2025 and initially returned 493 records using the following search string:

(TITLE-ABS-KEY (“blockchain” OR “blockchain technology” OR “distributed ledger technology” OR “DLT” OR “distributed ledger” OR “smart contract*” OR “immutable ledger” OR “tokenized system”) AND TITLE-ABS-KEY (“supply chain” OR “SCM” OR “procurement” OR “logistics” OR “materials management”) AND TITLE-ABS-KEY (“construction” OR “built environment” OR “AEC industry”)).

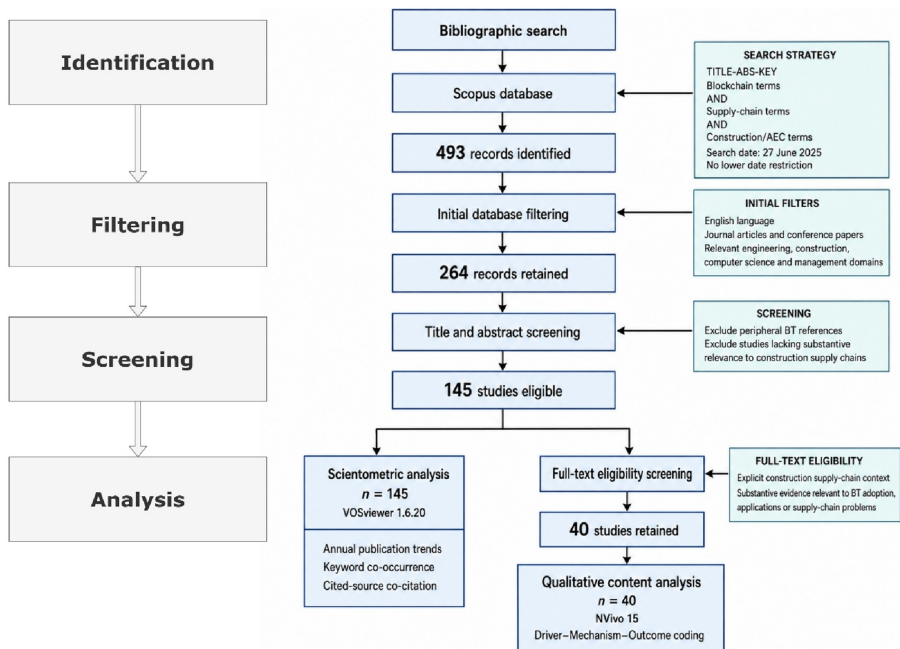


Figure 1. Literature selection process. Source: Figure created by the authors

A multi-stage screening process was subsequently applied using the predefined inclusion and exclusion criteria presented in Table 1. The review was restricted to English-language journal articles and conference papers within relevant engineering, construction, computer science and management domains. No lower publication-date restriction was imposed because BT represents a relatively recent area of research in construction. Initial database filtering excluded records that did not satisfy the publication type, language and disciplinary criteria, reducing the sample from 493 to 264 records. Title and abstract screening subsequently removed studies in which BT was only mentioned peripherally or that lacked substantive relevance to CSCs. This resulted in 145 eligible publications for scientometric analysis. The screening process and subsequent selection of studies for qualitative content analysis are illustrated in Figure 1.

2.2 Data analysis

2.2.1 Scientometric analysis. Scientometric analysis was performed using VOSviewer (version 1.6.20) in accordance with established guidelines (Van Eck and Waltman, 2020). VOSviewer was chosen for its strong capability to construct and visualise bibliometric networks, enabling systematic identification of knowledge structures within a research domain (Van Eck and Waltman, 2020; Pittri et al., 2026c) and aligning with recommended criteria for selecting science-mapping tools (Chen, 2017). Keyword co-occurrence and co-citation analyses were undertaken to examine intellectual foundations and thematic evolution. Bibliometric indicators, including keyword frequency and total link strength, were employed to assess thematic relationships, consistent with prior science-mapping studies in construction management and procurement research (Yoon and Pishdad-Bozorgi, 2022; Pittri et al., 2026b).

2.2.2 Qualitative content analysis. To complement the scientometric analysis, the 145 eligible publications underwent full-text screening using the predefined inclusion and

Table 1. Inclusion and exclusion criteria and literature screening procedure

Stage/criterion	Inclusion criteria	Exclusion criteria	Rationale	Outcome
Database selection	Publications indexed in Scopus	Records outside Scopus	Scopus provides broad coverage of engineering, construction, computer science and management literature and consistent metadata suitable for scientometric analysis	Scopus selected
Search fields	Terms appearing in title, abstract or keywords relating to blockchain, supply chains and construction	Records not satisfying all three conceptual components	Combining the three concept groups limits retrieval to studies at the intersection of BT, SCM and construction	493 records identified
Language	English-language publications	Non-English publications	Ensures consistent interpretation and coding of full-text evidence	Applied during initial filtering
Publication type	Peer-reviewed journal articles and conference papers	Books, book chapters, editorials, notes, reports and other non-peer-reviewed sources	Peer-reviewed articles and conference papers provide academically scrutinised evidence while capturing an emerging technological field	Applied during initial filtering
Time period	All publication years up to the search date (27 June 2025)	Publications after the search date	No lower date boundary was imposed because BT research in construction is relatively recent	Applied during initial filtering
Disciplinary/contextual relevance	Studies within construction, built environment, engineering, computer science and relevant management domains	Studies from unrelated sectors with no construction/AEC relevance	Maintains alignment with the construction supply-chain context	264 records retained after initial filtering
Title and abstract screening	Studies substantively addressing BT in construction, CSCM, procurement, logistics, material management or closely related construction supply-chain processes	Studies mentioning BT, construction or supply chains only peripherally or addressing unrelated application domains	Removes false positives generated by the broad search string while retaining the multidisciplinary character of CSCM	145 studies retained for scientometric analysis
Full-text eligibility for qualitative analysis	Studies explicitly examining BT in a construction-specific supply-chain context and providing substantive evidence on adoption motivations, implementation considerations, applications or relevant supply-chain problems	Studies with only incidental discussion of BT; non-construction supply chains; or insufficient substantive evidence from which relevant adoption-related constructs could be extracted	Ensures that qualitative coding is grounded in studies capable of informing the adoption-driver synthesis	40 studies retained for qualitative content analysis

(continued)

Table 1. Continued

Stage/criterion	Inclusion criteria	Exclusion criteria	Rationale	Outcome
Scientometric analysis	All 145 studies satisfying title/abstract eligibility criteria	Records excluded during preceding screening stages	The broader corpus is appropriate for mapping the intellectual and thematic development of the research domain	145 studies analysed using VOSviewer
Qualitative content analysis	40 studies satisfying full-text eligibility criteria	Studies not meeting full-text criteria	Enables detailed coding and distinction among adoption drivers, BT mechanisms and outcomes	40 studies analysed using NVivo

Source(s): Table created by the authors

exclusion criteria presented in Table 1. Studies were retained where they (1) substantively addressed BT within a construction-specific supply-chain context and (2) provided sufficient evidence to extract information on adoption motivations, blockchain-enabled mechanisms, implementation conditions or associated outcomes. Studies were excluded where BT was mentioned only marginally, the application context was outside construction, or the study provided insufficient evidence relevant to the CSCM adoption context. Applying these criteria resulted in 40 studies eligible for qualitative content analysis.

The qualitative content synthesis was conducted using a hybrid coding approach (deductive and inductive). A deductive framework was initially developed based on study objectives and recurring constructs. Inductive codes were added as new patterns emerged. The framework was refined through pilot coding, with two researchers independently coding the included studies using NVivo (version 15). Discrepancies were resolved through consensus, refining code definitions. Inter-coder reliability was assessed via NVivo’s coding comparison query, yielding Cohen’s kappa of 0.73, indicating substantial agreement (Chaturvedi and Shweta, 2015). Themes were repeatedly cross-checked against the original studies to ensure that interpretations remained grounded in the reviewed evidence.

Thematic saturation was reached after the 30th study, as the coding of the remaining publications generated no substantively new driver themes, supporting the adequacy of the final qualitative sample.

3. Results and discussion

3.1 Scientometric analyses

3.1.1 Annual publication trend. Figure 2 shows a clear and sustained increase in scholarly output on BT in CSCM. Early publications are sparse, indicating that the field was initially at an exploratory stage. From approximately 2020 onward, publication activity rises sharply, reflecting heightened attention to digital transformation in construction and the increasing technological maturity of BT. This growth signals broader recognition of BT’s potential to improve transparency, traceability and operational efficiency in procurement and supply chain processes. The trend also points to an expanding thematic scope, particularly through the integration of BT with complementary technologies such as BIM and IoT (Hijazi et al., 2024; Li et al., 2022). Overall, the literature shows a transition from early conceptual contributions e.g. (Lanko et al., 2018), to more applied and integrative studies e.g. (Hijazi et al., 2024; Wang et al., 2020), indicating increasing maturity of BT research in CSCM, albeit with limited large-scale empirical validation.

3.1.2 Co-occurrence network analysis. To construct a reproducible co-occurrence network, index keywords was selected as the unit of analysis. A minimum occurrence threshold of three

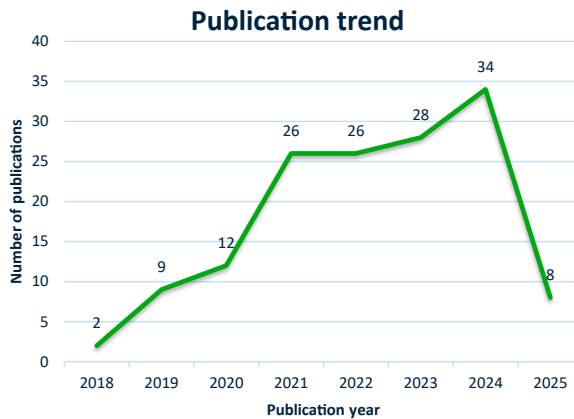


Figure 2. Annual publication trends. Source: Figure created by the authors

was applied; of the 718 keywords identified, 48 met this threshold. A thesaurus text file was created as a data cleaning tool to ensure consistency for different spellings, synonyms, acronyms, abbreviations and omissions of identical terms. For example, “iot”, “Internet of thing”, “Internet of things (IoT)” and “IoTs” were merged as “Internet of things”. The counting method selected was “Full counting”. Table 2 shows the extracts of the top active themes with high link strength (≥ 40) from the analysis, while Figure 3 depicts the network of keywords co-occurrence analysis.

Six interrelated clusters representing the dominant thematic structure of BT research in CSCM were identified. The red cluster, comprising terms such as transparency, information sharing and decentralisation, reflects a strong research emphasis on information governance, visibility and trusted data exchange within fragmented CSCs. The blue cluster, centred on

Table 2. Top active keywords (total strength ≥ 40) regarding BT drivers and CSCM

Keyword	Occurrences	Total link strength	Average year published	Average citations	Ave. Norm. Citation	Cluster
Blockchain technology	80	376	2022	35.52	1.22	1
Construction supply chain	69	330	2022	38.99	1.34	1
Construction industry	48	260	2022	35.69	1.21	5
Building information modelling	20	141	2022	38.50	1.53	2
Architectural design	17	128	2022	41.65	1.68	2
Smart contracts	17	106	2022	29.29	1.19	3
Information management	16	99	2022	59.81	1.75	3
Construction project management	16	84	2022	30.88	1.24	5
Sustainable development	14	81	2023	31.64	1.66	4
Decision making	11	74	2023	29.55	1.99	4
Life cycle	10	70	2022	28.30	0.80	5
Transparency	9	64	2022	25.67	1.27	1
Decentralised	7	60	2024	37.14	2.68	2
Distributed ledger technology	8	58	2023	27.75	1.79	3
Internet of things	7	55	2022	73.00	2.61	2
Information theory	5	50	2022	48.20	2.04	2
Circular economy	7	49	2022	47.43	2.19	4

Source(s): Table created by the authors

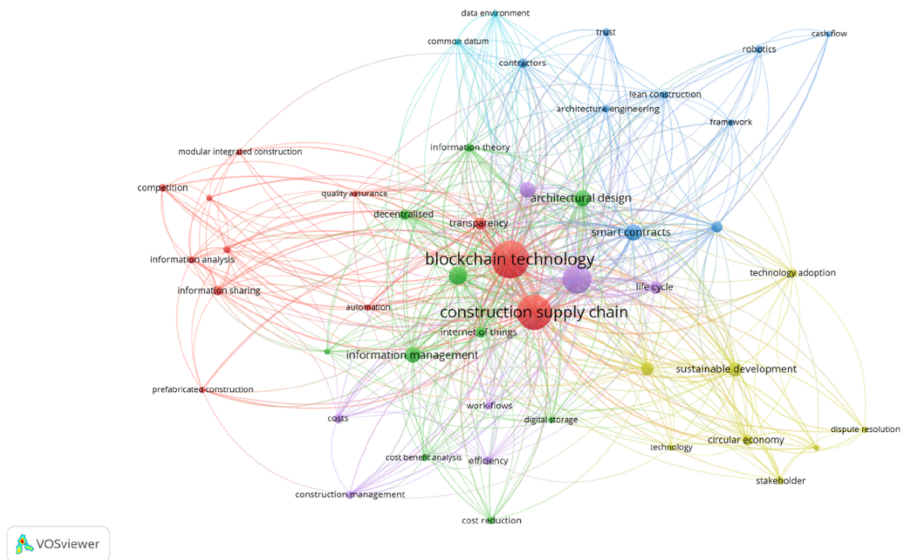


Figure 3. Keywords co-occurrence analysis. Source: Authors' analysis using VOSviewer

smart contracts, lean construction and cash flow, captures research concerned with transaction automation, payment processes and workflow efficiency. These themes are consistent with previous reviews that identify information management, payments, procurement and supply-chain management as prominent areas of blockchain application in construction (Li and Kassem, 2021; Xu *et al.*, 2022; Zhang *et al.*, 2023).

The green cluster, encompassing BIM and IoT-related terms, represents the growing literature on integrating BT with complementary digital technologies, while the cyan cluster reinforces interest in common data environments and shared information infrastructures. This convergence supports previous reviews identifying BIM, IoT and broader digital integration as increasingly prominent areas of blockchain research (Xu *et al.*, 2022; Shishehgharkhaneh *et al.*, 2023; Saah and Choi, 2023). The yellow cluster, characterised by sustainability, lifecycle and circular-economy concepts, indicates an emerging research stream concerned with material traceability, lifecycle information and environmental accountability. Similarly, the purple cluster reflects managerial and economic themes relating to cost, efficiency and process optimisation. The growing prominence of sustainability alongside established themes such as smart contracts, supply chain management (SCM), BIM and IoT is consistent with the thematic patterns reported by Shishehgharkhaneh *et al.* (2023), indicating a gradual broadening of BT research from predominantly technological and operational applications towards sustainability-oriented construction practices. These clusters demonstrate that BT research in CSCM has evolved around interconnected themes of information governance, transaction management, digital integration, sustainability and operational performance.

3.1.3 Cited source co-citation analysis. Cited source co-citation analysis presents the co-citation relationships among journal sources that have significantly contributed to the development of BT research in CSCM. A minimum citation threshold of 15 was set, and of the 3,218 sources, 36 met the threshold. As shown in Figure 4 and Table 3, journals such as *Automation in Construction*, *Journal of Cleaner Production*, *Journal of Construction Engineering and Management*, *Buildings*, and *Engineering, Construction and Architectural Management* emerged as the most frequently co-cited and influential sources. These high-

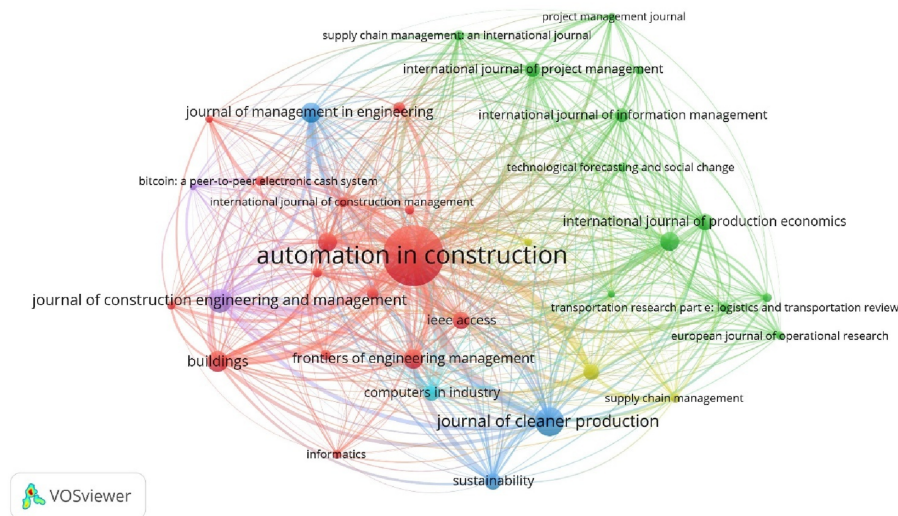


Figure 4. Cited source co-citation analysis. Source: Authors' analysis using VOSviewer

Table 3. Top 10 journals by citation and total link strength

Journal source	Number of citations	Total link strength	Number of articles
Automation in Construction	629	12,142	8
Journal of Cleaner Production	171	3,743	4
Journal of Construction Engineering and Management	125	3,472	2
Buildings	97	2,681	5
Engineering, Construction and Architectural Management	80	2,549	5
Construction Management and Economics	80	2,204	2
Journal of Management in Engineering	90	2,178	1
Frontiers of Engineering Management	58	1,728	2
International Journal of Production Research	82	1,690	2
Sustainability	62	1,655	3

Source(s): Table created by the authors

ranking journals not only demonstrate strong interconnections within the field but also represent leading platforms for publishing research at the intersection of BT and CSCM.

3.2 Content analysis

3.2.1 Drivers of blockchain technology adoption in construction supply chains. The qualitative synthesis of the 40 reviewed studies (see Table S2 in supplementary file) identified five interrelated themes underpinning BT adoption in CSCs: information governance, transactional and operational efficiency, digital integration, sustainability and institutional pressures, and strategic and contextual pressures. The distribution of drivers across these themes indicates that adoption is shaped primarily by persistent structural deficiencies in inter-organisational information exchange, trust and process coordination, rather than by the technological appeal of BT itself (Pittri *et al.*, 2026b). As presented in Table 4, n denotes the

Table 4. Thematic synthesis and frequency of BT adoption drivers in CSCs

Driver theme	Specific adoption driver	Frequency, n (%)	Supporting studies
Information governance drivers	D1: Fragmented information flows, poor information sharing and limited visibility	29 (72.5%)	Hamledari and Fischer (2021), Jiang <i>et al.</i> (2021), Celik <i>et al.</i> (2023), Wang <i>et al.</i> (2020), Lu <i>et al.</i> (2021), Elghaish <i>et al.</i> (2023), Li <i>et al.</i> (2021), Wu <i>et al.</i> (2022), Wang <i>et al.</i> (2025a), Xu <i>et al.</i> (2025), Eze and Ameyaw (2025), Heydari <i>et al.</i> (2024), Zhang and Teng (2022), Eltoukhy <i>et al.</i> (2023), Wang <i>et al.</i> (2021), Lee <i>et al.</i> (2023), Yang <i>et al.</i> (2022), Zhou (2024), Amiri Ara <i>et al.</i> (2022), Li <i>et al.</i> (2022), Sun <i>et al.</i> (2024), Wang <i>et al.</i> (2025b), Tezel <i>et al.</i> (2020), Hijazi <i>et al.</i> (2024), Ma <i>et al.</i> (2024), Tezel <i>et al.</i> (2021), Singh <i>et al.</i> (2023), Tran <i>et al.</i> (2024), Kim <i>et al.</i> (2020)
	D2: Trust, data-integrity, security and accountability deficits	24 (60.0%)	Xu <i>et al.</i> (2023), Jiang <i>et al.</i> (2021), Celik <i>et al.</i> (2023), Lu <i>et al.</i> (2021), Wu <i>et al.</i> (2022), Wang <i>et al.</i> (2025a), Xu <i>et al.</i> (2025), Eze and Ameyaw (2025), Zhang and Teng (2022), Eltoukhy <i>et al.</i> (2023), Kuan <i>et al.</i> (2024), Luo <i>et al.</i> (2019), Yang <i>et al.</i> (2022), Qian and Papadonikolaki (2021), Zhou (2024), Nanayakkara <i>et al.</i> (2021), Li <i>et al.</i> (2022), Sun <i>et al.</i> (2024), Sarkar <i>et al.</i> (2023), Wang <i>et al.</i> (2025b), Tezel <i>et al.</i> (2020), Hijazi <i>et al.</i> (2024), Ma <i>et al.</i> (2024), Tezel <i>et al.</i> (2021)
	D3: Inadequate traceability, provenance and quality verification	14 (35.0%)	Xu <i>et al.</i> (2023), Wang <i>et al.</i> (2020), Lu <i>et al.</i> (2021), Wu <i>et al.</i> (2022), Rodrigo <i>et al.</i> (2020), Wang <i>et al.</i> (2021), Rocco (2023), Kuan <i>et al.</i> (2024), Zhou (2024), Amiri Ara <i>et al.</i> (2022), Li <i>et al.</i> (2022), Sun <i>et al.</i> (2024), Wang <i>et al.</i> (2025b), Hijazi <i>et al.</i> (2024)
Transactional and operational drivers	D4: Payment, contract-administration and transaction inefficiencies	10 (25.0%)	Hamledari and Fischer (2021), Eze and Ameyaw (2025), Heydari <i>et al.</i> (2024), Luo <i>et al.</i> (2019), Lee <i>et al.</i> (2023), Nanayakkara <i>et al.</i> (2021), Sarkar <i>et al.</i> (2023), Tezel <i>et al.</i> (2020, 2021), Kim <i>et al.</i> (2020)
	D5: Coordination, procurement, logistics and process inefficiencies	23 (57.5%)	Hamledari and Fischer (2021), Jiang <i>et al.</i> (2021), Celik <i>et al.</i> (2023), Wang <i>et al.</i> (2020), Li <i>et al.</i> (2021), Wu <i>et al.</i> (2022), Wang <i>et al.</i> (2025a), Waqar <i>et al.</i> (2024), Heydari <i>et al.</i> (2024), Zhang and Teng (2022), Eltoukhy <i>et al.</i> (2023), Lee <i>et al.</i> (2023), Yang <i>et al.</i> (2022), Amiri Ara <i>et al.</i> (2022), Li <i>et al.</i> (2022), Sun <i>et al.</i> (2024), Sarkar <i>et al.</i> (2023), Wang <i>et al.</i> (2025b), Tezel <i>et al.</i> (2020), Hijazi <i>et al.</i> (2024), Ma <i>et al.</i> (2024), Tezel <i>et al.</i> (2021), Kim <i>et al.</i> (2020)
Digital integration drivers	D6: Interoperability problems and disconnected or centralised digital systems	11 (27.5%)	Jiang <i>et al.</i> (2021), Celik <i>et al.</i> (2023), Elghaish <i>et al.</i> (2023), Li <i>et al.</i> (2021), Heydari <i>et al.</i> (2024), Zhou (2024), Amiri Ara <i>et al.</i> (2022), Li <i>et al.</i> (2022), Sarkar <i>et al.</i> (2023), Hijazi <i>et al.</i> (2024), Tran <i>et al.</i> (2024)

(continued)

Table 4. Continued

Driver theme	Specific adoption driver	Frequency, <i>n</i> (%)	Supporting studies
Sustainability and institutional drivers	D7: Sustainability, carbon-reduction, circularity and waste-management pressures	10 (25.0%)	Elghaish <i>et al.</i> (2023), Li <i>et al.</i> (2021), Singh and Kumar (2024), Waqar <i>et al.</i> (2024), Rodrigo <i>et al.</i> (2020), Rocco (2023), Kuan <i>et al.</i> (2024), Ma <i>et al.</i> (2024), Singh <i>et al.</i> (2023), Gu <i>et al.</i> (2025)
	D8: Regulatory, compliance and auditability requirements	6 (15.0%)	Eze and Ameyaw (2025), Zhang and Teng (2022), Rocco (2023), Wang <i>et al.</i> (2025b), Hijazi <i>et al.</i> (2024), Ma <i>et al.</i> (2024)
Strategic and contextual drivers	D9: Supply-chain disruption, resilience and environmental-uncertainty pressures	3 (7.5%)	Wang <i>et al.</i> (2025a), Zhang and Teng (2022), Sun <i>et al.</i> (2024)
	D10: Productivity, competitiveness and digital-transformation pressures	3 (7.5%)	Zhang and Teng (2022), Tezel <i>et al.</i> (2020), Hijazi <i>et al.</i> (2024)
	D11: Safety and risk-management requirements	1 (2.5%)	Yang <i>et al.</i> (2022)

Source(s): Table created by the authors

number of studies reporting a specific adoption driver, while the percentage represents its prevalence within the 40 studies included in the qualitative content analysis.

3.2.1.1 Information governance drivers. Information governance emerged as the most prominent theme, reflecting the fragmented organisational structure of construction, where project information is generated and controlled by multiple temporarily assembled organisations with divergent systems and contractual interests. This fragmentation creates information silos, inconsistent records and restricted visibility across supply-chain tiers (Wang *et al.*, 2020; Celik *et al.*, 2023). Fragmented information flows and limited visibility were the most prevalent specific driver, identified in 72.5% of studies and were linked to scheduling delays, coordination failures and decision-making inefficiencies across precast, modular and international supply chains. BT is attractive in these settings because a shared ledger can establish a consistent, time-stamped record of events without requiring organisations to surrender data control (Li *et al.*, 2021; Wu *et al.*, 2022). Closely related, trust, data-integrity and accountability deficits appeared in 60.0% of studies, reinforcing the view that information fragmentation is a governance problem as much as a technical one. Adversarial relationships and opportunistic behaviour discourage data sharing, perpetuating the very fragmentation BT aims to resolve (Qian and Papadonikolaki, 2021; Xu *et al.*, 2025). While BT addresses this through cryptographic verification and tamper-evident records, it does not eliminate trust but shifts it to the underlying digital infrastructure, consensus mechanisms and data-entry procedures. Its effectiveness remains contingent on complementary off-chain verification, reliable physical–digital interfaces and accountable data ownership (Lu *et al.*, 2021; Mahpour, 2026). Inadequate traceability, provenance and quality verification – identified in 35.0% of the studies – further underscore governance deficiencies, particularly for materials, embodied carbon and modular components, where immutable chain-of-custody records can strengthen verification if supported by consistent identifiers and data standards (Rodrigo *et al.*, 2020; Kuan *et al.*, 2024). These findings position information governance not as a collection of independent benefits but as the foundational adoption theme from which operational and institutional motivations develop (Yoon and Pishdad-Bozorgi, 2022).

Existing reviews similarly identify transparency, traceability and trust as central themes in blockchain-enabled CSCs (Yoon and Pishdad-Bozorgi, 2022; Shishehgharkhaneh *et al.*, 2023). The present findings deepen this understanding by showing that these technological capabilities respond to a connected set of antecedent governance deficiencies: fragmented records, information asymmetry, weak accountability and unreliable provenance. Information governance consequently emerges not as a collection of independent technological benefits but as the foundational adoption theme from which many operational and institutional motivations develop.

3.2.1.2 Transactional and operational drivers. Transactional and operational drivers constitute the second theme, encompassing coordination, procurement and process inefficiencies (57.5% of studies), alongside payment and contractual deficiencies (25.0%). Construction transactions are characterised by repeated verification, manual documentation and reconciliation between incompatible records, which increase administrative burden and delay decisions. These problems are acute in prefabricated and modular contexts requiring timely coordination across design, manufacturing and logistics (Wang *et al.*, 2020; Lee *et al.*, 2023). A shared blockchain record can reduce reconciliation by providing a consistent account of events, supporting tracking, contracting and transfer functions (Qian and Papadonikolaki, 2021). However, value realisation depends on underlying workflow quality; digitising inefficient processes without standardisation may yield limited improvement. Payment and contract-administration deficiencies – delayed payments, retentions and ambiguous obligations – create severe cash-flow pressures, particularly for subcontractors and suppliers (Nanayakkara *et al.*, 2021; Tezel *et al.*, 2021). Smart contracts can connect physical progress verification with payment execution, reducing the temporal gap between work completion and settlement (Hamledari and Fischer, 2021). Nevertheless, contractual automation is constrained by the inherent complexity and incompleteness of construction contracts; many decisions rely on professional judgement and negotiated variations that resist reduction to predetermined computational rules. Thus, smart contracts are more applicable to routine, objectively verifiable obligations and their adoption cannot eliminate the underlying contractual uncertainty characteristic of complex projects.

Previous reviews of blockchain applications in procurement and contract management have emphasised automation, transaction efficiency and dispute reduction (Zhang *et al.*, 2023; Kim and Kim, 2024). The findings of this study indicate that these anticipated outcomes are rooted in more fundamental pressures: payment insecurity, fragmented verification, contractual administration burdens and weak coordination between physical and financial flows. This distinction explains why the relevance of BT varies across use cases. Its relative advantage is likely to be greater where transactions involve multiple organisations, verification costs are high and no participant can provide a universally accepted record.

3.2.1.3 Digital integration. Digital integration emerged as a distinct theme through interoperability problems and disconnected or centralised digital systems, identified in eleven studies (27.5%). Although less prevalent than information-governance and operational drivers, this theme is critical because the effectiveness of BT depends substantially on its relationship with existing construction technologies. Studies reported information islands, incompatible databases, single points of failure and weak data exchange across BIM, IoT, digital-twin and supply-chain-management platforms (Jiang *et al.*, 2021; Li *et al.*, 2022; Zhou, 2024).

The findings position BT as a complementary infrastructure rather than a substitute for established digital technologies. BIM provides structured project and asset information, IoT devices capture physical events and digital twins represent changing conditions within physical systems. Blockchain can add a verifiable transaction and provenance layer through which data generated by these technologies are exchanged across organisational boundaries. For example, Li *et al.* (2022) integrated blockchain with BIM and IoT to address data manipulation, centralised control and single-point failure, while Zhou (2024) highlighted the value of trusted information exchange within multidisciplinary digital-twin environments.

Similarly, [Sarkar et al. \(2023\)](#) connected blockchain adoption to the need for improved accountability, monitoring and integration across disconnected project technologies.

The growing convergence of BT with BIM and IoT is consistent with the thematic structures observed by [Shishegarkhaneh et al. \(2023\)](#) and [Saah and Choi \(2023\)](#). However, much of the literature proposes architectures or prototypes, while evidence of stable, scalable and interoperable deployment across complete CSCs remains limited. The technical integration of multiple platforms can also increase system complexity, cybersecurity exposure and dependence on specialist expertise. In some cases, a conventional shared database may provide the required functionality more efficiently, particularly where participants already operate under a trusted central authority.

These findings align with [Pittri et al. \(2026d\)](#), whose BIBECT framework positions BIM, IoT and BT as complementary technologies for verifiable embodied-carbon tracking. However, while their framework demonstrates conceptual feasibility, the present synthesis shows that interoperability and digital readiness function simultaneously as adoption pressures and implementation conditions.

3.2.1.4 Sustainability and institutional pressures. Sustainability and institutional pressures – including carbon reduction, circularity, waste management (25.0%) and regulatory compliance (15.0%) – reflect growing demands for lifecycle accountability and verifiable environmental reporting.

Studies have examined BT in relation to embodied-carbon information, construction-waste management, circular material flows, material passports and sustainable prefabrication ([Rodrigo et al., 2020](#); [Elghaish et al., 2023](#); [Rocco, 2023](#); [Kuan et al., 2024](#); [Ma et al., 2024](#)). These applications respond to a fundamental information problem: environmental data are generated by multiple organisations at different lifecycle stages but must remain sufficiently consistent, traceable and auditable to support procurement, reporting and recovery decisions. Blockchain can preserve records of material origin, composition, carbon attributes, ownership and transfer, thereby supporting lifecycle information continuity beyond the temporary duration of individual projects.

The increasing prominence of sustainability alongside established themes such as smart contracts, supply-chain management, BIM and IoT is consistent with the thematic evolution reported by [Shishegarkhaneh et al. \(2023\)](#). Nevertheless, the current evidence remains more developed at the level of information capability than demonstrated environmental performance. Securely recording carbon data does not resolve inconsistencies in emission factors, system boundaries, allocation procedures or product classifications. Similarly, material traceability does not automatically result in reuse, recycling or waste reduction. These outcomes depend on market demand, procurement criteria, recovery infrastructure and the willingness of stakeholders to act on the information provided.

Regulatory, compliance and auditability pressures further strengthen the sustainability rationale where organisations are required to provide verifiable evidence of material quality, environmental performance or contractual compliance. Studies of public–private partnerships, cross-border supply chains, concrete quality and construction-waste management illustrate how regulatory complexity and weak auditability can motivate interest in blockchain-supported records ([Zhang and Teng, 2022](#); [Eze and Ameyaw, 2025](#); [Wang et al., 2025b](#); [Ma et al., 2024](#)). Institutional requirements can therefore convert traceability from a desirable technological capability into an organisational necessity.

However, recent reviews (e.g. [Pittri et al., 2026b](#)) posit that these pressures vary across jurisdictions, procurement systems and project types. In environments without mandatory digital reporting, standardised environmental data or legal recognition of blockchain records, sustainability motivations may remain insufficient to support investment. The relatively modest frequency of institutional drivers may consequently reflect uneven regulatory development rather than limited practical significance. It also indicates that sustainability-oriented adoption remains contingent on the interaction between technological capability and external institutional demand. BT is most likely to generate environmental value where

reporting requirements, measurement standards and procurement incentives are sufficiently developed to make trustworthy lifecycle information operationally consequential.

3.2.1.5 Strategic and contextual pressures. Strategic and contextual pressures comprised supply-chain disruption, resilience and environmental uncertainty; productivity, competitiveness and digital transformation; and safety and risk management. These were the least frequently identified drivers: resilience-related pressures and productivity or competitiveness pressures each appeared in three studies (7.5%), while safety and risk management appeared in one study (2.5%). Their lower prevalence reflects the current orientation of the literature rather than the practical importance of the underlying issue.

Recent supply-chain disruptions have increased interest in systems capable of maintaining visibility and accountability across geographically dispersed and organisationally fragmented networks. Zhang and Teng (2022), Sun *et al.* (2024) and Wang *et al.* (2025a) associated information asymmetry, disruption and environmental uncertainty with the need for more integrated and resilient supply-chain arrangements. Distributed records may support resilience by preserving transaction histories and enabling authorised actors to access consistent information when individual organisational systems are unavailable or unreliable.

However, decentralised record-keeping does not guarantee supply-chain continuity. Blockchain networks remain dependent on communication infrastructure, data capture, network participation and appropriate governance. They may also introduce new vulnerabilities associated with cryptographic-key management, platform dependence and technical expertise as postulated by Pittri *et al.* (2026b). Resilience should therefore be assessed at the level of the complete socio-technical system rather than inferred from decentralisation alone.

Productivity, competitiveness and digital-transformation pressures were reported in studies linking BT to broader construction digitalisation, operational savings, reputation and participation in emerging digital ecosystems (Tezel *et al.*, 2020; Hijazi *et al.*, 2024). These motivations suggest that some organisations may view BT as part of a wider strategic response to changing procurement expectations and technological competition. Nevertheless, the adoption of an accessible technology is unlikely to create sustained competitive advantage independently. Strategic value depends on complementary resources, including integration capability, data-governance expertise, contractual knowledge and relationships with supply-chain partners. Adoption undertaken primarily for signalling or reputational purposes may therefore remain symbolic if it is not connected to a clearly defined supply-chain problem.

Safety and risk management received the least direct attention. Yang *et al.* (2022) examined blockchain-supported scaffolding management in response to forgery risks, manual verification, poor information exchange and limited inspection capacity. Although this study demonstrates the potential relevance of BT to safety-critical supply-chain information, a single study does not establish safety as a mature adoption theme. Instead, it points to an emerging research opportunity involving the provenance and verification of safety-critical materials, equipment, certifications and inspection records.

3.2.2 Stakeholder differences in blockchain adoption drivers. The findings of this study indicate that BT adoption drivers vary according to stakeholders' positions within CSCs and their corresponding exposure to information, contractual and operational risks. Clients and public authorities prioritise oversight, auditability, quality assurance and regulatory compliance, whereas contractors and project managers are more concerned with coordination, procurement efficiency and reliable progress information. Subcontractors and SMEs are particularly motivated by payment security and protection from opportunistic practices, while suppliers, manufacturers and logistics providers emphasise demand visibility, provenance, inventory management and delivery coordination. Designers and consultants primarily require reliable information integration and traceable professional decisions, while downstream actors value lifecycle information continuity and material recovery. Table 5 summarises these stakeholder-specific drivers, associated blockchain mechanisms, expected value and supporting studies.

Table 5. Stakeholder-specific blockchain adoption drivers across CSCs

Stakeholder group	Principal adoption drivers	Relevant blockchain mechanisms	Expected stakeholder value	Supporting studies
Clients, owners and public procuring authorities	Limited supply-chain visibility; weak accountability; quality and provenance risks; procurement, sustainability and regulatory oversight	Shared permissioned ledger; provenance records; smart contracts; auditable lifecycle data	Improved oversight, compliance, quality assurance and lifecycle accountability	Wang et al. (2020) , Elghaish et al. (2023) , Lee et al. (2023) , Eze and Ameyaw (2025) , Tezel et al. (2021)
Main contractors and project managers	Coordination failures; unreliable progress information; procurement inefficiency; contractual and quality-control risks	Real-time shared records; BIM–blockchain integration; automated verification; smart contracts	Better coordination, schedule visibility, procurement control and reduced administrative burden	Wang et al. (2020) , Amiri Ara et al. (2022) , Lee et al. (2023) , Heydari et al. (2024) , Xu et al. (2025)
Subcontractors and SMEs	Delayed, partial or non-payment; retention; financing costs; limited visibility and bargaining power	Escrow arrangements; project bank accounts; milestone-triggered payment; immutable transaction records	Payment security, faster settlement, lower financing risk and more equitable participation	Hamledari and Fischer (2021) , Nanayakkara et al. (2021) , Wang et al. (2021) , Tezel et al. (2021)
Suppliers and manufacturers	Poor demand visibility; inventory risk; supplier verification; material provenance and quality requirements	Product provenance records; shared demand information; digital identities; IoT-linked traceability	Improved forecasting, reduced inventory costs, verified credentials and stronger market access	Wang et al. (2020) , Xu et al. (2023) , Li et al. (2022) , Sun et al. (2024) , Wang et al. (2025a)
Logistics and transport providers	Fragmented shipment information; cross-border supervision; delivery disputes; pressure to share timely data	Time-stamped logistics records; blockchain-IoT tracking; permissioned access; reputation and incentive mechanisms	Improved shipment coordination, evidence for dispute resolution and enhanced service reliability	Wang et al. (2020) , Wu et al. (2022) , Amiri Ara et al. (2022) , Lee et al. (2023)
Designers, engineers and professional consultants	Disconnected design and supply-chain information; change-control problems; verification and certification burdens	BIM–blockchain integration; immutable approval records; reusable digital product information; smart-contract validation	Reliable design information, traceable decisions and more efficient professional verification	Luo et al. (2019) , Elghaish et al. (2023) , Li et al. (2022) , Zhou (2024)
Regulators, auditors and certification bodies	Weak auditability; compliance failures; unreliable certification and environmental records	Tamper-evident compliance records; digital certificates; auditable material and environmental data	Stronger regulatory oversight, evidence verification and enforcement	Zhang and Teng (2022) , Eze and Ameyaw (2025) , Ma et al. (2024) , Wang et al. (2025a)

(continued)

Table 5. Continued

Stakeholder group	Principal adoption drivers	Relevant blockchain mechanisms	Expected stakeholder value	Supporting studies
Technology providers and data intermediaries	Disconnected platforms; unreliable off-chain data; system-security and interoperability requirements	APIs; digital identities; blockchain oracles; BIM–IoT–digital-twin integration	Interoperable and verifiable multi-organisational digital infrastructure	Lu et al. (2021) , Li et al. (2022) , Sarkar et al. (2023) , Zhou (2024)
Financiers, insurers and investors	Separation of physical and financial flows; limited project visibility; financing and transaction risks	Escrow; tokenisation; automated settlement; verified progress records	Greater transaction visibility, more secure fund release and alternative financing opportunities	Hamledari and Fischer (2021) , Tezel et al. (2021)
Asset operators and circular-economy actors	Loss of lifecycle information; uncertain component provenance; waste and recovery inefficiencies	Material passports; lifecycle ledgers; ownership-transfer records; circular-material platforms	Improved maintenance information, reuse decisions, waste traceability and residual-value recovery	Elghaish et al. (2023) , Rocco (2023) , Ma et al. (2024)

Source(s): Table created by the authors

These differences reveal that the business case for BT is not distributed evenly across the supply chain. Stakeholders expected to finance, govern or provide data to the blockchain network may not receive its most immediate benefits. Clients may possess the authority to mandate adoption, contractors may bear substantial integration and coordination costs, suppliers may be required to disclose commercially sensitive information, and subcontractors may obtain the most direct benefits through improved payment security ([Wang, 2019](#); [Tezel et al., 2021](#); [Nanayakkara et al., 2021](#)). Adoption is therefore a collective-action problem in which participation depends not only on the technological value offered to individual stakeholders but also on how implementation costs, data control, risks and benefits are distributed across the network.

The evidence is also uneven across stakeholder groups. Although several studies provide empirical insights into clients, contractors, suppliers and subcontractors, the motivations of regulators, technology providers, financiers, insurers and downstream lifecycle actors are commonly inferred from proposed applications rather than investigated directly. Moreover, blockchain may redistribute rather than eliminate existing power asymmetries if dominant organisations control network membership, validation rules and data-access permissions. Effective adoption consequently requires governance arrangements that align stakeholder incentives, protect commercially sensitive information and provide equitable participation, particularly for SMEs and less powerful supply-chain actors. Future empirical research should therefore compare stakeholder motivations directly and examine how contractual position, organisational size, digital maturity and network governance influence adoption priorities.

4. Research gaps and directions for future studies

Despite increasing research on BT in CSCM, the evidence remains theoretically fragmented. Many studies explain adoption through anticipated technological capabilities, such as transparency, traceability and automation, without distinguishing these mechanisms and expected outcomes from the antecedent problems that motivate adoption. Consequently,

limited attention has been given to how information fragmentation, trust deficits, payment insecurity, operational inefficiency and institutional pressures translate into adoption decisions. Future studies should develop and test theoretically grounded models that distinguish drivers, enabling mechanisms, implementation conditions and realised outcomes. The TOE framework, institutional theory and the RBV offer complementary explanations, but should be applied according to their respective analytical roles and extended with inter-organisational governance perspectives appropriate to temporary, multi-actor CSCs.

A second gap concerns the predominance of conceptual frameworks, technical architectures, simulations and prototype demonstrations. Although several studies provide empirical evidence through surveys, case studies and expert evaluation, comparatively few examine BT adoption and value realisation across complete, multi-tier supply chains. The literature therefore establishes the persistence of information, trust and coordination problems more convincingly than it demonstrates that BT resolves them at an acceptable cost. Longitudinal case studies, comparative project evaluations and mixed-method research are required to examine how adoption drivers change from initial interest to implementation and continued use. Such studies should assess both intended and unintended outcomes, including implementation costs, data-quality problems, changes in organisational responsibilities and the redistribution of risk among participating actors.

The interaction and relative influence of the identified drivers also remain insufficiently understood. Information fragmentation, mistrust and weak provenance may contribute to procurement, payment and coordination inefficiencies, while digital integration and regulatory pressure may determine whether these motivations result in adoption. However, most studies examine particular applications or drivers independently and provide limited evidence regarding their causal ordering, complementarity or substitution. Future research should use structural modelling, configurational methods, longitudinal process analysis and multi-criteria approaches to determine which combinations of governance, operational, technological and institutional conditions lead to adoption. Particular attention should be given to whether digital integration functions as an antecedent driver, an implementation enabler or a boundary condition under different organisational circumstances.

Stakeholder-level evidence is similarly uneven. The literature provides comparatively stronger insights into clients, contractors, suppliers and subcontractors, but the motivations of regulators, technology providers, financiers, insurers and downstream lifecycle actors remain underexamined. Moreover, few studies compare stakeholder groups within the same supply-chain network. This limits understanding of how adoption costs, benefits, data-control rights and risks are distributed among actors. Future studies should employ multi-stakeholder and network-level research designs to investigate how contractual position, organisational size, digital maturity and bargaining power influence adoption priorities. Such research should also examine whether client-led or platform-led governance arrangements facilitate collective participation or reproduce existing power asymmetries, particularly for SMEs and specialist suppliers.

Data governance and physical–digital integrity constitute another important gap. Although BT can preserve tamper-evident records, its effectiveness depends on the reliability of off-chain data, digital identifiers, IoT devices and blockchain oracles (Lu *et al.*, 2021). Current studies give comparatively limited attention to responsibility for erroneous data, correction procedures, access permissions, commercial confidentiality and liability for automated decisions. Interoperability standards and legal recognition of smart-contract transactions also remain insufficiently developed. Future research should evaluate alternative permission, identity and governance models and examine how data standards, oracle validation, cybersecurity and privacy arrangements affect trust and participation. These questions are particularly important in public procurement, international supply chains and safety- or quality-critical applications.

Sustainability and circular-economy motivations are growing but remain supported largely by proposed systems and anticipated benefits. Studies demonstrate the potential of BT to

maintain embodied-carbon records, material passports and waste-traceability information (Rodrigo *et al.*, 2020; Elghaish *et al.*, 2023; Rocco, 2023; Kuan *et al.*, 2024; Ma *et al.*, 2024), but evidence linking these capabilities to measurable carbon reduction, material reuse or waste prevention remains limited. Future studies should evaluate BT-enabled systems using established lifecycle-assessment, material-circularity and waste-performance indicators and compare them with less complex digital alternatives. They should also investigate whether regulatory mandates, client procurement requirements and secondary-material markets are necessary for improved information traceability to generate environmental value.

Finally, the uneven frequency of the themes reveals several underdeveloped research areas. Resilience, competitiveness, safety, financing, insurance and end-of-life material recovery received substantially less attention than information governance and operational efficiency. Their lower representation reflects an immature knowledge base. Future research should examine these drivers across different project types, procurement systems, geographical contexts and levels of institutional development. Comparative studies involving developing and developed economies are particularly needed to establish whether the identified drivers are transferable across settings characterised by different regulatory capacity, digital infrastructure, supply-chain informality and technological readiness.

5. An integrated conceptual framework of BT adoption drivers in CSCM

Drawing on the scientometric analysis and qualitative synthesis, Figure 5 presents an integrated stakeholder–driver framework explaining how pressures within CSCs translate into BT adoption decisions and realised value. The framework distinguishes five analytically connected stages: adoption pressures, stakeholder–driver alignment, collective adoption decisions, BT-enabled mechanisms and realised value. Enablers, barriers and boundary conditions moderate this process, while implementation experience creates feedback that can reinforce, weaken or reconfigure subsequent adoption decisions.

The framework employs four complementary theoretical lenses. Institutional theory explains how coercive pressures from regulation and procurement requirements, normative expectations surrounding transparency and professional accountability, and mimetic pressures generated by competitors or leading clients shape organisational interest in BT (DiMaggio and

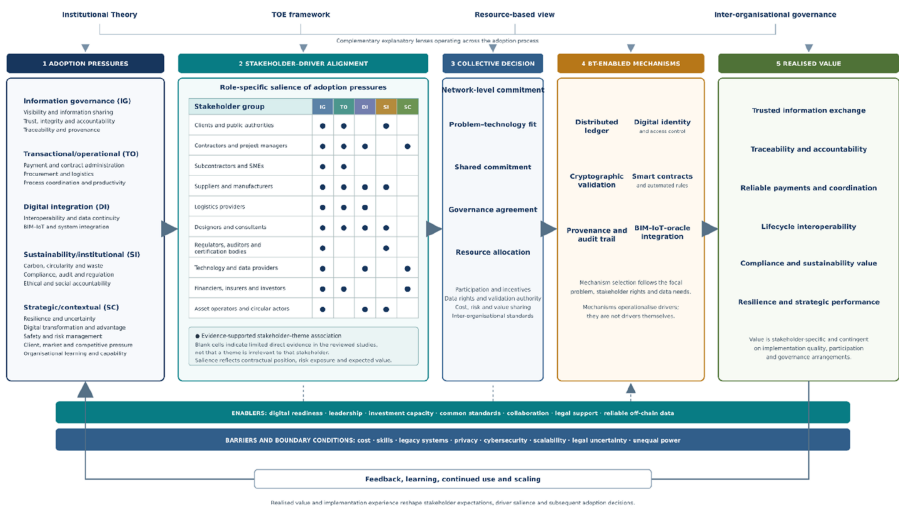


Figure 5. An integrated conceptual framework of BT adoption drivers in CSCs. Source: Figure created by the authors

Powell, 1983). The TOE framework explains how such pressures interact with technological suitability, organisational readiness and environmental conditions (Tornatzky and Fleischer, 1990). However, neither external pressure nor technological compatibility guarantees adoption. The RBV directs attention to the complementary capabilities required to derive strategic value from BT, including digital integration expertise, data-governance routines, contractual knowledge and inter-organisational relationships (Barney, 1991). Inter-organisational governance provides the network-level perspective needed in temporary and fragmented CSCs, where adoption depends on agreement over participation, data rights, validation authority, costs and risk allocation (Qian and Papadonikolaki, 2021). These theories are therefore not interchangeable: Institutional Theory explains external legitimacy pressures, TOE structures the adoption context, RBV explains capability-based value creation, and inter-organisational governance explains collective coordination.

The first stage consolidates the evidence into five interconnected adoption-pressure themes identified in section 3.2.1. Moreover, the framework rejects the assumption that these pressures possess uniform relevance across the supply chain. The stakeholder–driver matrix represents associations directly supported by the reviewed studies as presented in section 3.2.2. Blank cells indicate limited direct evidence rather than the absence of stakeholder relevance, highlighting an important empirical gap.

Stakeholder alignment subsequently informs a collective adoption decision based on problem–technology fit, shared commitment, governance agreement and resource allocation. This stage is critical because the actors providing data, financing implementation or assuming new responsibilities may not receive the most immediate benefits. For example, subcontractors may benefit from faster payment, while contractors or clients bear integration and governance costs. BT adoption is consequently a collective-action problem requiring explicit arrangements for incentives, access permissions, data ownership, validation responsibilities and value distribution. Unequal control over network membership or validation rules may reproduce existing power asymmetries rather than decentralise governance. Adoption should therefore follow evidence of a multi-organisational verification or coordination problem that cannot be addressed more efficiently through a conventional shared database.

Once collective commitment is established, appropriate mechanisms can be configured, including distributed ledgers, digital identities and access controls, cryptographic validation, smart contracts, provenance records and BIM–IoT–oracle integration. These mechanisms operationalise adoption pressures; they are not drivers themselves. Their selection must follow the focal problem and the reliability of associated off-chain data. For instance, smart contracts may support objectively verifiable payment obligations but cannot fully encode negotiated variations or professional judgement (Hamledari and Fischer, 2021). Similarly, immutable records preserve submitted information but do not ensure its original accuracy (Lu *et al.*, 2021). Realised outcomes – including trusted information exchange, accountability, payment reliability, lifecycle interoperability, sustainability compliance and resilience – therefore depend on digital readiness, leadership, common standards, collaboration and legal support. They are constrained by cost, skills shortages, legacy systems, privacy, cybersecurity, scalability, legal uncertainty and unequal power. The feedback loop recognises that demonstrated value, implementation failure and organisational learning subsequently reshape stakeholder expectations, driver salience, continued use and scaling. The framework thus advances a contingent and testable explanation of BT adoption rather than assuming a linear progression from technological capability to supply-chain benefit.

6. Conclusion

This study examined the drivers of BT adoption in CSCM by integrating scientometric mapping with qualitative content analysis. Five interrelated driver themes were identified: information governance; transactional and operational pressures; digital integration;

sustainability and institutional pressures; and strategic and contextual pressures. Information fragmentation, limited visibility, weak trust, payment insecurity and unreliable provenance emerged as particularly influential motivations. These findings position BT not merely as a technological application but as a potential governance and integration infrastructure for addressing persistent information and coordination deficiencies across fragmented CSCs.

6.1 Theoretical contributions

The study makes several theoretical contributions. First, it redirects the literature from a predominantly technology- and application-centred perspective towards a driver-centred explanation of BT adoption. Second, the integrated framework combines institutional theory, the TOE framework, the RBV and inter-organisational governance. These lenses respectively explain external legitimacy pressures, technological and organisational conditions, complementary capability requirements and the collective governance arrangements necessary for adoption across multi-actor supply chains. The stakeholder–driver alignment further demonstrates that adoption is not a uniform organisational decision but a negotiated process shaped by contractual position, risk exposure, expected value and network power.

For academia, the study provides a consolidated driver taxonomy, stakeholder–driver matrix and theoretically grounded framework for cumulative research. These outputs establish a basis for developing and testing models of driver salience, stakeholder alignment, adoption decisions and value realisation. The framework therefore advances the field beyond descriptive application catalogues and pilot demonstrations towards theoretically informed explanations of adoption, continued use and scaling.

6.2 Practical and policy implications

The practical and industry implications emphasise problem-driven rather than technology-led implementation. Organisations should first identify the supply-chain deficiency to be addressed before selecting distributed ledgers, smart contracts, digital identities or BIM–IoT integration. Clients and public authorities can apply the framework to establish information, auditability and lifecycle-reporting requirements. Contractors and project managers can use it to prioritise coordination, payment and integration applications, while suppliers, manufacturers and logistics providers can focus on provenance, demand visibility and delivery verification. However, adoption may fail where the actors financing or supplying data to the network do not receive commensurate benefits. Implementation strategies must therefore specify network membership, data ownership, validation authority, access permissions, commercial confidentiality, cost allocation and dispute-resolution arrangements.

The findings also have important policy implications. Policymakers, regulators and professional bodies should prioritise interoperable data standards, consistent material identifiers, cybersecurity requirements, legal clarity for blockchain records and smart contracts, and harmonised sustainability-reporting protocols. Public procurement can encourage transparent and auditable supply-chain practices, but mandating BT without establishing problem–technology fit or adequate industry readiness may create additional compliance costs. Policy should therefore remain technology-neutral and outcome-oriented, requiring verifiable information and accountability while allowing organisations to determine whether BT offers advantages over less complex alternatives. Regulatory sandboxes, implementation guidance and targeted support for SMEs could reduce legal and capability barriers while promoting more equitable participation.

6.3 Limitations and avenues for future research

Notwithstanding these contributions, the study has limitations. The review was restricted to English-language, peer-reviewed journal articles and conference papers indexed in Scopus, potentially excluding relevant studies indexed elsewhere and evidence contained in industry

reports. Moreover, the study synthesised reported drivers without empirically testing their relative importance, causal relationships or performance implications. The literature also remains dominated by conceptual frameworks, technical architectures and pilot applications, limiting conclusions regarding long-term implementation and value realisation. Future research should employ longitudinal case studies, surveys, comparative project evaluations and mixed-method designs to validate the framework across project types, procurement systems, jurisdictions and levels of digital maturity.

Supplementary material

The supplementary material for this article can be found online.

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