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A Review on Leveraging from Block-chain Technology to Improve Supply-chain Management in the Construction Industry

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Abstract

Block-chain technology will allow more transparent and reliable end-to-end monitoring in the supply chain. Construction companies can digitize physical assets and establish a decentralized, secure database of all purchases, allowing assets to be monitored from source to distribution or used by the end consumer. We seek to guide construction supply chain research to leverage blockchain technology to enhance supply chain management in the construction industry. Although considerable research on opportunities that blockchain technology presents for supply chain management, little is known about the factors that will lead to better management of the construction supply chain. We first identify the opportunities that blockchain technology offers for the construction supply chain by conducting an extensive search on available literature. Next, the authors categorized the key benefits that can be leveraged by implementing blockchain technology into the construction supply chain. Finally, we present our results that implementing blockchain technology can positively impact supply chain management in the construction industry through improved transparency, traceability, information sharing, and trust among key stakeholders. These findings provide a promising measurement model for empirical research and a foundation for descriptive and normative research on blockchain applications for improved supply chain management in the construction industry.

Keywords: Block-chain technology; key benefits; construction supply-chain; supply-chain management; transparency; traceability; information sharing; trust.

Introduction

A significant number of building materials are developed globally through diverse supply chains that span all parts of the globe. It differs how these materials are sourced and how and when they are used in various construction projects (O'Brien *et al.*, 2008). With the growing complexity of building projects and the increased focus on quality, the industry is searching for ways to ensure products' sustainability across the supply chain (Pryke, 2009). To add more to the growing complexity of modern-day construction supply chains, many stakeholders with different educational and professional backgrounds are becoming part of the construction supply chain. Usually, construction companies and other key stakeholders that collaborate in the projects are physically dispersed, situated in various areas, working together to meet shared aims, but mostly with a project orientation (Winch, 2009). The construction sector's supply chain developments are losing ground, contributing to a rise in transactions and a decline in mean value. The issue of low trust in the construction

supply chain has been exacerbated for a long time due to decentralized teamwork (Pryke, 2009). The approach to accomplish these criteria of centralized teamwork with high transparency may be enabled with digital technologies. These technologies' primary purpose will be to increase trust, visibility, and traceability to validate the materials' sustainability and strengthen the partnership among key stakeholders (Čuš-Babič *et al.*, 2014). By leveraging the advancements in the technology field, professionals can manage the construction supply chains effectively.

Among the spread of numerous innovative technologies, blockchain technology is emerging as a breakthrough in revolutionizing the structure and growth of supply chain links in the construction industry. Indeed, blockchain technology can offer a streamlined framework for knowledge exchange and protected transactions (Nakamoto & Bitcoin, 2008). A central archive function in blockchain technology preserves an ever-increasing collection of data records to avoid infringement action and alteration (Li *et al.*, 2019; Nakamoto & Bitcoin, 2008). Leveraging blockchain technology in the construction supply chain is a relatively new idea. Recently researchers have proposed and found its numerous applications in the construction industry, such as streamlining energy demand and supply (Hu *et al*., 2019), connecting with Building Information Modeling (BIM), and typical data environments (Erri Pradeep *et al.*, 2019; Nawari & Ravindran, 2019; Parn *et al.*, 2019; Ye *et al*., 2018), and maintaining cyber protection (Nawari & Ravindran, 2019; Singh & Singh, 2016).

Based on these pioneer researches, the current study's scope is to analyze the benefits of blockchain technology for the construction supply chain. In particular, this study aims to figure out what blockchain technology may add to enhancing supply chain management in the construction industry.

Methodology

This paper utilized secondary data, i.e., published research papers or articles on blockchain technology and the construction supply chain using different keyword schemes—the data collected from the databases, i.e., Scopus, ScienceDirect, Web of Sciences, etc. Keyword strings combinations such as blockchain technology, opportunities, challenges, role, leverage, drivers, and advantages for the construction supply chain have been used to optimize search results. Various construction supply chain-related keywords were used to broaden our research. The motive was to find as many articles as possible about blockchain technology application in the construction supply chain, better to answer the research question of the current study. Construction-related supply chain variants such as sourcing, logistics, and procurement were used to enhance the search. In-line with the research questions, the purpose was to extract the articles on blockchain technology's application into construction supply chain management.

Our search was able to gather a sufficient number i.e. 64 of related publications indicates that the keywords chosen were suitable for the study. It also emerged in the Analysis that the research papers investigating leveraging the blockchain technology in the construction supply chain remained limited, thereby confirming the need for this research review to analyze and summarize the potential benefits of implementing the blockchain technology in the construction supply chain.

The paper search produced and chosen 64 related papers. The 32 papers were then checked and grouped into various themes, based on the potential benefits of blockchain technology that a particular article found. The analysis led us to the conclusion that nearly all of the 32 papers addressed one or more of the advantages of implementing blockchain technology in the context of the construction supply chain, resulting in the grouping of the papers into four key possible benefits provided by blockchain technology, i.e. transparency, traceability, knowledge sharing, and trust. To

gain a more precise overview, we reviewed the introduction, the research objective(s), and each article's results.

The classification of papers in themes (see Table 1) has aided in the comprehensive structuring and arrangement of literature and in highlighting and providing a valuable viewpoint on some of the main benefits that can be leveraged through the application of blockchain technology in construction supply chain management.

Once the papers were sorted into categories, the relevant papers were then reviewed using a content review approach to identify blockchain technology's potential for the construction supply chain. Next, we discussed the literature review (Section 3). Based on the study's literature, we consolidate the key themes from relevant papers and hypothesize that leveraging blockchain technology in the construction industry can improve supply chain management (Section 4). In the last section (see section 5), we present our findings of current research.

Table 1. Key benefits of blockchain technology for construction supply chain identified in the literature

Key benefits of the application of blockchain technology in construction supply chain	**References**
Transparency	(Ablyazov & Petrov, 2019; Belle, 2017; Hultgren & Pajala, 2018; Li *et al.*, 2019; Rodrigo *et al.*, 2018; Shojaei *et al.*, 2019)
Traceability	(Hultgren & Pajala, 2018; Rodrigo *et al.*, 2018; Z. Wang *et al.*, 2020)
Information Sharing	(Nakasumi, 2017; Rodrigo et al., 2018; Turk & Klinc, 2017; Z. Wang *et al.*, 2020; Yuan et al., 2019)
Trust	(Kinnaird & Geipel, 2018; Lewis *et al.*, 2016; Nanayakkara *et al.*, 2019; Qian, Papadonikolaki, & Management, 2020; Rodrigo et al., 2018; Weernink *et al.*, 2017)

Literature Review

The supply chain in the Construction industry

A construction project's core premise is to make diverse actors work together to construct a particular object for a specific customer. For any construction project, the usual supply chain involves architects, engineers, major contractors, subcontractors, specialists, and materials manufacturers. It is worth noting that, except for architects, engineers, or other building specialists whose fees are contracted, the "low bid wins" is a replicated pricing formula in each supply chain relation (Behera *et al.*, 2015).

The construction sector is project-based, where clients have particular product needs and specifications regarding their projects (Behera *et al.*, 2015), generates a need for quality management from start to end. This implies that every company/business involved in a particular project can have the ability to select its tools and supplies, which, in turn, generate complex supply chains that would need to be reorganized for each project (Pryke, 2009).

The mixture of a new project with a competitive procurement process for each material supplier generates short-term partnerships, inadequate information sharing, and little opportunity for

shared learning. Nevertheless, the sector has recently modified its strategy and sought to follow frameworks to manage the process industry's supply chain. The criteria for selecting new suppliers have become more concentrated on value-creating procurement, common creative technologies, shared learning and quality, performance assessment of suppliers, and their capacity to develop innovative solutions. This has transformed the construction industry's supply chain management by incorporating major changes in the valuation of the customer and the stakeholder and/or decreases in overall project costs (Behera *et al.*, 2015).

The construction industry can benefit tremendously from this era of digitization and technology. One indication of a lack of digitization was seen in the case study conducted. The case study results on a large construction company showed significant obstacles in traceability and coordination across the supply chain. Essentially, this communication was handled by telephone, postal, and paper documents. By consolidating and incorporating the project's documents into the Supply-chain, coordination of this method will improve the supply chain management and overall project monitoring. In a brief period, this culminated in two clear objectives. (1) The tracking of the project progress under the current framework should be strengthened, and (2) the quality of the construction materials should be protected by the construction processes. the results were that this leads to greater accountability in the flow of information and brings efficiency in the supply chain of the construction industry (Čuš-Babič *et al.*, 2014). To tackle these challenges, leveraging emerging technologies such as blockchain technology to manage the construction supply chain effectively may be possible.

Block-chain technology

Block-chain technology is indeed one of the revolutionary developments in decentralized information technology (Abeyratne *et al*., 2016). This technology's concept can be attributed directly to 1991 when Stuart Haber and Scott Stornetta identified the first work on encrypted blocks chain. While the idea underlying the technology was presented to the public, the technology did not gain popularity until the past decade when the digital currency gained momentum (Crosby et al., 2016). The first well-known application of this technology was in Bitcoin cryptocurrency. A work entitled "Bitcoin: A Peer-To-Peer Electronic Cash Method" was published in 2008 by a Nakamoto Satoshi blogger. The author chooses to stay anonymous, and hence this paper was written under the pseudonym of author Satoshi Nakamoto. To this day, nobody knows who the blogger is because he chose to stay anonymous (Meunier, 2018). The published paper described a peer-to-peer form of digital money that would offer internet transactions to be transferred directly from one individual to another without passing through a financial institution. The aim was to eliminate the need for financial intermediaries in every payment (Crosby *et al.*, 2016).

Satoshi has made pragmatic use of blockchain technology and has helped overcome the major problem of preventing double-spending, as defined in the paper published in 2008 (Ante, 2019). To understand the issue of double-spending, one might claim that the scheme contains a scenario where a group would move the asset twice (Drescher, 2017). Since 2008, blockchain technology has been closely related to Bitcoin, and people say it has been developed as part of Bitcoin's underlying architecture. Technology, though, goes well beyond digital currency and financial properties. As technology has achieved broader acceptance in recent years, significant developments have emerged, and new instances have emerged of this technology usage and applications (Abeyratne *et al., 2016)*.

Blockchain technology working procedure

A blockchain can be viewed as a technology that utilizes a distributed ledger, implying a consensus with decentralized and coordinated digital data that is otherwise widely dispersed across

various sites, regions, or organizations. There is no single controller or central data storage (Wu et al., 2017). The term blockchain's rationale is that this public ledger has a sequential chain of blocks where each block maintains a record of true network operation, information, or transactions (Abeyratne et al., 2016). The aim is to make the majority of system stakeholders validate the information that each block contains. If a block has been created and validated, the details cannot be removed or changed (J. Wang *et al.*, 2017). Each block can be described as an encrypted bit of information. Theoretically, everyone inside the framework can add content to the blockchain and check the information at any time, but no one can alter it without appropriate authorization (Abeyratne *et al*., 2016).

Consequently, all "blocks" create a full and permanent record of network events communicated with all users in the system. When a block has been checked, this block is connected to all the chronological blocks named blockchain technology. This allows the blockchain a chain that includes verifiable archives of any single transaction, text, etc. that has ever been added or created in the system (Nofer *et al*., 2017).

Block-chain comprises three main ideas: blocks, nodes, and miners. Each chain consists of several blocks, and every block has three main components: first, the data stored in that block, second, a nonce that is a 32-b number. It is formed randomly whenever a block is formed, producing a hash for the block header. The third component t e hash, is a 256-bit code closely tied to the nonce. Once the initial block of a chain is generated, the nonce develops a cryptographic hash. The block's information is known to be signed and permanently connected to the nonce and hash until it is mined (Xu *et al*., 2019).

The second component of blockchain technology is miner. Miners generate new blocks in the chain by a method known as mining. In a blockchain, every block has its specific nonce and hash, but it also corresponds to the hash of the chain's preceding block, so mining a block is not easy, particularly in large chains. Miners use specialized tools to solve the challenging problem of locating a nonce that automatically produces an agreed hash. When all this occurs, a new block is attached to the chain. Modifying or changing any block earlier in the chain involves re-mining the block with the modification and the blocks added after the transformation. That's why it's incredibly hard to exploit blockchain technology (Xu *et al*., 2019).

Decentralization is the most fundamental principle of blockchain technology. Not a single device or an entity owns the chain. Instead, the ledger is circulated through the nodes attached to the chain. Nodes are the third key component of blockchain technology. Nodes can be an electronic system that preserves the Blockchain records and maintains the network running. Each node has its copy of the entire blockchain, and the network needs to algorithmically authorize every new block for the chain to be modified, trusted, and validated. Since blockchains are transparent, any behavior in the ledger can be easily reviewed and displayed. Each participant shall be given a specific identification code indicating their activities. Consolidating public information with a system of controls and balances lets the Blockchain preserve transparency and builds trust across users. Fundamentally, blockchains can be considered as the optimization of trust through technology (Zheng *et al*., 2017).

Block-chain has a seemingly endless number of implementations and applications in nearly every industry. Ledger technology can be used to detect financial crime (Hyvärinen et al., 2017; Singh & Singh, 2016), safely exchange patient medical records among healthcare professionals (Mertz, 2018; Mubarakali *et al*., 2019; Sadiku *et al.*, 2018), improved supply chain management through information sharing, transparency and traceability (Nakasumi, 2017; Ray *et al.*, 2019; Yuan

et al., 2019), and even serve as a safer way of tracking intellectual property (Feng *et al*., 2017; Holland et al., 2018).

Block-chain technology in Constriction Supply Chain

The latest application of blockchain technologies in the construction industry offers improved supply chain foundations (Kim *et al.*, 2018). A distributed, consensus-based public ledger is being used in the supply chain to trace the sources and processes of the product/service (J. L. Zhao *et al*., 2016). The future monitoring of supply chains through blockchain offers greater traceability (Lu & Xu, 2017), visibility (J. Wang *et al*., 2017), and simplified processes for organizations to work with (Tan *et al*., 2018) Block-chain technology is leveraged to improve the management of the supply chain. It can also offer certification and documentation, including the product lifecycle details, to be open to all stakeholders but unable to forge (Peck *et al*., 2017). The stakeholders will track the product from the factory and proceed in transit to the dealer or shop.

Similarly, in the construction project, each object can be traced to the site and connected to the digital version of the same object in the Building Information Processing (BIM) model with the implementation of blockchain technology. In this way, the immutable data archive can be preserved and retained for the project's whole life cycle (Atlam *et al*., 2018; Dorri *et al*., 2016; Zheng *et al*., 2017). It also offers more excellent protection and gives rise to trust between suppliers and customers (Qian *et al.*, 2020; Sun *et al*., 2016; Weernink *et al*., 2017) and accountability for reporting and auditing purposes (Zheng *et al.*, 2017).

Results and Discussion

The Conceptual Model and Analysis

The extensive research has been done on blockchain technology and challenges in the supply chain, particularly for the construction supply chain, proposing four key benefits that can be leveraged by applying blockchain technology in the construction supply chain. The study's conceptual framework exhibited in figure 1 shows how leveraging the blockchain technology can present four key benefits i.e. transparency, traceability, information sharing, and trust among key stakeholders that all will consequently contribute to an improved supply chain management in the construction industry. Each aspect is elaborated thoroughly in the following sections.

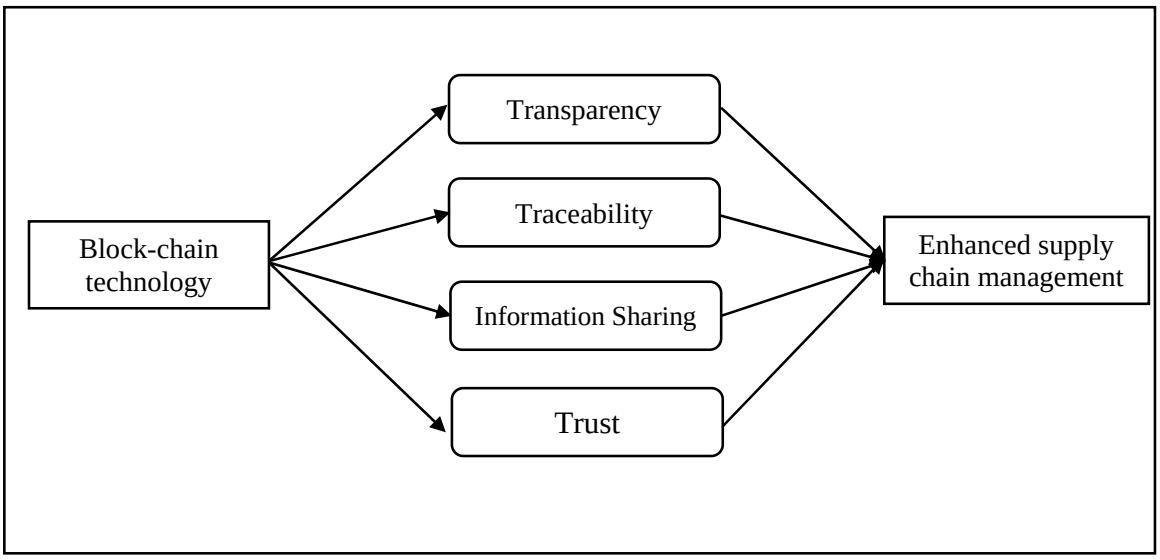

Figure 1. Conceptual Model

Block-chain technology and transparency

Blockchains are supposed to provide the most benefit to supply chains by their improved accessibility and transparency. The transparency of the operations/activities is expected to be the phase at which the blockchain experiences a large-scale implementation.

Centralized systems mostly inefficiently capture and approve every piece of data across the supply chain. Blockchain-enabled interactions (a sequence of activities are conducted regarding the purchase of materials to the payment of materials) provide transparency to all the stakeholders. A block could be produced for each activity reflecting the product/material's digital footprint, from development to delivery at the construction site to the payments.

Block-chain has been built to enable all the members/nodes to search for evidence of activities and the right to refuse a transaction (Toyoda *et al*., 2017). Academic researchers and pragmatists show a keen interest in investigating how blockchain technology is being used to resolve long-standing data integrity, accountability, and transparency concerns (Nanayakkara, et al., 2019; Nanayakkara *et al.*, 2019). Besides, Blockchain Technology and its potential have progressed to resolve many of the challenges of the construction industry, particularly in the field of supply chain management (Hijazi *et al*., 2019). Informed by the literature, it is therefore established that one of the potentials for blockchain technology is an improvement in transparency.

Hypothesis 1. Leveraging blockchain technology in the construction supply chain leads to improved transparency.

Block-chain technology and traceability

The lack of traceability in the construction supply chain to verify if materials are sustainable, materials are sourced ethically, adherence with regulations or product and labor safety is a major issue in the construction industry (Z. Wang *et al*., 2020). Often construction commodities have lengthy and complicated journeys before hitting the construction site. Stakeholders usually know nothing about the origin of the materials or the conditions they are procured, manufactured, and sold.

Traceability means understanding where the materials come from, their movements across the supply chains, and the factors affecting those supply chains. Tracing helps validate arguments made on materials, such as that they are produced without abuse of the workers (for instance, without the use of forced labor or child labor) and their emissions and energy consumption, efficiency, and so on. Stakeholders have little awareness of the sources of the products or materials used for construction. Therefore, visibility into the construction supply chain is a need of an hour (Zhong *et al*., 2017).

Construction projects usually involve several suppliers, contractors, and professionals. Block-chain technology offers them traceability that may help businesses comply with regulations and monitor the transfer of funds. Block-chain may also track the movement of money through intermediaries and identify fraudulent behavior that could render it insecure for certain stakeholders (Hastig *et al.*, 2020). Besides, because blockchain is distributed, it will preclude the Chain from being regulated by any entity.

Hypothesis 2. Leveraging blockchain technology in the construction supply chain leads to improved traceability.

Block-chain technology and information sharing

The construction sector includes a variety of companies in conducting its operation. The communication and assignment of each task to their relevant player is a very complicated process. Information is at the core of the transactions that occur in the supply chains of the construction industry. It has been suggested that construction is predominantly an information transaction opera-

tion. This indicates that how information is handled by the players engaged in the process will impact the successful supply chain management in the construction industry (J. Zhao, 2009). Most construction projects have a variety of main stakeholders with various tasks, such as land movements, structure, architecture, construction, irrigation, electricity, etc. The planning of these operations relies on multiple aspects, some of which are not entirely reliable, such as weather conditions, floods, incidents, delays in supplies, etc. To increase the construction project's efficiency, the contractor must gather information about the current status of the construction project and coordinate with other key players in the project for its successful execution. This information processing must be very reliable so that the subsequent decisions will positively affect the project's success.

During the construction project implementation, all of the parties involved must collaborate with others to achieve the project's standard, time, and expense target. The exchanging and dissemination of information is inevitable and required in this cycle (Hassan *et al*., 2018). The greater the level of sharing, the faster the goal would be to accomplish. Standard information management and exchanging strategies (e.g., communicating through paper, telephone, fax, postal, conference, etc.) lead to a pause in disseminating information and a substantial rise in costs (Xue *et al*., 2011). Digital technologies can significantly increase the reliability of information exchange. The recent development in the technology, which can consolidate and present the necessary information simultaneously, is also an incredible resource for supporting construction site personnel (Kong *et al*., 2004). There is a wide variety of applications available in the market that are very effective in many specialized fields but lacks an understanding of supply chain management. With blockchain technology, parties involved in the construction can share information across the supply chain securely and efficiently. Block-chain acknowledges participants as owners of cryptographic information. In particular, companies should rely on the use of data without being too worried about maintaining and categorizing it properly. With a decentralized network, it can be easier to make legal and regulatory decisions on the processing, handling, and distributing confidential data (Nakasumi, 2017). That is why we conclude that implementing blockchain technology in the construction supply chain will lead to efficient and secure information sharing across the supply chain.

Hypothesis 3. Leveraging blockchain technology in the construction supply chain leads to efficient and secure information sharing.

Block-chain technology and trust

Usually, construction companies working together in contracts are widely scattered. Construction supply chain partners are situated in various areas, employed together to meet shared targets, but with a greater emphasis on the project (Winch, 2009). The supply chain perspective of the construction industry is also beneficial for explaining it. Supply Chain is characterized as a chain of suppliers, distributors, factories, distribution centers, and retailers (CHRISTOPHER, 2017). Supply Chain Management is dedicated to enhancing the efficiency of companies across the supply chain (Chopra & Meindl, 2007). According to (Pryke, 2009), the construction sector's supply chain developments are losing ground, contributing to a rise in transactions and a decline in average value. The phenomenon of low trust among various stakeholders in supply chain management, particularly in the construction industry, has been intensified for a long time by a lack of coordination (Pryke, 2009).

Trust among the stakeholders is the foundation for overcoming needless waste and a loose partnership in supply chains (Sterman, 2002). Among the dissemination of numerous emerging innovations, blockchain technology offers a shift in the structure and growth of supply chain ties in construction. Evidently, due to its transactional existence, blockchain technology can provide a more

straightforward information sharing process and maintain protection or transactions (Nakamoto & Bitcoin, 2008). Trust in construction supply chain management increases due to blockchain implementation; its implementations positively impact construction supply chain management trust. The positive impact on trust due to the implementation of blockchain technology is exhibited more in the form of a system or cognition-based trust as compared to relationship-based trust (Qian *et al*., 2020). Based on this rationale that blockchain ensures data integrity and each record is saved with each node, we hypothesize that implementation of blockchain technology will significantly positively impact trust among stakeholders, resulting in enhanced construction supply chain management.

Hypothesis 4. Leveraging blockchain technology in construction supply chain management will positively impact the trust level among key stakeholders.

Leveraging blockchain to enhance construction supply chain management

Supply chain systems in the construction industry lack visibility and usually provide only one-up / one-down visibility. Through distributed ledger technology that offers a decentralized, original version of the reality, blockchain provides higher visibility to all the stakeholders across all supply chain activities (Nanayakkara *et al*., 2019). Through blockchain technology, it becomes easier for participants to track any activity within the supply chain from product traceability to the use of labor and materials (Zhong *et al.*, 2017). Block-chain technology uses encrypted data immutable thus, it provides a practical and secure platform for sharing the information across the supply chain participants (Nakasumi, 2017). In a construction project, various parties are not linked together through close ties, so trust remains crucial in a construction supply chain. Block-chain technology positively impacts cognitive or system-based trust that all the parties involved know that data shared in the blockchain is available to everybody in the chain and cannot be falsified (Qian *et al*., 2020). All these factors thus enhance the supply chain management in the construction industry. Based on these arguments we propose

Hypothesis 5. Leveraging blockchain technology can positively impact supply chain management in the construction industry through improved transparency, traceability, information sharing, and trust among key stakeholders.

Conclusion

Block-chain has revolutionized various sectors, such as banking, insurance, logistics, electricity, and transport, with its exciting advantages and varied applications. Blockchain is a decentralized public ledger that offers a range of benefits, including immutability, accountability, confidence, encryption, and audibility. Block-chain consists of a peer-to-peer network that allows mining to verify records before the formation of blocks. Blockchain technology facilitates transparency, traceability, information sharing, and trust in construction supply chains, resulting in improved supply chain management. Therefore, we suggest that blockchain technology in the construction supply chain is a promising area that can help tackle the issues embodied in the construction supply chain. The research project is based on the literature review of the article published on blockchain technology in construction. In a construction supply chain with various key players with different professional backgrounds, consolidating information and trusting the parties involved remain the main issue. Our findings suggest that implementing blockchain technology can help tackle those issues as the evidence from the literature suggests that leveraging blockchain technology can positively impact the transparency of activities and data, traceability of products and activities, secure and timely information sharing, and system-based trust. All these lead to improved and enhanced construction supply chain management.

Through a comprehensive literature review, the study has categorized a broad body of blockchain literature on the construction supply chain in different themes that will serve as a forum for future research in this area. It provides a consolidated view of the potential that blockchain technology offers for construction supply chain management. In the end, the current analysis of relevant literature builds knowledge that will contribute to initiatives to digitize the construction industry.

From a managerial perspective, this research will enable IT and supply chain personnel in construction companies to understand the need for digitalization of the construction supply chain through blockchain technology to overcome the issues pertinent in traditional construction supply chains.

The research opens up new directions for future academic studies from the study's limitation and future perspectives. First, this study lays the foundation for the empirical analysis of blockchain technology's potential for the construction supply chain. Second, future work can consider the other key variants of the construction sector that can leverage the blockchain technology, such as the precast industry. Third, further studies can explore the challenges that are posed in the implementation of blockchain technology.

This research investigated the efficacy of blockchain technology implementations in precast construction with the goal of introducing alternative approaches for construction supply chain management. The absence of pilot projects is a downside of this study; this was primarily attributable to the blockchain is still undergrowth in areas such as finance. Furthermore, the application of blockchain in prefabricated construction needs the full cooperation of all parties concerned. Multiple challenges may theoretically create obstacles to the application of blockchain in the construction supply chain.

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Conflicts of Interest

The authors declare no conflict of interest.

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