

Blockchain as a Tool for Improving Collaboration Among Construction Project Managers in Nigeria

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Abstract

The Nigerian building industry is plagued with numerous difficulties. One of such difficulties is the timely execution of projects. There is the need to minimize these risks as much as possible as this will improve the delivery of building projects in the industry. One of the best ways to do this is by improving collaboration and information sharing between all the professionals who work on a project through the use of distributed ledger technology (blockchain technology). Distributed ledger technology is described as a type of distributed ledger data structure that transmits and stores data in units known as blocks that are linked together by a virtual chain known as a "block chain. Blockchain technology is a peer-to-peer, controlled, distributed transactional database used to record and store lists of transactions (called blocks) that are verified through cryptography. The objective of the study is to show how blockchain can be used as a tool for improving collaboration among construction project managers in Nigeria. The study is qualitative in nature adopting a content analysis research methodology approach. Therefore, information for the study will be obtained from industry reports and reviews of academic papers from 2017 to 2022. The study revealed that blockchain technology can be used to improve knowledge sharing, collaboration, trust and transparency among construction project managers. It recommends that apart from changing its working culture. In conclusion, continuous professional development is a key component that will boost collaboration amongst construction personnel.

Keywords: Blockchain technology, construction industry, construction project managers, project execution, collaboration.

Introduction

The construction industry is recognized as one of the largest in the world, with global annual spending on goods and services exceeding \$11 trillion in 2019 and expected to grow at a 3% annual rate. However, according to a study by Ghada (2021), despite the fact that industry 4.0 is a recent common concept to characterize the industrial world's movement toward digitization and automation. Rapid digitalization is influencing the way we interact, work, shop receive and deliver services; including how value is created and exchanged (Lember, 2018; Zimmermann, 2018; Genzorova *et al.*, 2019). Digital transformation in the construction industry refers to utilizing the potential of digital technologies to make construction operations more efficient, productive, and safe. According to Aleksandrova *et al.*, (2019), digital technologies can be introduced both at the planning stages of a construction project and during the execution of the same construction project. This will be as a result of fewer change orders, better decision making due to improved collaboration and trust among the construction professionals engaged on the project (Wang *et al.*, 2022). According to Abioye *et al.* (2021), the global construction industry is still one of the least digitalized industries (Barbosa *et al.*, 2017). Research has shown that the construction industry has been repeatedly challenged to improve its efficiency and productivity by making use of digital technology (Agenda, 2016; Jia *et al.*, 2019). As a result, in recent years, a number of technological developments have been invented to improve the

processes of project delivery within the construction industry (Zainon et al., 2011; Boje et al., 2020; Prakash & Ambekar, 2020; Reza,2020). However, in developing nations such as Nigeria, the rate of this revolution has been slow and the construction industry in Nigeria continues to be one of the least digitalized industries (Abioye *et al.*, 2021).

Presently, Nigerian construction project managers faces numerous constraints, which includes a lack of coordination, communication, collaboration, technological advancement, transparency, poor planning, and control in the successful execution and delivery of construction projects (Adetola *et al.*,2011; Igwe & Ude,2018; Amoah *et al.*, 2021). As a result, there is a need to embrace and adopt new technology that will improve the industry's efficiency and productivity. This is the significance of this research. The aim of this paper is to analyze blockchain technology as a tool for increasing collaboration among construction project managers in Nigeria.

The objectives set for this paper are to:

- i. Examine the extent blockchain has been adopted in the global construction industry.
- ii. Explore the extent to which blockchain is being used as a collaborative tool by project managers, and
- iii. Highlight the relevance of blockchain tool to project managers.

Literature Review

Adoption of new technology in the construction industry is a relatively slow process (Nasserredddine *et al.*, 2020; Wahab *et al.*, 2021; Saka & Chan, 2019; Olawumi & Chan, 2019). Hamma-adama *et al.*, (2020) and Kouider (2018) reported that in Nigeria, the implementation of technology in the construction industry is still very low while the awareness level is reasonable. The acceptance of technology such as blockchain technology has remained a challenging task due to the significant level of change management required as a result of being comfortable with using existing traditional methods for the execution of construction projects (Abioye *et al.*, 2021).

With inherent characteristics such as transparency, immutability, and resilience, emerging technologies such as blockchain technology were developed to address some of the key concerns impeding collaboration in the construction industry and trust (Kounelis et al., 2017). Blockchain has the potential to transform the way businesses and organizations operate, resulting in improved auditability and traceability as well as increased collaboration and information sharing (Winfield, 2018). Furthermore, blockchain technology has the potential to record, enable, and secure a large number and variety of transactions (Shojaei et al., 2019; Perera et al., 2020; Shojaei et al., 2021); therefore, the question that begs an answer is, "Can it enable the execution of projects in a sector like construction, which involves large teams of contractors and subcontractors and an abundance of building codes, safety regulations, and standards?" This question is being posed because ingrained practices in the construction industry have stymied the adoption of digital technologies that can improve efficiency and overall project turnover. If blockchain technology can improve collaboration, information sharing, and data management, it can solve the problem of lack of trust among construction project managers in Nigeria's construction industry.

Block chain technology

A unique and quickly developing technique for storing and distributing data across many data storage is distributed ledger technology (DLT or ledgers). Transactions and data can be recorded, sent, and synchronized across a distributed network of various network members using this technology. A "blockchain" is a type of distributed ledger data structure that transmits

and stores data in units known as "blocks" that are linked together by a virtual "chain" known as a "block chain" (Kumar et al., 2020). Blockchains use algorithmic and cryptographic techniques to immutably synchronize and record data across a network (Carlozo, 2017; Hileman & Rauchs, 2017). Its popularity stems from its unrivaled security and ability to address all aspects of digital identification challenges. It is the digital ledger of a peer-to-peer network (Sarode et al., 2021). This implies that personal computers can exchange data and resources without the need for a specialized central server. According to Hileman & Rauchs (2017), a blockchain generally consists of five elements: encryption, a peer-to-peer (P2P) network, a consensus mechanism, a ledger, and validity criteria. The distinctive features of blockchain are provided by this group of elements. By employing blockchain, contractual processes can be automated, saving money on the costs associated with carrying out complex projects while also freeing up important resources and accelerating project completion (Tapscott & Vargas, 2019). Blockchain offers a framework for transparently cascading work items down the chain and holding everyone responsible for finishing crucial tasks.

Blockchain functionality

As the name implies, blockchain is a chain of informational blocks (Figure 1). It is distinctive because: X the chain is replicated across multiple devices; X once "chained," the block contents cannot be changed; and X despite data being duplicated across multiple devices, the blockchain algorithm ensures that there are no conflicts and that all copies are identical (Turk & Klinc 2017; Panda et al., 2021). As a result, blockchain-based data stores have two characteristics that are not typically found in traditional databases: The solution is decentralized, and no central trusted authority is required. X the entire history of data, including all modifications, as well as the metadata (timestamps, author information), are recorded and protected by the equivalent of a cryptographically strong digital signature (Thakare & Pund, 2022). Both of these characteristics are consistent with the nature of a peer-to-peer collaborative network of businesses and individuals engaged in the process of building design (Ravishankar & Kavitha, 2022).

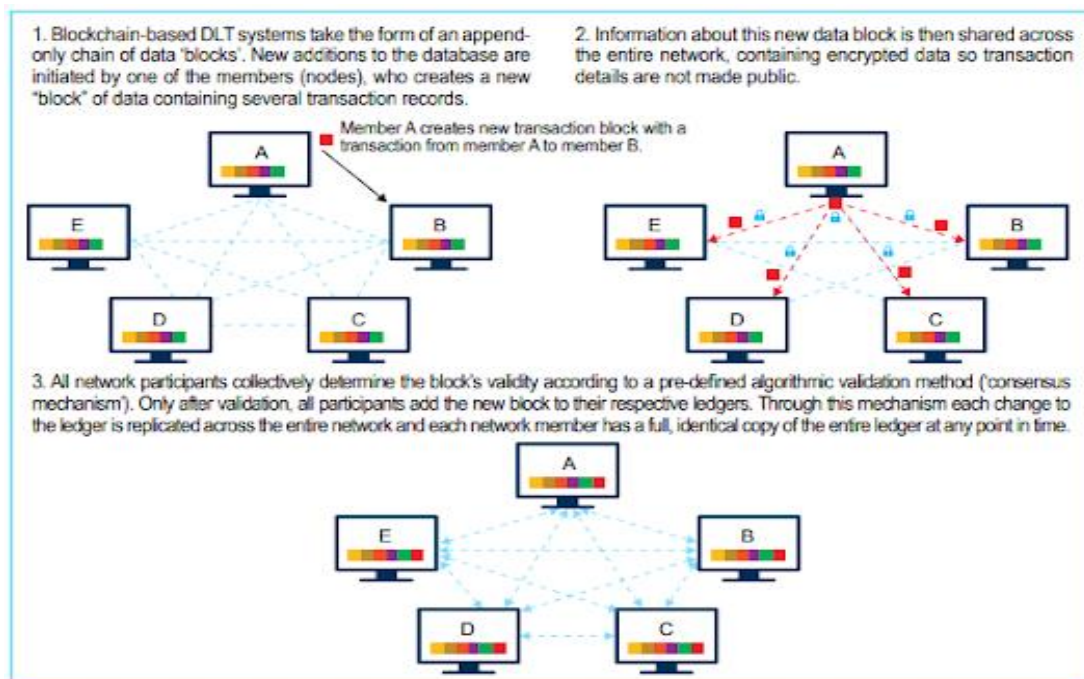


Figure 1: How Blockchain-based DLT Works

Source: Lohade, N. (2017). Dubai Aims to be a city built on Blockchain. Wall Street Journal.

Several key requirements must be fulfilled in order to use blockchain technology on a project; this is explained by figure 2.

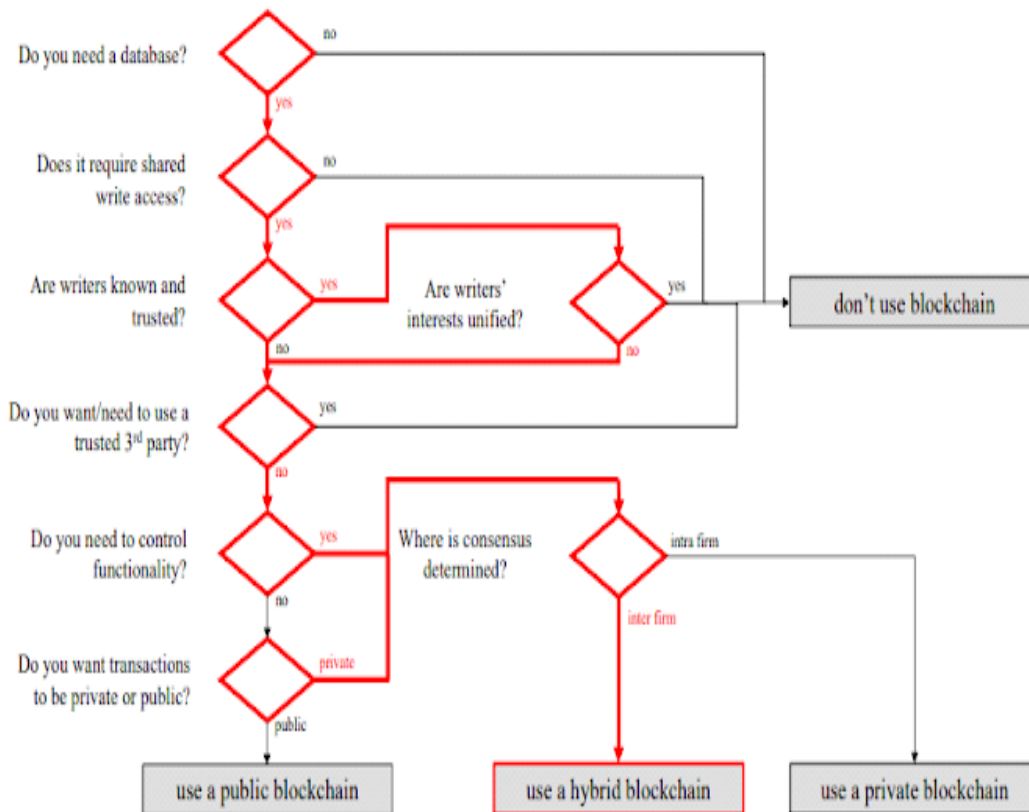


Figure 2: A flowchart showing how the decision on what type of blockchain to use is made
 Source: Turk, Ž & Klinc, R. (2017). Potentials of blockchain technology for construction management. *Procedia Engineering*, 196, 638-645.

For this study, a perfect use case for the use of blockchain technology is the nature of transactions in collaborative building projects as well as the legal repercussions in the event of project failures.

Advantages of Blockchain Technology (Distributed Ledger Technology)

The key innovation of blockchain technology in the context of digital currencies is that it offers a cryptographic solution for security and system integrity in a decentralized ledger that is kept up by a network of anonymous participants without the requirement for confidence across one or more institutions (World Bank group, 2017). Distributed ledger technology provides a framework for reducing fraud, corruption, errors, and the cost of paper-intensive processes. It has the potential to reshape the relationship between the government and the people in terms of data exchange, transparency, and trust (World Bank group, 2017).

The blockchain process is intricately linked. All parties involved in a project that uses blockchain technology for transactions would have access to a shared ledger (Belle,2017). A transaction log would ensure that accurate data is synchronized across all of these systems automatically and in real time. Blockchain-based construction projects are distinguished by three key characteristics (Goh et al., 2019). First, because distributed ledger technology in blockchain allows everyone to have their own copy, risk management is shared by all parties (Hargaden et al., 2019).

As a result, all stakeholders can agree on the ledger's contents and are notified whenever changes are made (Hamma-Adama et al., 2020). Second, because the immutable blockchain includes the "loss and inaccessibility of critical data and building equipment," asset and data provenance are more easily accessible than ever before (Bowcott, 2018; Li et al., 2018; Li et al., 2019a; Li et al., 2019b). Finally, because errors are easily identified, discovery and legal fees may be reduced. Blockchain is a peer-to-peer distributed, decentralized system that can securely trace and verify digital transactions. Its goal is to increase data integrity, security, and transparency (Hewavitharana et al., 2019).

Collaboration

A bigger or smaller group of collaborators have always been involved in the collaborative process of construction. Communication technology has had a big influence on interpersonal relationships throughout history (Kapogiannis & Sherratt, 2018). Transparency, traceability, and cooperation are blockchain-enabled characteristics for the construction sector. Smart contracts that facilitate and automate contractual collaboration can considerably reduce the number of claims and disputes (Khalfan *et al.*, 2022). Construction information management systems can be further enhanced with the use of blockchain technology, which will boost cooperation and confidence amongst industry professionals (Shojaei, 2019).

The same is true for the construction industry; a collaborative environment based on trust is required to promote high levels of information exchange from the start of a project to its completion. Significant research focus is still required to achieve trust-based collaboration in the construction industry (Mathews *et al.*, 2017). Rivalry and a lack of cooperation are common in the construction industry (Kapogiannis & Sherratt, 2018). As a result, construction project managers cite a variety of factors as difficulties in the building industry, including a lack of trust, unequal risk sharing, and poor communication. Collaboration has been shown to be an effective method of overcoming the difficulties confronting the construction industry (Faris *et al.*, 2019).

Construction projects necessitate interdisciplinary and multi-actor collaboration, which generates massive amounts of data over the course of their existence. Data frequently contains sensitive information and represents the rights, property, and intellectual property of the creator. Concerns about security, consistency, and data loss arise when managing project data (Alreshidi *et al.*, 2018; Qian & Papadonikolaki, 2021).

Methodology

This study looked at how blockchain technology can be used to improve collaboration among Nigerian construction project managers. For data collection, the author used a qualitative technique based on content analysis. This study defines knowledge as something gained only through social constructions such as language, shared meanings, documents, industry reports, academic paper reviews, and tools; it is a changing and relative phenomenon. The researcher gathered information about block chain technology and its applications in the construction industry from e-journals, articles, websites, and e-books. The journal publications used for the study were those published on the subject between 2017 and 2022. The database search was carried out using Google Scholar searches. The researcher read through the following journals and reviews- *Journal of Building Engineering*, *Journal of Surveying, Construction and Property*, the *Institute of Electrical and Electronics Engineers journal (IEEE)*, *Computational Intelligence and Neuroscience*, *Harvard Business Review*, *Built environment project and asset management*, *Proceedings of International Structural Engineering and Construction*, *Engineering, Construction and Architectural Management*, *Journal of information technology*

case and application research, Sustainability, Journal of Electrical and Computer Engineering, Built Environment Project and Asset Management, Automation in Construction, European Scientific Journal, International journal of information management, Journal of Construction Engineering and Management. The researcher came up with inclusion and exclusion criteria to narrow the research focus. For the inclusion criteria, all publications reviewed that contained the words the Nigerian construction industry, collaboration, blockchain technology, project management and the exclusion criteria meant that any journals that explained blockchain technology but was not related to the Nigerian construction industry context was excluded. The results were validated using data from three other digital journal databases, including built environment journals, construction research congress 2022 and construction management/engineering journals. These databases were chosen for their robustness and integrity in order to reduce bias.

Data collection and analysis

Owing to the fact that quite a number of researchers in different fields have written extensively on how blockchain technology can be used to enhance transparency, information sharing, knowledge management and trust in their field. The researcher used Google scholar to search for journal publications, and construction industry reports on the use of blockchain technology in the construction industry. The following key words were used as codes to search to collect data between 2017 to 2022. They are blockchain technology, construction industry, construction project managers, construction projects, collaboration.

Results and Discussion

Year and Code Names (keywords), and the number of times the codes names appeared in the journal publications in Google Scholar							
S/N	Year	Blockchain technology	Construction industry	construction projects	Nigerian construction industry	Collaboration	Construction project managers in Nigeria
1.	2017	0	2	3	0	1	1
2.	2018	3	3	3	3	2	3
3.	2019	4	4	4	3	3	4
4.	2020	5	4	4	4	3	4
5.	2021	5	5	5	4	3	4
6.	2022	5	5	5	4	3	4

Findings

- i. Block chain technology can be used to enhance collaboration: Collaboration in the construction industry is essential because trust is one of the gaps in the construction process. Even though the level of collaboration between construction team members has improved, there is a need for a higher level of collaboration as problems between the client, and construction team members still persists. The inability of construction team members to work collaboratively has resulted in payment delays, a lack of efficient channels for communication, a failure to provide correcting information on the job site, inadequate document control procedures, and contractual duties related to a specific construction project. Therefore, resolving these present problems require a newer strategy. In order to validate and come to an agreement among one another in order to construct the trust connections, blockchain technology depends on the mistrusts between

nodes of users in the network. This technology is ideal for the construction industry because mistrust is a fundamental problem and blockchain technology can be utilized to build trust between parties involved in a construction project. The potential for blockchain to function as a trust governance system across a project lifecycle is the driving force behind the idea of blockchain in construction. The blockchain can be used to manage building operations, subcontractor work, project scheduling, and funding.

- ii. **Blockchain technology as a driver of innovation:** According to studies, the built environment industry can change in the twenty-first century thanks to technologies from the fourth industrial revolution (4IR). One of the 4IR drivers that has the potential to be a source of innovation in the built environment is blockchain technology.
- iii. **Enhancing supply chain transparency:** Stakeholders in the construction supply chain (CSC) often work together transiently to complete one-off projects. The nature of construction projects is one factor in the CSC's lack of openness. Blockchain is thought to be able to solve this problem by producing reliable data that can be shared between many parties and throughout project phases for facility management during the operational stage. It is therefore a game-changer will be introduced for a variety of industries, including construction.

Discussion

Currently the level of awareness regarding the benefits of digital transformation in the construction industry has increased as opposed to what it used to be. The use of blockchain in the construction industry is still in its early stages in Nigeria. Communication is now an essential component of every organization. In the construction industry, information must be communicated accurately and timely among project stakeholders in order to achieve project objectives. For there to be effective communication and less disputes among the construction team members, they must collaborate. And this is where blockchain comes in because it can also be used for record keeping and decision making. The Nigerian construction industry has gone beyond the use of oral communication. Information regarding project activities must be documented in such a way that they can be referred to from anywhere in the world and at any time of the day.

Recommendations

The result of the findings has shown that the Nigerian construction industry continues to fall behind in the adoption and application of novel technology that can enhance efficiency and productivity unless it creates a working environment that will foster the use of technology. Apart from changing its working culture, continuous professional development should be stressed as a key component for those who work in the construction industry from the most junior staff to the senior staff. This will help to foster collaboration amongst construction personnel. Construction projects at all stages require the sharing and management of data.

Conclusion

Lack of payment, lack of transparency, and insufficient collaboration for information sharing are just a few of the challenges that construction project managers face in Nigeria. With blockchain, this can be improved to become more effective, transparent, and accountable to all project participants.

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