Research Article

AN OVERVIEW OF BLOCKCHAIN TECHNOLOGY AND ITS ADOPTION ON SUPPLY CHANGE MANAGEMENT: INSIGHTS FROM LITERATURE REVIEW

* Md. Abdur Rashid

Director (Admin & Finance), National Academy for Planning and Development, Bangladesh

Abstract

Blockchain technology, which uses the concept of a cryptocurrency, is employed in the management of currencies like bitcoin and others. But today, non-financial applications like Supply Change Management (SCM) can leverage blockchain as the management system. Comparing the current supply chain to new and cutting-edge technology reveals how inefficient, immobile, and unmanageable it is. Utilizing blockchain in SCM will help the business avoid third parties and increase transparency and traceability. A literature review has been done following the research method of a semi-systematic or narrative review approach. The time period of this general literature review was between March-July 2023. The purpose of the reviews was to know the fundamentals of blockchain technology and its adoption of non-financial platforms like SCM and the decision-making process for such adoption considering energy consumption. Besides, the impact of blockchain technology on the supply chain is discussed in this article. By reading this article, researchers and other relevant parties will gain insights into the adoption of blockchain in SCM and also about precautions.

Keywords: Supply chain management, Blockchain, Distributed ledger, Cryptocurrency, Bitcoin, energy consumption, Literature review.

INTRODUCTION

Blockchain is an emerging and revolutionary digital technology (Nur *et al.,* 2020) that impacts the supply chain networks significantly. With blockchain, data can be recorded and shared in a secure, decentralized, and transparent without intermediaries, i.e., controlling the central server system. The significance of blockchain technology features is that user data is not in the hands of company owners like Google, Facebook and other social media apps. So, user information cannot be leaked in any way. It is a neutral platform because it is only being shared by valid stakeholders. Blockchain was first introduced in 2008 (Ahmed *et al.,* 2022) as the technology behind Bitcoin, a peer-to-peer electronic cash system. According to a 2021 report by the *World Economic Forum*, blockchain is the second most important technology for the future behind only Artificial Intelligence (AI). Blockchain is now not only used in coins. Rather, several applications have been started as non-financial issues. SCM process improvement is one of the application software developments where each point of materials traceability is pointed out sharply. It helps to identify the originality of all raw materials used in the production process. Blockchain Technology (BT) is a new technology and still an infant (Nur *et al.,* 2020) in using SCM, so there is a lack of experts and knowledge on the issues when adopted. BT is so costly. Only big corporates can take advantage of its applications. The article's primary objective is to provide some background information on the concept of blockchain technology, supply chain management (SCM), and the application of blockchain technology in SCM. The review's purpose is to strengthen the ability of decision-making while implementing blockchain in a business while considering expenses. The following three research questions have been considered according to the objective of the study. The research questions are-

RQ1: What are the potential applications of BT in SCM?
RQ2: How can BT be more helpful in overcoming SCM challenges?
RQ3: What are the barriers to BT's adoption in SCM?

LITERATURE REVIEW

What is Blockchain Technology (BT)?

A blockchain is a chain of blocks that contains information. It is a distributed ledger. It was intended to timestamp digital documents so that it is not possible to tamper with them or backdate them. Blockchain is a system of recording information in a decentralized network using cryptographic tokens where no one owns any record. As in this network, everyone has equal access to records. This system of storing records is very safe and secure. Blockchains and decentralized applications use a peer-to-peer (P2P) network that places equal value on all nodes or computers (Keresztes *et al.,* 2022).

Each of the blockchain ledgers holds its components, like

- Data
- Hash of the block
- Hash of the previous block

Blockchain Technology Platform and Programming Languages

The following **Table 1** gives a list of some popular blockchain platforms and programming languages used to develop the platform (Keresztes *et al.,* 2022).

Types of Blockchain Structure

There are various distinct kinds (Keresztes *et al.,* 2022) of blockchain technology, and a classification distinguishes

*Corresponding Author: *Md. Abdur Rashid*
Director (Admin & Finance), National Academy for Planning and Development, Bangladesh.

between access-based options. There are four types of blockchains (Wegrzyn and Wang 2021) structure.

Table 1. Blockchain Technology and Programming Languages

Blockchain Technology Platform	Start Year	Programming Languages
Bitcoin	2009	C++
Ripple	2012	C++, JavaScript
Corda R3	2015	Java, Kotlin
Ethereum	2015	Go, C++, Rust, Solidity
IOTA	2015	Go, C, C++, Java, JavaScript
MultiChain	2015	C++
NEM	2015	Java, C++
BigChainDB	2016	Python, JavaScript, Java
HydraChain	2016	Python
Hyperledger Sawtooth	2016	Rust, Python, JavaScript, Go, C++, Java
Hyperledger Fabric	2016	Go, JavaScript, Java
Kadena	2016	Pact
OpenChain	2016	C#
Quorum	2016	Go
Tezos	2018	Michelson
IBM MineHub	2019	n/a
Nexledger Universal	2019	n/a
XuperChain	2019	Solitidy, C/C++, Java
AntChain	2020	Solidity, Java, C++, Golang

Source: (Keresztes *et al.,* 2022)

- *Public Blockchains* - Any user can access and read the information using its unique identifier (i.e., barcode, QR code, RFID). It is permission less in nature. There is no central authority where all transactions can be viewed and submitted by anyone.
- *Private (or Managed) Blockchains* - A limited number of users are given an access key. This blockchain structure is controlled by single entity. It is permissioned where a connection request or invitation is necessary.
- *Consortium Blockchains-* This is permissioned blockchain which is controlled by group of organizations rather than one organization.
- *Hybrid blockchains* - Elements of both (e.g. unlimited users but permissions restricting certain information). It is controlled by one authority with some permission less process also. Any public, private, community, or consortium blockchain can be combined to speed up transaction processing.

How Blockchain Technology Works?

A blockchain is built up of data sets, each of which is composed (Sabry *et al.,* 2019) of a number of blocks or data packages, each of which is composed of a number of transactions. Each new block makes the blockchain longer and so provides the full record of all transactions. The blocks can be cryptographically verified by the network. A timestamp, the hash value of the blocks before it ("parent"), and a nonce (a random number for the hash verification). In the context of blockchain technology, a nonce is an artificial number that is employed as a counter during the mining process) are also included in each block. This idea ensures the integrity of the whole blockchain, right up to the genesis block. Since each hash value is distinct, fraud would be simple to avoid since tampering with any block in the chain would immediately change the value of the associated hash.

Supply Chain Management

Coordination of all the activities and processes involved in manufacturing and distributing goods and services

(Mahmood, 2023) is referred to as supply chain management (SCM). It covers everything, from locating the raw materials to giving clients the final goods. The success of many organisations depends on the supply chain since it affects things like cost, efficiency, and customer happiness. The definition of supply chain management (SCM) is the control (Goyat *et al.,* 2019) of the movement of products and services from raw materials to finished items. In other words, the SCM process includes overseeing the flow of any items from their raw state to their eventual customers in the most efficient and economical manner possible. It safeguards the transfer of all items from production to finished product. Any product's creation, transportation, and distribution are all governed centrally.

SCM Stakeholders

The following stakeholders (Singh *et al.,* 2022) are directly related to SCM as beneficiaries are shown in **Figure 1.**

Figure 1. Supply Change Management Participants

Blockchain Technology Adoption in SCM

There is a long journey to perceive the full benefits of blockchain technology in SCM. The technology is not so familiar, and potential blockchain application developers are yet to make it in Bangladesh in 2023.

Potential Application of Blockchain in SCM

Though from the beginning of this blockchain technology, everybody knows about the applications of cryptocurrencies. But after huge research, companies are developing applications for non-financial areas also. A few important applications of BC in SCM are-

- Including making supply chains traceable
- To store the information on each step of the supply chain of a company
- Ensuring sustainable sourcing
- Tracing products at manufacturing, distribution and consumer levels
- Ensuring transparent payment systems
- Ensuring business operation
- Ensuring trusty communications among business communities

Table 2. Improve the Existing Limitations of Supply Chains by Blockchain Technology

Supply Chain Stakeholders	Current Limitations	Blockchain Impact	Source
Producer	Product originality	Keep track of production of raw materials	(Singh *et al.,* 2022)
Manufacturer	Limited ability to monitor the product manufacturer	Added value from shared information systems	(Singh *et al.,* 2022)
Distributor	Custom tracking with poor collaboration, trust and certification	Proof of location and real conditions	(Singh *et al.,* 2022)
Wholesaler	Lack of trust and certification and product path	Ability to check	(Singh *et al.,* 2022)
Retailer	Tracking of product between wholesaler and consumer	Ability to handle return of malfunctioning products	(Singh *et al.,* 2022)
Consumer	Lack of trust about compliance on product originality	Full and transparent view about product originalty	(Singh *et al.,* 2022)

- The supply chain will be more flexible and secure
- In the future, BT and SCM integration will transform (Lim *et al.,* 2021) relationships not only in business-to-business contexts but also in business-to-customer and customer-to-customer contexts
- Promote international trade (European Parliament 2020)
- Decentralized marketplaces;
- Blockchain-based letters of credit;
- Cross-border payment systems;
- Maritime insurance;
- Tracking systems for shipping documents and supply chain events;
- Blockchain-based e-certificate of origin;
- Proof of authenticity of luxury products;
- Tracking of ethical sourcing in the food industry

Blockchain Impact over Some Current Challenges

BT is too helpful in overcoming present challenges at any organizations. Some of the impact of application BT in SCM has been explored in **Table 2.**

Blockchain Decision Path

One must consider the costs associated before deciding to embrace blockchain at any firm. If cost-benefit analysis is done, making a decision is not as simple. Before implementing blockchain in SCM, a checklist must be created, and a SWOT analysis must be completed if necessary. Carefully, make a decision regarding blockchain adoption in SCM. The decision-making process (United Nations 2021) for blockchain adoption is illustrated in the following **Figure 2.**
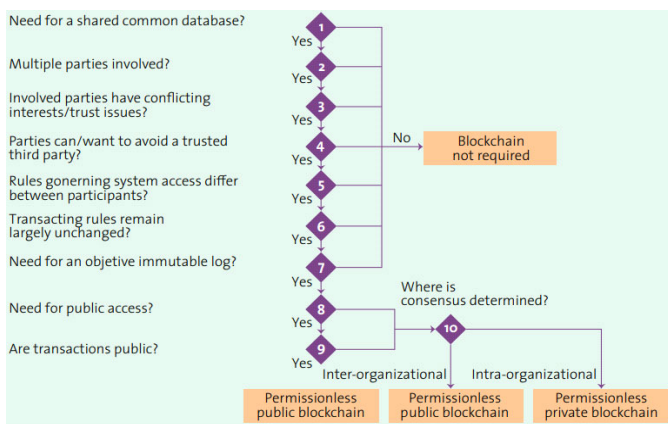

Figure 2. BT Decision Making Process

Barriers Adopting BT in SCM

There are more barriers and are yet to explore. Few potential barriers are explored here from literature review phases.

Energy Problem and SCM

Solutions for the SCM based on blockchain and distributed ledger technology (DLT) use less energy (George Lawton 2019) than bitcoin, but a lot more than equivalent supply chain solutions based on conventional databases like structured query language (SQL), key-value pair (KVP) and other NoSQL databases. Because, a centralized database requires about 10,000 computational steps, whereas mining bitcoins with brute-force search techniques requires billions of computational steps. When considering the use of blockchain in SCM, the high energy consumption, increasing costs, and CO_2 emissions are a major worry.

Cost Problem

A systematic literature review-based research article (Nur *et al.,* 2020) discussed that BT is costly and applicable to big corporations.

Security Problem

Even though BT is quite secure (Nur *et al.,* 2020), it does have several weaknesses. The 51% attack can take control of the entire blockchain, even though it may not be practical in most circumstances. Blockchain has a few design flaws as well. The current cryptographic functions run the risk of becoming inoperable in a few years.

Management Problem

Managers can fail to commit to sustainability (Nur *et al.,* 2020) over the long term and may not encourage the implementation of new technologies (Nur *et al.,* 2020). Adoption of blockchain would be challenging if organizational policies hadn't been developed, as blockchain might change company cultures.

METHODS

This research approach of this literature review was search strategy. The semi-systematic or narrative review approach was used as research design (Valliappan and Siew 2021). This method helped to build the knowledge on the BT, SCM, and adoption issues on non-financial area.

The narrative examination (Snyder, 2019) helped to analysis and synthesizing a volume of literature in this study. The Microsoft Edge (Bing) and Google Search engine are used here to find the relevant articles. Important search keys relating to the study topics and questions were in the search engine home page. Time period of this literature review was between March-July 2023. Fourteen relevant articles have been studied and referenced in this study as source of information.

FINDINGS AND DISCUSSION

Researcher has looked at the foundations of BT and how it may be used to non-financial platforms like supply change management. The implementation of BT in SCM for small organizations will be hampered by some significant issues like energy, cost, security, and management. Before deciding to implement BT in SCM, a cost-benefit analysis is required. Also follow the decision making process. There are still more obstacles to overcome.

Conclusion

Based on a literature review search method, a study has been conducted. The research design employed was a semi-systematic or narrative review technique. Here, various obstacles related to energy, cost, security, and management are examined after conducting a literature review. A check list and, if necessary, a SWOT analysis must be made before integrating blockchain in SCM. Make a decision on implementing blockchain in SCM carefully. A thorough investigation of the decision-making process is required, especially for small businesses.

Conflicts of Interest: The author declares that he has no conflicts of interest.

Additional information: *Notes on contributor*

REFERENCES

Ahmed G. Gad, Diana T. Mosa, Laith Abualigah, Amr A. Abohany (2022). Emerging Trends in Blockchain Technology and Applications: A Review and Outlook. *Journal of King Saud University - Computer and Information Sciences,* Volume 34, Issue 9, PP. 6719-6742

European Parliament (2020). Blockchain for supply chains and international trade. *European Parliamentary Research Service.*

George Lawton (2019). How blockchain energy consumption affects supply chains[Online]. Available at: https://www. techtarget.com/searcherp/feature/How-blockchain-energy-consumption-affects-supply-chains [Accessed on 30 June 2023]

Goyat, Kumar, Rai and Saha (2019). Implications of Blockchain Technology in Supply Chain Management. *Journal of System and Management Sciences,* Vol.9, No.3, pp.92-103 DOI:10.33168/JSMS.2019.0306

Keresztes, Éva Réka, Ildikó Kovács, Annamária Horváth, and Krisztina Zimányi (2022). Exploratory Analysis of Blockchain Platforms in Supply Chain Management. *Economies*, 10: 206, pp. 4. https://doi.org/ 10.3390/ economies10090206

Lim, M, Li, Y, Wang, C & Tseng, M-L (2021). 'A literature review of blockchain technology applications in supply chains: A comprehensive analysis of themes, methodologies and industries'.*Computers & Industrial Engineering*, vol. 154, 107133. https://dx.doi.org/10.1016/ j.cie.2021.107133

Mahmood (2023). Impact of Blockchain Technology on Supply Chain Management in the Retail Industry [Online]. Available at: https://www.researchgate.net/publication/ 368450289_Impact_of_Blockchain_Technology_on_Supply_Chain_Management_in_the_Retail_Industry [Accessed 10 June 2023]. DOI:10.5281/zenodo.7632728

Sabry, Kaittan and Ali (2019).The road to the blockchain technology: Concept and types. *Periodicals of Engineering and Natural Sciences*, Vol. 7, No. 4, December 2019, pp.1821-183

Singh,Thakkar and Warraich (2022). Blockchain in Supply Change Management. *European Journal of Engineering and Technology Research,* Vol 7,Issue 5,pp. 60-69. DOI: http://dx.doi.org/10.24018/ejeng.2022.7.5.2888

Snyder Hannah (2019). Literature review as a research methodology: An overview and guidelines Hannah Snyder. *Journal of Business Research*, 104 (2019) 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

United Nations (2021).Blockchain implementation opportunities and challenges in the Latin American and Caribbean logistics sector [Online].Available at: htpps://repositorio.cepal.org/bitstream/handle/11362/47165 /1/S2100364_en.pdf [Accessed 28 June 2023]

Valliappan Raju and Siew Poh Phung (2021). Resilient Motive for Reviewing Literatures in Business Research: Exploring Process of Research Design. *Annals of R.S.C.B.*, Vol. 25, Issue 4, pp.6309

Wegrzyn and Wang (2021). Types of Blockchain: Public, Private, or Something in Between [Online].Available from: https://1npdf11.onenorth.com/pdfrenderer.svc/v1/abcpdf11 /getrenderedpdfbyurl/types%20of%20blockchain%20publi c%20private%20between.pdf [Accessed 10 June 2023]

Nur, Hakim and Amrozi (2020).Challenges in Using Blackchain for Supply Change Mangement Information Systems.*Jurnal Teknik Industri*, Vol. 15, No. 2, pp. 83-92.

****