The Role of Blockchain Technology in Transforming International Trade Facilitation

Samir Sham Keskar* **Sarita Vichore****

ABSTRACT

This literature review explores the transformative capacity of blockchain technology to enhance international trade facilitation. It consolidates current research on the application of blockchain across crucial aspects of global trade, such as supply chain management, trade finance, and customs and compliance procedures. The review highlights how blockchain's fundamental characteristics of decentralization, transparency, and immutability address persistent challenges in international trade. Key findings suggest that blockchain can significantly enhance supply chain traceability, streamline trade finance processes, and boost the efficiency of customs procedures. The technology shows promise in lowering trade costs, boosting trade volumes, and building trust among trade partners. However, the review also identifies several obstacles to widespread adoption, including the need for standardization, regulatory frameworks, and overcoming technical and implementation barriers. The paper concludes that while blockchain has significant potential to transform international trade facilitation, realizing its full benefits requires collaborative efforts from various stakeholders to tackle existing challenges. This review enriches the expanding body of knowledge on blockchain in international trade and provides valuable insights for policymakers, practitioners, and researchers in the field.

Keywords: *blockchain, international trade, trade facilitation, supply chain management, trade finance, customs procedures, digital transformation, smart contracts*

INTRODUCTION

International trade has historically been characterized by complex processes, multiple intermediaries, and substantial paperwork, resulting in inefficiencies, delays, and increased costs. However, the advent of blockchain technology offers a highly effective solution to enhance and revolutionize international trade facilitation. This literature review examines the potential of blockchain technology to revolutionize various aspects of international trade, such as supply chain management, trade finance, customs procedures, and overall trade facilitation.

**** Research Scholar, Durgadevi Saraf Institute of Management Studies (DSIMS), Mumbai***
***** Director, Durgadevi Saraf Global Business School (DSGS), Mumbai***

Methodology:

This study employed 'Elicit', a research tool that assists in the retrieval, data extraction, and organization of pertinent academic publications. This tool was utilized to conduct a comprehensive search of available literature using an interrogative prompt containing the key terms 'Blockchain', 'International', and 'Trade Facilitation'. The query yielded a corpus of 288 relevant published articles. To enhance the comprehensiveness of the review, three additional publications from international organizations, specifically, the United Nations (UN), World Trade Organization (WTO), and the World Customs Organization (WCO) were manually included. This approach resulted in a final set of 291 documents for analysis.

A structured database was subsequently developed, encompassing salient bibliometric information for each publication, including title, authorship, DOI, journal, citation frequency, year of publication, abstract, and blockchain-specific findings. This database was then subjected to a comprehensive screening process employing the following inclusion criteria, applied sequentially:

a) Relevance of title and abstract to the research focus (blockchain and international commerce)
b) Significance of blockchain-specific findings
c) Citation frequency (minimum threshold of 5 citations)

The application of these filtration criteria resulted in the identification of 46 articles of high relevance, which were subsequently subjected to full-text review. During this process, it was observed that certain findings were replicated across multiple publications. Consequently, a final selection of 22 publications was made, with due consideration given to citation frequency and the significance of the findings presented in each paper. This methodological approach ensured a comprehensive yet focused review of the most pertinent and impactful literature in the field, providing a solid foundation for further analysis and discussion.

Blockchain Technology: An Overview

Blockchain technology, initially conceptualized as the underlying architecture for Bitcoin by Nakamoto in 2008, has evolved into a decentralized digital ledger system with wide-ranging applications beyond cryptocurrencies (Chang, Chen & Wu, 2019; Bogucharskov et al., 2018). At its core, blockchain is a cryptographic protocol that enables separate parties to enhance the trustworthiness of transactions by creating an

immutable and transparent record (De Villiers, Kuruppu & Dissanayake, 2021; UNCEFACT, 2020). The technology functions as a distributed database, generating time-stamped blocks via cryptography, which permanently maintains transaction records and improves the transparency and security of transactions (Chang, Luo & Chen, 2019; Sinha & Chowdhury, 2021).

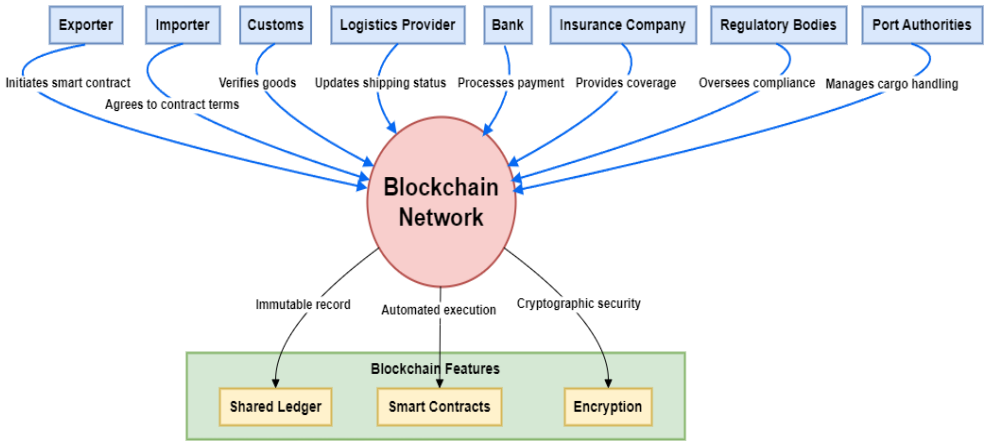

Fig 1: Blockchain Architecture in International Trade

Blockchain technology is characterized by its decentralized nature, transparency, unchangeable records, robust security, and the implementation of collaborative consensus protocols. (Chang, Iakovou & Shi, 2019; Sinha & Chowdhury, 2021; Belu, 2019). These characteristics make blockchain particularly suitable for applications requiring trust, transparency, and security across various industries, including international trade (Chang, Iakovou & Shi, 2019; Irannezhad, 2020).

Blockchain technology can be broadly classified into three primary types: public, private, and consortium or federated. (Sinha & Chowdhury, 2021; Balci & Surucu-Balci, 2021). Public blockchains are accessible to anyone, while private and consortium blockchains have restricted access and are often used in business applications (Ioannou & Demirel, 2022).

BLOCKCHAIN'S IMPACT ON CROSS-BORDER TRADE FACILITATION

One of the key areas where blockchain technology is set to have a profound impact is supply chain management (SCM). The complexity and opacity of global supply chains have long been challenges for international trade. Blockchain technology provides an

effective, safe, and transparent means of monitoring and controlling the flow of goods across international borders. (Koh, Dolgui & Sarkis, 2020; Irannezhad, 2020).

Traceability and Transparency

Blockchain is especially useful for improving supply chain traceability because it can produce an unchangeable and transparent record of transactions. Blockchain, as mentioned by Hooper and Holtbrügge (2020) enables businesses to trace a product's history from the acquisition of raw materials through the supply chain to the point of sale. This level of transparency not only improves supply chain efficiency but also addresses growing consumer demands for ethical standards and product provenance (De Villiers, Kuruppu & Dissanayake, 2021).

Several major companies have already begun implementing blockchain solutions in their supply chains. For example, the TradeLens platform, created by IBM and Maersk, reduced the need for third-party validation during freight shipment by offering authenticity to all supply chain players (Hooper & Holtbrügge, 2020; Jensen, Hedman & Henningsson, 2019). In a similar vein, Walmart and IBM have collaborated to monitor the flow of food items through their supply chain; one of their initial significant initiatives involved tracking pork in the Chinese supply chain in order to improve food safety (Hooper & Holtbrügge, 2020).

Efficiency and Cost Reduction

Blockchain use in supply chain management (SCM) has the potential to significantly increase productivity and cut costs. Blockchain can save trade expenses and improve overall trade performance by doing away with middlemen and simplifying procedures (Chang, Chen & Wu, 2019; Siddik et al., 2020). According to projections from the World Economic Forum, blockchain-enabled IT solutions could raise global trade volume by 10-15%, lower the cost of doing business internationally by 5-20%, and increase GDP globally by 3-5% (Jensen, Hedman & Henningsson, 2019).

Smart Contracts and Automation

Blockchain technology's self-executing contracts, or "smart contracts," are a crucial component that has the potential to completely transform supply chain management. According to Toorajipour et al. (2022) and Sinha & Chowdhury (2021), these contracts have the ability to automatically initiate actions or payments when predetermined

conditions are met. This minimizes the need for manual intervention and reduces the possibility of errors or disagreements. Smart contracts can streamline the entire supply chain process in the context of international trade by automating a number of tasks like payments, document verification, and compliance checks (Segers et al., 2019; Bogucharskov et al., 2018).

Revolutionizing Trade Finance

Trade finance, a critical component of international trade, is another area where blockchain technology is making significant inroads. Traditional trade finance processes are often slow, paper-intensive, and prone to fraud. By giving trade finance transactions, a safe, transparent, and effective platform, blockchain provides an answer to these problems. (Ioannou & Demirel, 2022; Hofmann et al., 2017).

Letter of Credit Process Improvement

The letter of credit is among the most promising uses of blockchain in trade finance. (L/C) process. Chang, Chen & Wu (2019) propose a blockchain-based re-engineering of the L/C process, which could significantly improve the efficiency and security of this crucial trade finance instrument. By leveraging blockchain and smart contracts, the proposed system could automate document verification, reduce processing time, and minimize the risk of fraud (Chang, Luo & Chen 2019; Toorajipour et al., 2022).

Blockchain use in L/C payments would lower costs associated with this payment method, expedite document handling, and simplify the payment process (Belu, 2019; Bogucharskov et al., 2018). By cutting the time needed to complete a capital exchange from the usual week or ten days to less than one day, Barclays Bank, for example, has already shown the promising potential of blockchain in trade finance (Hooper & Holtbrügge, 2020).

Enhancing Access to Finance

Additionally, blockchain technology may make it easier for small and medium-sized businesses (SMEs) in developing nations to obtain trade finance. By providing a transparent and secure platform for transactions, blockchain can help reduce the perceived risk associated with lending to SMEs, potentially expanding the availability of trade finance (Dahdal, Truby & Botosh, 2020).

Moreover, blockchain-based platforms can enable new forms of trade finance, such as reverse factoring and dynamic discounting. These innovations can optimize working capital management for both buyers and suppliers, further facilitating international trade (Ioannou & Demirel, 2022; Hofmann, Strewe & Bosia, 2017).

Streamlining Customs Procedures

Customs procedures are often a significant bottleneck in international trade, causing delays and increasing costs. Blockchain technology offers several opportunities to streamline these processes, enhancing efficiency and reducing the potential for fraud (Segers et al., 2019).

Digital Documentation and Verification

The capacity of blockchain technology to digitize and securely retain trade documents is one of its main advantages in customs processes. This can significantly reduce paperwork and streamline the verification process. Blockchain technology has the potential to enable shippers to digitize their supply chains and remove several middlemen that cause expensive delays and corruption, as highlighted by McDaniel and Norberg (2019)

Trade documents are more reliable due to the unalterable nature of blockchain records. Blockchain technology can guarantee data integrity by making it nearly impossible to change or delete once it has been recorded (Chang, Iakovou & Shi, 2019). This feature is particularly valuable for customs authorities, as it can help prevent fraud and improve the accuracy of declarations (UNCEFACT, 2020).

Cross-Border Data Exchange

Blockchain can facilitate secure and efficient cross-border data exchange between customs authorities and other relevant parties. By allowing traders to submit all import, export, and transit information through a single input point, this can aid in the realization of the idea of a "Single Window" system (Chang, Iakovou & Shi, 2019; UNCEFACT, 2020). Blockchain can dramatically cut processing times and enhance overall trade facilitation by enabling real-time information exchange and processing with all interested parties in a highly secure manner (Segers et al., 2019; Juma, Shaalan & Kamel, 2019).

Risk Management and Compliance

The transparent and traceable nature of blockchain can enhance risk management and compliance in customs procedures. By providing a complete and immutable record of transactions, blockchain can help customs authorities more effectively identify high-risk shipments and focus their resources on these areas. This risk-based approach can lead to more efficient customs clearance processes while maintaining or improving compliance levels (Juma, Shaalan & Kamel, 2019).

Enhancing Overall Trade Facilitation

Beyond specialized uses in trade finance, supply chain management, and customs processes, blockchain technology can improve overall trade facilitation in a number of ways:

1. Increased Transparency and Trust: Blockchain's immutable and transparent nature can foster trust among trade partners and regulatory bodies, reducing the need for intermediaries and facilitating smoother transactions (Siddik et al., 2020; Belu, 2019).
2. Improved Data Quality and Accessibility: By providing a single, shared source of truth, blockchain can improve the quality and accessibility of trade-related data, enabling better decision-making and risk management (UNCEFACT, 2020).
3. Enhanced Coordination and Collaboration: Blockchain platforms can facilitate better coordination and collaboration among various stakeholders in the trade ecosystem, including exporters, importers, logistics providers, and regulatory bodies (Jensen, Hedman & Henningsson, 2019).
4. Reduced Trade Costs: Through process automation, reduced paperwork, and improved efficiency, blockchain can significantly reduce overall trade costs (Siddik et al., 2020; Chang, Iakovou & Shi, 2019).
5. Facilitation of Cross-border E-commerce: Blockchain can support the growth of cross-border e-commerce by providing secure and efficient platforms for international transactions and logistics (Macedo, 2018).

CHALLENGES AND CONSIDERATIONS

Although blockchain has a lot to offer in terms of facilitating international trade, there are a number of issues and concerns that must be resolved before it can be widely used.

Standardization and Interoperability

One of the primary challenges in implementing blockchain solutions for international trade is the need for standardization and interoperability. As noted by Allen et al. (2019) and UNCEFACT (2020), the development of blockchain standards can take two broad paths: open or closed. Achieving consensus on standards and ensuring interoperability between different blockchain platforms is crucial for realizing the full potential of this technology in international trade (Balci & Surucu-Balci, 2021; Koh, Dolgui & Sarkis, 2020).

Regulatory and Legal Frameworks

Appropriate legislative and regulatory frameworks are also necessary for the deployment of blockchain in global commerce. To provide a solid basis for blockchain-based trade facilitation, concerns including the legal standing of smart contracts, data privacy laws, and cross-border jurisdiction must be resolved. It is frequently mentioned that one of the main obstacles to blockchain adoption in international trade is the absence of clear legislation and legal frameworks (Balci & Surucu-Balci, 2021).

Scalability and Technical Challenges

As blockchain technology is still evolving, there are concerns about its scalability and ability to handle the massive volume of transactions in international trade. Technical challenges such as transaction speed, energy consumption, and data storage need to be addressed to ensure the viability of blockchain solutions at a global scale (Balci & Surucu-Balci, 2021). Concerns over the potential environmental effects of specific blockchain consensus algorithms, particularly in public blockchains, have also been voiced (De Villiers, Kuruppu & Dissanayake, 2021).

Adoption and Change Management

The effective use of blockchain technology in global trade requires widespread adoption by various stakeholders, including traders, banks, customs authorities, and logistics providers. Overcoming resistance to change and ensuring all parties have the necessary technical capabilities are significant challenges that need to be addressed (Balci & Surucu-Balci, 2021; Irannezhad, 2020). The lack of understanding and

expertise in blockchain technology among trade professionals may also be a barrier to adoption.

Data Privacy and Security Concerns

While blockchain's cryptographic features provide increased security, concerns remain about data privacy and the potential for cyber-attacks. Ensuring the privacy of sensitive trade information while maintaining the transparency benefits of blockchain is a delicate balance that needs to be struck. Additionally, the immutability of blockchain records raises questions about the right to be forgotten and compliance with data protection regulations like GDPR (UNCEFACT, 2020).

Implementation Costs

The initial costs of implementing blockchain solutions in international trade can be significant, particularly for smaller businesses and developing countries. These costs include not only the technology infrastructure but also training and change management expenses.

FUTURE OUTLOOK

Despite the challenges, blockchain technology has enormous potential for transforming the facilitation of international trade. As this technology matures and more use cases are developed, we can expect to see increased adoption across various aspects of international trade.

Future Outlook

Blockchain's role in international trade will probably grow as it integrates more with other cutting-edge technologies like big data analytics, artificial intelligence (AI), and the Internet of Things (IoT). Even more advanced and effective trade facilitation solutions may result from this convergence of technologies. For example, real-time tracking of commodities and autonomous execution of smart contracts based on predetermined criteria could be made possible by the integration of blockchain with IoT.

As governments and international organizations recognize the potential of blockchain, we may see increased efforts to develop supportive regulatory frameworks and standards. The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT), for instance, is already working on developing standards and best practices for blockchain implementation in international trade. Similarly, initiatives like the World Trade Organization's blockchain for trade project are exploring how technology can be leveraged to enhance global trade.

The potential impact of blockchain on developing countries and small businesses is particularly noteworthy. By reducing trade costs and improving access to finance, blockchain could help level the playing field in international trade, enabling smaller players to compete more effectively in the global marketplace.

Further Research Propositions

Though several research gaps in the field of blockchain technology applications to facilitate international trade can be identified, there are some key areas that may warrant further comprehensive investigation. Some such key research propositions are provided below. These propositions could serve as starting points for future research projects, helping to address crucial questions in this field and contribute to a more thorough understanding of blockchain's potential and challenges in international trade facilitation.

- Investigation into the quantifiable impact of blockchain adoption on trade facilitation costs and efficiency.
- Studies investigating interoperability challenges between different blockchain platforms in international trade ecosystems.
- Research on the effectiveness of blockchain in reducing fraud and enhancing transparency in global supply chains.
- Examination of the evolution of legal and regulatory frameworks necessary to support blockchain adoption in cross-border trade.
- Analysis of blockchain's impact on trade participation for SMEs, and assessment of such trade participant’s inclusion and diversity.
- Studies on the integration of blockchain with IoT and AI for enhanced trade facilitation and cross-border supply chain management.
- Research on the role of blockchain in improving access to trade finance for businesses in developing countries.

- Analysis of the cybersecurity risks and data privacy challenges associated with implementation of blockchain-based trade platforms.

These propositions address critical areas where current knowledge seems to be limited or where there are significant opportunities for empirical investigation. They focus on quantifiable impacts, practical challenges in implementation, regulatory aspects, and inclusivity – all crucial aspects for the future of blockchain in international trade facilitation.

CONCLUSION

In summary, blockchain technology demonstrates significant potential to address many long-standing challenges in international trade facilitation. The transformative capacity of blockchain extends to various aspects of international trade, including supply chain traceability, streamlining of trade finance processes, and boosting the efficiency of customs procedures. By enhancing transparency, security, and efficiency across supply chains, trade finance, and customs procedures, blockchain can contribute to reducing trade costs, increasing trade volumes, building trust among trade partners and ultimately fostering economic growth.

Limitations

Despite the promising outlook, this review has several limitations that should be acknowledged:

Limited Empirical Evidence: Much of the literature reviewed is theoretical, with limited real-world case studies or empirical data on blockchain's impact on international trade.

Interdisciplinary Gap: The review might not fully capture the interdisciplinary nature of the topic, potentially overlooking insights from fields such as international relations, global trade economics, socio-political landscape or mercantile law.

Inclusion Criteria: The scope of this literature review is primarily confined to peer-reviewed academic publications, which may have resulted in the exclusion of pertinent information from alternative sources. Given the rapidly evolving nature of this field, significant developments, including empirical evidence, are frequently disseminated

through trade publications, industry-specific news releases, and proceedings from academic or professional conferences. The omission of these sources may limit the comprehensive nature of the review and potentially exclude recent, practical insights into the application of blockchain technology in international trade facilitation.

Implications

The findings of this review have several important implications:

Transformative Potential: Blockchain technology has significant potential to revolutionize various aspects of international trade, necessitating preparation and adaptation from all stakeholders.

Efficiency and Cost Reduction: The adoption of blockchain in international trade could lead to substantial improvements in efficiency and reductions in trade costs, potentially reshaping global trade dynamics.

Enhanced Transparency and Trust: Blockchain's inherent characteristics could foster greater transparency and trust among trade partners and regulatory bodies, potentially reducing fraud and disputes in international trade.

SME Empowerment: Blockchain could potentially level the playing field in international trade, enabling smaller businesses and developing countries to participate more effectively in global markets.

Regulatory Challenges: There is a clear need for supportive regulatory frameworks and standards to facilitate the widespread adoption of blockchain in international trade.

Technological Integration: Future developments in blockchain for international trade are likely to involve integration with other emerging technologies such as IoT, AI, and big data analytics, necessitating a multidisciplinary approach to research and implementation.

Environmental Considerations: The potential environmental impact of certain blockchain consensus mechanisms, particularly in public blockchains, needs to be carefully considered and addressed in future implementations.

Realizing the full potential of blockchain in international trade facilitation will require concerted efforts from all stakeholders to address technical, regulatory, and adoption

challenges. As blockchain technology continues to develop and mature, it is expected to play an increasingly important role in shaping the future of international trade. Further research, particularly empirical studies and real-world case analyses is crucial to better understand the practical implications and challenges of implementing blockchain in international trade.

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