Blockchain in Dynamic Supply Chain: A Review

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Abstract

This paper reviews the application of blockchain technology in the dynamic supply chain management to enhance the transparency, data integrity and coordination among stakeholders. Blockchain was created to record transactions in a secure and transparent way without depending on a central authority. Traditional supply chains face several challenges including lack of traceability, data inconsistency, counterfeiting, delayed data sharing and dependence on centralized control systems. This study explains a systematic review methodology, analyzing recent academic literature, industry reports and real-world implementations of blockchain across different supply chain sectors to address these challenges. Some case examples such as the food traceability solution implemented by Walmart, blockchain adoption in pharmaceutical supply chains, healthcare in blockchain and blockchain-enabled logistics solutions are reviewed to evaluate practical applications. The results indicate that blockchain's fundamental feature of immutability, decentralization and smart contracts provide effective solutions to supply chain challenges by enabling secure data sharing, real-time tracking, automated compliance and improved trust among participants. Overall, this work provides a comprehensive overview of recent advancements and identifies future opportunities for utilizing blockchain to build resilient, adaptive and data-driven supply chain networks.

Keywords: Decentralization, Ledgers, Smart Contracts, Ethereum, Real-Time Data Sharing, Transparency, Traceability, Data Immutability.

1. Introduction

Blockchain is a technology established in 2008 with the introduction of Bitcoin as a decentralized and tamper-resistant digital ledger designed to enable secure peer-to-peer transactions without a central authority. Blockchain has evolved to support programmable transactions through smart contracts and enterprise-level applications across various sectors to develop cryptocurrency applications. The growth of global trade and digitalization has significantly increased the complexity of modern supply chains. Traditional supply chain systems were linear and centralized management depending on manual documentation and various information systems.

Supply chain management is a linear process (i.e., from manufacturer to end-user) that happens in a specific timeframe. As shown in Figure 1, products move from various suppliers to the manufacturer, the wholesaler, the retailer and the consumer [11]. Due to limited visibility in the supply chain leads to inefficiencies in practices such as manual data sharing, various information systems and periodic reporting resulting in longer response times and reduced flexibility in meeting changes for consumer demands. Demand forecasting in the supply chain depends on historical sales records and static statistical model, lead to excess inventory and/or product shortages [12]. The data is collected in supply chain management contains sensitive consumer and operational data makes it an easy target for cybercriminals. As the number of supply chain partners continues to grow, coordinating them becomes complicated and the blockchain technology will allow all parties to maintain a secure and immutable ledger of transactions. A supply chain dynamic is a capacity to react rapidly for variations in market conditions, supply disruption and demand. Traditional supply chains prefer to follow predefined plans and have longer response times when these variable changes., Dynamic supply chains make use of real-time data when making decisions related to sourcing, producing, storing and delivering product vs. depending on an established forecast was developed prior to an unexpected event because the importance of timely access to data and continuous collaboration between all entities throughout the supply base. Dynamic flexibility across the supply chain is achieved through a combination of full supply chain transparency, timely data exchange, flexible processes and collaboration with partners that also strengthened via the use of emerging digital technologies like blockchain, Internet of things (IoT) and data analytics. Dynamic supply chains are more capable to increase the levels of uncertainty while delivering products profitably and reliably [24].

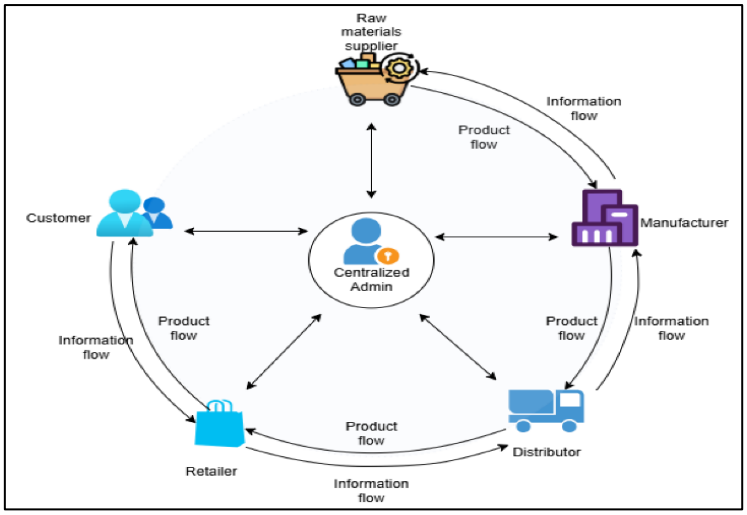

Figure 1. Traditional Supply Chain Process [10]

Supply Chain Management (SCM) has evolved from its more traditional methods [Figure 1] to include digital collaborative, Adaptive SCM processes. Transparency and real-time access to critical data is now paramount within today's new SCM approaches as shown in Figure 2. Advanced technologies like the Internet of Things (IoT) and the use of predictive analytics will increase the ability to forecast, produce and distribute. The modern SCM face challenges related to both interoperability, data privacy/resources and integration with existing infrastructure. Blockchain technology provides a way for increasing SCM systems by creating a decentralized trusted layer; allowing all organizations to securely share data with one another and improve the auditability of supply chains for each partner organization.

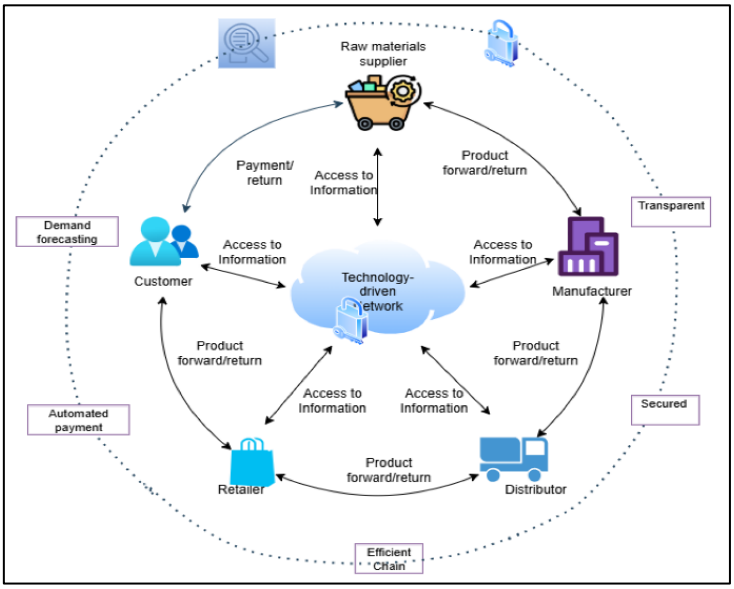

Figure 2. Modern Supply Chain Process [10]

In this model, it helps different blockchain networks share data with each other. It works like a connection layer allows data to move safely between them. Details such as inventory updates, production data, delivery status and payment requests can be shared across blockchains using secure inputs that makes the data is correct and trusted [5].

2. Related Work

The purpose of this paper is to provide a summary of the body of literature available about using blockchain technology to improve supply chain resilience during periods of elevated risk and uncertainty with the help of author keyword analysis. This review utilizes a dynamic quantitative bibliometric approach referred to as systematic literature network analysis (SLNA) [1]. SLNA is a combination of two different approaches: Systematic Literature Review (SLR) and Bibliometric Network Analysis (BNA). Companies help to utilize innovative technologies such as AI, Cloud Computing, Big Data, etc., because many companies have successfully implemented these technologies. The emergence of cryptocurrency has generated in blockchain technology and its use in the creation of these currencies (i.e., Bitcoin and Ethereum) [2]. Management of supply chains is one of an organization's most critical functions and is responsible for moving products and services from one location to another through a network. In traditional supply chain management, the model is centralized and under the direction of a central management office provides instructions to all sub-offices of the organization. Current systems for supply chain management face numerous challenges that include security issues, lack of transparency in transactions, traceability, lack of stakeholder involvement, fake products, delays, fraud and instability [3].

Innovative applications of blockchain technology are changing the supply chain issues through the provision of a decentralised and secure framework for supply chain management. The impact of blockchain on supply chains will be reviewed in detail to its ability to improve efficiency, increase transparency and stimulate innovation. Efficiency improvements afforded by blockchain in supply chain management will be evaluated, that decreased the use of intermediaries, decreased amounts of paperwork and increased real time visibility throughout the supply chain process. These improvements create more streamlined business operations, lower costs and a more responsive supply chain and business to market changes [4]. In addition, this review examines existing blockchain based supply chain solutions, first categorizing them through analysis of their architecture, then examining their cryptographic underpinnings and finally categorizing them through examination of their storage strategies. Furthermore, the

evaluation of blockchain technologies as they relate to underdeveloped humanitarian logistics situations will receive significant consideration. A three-dimensional evaluation framework will be introduced as a means of evaluating the security, traceability and integrity of blockchain applications within each of these three tiers of architectural development. Additionally, this evaluation will provide the foundation upon key technological enablers such as Zero Knowledge Proofs (ZKPs) and cross-chain architectures can be developed and improved as both privacy and interoperability continue to evolve [5]. Finally, publications that provide data regarding both the integration of blockchain technologies with supply chains will be investigated and as the need to categorise these publications based upon the complexity of the processes and increase the connection of blockchain [6].

Adding new technology into existing supply chains can be accomplished through SCM. Logistics act as a vital connection between new technologies and the addition into supply chains [7]. Hu et al. suggested the continued research and development of more comprehensive industrial implementation methods with blockchain technology, combined with other advanced technologies could help reduce supply chain risk more effectively and efficiently [8]. A recommendation made in view of recent termination of TradeLens, and a collaborative blockchain platform created between IBM and Maersk due to a lack of involvement from supply chain stakeholders. A review on the literature based on the implementation of blockchain applications by supply chain stakeholders was performed. This review is significant because it explores to create a more general analysis of the factors that affect blockchain implementation and serves as a requirement for the technical sustainability of blockchain technology in supply chain processes [9]. The challenges of integrating Blockchains within SCM processes such as technical challenges, operational challenges and regulatory challenges. This review has evaluated the potential of blockchains as applied to SCM, particularly in reference to four (4) key challenge areas increases within the application of blockchain Technology: scalability issues; interoperability challenges; high costs for implementation and information privacy and security considerations [10].

3. Supply Chain Model

The supply chain model includes five core functions such as procurement, operations, logistics, resource management and data flow are improved through blockchain integration as illustrated in Figure 3.

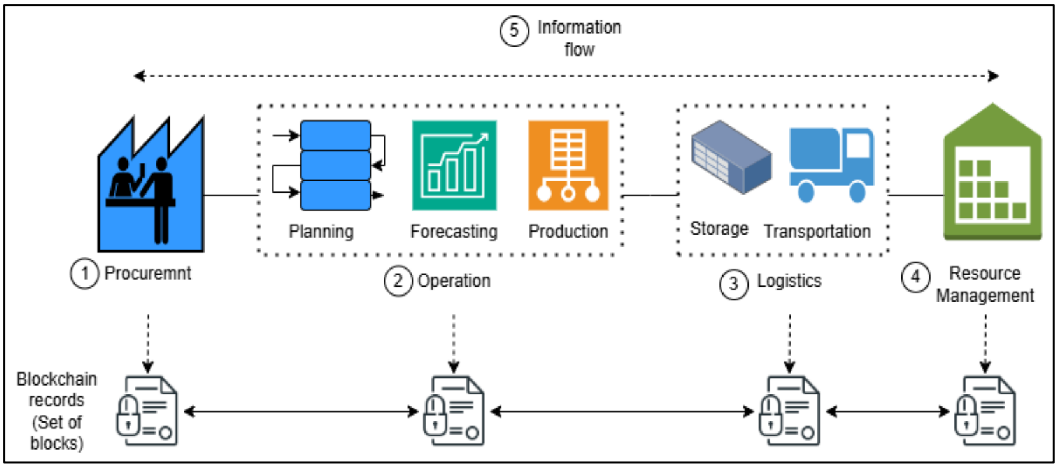

Figure 3. Core Functions of Blockchain Integrated System with Supply Chain [10]

3.1 Procurement

Procurement refers to obtaining raw materials/resources through direct interaction with suppliers to evaluate the quality and timing of the delivery of these goods. Purchasing provides the 'fuel' that encourages operations. If the flow of product stops, production are not able to keep the help of scheduling. There must be coordination between suppliers and their logistics providers between the various internal teams involved in the process to obtain materials in-house when they needed.

3.2 Planning, Forecasting & Production

Demand planning depends on historical data and live market data decisions are speculation. Forecasts also take many forms including customer demand, labor availability, supplier reliability and long-term materials. A plan can rapidly disintegrate when the first machine malfunctions or an urgent request is received. The blockchain will also assist in tracking devices and materials for IoT will decrease costs and maintain a transparent record of the quality of outputs produced.

3.3 Logistics

The logistics including route optimization and document management tracking in real-time and decentralized/hybrid storage methods are all facilitated by blockchain technology. Blockchain's immutability allows for increased coordination, enhanced dispute resolution speed and provides data integrity in disruption situations [10].

3.4 Resource Management

In the production process of a company, there are many different types of orders are waiting to be processed by the resource limitation. While making the most use of them to manage the resources (labor, raw materials, equipment, and time) and make sure they are not over utilized. Resource management uses supplies, labour and equipment most efficiently.

3.5 Information Flow

In a supply chain, data crossings act as traffic signals. Therefore, operation is achieved when the signals are accurate and consistent. When the traffic signals are lost or opposing, the system's functionality is stopped. An effective data workflow depends on a single system of record shared across all functions.

On-chain operations should be used for any function that based on a large amount of trust, transparency and verification such as managing asset ownership, settling transactions, controlling access to data and updating consensus states. All these operations require data that cannot be changed after it has been created. The effectiveness of smart contracts (to facilitate token transfers, manage governance decisions, enforce rules, etc.) stems from their ability to provide certainty for users that transactions have taken place without the use of third parties and that they cannot be tampered. Off-chain operations are suited for those processes that require a large amount of computational power, a large presence of data, rapid decision making and responses. Examples of off-chain operations can use an oracle to securely connect and verify that a blockchain transaction include preparing a data set (i.e., machine learning), running business processes, or interacting with a third party (i.e., sending or receiving a payment from a bank). A combined approach of using both off-chain and on-chain processes produces a balanced environment of trust with increased overall throughput (faster processing), improved scalability and better cost-effectiveness.

4. Strategies for Managing Dynamic Supply Chains

A dynamic supply chain can be approached through strategies such as Agile Supply Chain Management (ASCM), Resilient Supply Chain Design (RSCD), Digital Supply Chain Integration (DSCI) and Data-Driven Decision-Making (DDDM). An agile supply chain reacts rapidly to consumers' demands as they change and atmospheric demand changes by using flexible sourcing methods and lowering lead time by means of closer collaboration with

suppliers to reduce disruptions [4]. Resilient supply chains reduce risk and improve resiliency in the supply chain using supplier diversion, maintaining strategic inventories and using predictive analytics to help manage disruptions. Digital Supply Chains use a combination of the Internet of Things (IoT), Blockchain, Artificial Intelligence (AI) and Cloud Technology allows for real-time visibility, traceability and automation throughout all levels of the Supply Network. Data-Driven Demand and Adaptive Planning (DDALP) models provide supply chains with the ability to respond more rapidly and adaptable demand changes will improve inventory management and logistics to increase production efficiency and develop Sustainable Supply Chains by leveraging Real-time data, Machine Learning (ML), Continuous Feedback (CF) and Adaptive Decision-Making (ADM) [6]. According to the strategies discussed, agile supply chain management and resilient supply chain design can exist and function well with the technology of blockchain, as they are primarily based upon being flexible enough, creating collaboration opportunities, performing a risk analysis and using forecasting and predictive tools. In addition, companies utilize data analytics in their decision-making processes and operate under adaptive planning that not need to implement the use of blockchain technology for these functions. These companies are also utilizing the capabilities of machine learning and feedback methods based upon the real-time analysis of historical and obtained performance data. In summary, the integration of digital supply chains benefits considerably using blockchain because of its ability to provide a secure environment to share data, create transparency and build trust between all participants. Many applications face challenges in operating without the assistance of blockchain technology. For example, traceability, automated transactions and tamper-resistant records. Therefore, blockchain technology does not have to be utilized for every dynamic supply chain strategy that plays a vital role in providing companies with an opportunity to develop a fully digitalized, transparent and highly integrated supply chain system.

5. Blockchain Applications in Supply Chain Sectors

Blockchain technology is currently adopted across multiple domains using in supply chain management are illustrated in Table 1. Table 2 demonstrates the real time applications using blockchain in supply chain domains.

Figure 4. Use of Blockchain in Food Supply Chain (Food Quality & Safety) [18]

a) **Blockchain in Food:** In many traditional food systems, tracking the source and movement of food products is slow and misaligned process, preventing the immediate response to food products that may have become contaminated or fake. Blockchain technology has been developed to solve this issue by providing a secure, immutable digital ledger that records and distributes all transactions (from the farm, through processing and transporting, to retails) among all parties authorized to view that data [13], [14]. This allows food product stakeholders to track food products and to locate sources of contamination that improves food safety as shown in Figure 4.

Walmart has been a high-profile early adopter of blockchain for food traceability, operating pilots (mangoes in the Americas and pork in China) with IBM's Hyperledger-based Food Trust to create an immutable, farm-to-shelf record [18].

b) **Blockchain in Healthcare:** Many modern advances in healthcare involve the use of blockchain technology. The evolution of electronic health (EHR) records, data storage using cloud computing and regulatory approaches to protecting a patient's privacy with new opportunities created by applications of Health Care and Management Systems [19]. In addition to improve the management of health data, these new technologies create new opportunities for patients to easily manage their own health data including their EHRs and other health-related data. Blockchain can solve the challenges associated with securing, storing, transacting and integrating health-related data into the operations of a health care organization [23].

c) **Blockchain in Pharmaceutical:** The use of blockchain technology in the pharmaceutical supply chain in Egypt to obtain an opportunity to twenty-five Semi-Structured interviews were conducted with pharmacies and employees in a company [15]. The pharmaceutical industry in Egypt currently faces many significant challenges such as governmental regulations enforcing drug prices, multinational

corporations controlling the market, delays in implementing a comprehensive price increase, a loss of the Egyptian currency (pound) and an excessive amount of fake products availability [16].

d) **Blockchain in Logistics:** Logistics & Supply Chain Networks are being transformed the design, product flows and activities using a new technology called Blockchain. The Logistics Industry focuses on Block Chain and smart contracts with different opportunity and challenges. Due to the traditional conservative approach of logistics, the initial adoption of Blockchain will be reduced [17].

e) **Blockchain in Retail:** The retail supply chain has many participants including the manufacturer, supplier, carrier, storage, terminal buyer and financier, etc., had limited peer-to-peer communication about their own issues in traditional system [21], [22]. The retail industry using blockchain technology to improve traceability and support retail and e-commerce sector by improving business models and enabling more visibility and store service and blockchain applications for retailers are based on permission ledgers, evaluation and confirmed by miners ensures traceability and security [20].

Table 1. Comparison of Various Sectors using the Blockchain and Supply Chain

Sectors	Ref	Issues	Solutions	Benefits
Food	[13]	Lack of end-to-end traceability, food safety risks, delayed recalls, data inconsistency among stakeholders	Blockchain-enabled food traceability systems with immutable records and shared ledgers	Improved transparency, faster contamination tracking, enhanced food safety, increased consumer trust
	[14]	Long traceability times using traditional systems (days to locate source of contamination)	Implementation of a Hyperledger Fabric-based blockchain platform (IBM Food Trust) for end-to-end tracking	Improved food safety response, enabling quick detection and targeted recalls. Reduced risk of waste and economic loss by

				limiting recalls to affected batches
Healthcare	[23]	Counterfeit drugs and opaque healthcare supply chains	Decentralized distributed ledger for secure EHR storage and controlled data access	Improved data integrity and security without central intermediaries
	[19]	Inefficient access, management, and secure sharing of health records	Smart contracts for automating healthcare transactions and billing	More secure and tamper-proof health information exchange
Pharmaceuticals	[15]	Drug counterfeiting, lack of visibility, regulatory non-compliance, poor coordination among supply chain actors	Blockchain for drug provenance tracking, secure data sharing, and compliance automation	Reduced counterfeit drugs, improved regulatory compliance, enhanced patient safety
	[16]	High transaction costs, limited transparency, cold-chain monitoring issues, cultural and adoption barriers	Blockchain-supported governance frameworks and secure transaction records	Reduced lead times and transaction costs, improved collaboration, safer drug delivery
Logistics	[7]	Fragmented information systems, lack of trust, excessive paperwork, inefficient coordination	Decentralized blockchain platforms for data sharing and smart contract execution	Improved traceability, reduced paperwork, cost and time efficiency

	[17]	Contract enforcement delays, manual processes, lack of real-time visibility	Blockchain-based smart contracts for automated logistics operations	Faster settlements, improved reliability, enhanced operational efficiency
Retail	[20]	Poor supply chain visibility, data silos, weak customer trust	Blockchain integration for transparent inventory and transaction tracking	Improved supply chain performance, better decision-making, increased customer confidence
	[21]	Cybersecurity risks, data breaches, counterfeit products	Blockchain for secure transactions, immutable data storage, and provenance tracking	Enhanced data security, reduced fraud, improved supply chain integrity
	[22]	Inefficient financing processes, trust issues among stakeholders, slow cash flows	Blockchain-driven supply chain finance platforms with smart contracts	Faster financing, reduced costs, improved SME participation

Table 2. Real Time Applications using Blockchain and Supply Chain

Sectors	Applications	Descriptions
Food [13, 14]	Walmart	Tracking products (e.g., leafy greens, fruits) from farms to store shelves in real time.
	Carrefour (Europe)	Blockchain using for real-time tracking of meat, milk, and fresh produce, allowing consumers to scan QR codes to view origin, processing dates, and transport details.

	Nestlé	Blockchain using to track baby food, dairy, and coffee products, ensuring real-time visibility of sourcing and quality data.
Healthcare [19, 23]	MediLedger	Pharmaceutical supply chain compliance and drug traceability (DSCSA-focused).
	IBM Blockchain / IBM Supply Chain	Drug and medical supply traceability solutions.
Pharmaceuticals [15, 16]	PharmaLedger	European blockchain project for secure pharma supply chains.
	OriginTrail	Decentralized traceability and data sharing for pharma supply chains.
Logistics [7, 17]	TradeLens	Blockchain platform by Maersk and IBM for global shipping and logistics.
	CargoX	Blockchain-based document transfer (e.g., Bill of Lading)
Retails [20, 21, 22]	Carrefour	Retail product traceability platform.
	Everledger	Lifecycle tracking and authenticity verification for luxury goods and high-value retail products.

5.1 Sector-Specific Constraints

In the food sector, continuous data from sensors and traceability systems creates a large volume of records impact pressure on blockchain storage and processing capacity. Healthcare systems deal with highly sensitive patient data and privacy regulations limiting that data can be handled on public blockchains. In the pharmaceutical sector, regulatory requirements, drug tracking and coordination across countries increase transaction complexity and decrease blockchain operations. Logistics generates frequent real-time tracking updates can cause network congestion and delays when recorded on-chain. In retail, high transaction volumes and

peak time for spending demand require rapid processing, making it challenging for blockchain networks to scale without increased cost or latency.

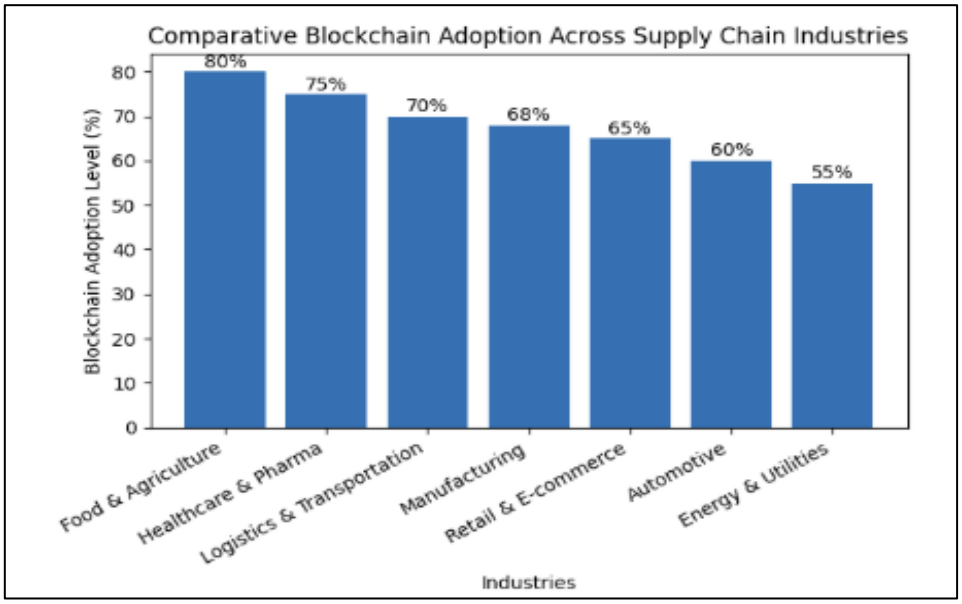

Figure 5. Application of Blockchain Techniques in Supply Chain Industries.

Figure 5 represents the blend of food-agriculture and health-pharma domains have the increased blockchain implementations, however the retail has decreased implementation. This can be attributed to the fact that food and pharmaceutical companies must track their products from the level of production to the final customer to ensure quality control, to reduce damage risk and able to swiftly execute product recalls when required. The use of blockchain technology offers a safe, secure, transparent and immutable record of each transaction between buyers (e.g., consumers and retailers) and sellers (e.g., manufacturers). This builds trust for the consumer and the regulatory authority. Retail, poses a lower level of risk in terms of health and safety requires lower levels of traceability and verification. Hence, retail companies have experienced a slower rate of blockchain adoption than the other industries (food, pharma, etc.). This shows the importance of product integrity and increased compliance with regulations.

6. Discussion

Blockchain has gained significant attention in dynamic supply chain management due to its ability to improve transparency, traceability, data integrity and trust among stakeholders. The real-time data sharing using immutable and decentralized ledgers enables the blockchain to improve coordination, reduces fraud, demand forecasting accuracy and supports efficient inventory and resource management [2]. These advantages contribute to improved operational

efficiency, faster decision-making and better compliance. However, blockchain implementation in supply chain faces several challenges and disadvantages. Scalability remains an issue in blockchain network challenges to process and store large volumes of transactional data generated across complex supply chains. Integrating blockchain platforms with existing legacy systems is complex, time-consuming and requires significant organizational changes. High implementation and maintenance costs further restrict implementation, particularly for small and medium-sized enterprises [5]. Additionally, data privacy concerns and varying regulatory frameworks across regions and industries complicate deployment, while the lack of standardized protocols and skilled technical expertise continues to prevent widespread implementation. Figure 5 illustrates the comparison of blockchain in supply chain mostly applied in real time. Therefore, blockchain offers substantial advantages for creating resilient and dynamic supply chains, addressing these technical, economic and regulatory limitations is essential for its sustainable implementation.

7. Future Scope

Blockchain technology will improve the future of dynamic supply chains by providing companies real-time and end-to-end visibility and traceability of things that happens during each step of their supply chain activities. In addition, as companies continue to observe the convergence of blockchain with Internet of Things (IoT), artificial intelligence (AI) and big data analytics. The execution of supply chain processes will initiate the transformation from reactive management to predictive and adaptive decision-making capabilities. This combination of technologies will allow for improved accuracy in forecasting demand, inventory control and proactive ways of managing risks. These types of integrated systems should also allow the automated execution of procurement processes, settlements for payment, compliance with regulations and processes used to resolve disputes using the expanded use of smart contracts, resulting in a reduction of the amount of manual intervention needed, delays in operations and costs associated with transactions. In addition to developing more efficient and sustainable forms of working towards operating within a circular economy, the ongoing development of blockchain-enabled dynamic supply chains will continue to expand the support and sustainable supply chains by enabling companies to verify the reliability of their ability to track returns of products, the reuse of products and the recycling of products. Collectively, as dynamic supply chains continue to develop into more intelligent, efficient, and sustainable

systems will have an increasing amount of significance on the development of product-based companies.

8. Conclusion

Blockchain demonstrates as an emerging technology in establishing more adaptive and efficient supply chains. Historical problems in supply chains such as insufficient transparency, insufficient trust among supply chain participants, and ineffective coordination between supply chain participants can be resolved via the use of blockchain based solutions. This study provides examples and real-life applications of blockchain technology, which indicates decentralised and tamper-increase in the reliability of data, improvement in traceability of goods and facilitates real-time sharing of data throughout the supply chain network. Thus, when the benefits of blockchain are integrated into existing processes and systems within an organisation that are designed to manage the flow of materials and services through the supply chain or operating environment, the organisation will have the capability to make decisions and respond better to changes in customer demands, supply chain disruptions and other changes affecting supply chain operations. Examples of practical applications of blockchain in various industries such as the food industry, healthcare, pharmaceuticals, logistics and retail, demonstrate that the blockchain can create new levels of transparency, efficiency and security within supply chains and contribute to the development of supply chains that are more responsive, reliable and resilient.

The advantages of implementing blockchain technology in supply chains have some challenges. A key challenge of implementing a blockchain system is the initial cost to establish and continue operating will increase and potentially reduce the large number of transactions. Connecting a blockchain to their current (legacy) supply chain systems is also a challenge for many companies. The rules and regulations are being developed and companies are created uncertain on the way to operate and function. Data privacy issues and the overall high energy consumption associated with some types of blockchain systems may limit their ability to become widely accepted by dynamic supply chain systems without additional testing, clear standards and the development of the technology.

References

[1] Etemadi, Niloofar, Yari Borbon-Galvez, Fernanda Strozzi, and Tahereh Etemadi. "Supply Chain Disruption Risk Management with Blockchain: A Dynamic Literature Review." Information 12, no. 2 (2021): 70.

[2] Chang, Aichih, Nesreen El-Rayes, and Jim Shi. "Blockchain Technology for Supply Chain Management: A Comprehensive Review." FinTech 1, no. 2 (2022): 191-205.

[3] Agarwal, Udit, Vinay Rishiwal, Sudeep Tanwar, Rashmi Chaudhary, Gulshan Sharma, Pitshou N. Bokoro, and Ravi Sharma. "Blockchain Technology for Secure Supply Chain Management: A Comprehensive Review." Ieee Access 10 (2022): 85493-85517.

[4] Oriekhoe, Osato Itohan, Oluwaseun Peter Oyeyemi, Binaebi Gloria Bello, Ganiyu Bolawale Omotoye, Andrew Ifesinachi Daraojimba, and Adedayo Adefemi. "Blockchain in Supply Chain Management: A Review of Efficiency, Transparency, And Innovation." International Journal of Science and Research Archive 11, no. 1 (2024): 173-181.

[5] Karaduman, Özgür, and Gülsena Gülhas. "Blockchain-Enabled Supply Chain Management: A Review of Security, Traceability, and Data Integrity Amid the Evolving Systemic Demand." Applied Sciences (2076-3417) 15, no. 9 (2025).

[6] Dietrich, Fabian, Yiwen Ge, Ali Turgut, Louis Louw, and Daniel Palm. "Review and Analysis of Blockchain Projects in Supply Chain Management." Procedia computer science 180 (2021): 724-733.

[7] Karakas, Serkan, Avni Zafer Acar, and Berk Kucukaltan. "Blockchain Adoption in Logistics and Supply Chain: A Literature Review and Research Agenda." International Journal of Production Research 62, no. 22 (2024): 8193-8216.

[8] Hu, Yang, and Pezhman Ghadimi. "A Review of Blockchain Technology Application on Supply Chain Risk Management." IFAC-PapersOnLine 55, no. 10 (2022): 958-963.

[9] Wong, Simon, John Kun Woon Yeung, Yui-Yip Lau, Tomoya Kawasaki, and Raymond Kwong. "A Critical Literature Review on Blockchain Technology Adoption in Supply Chains." Sustainability 16, no. 12 (2024): 5174.

[10] Khatun, Mahafuja, and Tasneem Darwish. 2025. "Unlocking Blockchain's Potential in Supply Chain Management: A Review of Challenges, Applications, and Emerging Solutions" Network 5, no. 3: 34. https://doi.org/10.3390/network5030034

[11] Kouhizadeh, Mahtab, and Joseph Sarkis. 2018. "Blockchain Practices, Potentials, and Perspectives in Greening Supply Chains" Sustainability 10, no. 10: 3652. https://doi.org/10.3390/su10103652

[12] Hübschke, Marc, Eugen Buss, Elmar Holschbach, and Stefan Lier. "Blockchain in Supply Chain Management: A Comprehensive Review of Success Measurement Methods." Management Review Quarterly (2025): 1-55.

[13] Fahreza, Faizal, Falia Nurnabila, Mohammad Rizki Riyadi, Indra Bayu Muktyas, Nerru Pranuta Murnaka, and Samsul Arifin. "A Systematic Literature Review: Analysis and Improvement of Walmart Supply Chain." In AIP Conference Proceedings, vol. 3024, no. 1, p. 040024. AIP Publishing LLC, 2024.

[14] Sharma, Minky, and Pawan Kumar. "Adoption of blockchain Technology: A Case Study of Walmart." In Blockchain technology and applications for digital marketing, IGI Global Scientific Publishing, 2021, 210-225.

[15] Ghadge, Abhijeet, Michael Bourlakis, Sachin Kamble, and Stefan Seuring. "Blockchain Implementation in Pharmaceutical Supply Chains: A Review and Conceptual Framework." International Journal of Production Research 61, no. 19 (2023): 6633-6651.

[16] Gruchmann, Tim, Sara Elgazzar, and Ahmed Hussein Ali. "Blockchain Technology in Pharmaceutical Supply Chains: A Transaction Cost Perspective." Modern Supply Chain Research and Applications 5, no. 2 (2023): 115-133.

[17] Alqarni, Mohammed Ali, Mohammed Saeed Alkatheiri, Sajjad Hussain Chauhdary, and Sajid Saleem. "Use of Blockchain-Based Smart Contracts in Logistics and Supply Chains." Electronics 12, no. 6 (2023): 1340.

[18] Ellahi, Rizwan Matloob, Lincoln C. Wood, and Alaa Ei-Din A. Bekhit. "Blockchain-Driven Food Supply Chains: A Systematic Review for Unexplored Opportunities." Applied sciences 14, no. 19 (2024): 8944.

[19] Attaran, Mohsen. "Blockchain Technology in Healthcare: Challenges and Opportunities." International Journal of Healthcare Management 15, no. 1 (2022): 70-83.

[20] Hader, Manal, Abderrahman Elmhamedi, and Abdellah Abouabdellah. "Blockchain Technology in Supply Chain Management and Loyalty Programs: Toward Blockchain Implementation in Retail Market." In 2020 IEEE 13th international colloquium of logistics and supply chain management (LOGISTIQUA), IEEE, 2020, 1-6.

[21] Ray, Rejon Kumar, Faiaz Rahat Chowdhury, and MD Rokibul Hasan. "Blockchain Applications in Retail Cybersecurity: Enhancing Supply Chain Integrity, Secure

Transactions, And Data Protection." Journal of Business and Management Studies 6, no. 1 (2024): 206.

[22] Chen, Jingjing, Tiefeng Cai, Wenxiu He, Lei Chen, Gang Zhao, Weiwen Zou, and Lingling Guo. "A Blockchain-Driven Supply Chain Finance Application for Auto Retail Industry." Entropy 22, no. 1 (2020): 95.

[23] Khezr, Seyednima, Md Moniruzzaman, Abdulsalam Yassine, and Rachid Benlamri. "Blockchain Technology in Healthcare: A Comprehensive Review and Directions for Future Research." Applied sciences 9, no. 9 (2019): 1736.

[24] PlanetTogether. The Five Functions of Supply Chain Management. 2021. Available online: https://www.planettogether.com/aps-trends/the-five-functions-of-supply-chain-management.