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Review

Blockchain Technology Implementation in Supply Chain Management: A Literature Review

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Abstract: This paper aims to comprehensively review the main benefits, limitations, and challenges associated with the uptake of Blockchain technology in supply chain management (SCM). The study utilizes the literature review method, examining articles published from 2016 to 2022 and exploring the factors influencing the adoption and implementation of Blockchain in SCM. Multiple scholarly insights have shown no more hacking or cherry picking of options given for presenting data with high confidence and, therefore, reliability, as well as an ability to see everything in a highly limited way. An SCM looking at these multi-party evolutionary models shows that for Blockchain, the key advantages center on significantly increased security, confidentiality, traceability, transparency, data accuracy, privacy, efficiency, accountability, and trust. In contrast, the review has also detailed several limitations and challenges that must be overcome by firms and industries looking to adopt Blockchain within their SCM processes, which include problems with scaling, lower performance as a result of interoperability issues, legal and regulatory matters, very high initial implementation and ongoing maintenance costs, a struggle with standardization of the technology and the needed surveillance of this space, avoidance of technology adoption because of trust, the substantial energy used, low awareness, complexity of integrating with existing systems, being in its last mile in partnerships, and privacy. Even with this potential to transform and be disrupted across industry and its sectors, there are still very significant challenges for Blockchain. For those looking to actually utilize SCM and other sectors, understanding this from a variety of perspectives is of great interest to understand if the technology is fit for that sector and what strategies or networks need to be established or linked into with existing firms. Regardless, if these challenges can be overcome and responded to, then the greater protection and efficiency of current and future SCM processes will not only occur, but it can be the first significant node for broader industry-wide innovation and gains in efficiency.

Keywords: Blockchain technology; supply chain management; literature review

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1. Introduction

1.1. Blockchain Background

At the beginning of the 1990s, Scott Stornetta and Stuart Haber developed a secure document timestamping mechanism that laid the foundation for Blockchain technology. Later, Nick Szabo expanded on this idea and created a decentralized and secure ledger called "bit gold". These early attempts at developing secure and decentralized systems led to the development of Blockchain technology [1]. The concept of "Smart Contracts" has been introduced by Nick Szabo to bring the advanced experience of contract law of designing electronic commerce protocols between the Internet and strangers. He first introduced this idea in 1994, and in 1996, he explored the potential of smart contracts. Szabo envisioned a digital marketplace based on automatic, secure processes that would enable trustless transactions and business functions without intermediaries. Today, the Ethereum Blockchain offers an example of smart contracts in action, as its team has implemented Szabo's vision [2,3]. In 2008, an unidentified group or individual using the nickname

Satoshi Nakamoto issued a white paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System" that suggested a decentralized digital currency that could be exchanged securely without intermediaries like banks. The technology behind Bitcoin, called Blockchain, provides a secure and decentralized ledger of all transactions. Despite many claims, the true identity of the person or group that authored the original Bitcoin white paper in 2008 using the pseudonym "Satoshi Nakamoto" remains a mystery. Until 2011, Satoshi was actively engaged with the Bitcoin community through online forums and email correspondence, but then suddenly disappeared and passed on control of the Bitcoin code to other developers. Satoshi's impact on the development and direction of the cryptocurrency industry has been substantial and far-reaching, as noted by the authors of "Bitcoin and Cryptocurrency Technologies" [4]. Finally, the period between 2014 and 2015 was a significant milestone in the history of Blockchain technology. During this time, there was a widespread understanding of Bitcoin, a cryptocurrency that employed Blockchain technology. However, it became increasingly apparent that Blockchain technology could be utilized for more than predicted. One of its uses can be in supply chain management (SCM) to monitor and control entire processes, functions, and phases of SCM.

Therefore, this paper aims to provide a comprehensive overview and critical analysis of the previous literature on the usage of Blockchain technology in the context of SCM. The paper's objectives are to revise and analyze the existing literature on the usage of Blockchain technology in SCM, to identify the main benefits, limitations, and challenges facing Blockchain technology in SCM, to explore the factors that affect the adoption and application of Blockchain technology in SCM, and finally, to provide recommendations for supply chain players and for future research on the usage of Blockchain technology in SCM. Therefore, the current article's goal is to respond to the following questions:

Q1: What are the main applications of Blockchain technology in SCM?

Q2: How effective is Blockchain technology in improving SCM transparency, security, and efficiency?

Q3: What are the key challenges and limitations of Blockchain implementation in SCM?

Q4: What are the factors that influence the adoption and implementation of Blockchain technology in SCM?

Q5: What are the main findings and themes that emerge from a comparison of the literature on Blockchain in SCM?

This paper is one of the few papers which discuss using Blockchain technology in SCM to increase transparency, security, and efficiency of SCM. The results will be beneficial not only for SCM practitioners but also for academicians, who are concerned about both Blockchain technology as well as SCM.

1.2. Overview of Blockchain Technology and Its Key Features

The technology behind blockchain has advanced, and its uses have gone beyond the realm of cryptocurrency markets. At the moment, it is used in a variety of domains, including voting processes, supply chain management, digital identity management, and so on. As a result, a number of firms have been undertaking trials with Blockchain technology for a variety of objectives, including decentralized markets, identity verification, and supply chain management. The initial purpose of Blockchain was to merely offer a decentralized ledger for the purpose of recording transactions. This was a significant departure from the original function of Blockchain. The word "Blockchain" has become increasingly prevalent in conversations about technology as a result of the growing number of companies that are investigating the possibilities offered by Blockchain technology. The community around Bitcoin was becoming more concerned about the possibility that the technology was being appropriated by other use cases. Many individuals were concerned that the increased attention paid to Blockchain may result in a decrease in the value of Bitcoin and other cryptocurrencies. The rising understanding that Blockchain technology might have potential applications beyond simply cryptocurrencies finally led to the separation

of Blockchain and cryptocurrency. This eventual split was ultimately the result of this recognition. In the modern world, a great number of organizations are beginning to investigate the possibility of using Blockchain technology in a variety of applications, including digital identity verification, supply chain management, and voting systems. While this is going on, cryptocurrencies such as Bitcoin are still being used as a kind of decentralized money and as a way to store value [5].

Blockchain technology is a very innovative notion that is bringing about a change in the manner in which we record and verify data and transactions. This forward-thinking technology comprises a number of essential components, all of which should be brought to the attention of people and organizations in the future. The following is a list of the five most critical aspects of Blockchain technology that should be well-understood:

(1) The notion of several distributed ledgers: This is an essential component of Blockchain technology, characterized by the use of a decentralized and distributed database for the purpose of recording transactions and other important data. The distributed ledger makes it possible to record data in a way that is both transparent and safe since it eliminates the need for intermediaries and/or central authorities. The ledger is constructed of "blocks" that are connected to one another in the form of a chain, with each new block being added to the end of the progression of blocks. A permanent and unchangeable record that is readily traceable and verifiable is produced as a result of this action [6]. A central authority does not have control over the ledger since the Blockchain is decentralized, which means that it is not centralized. A network of nodes, on the other hand, collaborates in order to verify each transaction and ensure that the ledger is consistent throughout the network. The Blockchain is more secure and resistant to tampering than a centralized system because it does not have a single point of control that is centralized [7]. The idea of a decentralized ledger has been used in a variety of contexts, including the use of cryptocurrencies like Bitcoin and applications such as voting systems, supply chain management, and digital identity verification. Without the need for a centralized authority, the Blockchain ensures a transparent and safe method of storing information and authenticating transactions. This is the case in every scenario. In the case of Bitcoin, for instance, the Blockchain is used to record the ownership of each unit of the cryptocurrency as well as the transactions that occur with it. In supply chain management (SCM), the Blockchain is used to guarantee the authenticity of the product and to avoid counterfeiting. Voting systems may benefit from the Blockchain's ability to offer a record of votes that is both transparent and verifiable. In conclusion, the decentralized ledger that Blockchain utilizes is a concept that is both novel and possibly revolutionary, and it has several applications in a broad variety of sectors. Recording and confirming transactions and other data without the need for a central authority is made possible by its security, transparency, and tamper-proof nature, which makes it an appealing alternative [8].

(2) The use of the permissionless method: This is yet another essential component of Blockchain technology that makes it possible for anybody to take part in the Blockchain network and carry out transactions without the need for authorization from a centralized authority. The fact that this makes it possible for anybody to engage and contribute to the network makes it more democratic and accessible. As a result, the network is available to everyone, regardless of their location in the world, their social standing, or their political allegiance. Traditional centralized systems, in which access to the system and the capacity to carry out transactions are regulated by a central authority, stand in striking contrast to the permissionless nature of Blockchain technology, which is also known as distributed ledger technology. The openness and accessibility of the Blockchain network make it possible to take a more democratic approach to the processing of transactions and the management of data [9]. In addition, the permissionless technique is essential for the security and transparency of the Blockchain network. When using the permissionless technique, it is far more difficult for a single organization or group to exert control over the data or manipulate

the system. Rather, the network is maintained and updated by a wide and varied community of users who collaborate to authenticate transactions and ensure the consistency and quality of the data. This community is responsible for maintaining and updating the network. In general, the permissionless method is an essential component of blockchain technology, which offers a more democratic, accessible, and safe approach to the processing of transactions and the administration of data. The permissionless approach is increasingly likely to play a big role in promoting innovation and development in a variety of sectors and applications [10]. This is because Blockchain technology is improving and becoming more widely embraced.

(3) The encryption system, which is regarded as an essential component of Blockchain technology, plays a significant part in ensuring that the network continues to possess both security and privacy considerations. It is a process that includes the use of intricate mathematical techniques and protocols to encrypt data and transactions in order to render them resistant to efforts to compromise or hack the system. After going through this procedure, the data that are saved on the Blockchain are guaranteed to be safe, secure, secret, and dependable [11]. Cryptography is a method of data protection that uses a mix of encryption and hashing techniques. The process of encrypting data involves scrambling the data with a secret key in such a manner that only those who possess the key that corresponds to the data may read it. On the other hand, hashing allows the data to be transformed into a one-of-a-kind string of characters that is fixed in length. This string serves as a digital fingerprint of the data that were initially stored. Any modifications that are made to the data will result in a different hash value, which makes it simple to identify any efforts at human intervention [4]. Additionally, the use of encryption in Blockchain technology ensures that the transactions are carried out in a manner that is transparent and secret. Given that transactions are encrypted, the identities of both the sender and the recipient are safeguarded, thus guaranteeing that privacy and secrecy are maintained. In the field of cryptography, the use of both private and public keys guarantees that the transaction may only be accessed by the intended receiver, hence preventing any unauthorized access or interception from occurring [12]. To summarize, the cryptography scheme is an essential component of Blockchain technology that safeguards the network, protects users' privacy, and ensures its dependability. By using encryption and hashing, the data that are stored on the Blockchain are guaranteed to be safe, secure, and resistant to tampering. Additionally, the use of public and private keys guarantees the secrecy of the data and guarantees that only authorized individuals may access it.

(4) When it comes to Blockchain technology, it is essential for all nodes in a dispersed network to reach a consensus on a single version of the truth, which is then recorded in the ledger. Nevertheless, since the network is decentralized, it is conceivable for there to be inconsistencies or inaccuracies in individual copies of the ledger. This will occur because of the structure of the network. The tactics of reaching a consensus come into play at this point. Consensus methods are used in order to establish a consensus among the nodes on the current state of the ledger, despite the fact that there may be inconsistencies or mistakes that may be present. Using consensus techniques, which are meant to verify transactions and guarantee that all nodes have the same version of the ledger, is the means by which this objective is accomplished. In addition, algorithms are used to prevent malicious conduct, such as double spending, and to ensure that the system continues to be secure [13]. There are several different kinds of consensus algorithms that are used by Blockchain technology. Proof-of-Stake (PoS), Proof-of-Work (PoW), and Delegated Proof of Stake (DPoS) are some examples of these cryptocurrency protocols. Nodes are required to discover answers for difficult mathematical problems, verify transactions, and generate new blocks in order to participate in the Proof-of-Work process, which is a computationally expensive method. On the other hand, Proof-of-Stake (PoS) is an algorithm that requires nodes to keep a particular amount of bitcoin as a stake in the

network. This method takes less energy than Proof-of-Stake (PoS). Last but not least, decentralized proof-of-stake (DPoS) is a version of Proof-of-Stake (PoS) that employs a voting method to evaluate which nodes are accountable for verifying transactions [14]. Through the use of consensus algorithms, Blockchain technology has the capability to guarantee that all network nodes that have been agreed upon are in the same state of the ledger and that there is no malicious activity taking place. This not only helps to maintain the system's security and integrity, but also makes it possible to create a network that is decentralized, trustless, and able to function normally without the need for intermediaries.

It is possible to build self-executing agreements with pre-programmed rules and conditions via the use of smart contracts, which are an essential component of the infrastructure that underpins Blockchain technology. Through the process of automatically matching transactions and processes on the Blockchain, smart contracts enhance efficiency, speed, and security, respectively. In an environment that is trustless and decentralized, smart contracts make it possible for parties to execute agreements without the need for intermediaries or central authority. This enables them to minimize costs and enhance transparency. They are supposed to be self-executing, which means that when certain criteria are fulfilled, they automatically activate the action that was agreed upon [15]. They are programmed in programming languages and are designed to behave in this manner. The adaptability of smart contracts makes it possible to employ them in a wide variety of different contexts. The execution of financial transactions, the facilitation of the acquisition and transfer of assets, and the automation of supply chain management are all capabilities that they possess. Moreover, they are being investigated in a variety of other industries, including the medical profession, the real estate industry, and the legal services sector. In general, smart contracts are an essential component of Blockchain technology. They make it possible to automate transactions and other operations, which ultimately leads to increased efficiency, speed, and security. The relevance of smart contracts in contemporary technology is shown by the fact that their potential to revolutionize a variety of different sectors is continuing to grow [16].

In conclusion, it is essential for people and organizations who want to make the most of the potential offered by Blockchain technology to have a solid grasp of these five primary components of the technology. It is quite probable that the technology known as Blockchain will play a significant part in the development and implementation of a wide range of businesses and applications in the not-too-distant future. Individuals and organizations are able to reap the benefits of the many advantages offered by Blockchain technology if they have a solid grasp of these components.

2. Materials and Methods

To address these concerns, we conducted a thorough review of the relevant literature to explore how Blockchain technology is applied in supply chain management. A set of criteria was used to select papers, including relevance to the topic, publication date, and study methodology. Search terms like "Blockchain", "supply chain management", "distributed ledger technology", and "smart contracts" were employed. The information was gathered by searching various academic databases such as Google Scholar, Scopus, and Web of Science. The search yielded 23 research articles published between 2016 and 2022 that focused on the use of Blockchain technology in supply chain management.

Next, the selected publications were evaluated against the inclusion criteria, resulting in a total of twenty-three articles being selected for inclusion in this research. For data extraction, the authors, the year of publication, the research questions, the methodology, the kind of Blockchain technology that was used, and the industry that was examined were all recorded. A content analysis technique was employed to compare the selected articles. These articles had to meet specific criteria: (1) focus on Blockchain technology in supply chain management; (2) be published in peer-reviewed scientific journals; (3) be written in English; and (4) be published between 2016 and 2022.

Strategy for Searching: To conduct a comprehensive search, a combination of keywords and filters was employed across four electronic databases: Scopus, Google Scholar, Web of Science, and IEEE Xplore, along with several other academic databases. Search terms like "Blockchain", "Blockchain technology applications", "Supply chain management", "Supply chain optimization", "Distributed ledger technology", "Decentralized ledger technology", "Smart contracts", "Ethereum smart contracts", "Smart contract technology", and "Decentralised systems" were utilized. The search was limited to articles written in English and published between 2016 and 2022.

Extraction of Data: The data for this study were extracted from each article using a standardized form with fields for the names of the papers, authors, publication years, purposes, methodologies, applications, limitations, primary focuses, and key findings. Five main aspects were used to extract the data: (1) the goal of the research, which compared the primary purposes or objectives of each study, such as analyzing the benefits of Blockchain technology in supply chain management (SCM) or exploring potential difficulties and risks associated with its implementation; (2) methodology, which compared the research methodologies used in each paper, ranging from case studies or surveys to a more theoretical approach; (3) applications, which examined the various uses of Blockchain technology in the supply chain management sector, including ensuring traceability and transparency in food supply chains or its application in supply chain finance or logistics; (4) challenges, which identified obstacles and constraints related to the application of Blockchain technology, such as interoperability of different Blockchain systems and data security and privacy; (5) key results, which presented the most significant findings, conclusions, and implications of the research, providing a condensed overview of the most important and relevant information. The data extraction was performed independently by both researchers, and any inconsistencies were resolved through discussion.

3. Results

3.1. Tables of Literature Summary

The following two tables (Tables 1 and 2) contain the core information according to the targeted publications, Table 1 lists the names of the targeted publications concentrating on four aspects (purpose, methodology, used applications, and the limitations), while Table 2 lists references as well as the main focus and research questions for each paper with their key findings.

Table 1. Purpose, methodology, applications, limitations.

No.	Paper Name	References	Year	Purpose	Methodology	Applications	Limitations
1	"The Truth about Blockchain"	[17]	2017	To analyze the Blockchain challenges and benefits in the supply chain of agri-food	Using Blockchain to enhance both traceability and transparency of supply chain seafood	Traceability and transparency, particularly in the food industry. Financing, including invoice financing and trade finance.	Blockchain's immutability can create problems in situations where errors need to be corrected or transactions need to be reversed; scalability and privacy concerns
2	"Blockchain and the law: The rule of code"	[18]	2018	To propose a Blockchain-based solution for the traceability of pharmaceutical products.	Using Blockchain Framework for Data Sharing and Collaboration in SCM	food business, and logistics, such as transportation, warehousing, and delivery.	The code governing smart contracts can be hard to modify, leading to unintended consequences and legal disputes; legal frameworks for smart contracts and Blockchain technology are still in development
3	"Blockchain technology: Beyond Bitcoin"	[19]	2016	To investigate the potential use of Blockchain technology for improving the efficiency of SCM.	A decentralized system for food safety and traceability information: A case study	transportation, warehousing, delivery and QC, and product provenance tracking.	Scalability and privacy issues; difficulty in integrating with existing legacy systems; high energy consumption
4	"Leveraging Blockchain Technology to enhance supply chain management"	[20]	2018	To explore the use of Blockchain for ensuring the authenticity and integrity of data in the supply chain.	A holistic framework for Blockchain-based SCM and its Implementation in the food industry	Enabling circular supply chains and enhancing the sustainability of SCM.	Uncertainty in regulatory environments; the need for standardized processes and data formats; scalability challenges; lack of interoperability among Blockchain platform
5	"Blockchain technology and its applications in the food supply chain"	[21]	2019	To explore the role of Blockchain in increasing transparency and visibility in SCM.	Review of Blockchain-based SCM: Conceptual	logistics, such as transportation, delivery and QC	Limited adoption due to high costs; challenges in ensuring data accuracy and trustworthiness; lack of regulatory framework
6	"Blockchain technology for food traceability: A systematic review of the current status, applications, and future prospects"	[22]	2020	To identify the challenges and opportunities of using Blockchain in SCM.	Using Blockchain Technology for supply chain traceability system for the textile industry: A case study	Product provenance delivery and tracking.	High cost of use and maintenance; lack of data standards and uniformity across the industry; scalability and performance issues
7	"Blockchain for supply chain traceability: A systematic review of the literature"	[23]	2020	To propose a Blockchain-based solution for improving the traceability and accountability of the seafood supply chain.	An empirical study on the potential use of Blockchain Applications in the SCM: Survey	Enable circular supply chains and enhance sustainability in SCM.	Interoperability challenges due to the proliferation of Blockchain platforms; the need for standardization of data formats; lack of regulatory framework
8	"Blockchain-based supply chain finance: A systematic review and future research directions"	[24]	2020	To investigate the potential use of Blockchain in the automotive supply chain.	An IoT-based framework for traceability of supply chain using Blockchain technology: Case study	Financing, including invoice financing and trade finance.	Limited adoption due to high costs and lack of trust in the technology; the requirement for standardized data formats; scalability and privacy concerns
9	"Blockchain-based supply chain finance: A case study"	[25]	2019	To explore the usage of Blockchain for supply chain finance.	Blockchain adoption in SCM of agri-food: A systematic literature review of potential applications, benefits, and challenges: A literature review.	Logistics, such as transportation, storing system, delivery	High implementation and maintenance costs; limited adoption because of lack of trust in the technology; the need for standardized data formats

Table 1. *Cont.*

No.	Paper Name	References	Year	Purpose	Methodology	Applications	Limitations
10	"Blockchain for IoT security and privacy: The case study of a smart home"	[26]	2019	To identify the benefits and challenges of using Blockchain in SCM.	Blockchain and food safety: Critical success factors and research agenda: Conceptual	Standardization and quality assurance	Scalability and performance issues; security concerns with the use of IoT devices; need for standardization and interoperability
11	"Blockchain for supply chain management: A bibliometric analysis"	[27]	2021	To propose a Blockchain-based solution for the traceability and authentication of luxury goods.	Blockchain for food and agriculture: Findings from a global Delphi study: Delphi study	invoice financing and trading	Lack of standardization and interoperability; need for regulatory frameworks; scalability issues
12	"Blockchain in supply chain management: An analysis of applications and potentials"	[28]	2019	To investigate the use of Blockchain for improving supply chain transparency and efficiency.	Using Blockchain for supply chain traceability includes critical success factors business requirements and: A case study	food business and QA.	High costs and complexity of implementation; lack of trust in the technology; lack of standardized data formats
13	"An analysis of Blockchain adoption in supply chain management: A literature review"	[29]	2021	To investigate the usage of Blockchain for traceability and transparency in the food supply chain.	Blockchain in SCM: A review of the state-of-the-art applications and challenges: Literature review	Traceability and transparency, transportation, warehousing, and delivery.	Lack of standardization and interoperability; high costs and complexity of implementation; scalability and performance issues
14	"The impact of Blockchain on Supply Chain Management: A systematic literature review"	[30]	2019	To propose a Blockchain-based solution for improving the transparency and efficiency of the supply chain.	Blockchain in SCM: A review of the state-of-the-art applications and challenges: Literature review	particularly in the logistics, warehousing, and delivery.	Lack of standardization and interoperability; scalability and privacy issues; need for regulatory frameworks
15	"Research on Blockchain-based intelligent supply chain management system"	[31]	2021	To define the opportunities and challenges of using Blockchain in SCM.	Blockchain technology in the logistics and SCM industry: Survey	QA and QC, logistics	High costs and complexity of implementation; need for standardization and interoperability; privacy and security concerns
16	"Blockchain and its Coming Impact on Supply Chain Management"	[32]	2018	To investigate the use of Blockchain in SCM from a sustainability perspective.	Blockchain technology in the manufacturing industry: A survey of applications, challenges, and future research directions: Survey	product provenance tracking.	Lack of standardization and interoperability; scalability and performance issues; limited adoption due to lack of trust in the technology
17	"The application of Blockchain in e-supply chain management"	[33]	2018	To investigate the usage of Blockchain for improving the efficiency and transparency of the supply chain.	Blockchain technology in the gas and oil industry: A review of applications, challenges, and future research directions: Literature review	financing, including invoice financing and trade finance, and delivery.	Lack of standardization and interoperability; scalability and performance issues; high energy consumption
18	"Blockchain technology in logistics and supply chain management: A review"	[34]	2019	To identify the challenges and benefits of using Blockchain for the supply chain.	Blockchain technology in the supply chain: A case study of the Pharma supply chain: A case study	QC and product provenance tracking.	Lack of standardization, Scalability, Data privacy and security, and Integration with existing systems
19	"An Overview of Blockchain Technology: Architecture, consensus, and future trends"	[35]	2017	To propose a Blockchain-based solution for the traceability and transparency of the garment supply chain.	Blockchain technology in SCM: A case study on the pharmaceutical supply chain: A case study	food industry, transportation.	Scalability, Energy efficiency, Interoperability, Governance, and regulation
20	"Blockchain and supply chain: A review, a proposed framework, and future implications"	[36]	2019	To explore the potential of Blockchain in improving the efficiency and transparency of the supply chain.	Blockchain technology: Applications and challenges in the maritime industry: Survey	Logistics, such as transportation, warehousing, and delivery.	Lack of standards and regulations, High transaction costs, Integration with legacy systems, Security and privacy concerns

Table 1. *Cont.*

No.	Paper Name	References	Year	Purpose	Methodology	Applications	Limitations
21	"Blockchain technology for supply chain: A review"	[37]	2018	To test the use of Blockchain for improving the transparency and traceability of the coffee supply chain.	Distributed ledger technologies in the supply chain: A literature review: Literature review	Logistics, such as transportation, warehousing, delivery and QC, and product provenance tracking.	Limited adoption and awareness, Interoperability, Integration with existing systems, Data privacy, and security
22	"Blockchain technology and supply chain financing"	[38]	2020	To define the opportunities and challenges of using Blockchain in SCM.	Exploring the potential of Blockchain technology for SCM: Conceptual	Traceability and transparency, and trade finance.	Lack of standardization, Scalability, Interoperability, and Integration with existing systems
23	"Blockchain and supply chain finance: The missing link"	[39]	2019	To propose a Blockchain-based solution for improving the transparency and traceability of the olive oil supply chain.	The effect of Blockchain technology on business models in the logistics industry: A case study	Financing, including invoice financing, trade finance and QC, and product provenance tracking.	High transaction costs, Regulatory uncertainty, Integration with legacy systems, Privacy, and security concerns
24	"Exploring the Hype of Blockchain Adoption in Agri-Food Supply Chain: A Systematic Literature Review"	[40]	2021	Investigate Blockchain adoption in agri-food SCM	Systematic literature review	Traceability, transparency, sustainability	Lack of interoperability, data privacy concerns
25	"Blockchain Technology in Supply Chain Operations: Applications, Challenges and Research Opportunities."	[41]	2020	Survey Blockchain applications in SCM	Survey research	Traceability, logistics, quality control	Lack of scalability, regulatory uncertainty
26	"Blockchain Technology for Sustainable Supply Chain Management: A Systematic Literature Review and a Classification Framework"	[42]	2021	Examine Blockchain for sustainable SCM	Literature review	Sustainability, circular supply chains	Limited adoption, scalability issues
27	"The Role of Blockchain Technology for Transparency in the Fashion Supply Chain"	[43]	2020	Explore Blockchain in the fashion industry SCM	Case study analysis	Traceability, transparency	High implementation costs, scalability challenges
28	"Applications and Challenges of Blockchain with IoT in Food Supply Chain Management System: A Review"	[44]	2021	Investigate Blockchain for sustainable SCM	Systematic literature review	Sustainability, circular supply chains	Lack of standardization, scalability issues

Table 1. *Cont.*

No.	Paper Name	References	Year	Purpose	Methodology	Applications	Limitations
29	"Blockchain-Based IoT Devices in Supply Chain Management: A Systematic Literature Review"	[45]	2020	Review Blockchain for sustainable SCM	Systematic literature review	Sustainability, traceability	Data privacy concerns, lack of regulation
30	"A Review of Blockchain-Based Supply Chain Management: Applications, Challenges and Research Opportunities"	[46]	2021	Review Blockchain applications in SCM	Literature review	Traceability, transparency	Lack of scalability, interoperability issues
31	A survey on blockchain for big data: Approaches, opportunities, and future directions	[47]	2022	Conduct a comprehensive survey on Blockchain for big data, focusing on approaches, opportunities, and future directions.	Utilize a systematic literature review to gather relevant scientific/research articles on the application of Blockchain for big data. Focus on high-quality articles peer-reviewed in reputed journals, conferences, symposiums, workshops, and books. Extract data required for the survey on Blockchain applications in big data services.	- Present a brief overview of Blockchain and big data integration. - Survey various Blockchain services for big data, including secure acquisition, storage, analytics, and privacy preservation. - Review Blockchain's applications in domains such as smart city, healthcare, transportation, and smart grid. - Discuss challenges and future directions in the integration of Blockchain with big data.	Lack of precise definition for big data. - Challenges in big data techniques and applications, including security, privacy, scalability, and data interpretation. - Limited scope of existing surveys on Blockchain and big data. - Motivation for conducting a comprehensive survey on Blockchain for big data.

Table 1. *Cont.*

No.	Paper Name	References	Year	Purpose	Methodology	Applications	Limitations
32	Exploring Blockchain's Role in E-Government: Innovations, Automation, and Challenges	[48]	2022	Investigate the potential of Blockchain in promoting innovation and automation in e-government processes, identify areas where blockchain can be applied, and analyze illustrative examples of government efficiency.	Conducted a multiple-case study based on content analysis of Blockchain-based e-government solutions and public information projects implemented in various countries. Case studies were selected from emerging e-government areas like e-health, e-migration, e-municipality, and e-military.	Blockchain provides more decentralized systems for public information management in e-government. - Public information processes, including e-healthcare, e-migration, e-city, and e-army systems, could be automated through Blockchain. - Illustrative examples from countries like Estonia, Germany, and the United Arab Emirates were analyzed.	Regulatory issues and the risk of information leaks are key challenges for automating government processes with Blockchain. - Automating e-government processes is considered challenging due to many intangible variables and the need to create social values as a result of reforms.
33	Blockchain-based micro-credentialing system in higher education institutions: Systematic literature review	[49]	2023	Conduct a systematic literature review to provide an overview of Blockchain-based micro-credentialing systems in higher education institutions (HEIs), comparing identified systems against defined requirements and identifying research gaps.	Utilize a systematic literature review (SLR) to retrieve relevant studies published between 2016–2022, comparing them to defined requirements.	applications of Blockchain technology in streamlining the validation process of micro-credentials in HEIs. and micro-credentials (IPMM) and platforms solely for managing micro-credentials (PMM).	Limited scholarly research on Blockchain-based micro-credentialing systems in HEIs. - Challenges in validating micro-credentials through traditional means. - Scant literature available for analysis and comparison.

Table 2. Main focus, research questions, and key findings.

Reference	Main Focus and Research Questions	Key Findings
[17]	What is Blockchain technology and its potential impact on businesses?	Blockchain is a new type of database that can verify and record transactions securely and transparently, providing an opportunity for businesses to reduce costs and improve efficiency.
[18]	How can Blockchain technology transform legal systems and regulation?	Blockchain-based systems can automate legal contracts and compliance, but also pose new challenges for governance and regulation, requiring new forms of institutional design.
[19]	What are the technical foundations and applications of Blockchain technology beyond cryptocurrency?	Blockchain can enable decentralized, secure, and transparent data sharing, authentication, and transactions in various domains, like finance, healthcare, and identity management.
[20]	How can Blockchain technology enhance SCM?	Blockchain can improve supply chain visibility, tracking, and authentication, reducing fraud, errors, and delays, but also requires collaboration, standardization, and privacy protection.
[21]	What are the challenges and opportunities of using Blockchain in the food supply chain?	Blockchain can enhance food safety, quality, and traceability, but also faces challenges such as data accuracy, privacy, and adoption, requiring new forms of governance and incentives.
[22]	What are the current status, applications, and prospects of using Blockchain technology for food traceability?	Blockchain can support end-to-end traceability, provenance, and authenticity of food products, but also faces technical, economic, and social challenges, requiring more research and innovation.
[23]	What is the state of the art and research gaps in Blockchain for supply chain traceability?	Blockchain can enable more efficient, trustworthy, and sustainable SCM, but also faces issues such as scalability, interoperability, and governance, requiring more systematic and rigorous research.
[24]	What are the potential and challenges of using Blockchain-based supply chain finance?	Blockchain can increase the transparency, security, and accessibility of supply chain finance, but also faces issues such as legal and regulatory uncertainties, technical limitations, and organizational change, requiring more integrated and interdisciplinary research.
[25]	What are the benefits and limitations of using Blockchain-based supply chain finance in a real-world case study?	Blockchain can reduce financing costs and increase the financing efficiency of SMEs but also requires more cooperation and coordination between different actors in the supply chain finance ecosystem.
[26]	How can Blockchain enhance security and privacy in the Internet of Things (IoT)?	Blockchain can provide a decentralized and tamper-proof infrastructure for secure data exchange and privacy protection in IoT but also faces challenges such as scalability, interoperability, and usability, requiring more interdisciplinary and user-centric research.
[27]	What are the research trends and gaps in Blockchain for SCM?	Research on Blockchain for SCM has increased significantly in recent years with an emphasis on exploring the potential benefits of Blockchain, but there is still a lack of real-world applications and practical guidance.
[28]	What are the potential benefits and challenges of Blockchain adoption in SCM?	Blockchain can enhance SCM through increased transparency, efficiency, and security, but there are still challenges such as scalability, interoperability, and legal and regulatory issues that need to be addressed.

Table 2. *Cont.*

Reference	Main Focus and Research Questions	Key Findings
[29]	What are the current trends and patterns in Blockchain adoption in SCM?	Blockchain adoption in SCM is still in the early stages, with most of the current applications focused on traceability and transparency, while the potential benefits in other areas such as sustainability and trust remain to be explored.
[30]	What are the benefits and challenges of Blockchain in SCM, and what are the key research gaps?	Blockchain enhances SCM through increased transparency, security, and efficiency, but there are still challenges such as interoperability, standardization, and legal and regulatory issues that need to be addressed. There is also a need for more empirical research to validate the effectiveness of Blockchain in real-world applications.
[31]	How can Blockchain be integrated into an intelligent SCM system?	Blockchain improves SCM through increased transparency, traceability, and trust, and can be integrated into an intelligent SCM system to provide real-time monitoring, intelligent decision making, and autonomous operation.
[32]	What are the potential benefits and challenges of Blockchain adoption in SCM?	Blockchain enhances SCM through increased transparency, security, and efficiency, but there are still challenges like interoperability, standardization, and legal and regulatory issues that need to be addressed.
[33]	How can Blockchain be used to enhance e-SCM?	Blockchain improves e-SCM through increased transparency, security, and efficiency, and can be used to create a decentralized and trustless environment for information exchange and transaction processing.
[34]	What are the benefits and challenges of Blockchain adoption in logistics and SCM?	Blockchain can enhance logistics and SCM through enhanced transparency, security, and efficiency, but there are still challenges such as scalability, interoperability, and legal and regulatory issues that need to be addressed. There is also a need for more empirical research to validate the effectiveness of Blockchain in
[34]	What is the impact of Blockchain on logistics and SCM?	The use of Blockchain increases efficiency, traceability, and transparency in logistics, and SCM. It can also lower fraud and error risks, and enable real-time monitoring of goods.
[35]	What are the architecture, consensus, and future trends of Blockchain technology?	The architecture of Blockchain is based on decentralized nodes, a distributed ledger, and smart contracts. The consensus mechanism can be proof of work, proof of stake, or others. The future trends of Blockchain include scalability, interoperability, and privacy.
[44]	What is the potential of Blockchain in SCM?	The potential benefits of Blockchain in SCM involve transparency, traceability, accountability, and efficiency. The proposed framework includes four stages: pre-transaction, transaction, post-transaction, and ongoing transaction. The future implications of Blockchain in SCM include disruption, collaboration, and innovation.
[37]	How can Blockchain be used in SCM?	Blockchain can be used for different purposes in SCM, such as tracking and tracing goods, verifying authenticity and quality, reducing fraud and errors, and enabling secure and transparent transactions. The using of Blockchain in SCM challenges include technical, organizational, and regulatory issues.
[38]	How can Blockchain improve supply chain financing?	Blockchain can enhance supply chain financing by improving secure and transparent transactions, reducing risks, increasing trust, and enhancing liquidity. The key features of Blockchain-based supply chain financing include decentralization, automation, and smart contracts.

Table 2. *Cont.*

Reference	Main Focus and Research Questions	Key Findings
[39]	What is the missing link between Blockchain and supply chain finance?	The missing link between Blockchain and supply chain finance is the integration of Blockchain with other technologies and financial services, such as IoT, AI, and digital currencies. The potential benefits of Blockchain in supply chain finance include efficiency, transparency, and access to financing for SMEs.
[47]	Understanding the increased data traffic globally and the importance of big data in various industries, What are the challenges and issues in big data techniques and applications, and how can Blockchain address them?	Increased data traffic globally with the rise of big data. - Challenges in big data techniques and applications, including security, privacy, scalability, and data interpretation. - Role of blockchain in enhancing big data security, privacy, integrity, and real-time analytics. - Review of existing surveys on blockchain and big data. - Motivation for conducting a comprehensive survey on blockchain for big data.
[48]	Investigating the role of Blockchain in e-government. what are the areas in e-government where Blockchain can promote innovation? 2. What processes and procedures in e-government can be automated using Blockchain technology?	Blockchain offers decentralized solutions for managing public information in e-government. - Processes such as e-healthcare, e-migration, e-city, and e-army systems can be automated through Blockchain. - Case studies from various countries illustrate the potential benefits of Blockchain in e-government.
[49]	Investigate the state-of-the-art in managing micro-credentials using Blockchain technology in higher education institutions (HEIs).What is the current landscape of Blockchain-based micro-credentialing systems in HEIs, and how do they align with defined requirements?	Limited scholarly research on Blockchain-based micro-credentialing systems in HEIs. - Categorization of identified systems into two groups: intelligent platforms for managing micro-credentials (IPMM) and platforms solely for managing micro-credentials (PMM).

3.2. General Comparison

In "The Truth about Blockchain", Iansiti and Lakhani [17] present a comprehensive description of Blockchain and its possible practical applications in numerous areas such as healthcare, banking, and SCM. They bring to light the fact that in order for Blockchain to realize its full potential, it is necessary to solve problems in the areas of governance, regulation, and technology.

In contrast, the article "Blockchain and the law: The rule of Code" written by De Filippi and Wright [18] investigates the legal repercussions that are associated with the use of Blockchain technology. The authors contend that the use of self-executing smart contracts, which are made possible by Blockchain technology, has the potential to do away with the need for intermediaries, which would result in the disruption of conventional legal systems. In addition to this, they investigate the challenges associated with regulating Blockchain-based systems and the possibilities for decentralized autonomous organizations. Additionally, Iansiti and Lakhani provide a broad overview of the technology and the commercial applications it has.

Furthermore, "Blockchain Technology: Beyond Bitcoin", written by Crosby and his colleagues, presented an all-encompassing analysis of the potential deployment of Blockchain technology beyond its usage in Bitcoin. This was accomplished by focusing on the many applications that may potentially make use of Blockchain technology. The writers provide an explanation of the benefits of Blockchain technology, which include decentralization, security, transparency, and efficiency, and they outline the ways in which it might be used in several industries, including healthcare, government, and finance. In addition, they

name a number of challenges that must be conquered in order to fully realize the promise of Blockchain technology. These challenges include scalability, interoperability, and legislative restrictions [19]:

In their article titled "Leveraging Blockchain Technology to Enhance Supply Chain Management", Kim and Lacity concentrate specifically on the potential of Blockchain technology to enhance supply chain management. According to their argument, Blockchain technology has the potential to assist in resolving the issues that supply chain implementers are now facing, such as a lack of transparency, accountability, and traceability. The examples that they present illustrate how Blockchain technology may be used to monitor items, eliminate instances of fraud, and boost communication among participants in the supply chain. In addition, the paper examined the difficulties that are associated with the deployment of Blockchain technology in supply chain management (SCM) and offered suggestions for organizations that are contemplating the use of this technology [20].

These articles recognize the potential of Blockchain technology to alter industries; nevertheless, they focus on various areas of application and give diverse perspectives on the influence that it may have. While Crosby et al. provide a comprehensive introduction to the technology and its possible applications in a variety of industries, Kim and Lacity concentrate on the ways in which Blockchain technology has the potential to enhance supply chain management.

There are a few publications that investigate the use of Blockchain technology to improve food safety, transparency, and traceability; these studies vary in their methodology, their emphasis, and the degree of information that they provide.

The article "Blockchain Technology and its Applications in the Food Supply Chain" [21] by Chen et al. provides a comprehensive analysis of the possible applications of Blockchain technology in the food sector, with a particular focus on the safety and traceability of food. The authors provide examples of food traceability systems that are based on Blockchain technology in order to demonstrate how Blockchain technology may be used to address concerns such as food fraud, supply chain transparency, and data security measures. In addition to this, they bring to light the technological, economic, and regulatory factors that need to be taken into account in order to fully realize the promise of Blockchain technology in the food business.

The article "Blockchain technology for food traceability: A systematic review of the current status, applications, and Future prospects" [22] by Fan et al. [22] used a structural approach in order to investigate the application of Blockchain technology in the field of food traceability. A complete literature analysis of previous research and publications on the subject is carried out by the writers, who then proceed to analyze the findings and offer a comprehensive description of the current status of Blockchain technology in food traceability as well as its promise for the future. In addition, they provide an overview of the advantages, disadvantages, and difficulties associated with the use of Blockchain technology in the food business, as well as suggestions for further study.

Previous articles have acknowledged that Blockchain technology has the potential to revolutionize the food business; however, the breadth and depth of study that they have taken into consideration are different. Chen et al. present a basic overview of the prospective use cases of Blockchain technology in food safety and traceability, while Fan et al. perform an in-depth analysis of the existing state of Blockchain technology in food traceability as well as its potential for the future.

Although they concentrate on the possible applications of Blockchain technology in supply chain management (SCM), the following articles investigate various elements of this technology.

The article "Blockchain for supply chain traceability: A systematic review of the literature" [23] written by Sarmah and Yen is an example of a systematic review that analyzes the use of Blockchain technology in the context of supply chain traceability. They give a detailed analysis of the prior literature and highlight significant research topics and results linked to the potential of Blockchain technology to improve supply chain

traceability. Increased transparency, less risk of fraud, and greater consumer trust are some of the benefits that are highlighted in the paper associated with the use of Blockchain technology for supply chain traceability. In addition to this, it points out the difficulties that arise when attempting to utilize Blockchain technology for supply chain traceability and offers suggestions for further study.

An article titled "Blockchain-based supply chain finance: A systematic review and future research directions" [24] written by Li et al. focuses on the use of Blockchain technology in the field of supply chain finance. For the purpose of tackling the difficulties of information asymmetry, lack of transparency, and high transaction costs, they investigate the possibility of Blockchain technology to improve supply chain finance. The research article conducted a comprehensive analysis of the current literature on supply chain financing that is based on Blockchain technology. It also analyzes the benefits and limitations of using Blockchain technology in this particular domain. In addition, the paper presents suggestions for further study and draws attention to the difficulties and legislative obstacles that need to be taken into consideration in order for Blockchain-based supply chain financing to become a reality.

Despite the fact that these articles acknowledge the potential of Blockchain technology to improve supply chain management, they concentrate on a variety of difficulties related to it. While Sarmah and Yen concentrate on the use of Blockchain technology in supply chain traceability, Li et al. investigate the possibilities brought about by Blockchain technology in supply chain financing.

In addition, the article "Blockchain-based supply chain finance: A case study" written by Li and Cao [25] puts particular attention on the use of Blockchain technology in the field of supply chain finance. The purpose of this paper is to provide a case study of a supply chain finance platform that makes use of Blockchain technology in order to enhance the efficiency of transactions, decrease risk, and boost reliability among supply chain participants. In the research, the advantages of the platform and the ways in which it has contributed to the organization of financial transactions in SCM are investigated.

In a different vein, the documentary "Dorri, Kanhere, Jurdak" is an investigation into the use of Blockchain technology in the context of the Internet of Things (IoT) and smart homes. The purpose of this paper is to provide a case study of a Blockchain-based system that improves the safety and privacy of smart home devices. According to the findings of the research, Blockchain technology has the potential to provide safe and confidential communication between smart devices in the house, which is critical for preserving the effectiveness of the system [26].

In addition, Guo and Li's article "Blockchain for Supply Chain Management: A bibliometric analysis" provides a bibliometric analysis of the most recent literature on Blockchain and supply chain management. In addition to identifying the most influential writers, organizations, and publications in the area, the study also evaluates the features and trends of the existing body of literature. The paper offers a summary of the progress that has been made with Blockchain technology in supply chain management and draws attention to the areas that need more investigation [27].

The article by Srinivasan and colleagues, titled "Blockchain in Supply Chain Management: An Analysis of Applications and Potentials", examined the many potential uses of Blockchain technology in the supply chain management (SCM) industry. In addition to providing a framework for assessing supply chain solutions that are based on Blockchain technology, the paper explores the advantages and disadvantages of using Blockchain technology in supply chain management (SCM). In addition to shedding light on the difficulties associated with putting Blockchain technology into practice, the research underlines the promise of the technology in supply chain management [28].

A variety of viewpoints on the use of Blockchain technology in supply chain management were explored, each with its own distinct methodologies and areas of concentration. While Dorri et al. [26] concentrate on the use of Blockchain technology in smart homes and Internet of Things security, Li and Cao investigate the use of Blockchain technology for

supply chain financing. In this study, Guo and Li conduct a bibliometric analysis of the available literature, while Srinivasan et al. investigate the uses of Blockchain technology in supply chain management, both now and in the future.

Two articles that are presented here both examine the use of Blockchain technology in the field of supply chain management (SCM), despite the fact that they vary in the precise areas of emphasis and research techniques that they employ.

The article "An Analysis of Blockchain Adoption in Supply Chain Management: A Literature Review" written by Lee et al. is a comprehensive literature review on the topic of Blockchain adoption in supply chains. It examines the existing research and identifies the key dimensions that influence the adoption of Blockchain in supply chain management [29].

In contrast, Zeng et al. give a literature study in their article titled "The Impact of Blockchain on Supply Chain Management: A Systematic Literature Review". However, the authors' primary emphasis is on the impact that Blockchain technology has had on supply chain management. In order to determine the primary benefits and difficulties associated with using Blockchain technology in supply chain management, the authors conduct a literature review [30].

On the other hand, the article "Research on Blockchain-based Intelligent Supply Chain Management System" by He et al. provides a case study of a Blockchain-based intelligent supply chain management system. This case study discusses the design and implementation of the system, as well as analyzes its performance in terms of efficiency and security [31].

In their article titled "Blockchain and its coming impact on supply chain management", Fanning and Centres provide an outline of the impact that Blockchain technology would have on supply chain management. They discuss the difficulties and advantages of using Blockchain technology in supply chain management [32].

In "The application of Blockchain in e-supply chain management", Xu et al. present the design and deployment of a Blockchain-based e-SCM system in a case study. They analyze the effectiveness of the system as well as its safety [33].

Finally, the article "Blockchain Technology in Logistics and Supply Chain Management: A Review" written by Li and Jiang provides a comprehensive analysis of the use of Blockchain technology in the field of supply chain management and logistics. After reviewing the current literature, the authors conclude with the key benefits and difficulties associated with using Blockchain technology in supply chain management and logistics [34].

In general, these articles provide a wide range of viewpoints on the use of Blockchain technology in supply chain management (SCM). They include literature reviews, case studies, and evaluations of the possible impact that Blockchain might have on the sector.

The article titled "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends" [35] written by Zheng and colleagues offers a comprehensive review of Blockchain technology, including its consensus and future trends. The authors examine the fundamental elements that make up a Blockchain as well as the possible uses of this technology in a variety of fields, including supply chain management (SCM).

This article by Sarkis et al. [36] provides a review of the literature on Blockchain and its possible impact on supply chain management (SCM). The article is titled "Blockchain and supply chain: A review, a proposed framework, and future implications". The authors address the possible benefits and drawbacks of using Blockchain technology in supply chain management (SCM) and present a methodology for assessing the system's utilization of Blockchain technology.

Furthermore, Petrini and Pozzebon's article titled "Blockchain technology for supply chain: A review" provides a comprehensive analysis of the practical applications of Blockchain technology in supply chain management (SCM). An overview of the possible applications of Blockchain technology in supply chain management is presented by the authors. These applications include improvement of traceability, transparency, and efficiency [37].

A case study of a supply chain finance system that is based on Blockchain technology is presented in the article "Blockchain Technology and Supply Chain Financing" written by Li and Liu. An evaluation of the system's performance in terms of both security and efficiency is provided by the authors, who also discuss the design and implementation of the system [38].

Furthermore, the article "Blockchain and supply chain finance: The missing link" written by Tse examines the possible applications of Blockchain technology in the field of supply chain finance. The issues that are faced by conventional supply chain financing are discussed by the author, along with the ways in which Blockchain technology might address these challenges, notably in terms of providing better transparency and minimizing fraud [39].

Taking everything into consideration, these articles demonstrate that the technology of blockchain has the potential to bring about a multitude of advantages to supply chain management (SCM), including enhanced transparency, traceability, and efficiency. However, since every paper has a unique viewpoint on how it can be used and how it should be implemented, it is essential to take into account a variety of methods when considering the use of blockchain technology in supply chain management.

Finally, the paper "Blockchain-based micro-credentialing system in higher education institutions: Systematic literature review" concentrates specifically on the realm of higher education. Through a systematic literature review, it meticulously examines the landscape of Blockchain-based micro-credentialing systems, emphasizing their significance in validating micro-credentials efficiently [47]. In contrast, "Comprehensive survey on blockchain for big data", broadens its scope to explore the integration of Blockchain with big data across various sectors. Conducting a comprehensive survey, it delves into the potential applications and challenges associated with this integration, spanning domains such as smart cities and healthcare [48]. Finally, the third paper, "Blockchain technology for e-government: Towards sustainable smart governance", shifts its focus to the public sector, particularly e-government. Through multiple case studies and thorough analysis, it explores how Blockchain can automate processes and enhance transparency within governmental operations, with a particular emphasis on sectors like e-healthcare and e-migration [49].

4. Conclusions

Blockchain technology has been identified as having the potential to revolutionize various industries, but to achieve its full potential, several issues need to be addressed. These issues include technological, governmental, and governance issues, as the elimination of middlemen by Blockchain technology could upend established legal systems and make regulation challenging. Anyway, Blockchain technology has the potential to enhance several fields, such as finance, government, healthcare, and SCM, by bringing decentralization, security, transparency, and efficiency.

However, to fully achieve its promise, problems such as scalability, interoperability, regulation, and difficulties in application have to be overcome. For instance, Blockchain technology can assist supply chain managers in improving transparency, accountability, and traceability, but businesses need to carefully consider its implementation due to obstacles that may arise.

Studies have shown that Blockchain technology has the potential to provide transparency, traceability, and safety in the food sector, but technological, economic, and regulatory issues must be resolved for it to fulfill its potential. Similarly, Blockchain technology can enhance supply chain traceability, and while there are advantages, deployment may be challenging.

Several studies have focused on the usage of Blockchain technology in SCM, with various methodologies and focal points. These studies offer different viewpoints, highlighting the possible advantages and difficulties of applying Blockchain technology in SCM. Evaluating Blockchain applications and analyzing their essential elements, possible advan-

tages, and adoption obstacles is essential in determining their effectiveness in enhancing efficiency and security in SCM. Blockchain holds significant promise as a transformative technology for various industries, including finance, government, healthcare, and supply chain management (SCM). However, realizing and maximizing its potential requires addressing important challenges, such as scalability, interoperability, regulation, and application challenges. Blockchain has the potential to decentralize, secure, and make processes transparent, which could present a disruptive force against established legal systems and regulatory frameworks, leaving open how such a shift would be treated and/or managed within a legal framework.

Despite these challenges, Blockchain can offer decentralization, security, transparency, and other advantages that make it an appealing solution for many industries. For SCM, case studies and proofs of concept have been provided in support of Blockchain's ability to significantly enhance traceability, transparency, and authenticity. However, challenges stand in the way of realizing the technology's transformative potential.

As one analysis concluded, Blockchain can enhance transparency, traceability, and safety in the food sector, particularly in the face of a recall. However, technical, economic, and regulatory challenges must first be resolved to leverage Blockchain to its full potential. On the topic of traceability more broadly, every implementation of Blockchain for supply chain purposes introduces its own advantages and challenges.

Further research into the application of Blockchain to SCM has produced critical findings with regard to different systems, the value proposition of particular systems, and the impediments to their adoption. This may be considered essential reading to assess the extent to which Blockchain can, in fact, enhance SCM, and how to best conceive of its implementation.

In summary, while Blockchain technology has the potential to revolutionize various industries, there are still several issues that need to be addressed to fully realize its potential. Understanding the benefits and difficulties of applying Blockchain technology in different industries, including SCM, is essential in determining its effectiveness and the different strategies needed to assess its application and implementation.

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