Review

Blockchain-Based IoT Devices in Supply Chain Management: A Systematic Literature Review

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Abstract: Through recent progress, the forms of modern supply chains have evolved into complex networks. The supply chain management systems face a variety of challenges. These include lack of visibility of the upstream party (Provider) to the downstream party (Client); lack of flexibility in the face of sudden variations in demand and control of operating costs; lack of reliance on safety stakeholders; ineffective management of supply chain risks. Blockchain (BC) is used in the supply chain to overcome the growing demands for items. The Internet of Things (IoT) is a profoundly encouraging innovation that can help companies observe, track, and monitor products, activities, and processes within their respective value chain networks. Research establishments and logical gatherings are ceaselessly attempting to answer IoT gadgets in supply chain management. This paper presents orderly writing on and reviewing of Blockchain-based IoT advances and their current usage. We discuss the smart devices used in this system and which device is the most appropriate in the supply chain. This paper also looks at future examination themes in blockchain-based IoT, referred to as the executive's framework production network. The essential deliberate writing audit has been consolidated by surveying research articles circulated in highly reputable publications between 2016 and 2021. Lastly, current issues and challenges are present to provide researchers with promising future directions in IoT supply chain management systems.

Keywords: blockchain; internet of things; supply chain; devices; sustainability; supply chain management; operations; distributions

1. Introduction

A blockchain is a permanent record for recording transactions. It exists inside an appropriate system of unsecured nodes. Nodes can produce and read exchanges to use a consensus protocol to compose transactions in a block within the order. It has a list of blocks, each with an alternate size to store a rundown of trades. Hubs that participate in an agreement convention refer to gathering [1]. There are two classes of Blockchain: permissioned and public. In a public blockchain, anybody can inspect the chain's substance and check the validity of the data set aside [2].

Blockchain technology is not only used in bitcoin cryptocurrency but also in various domains such as smart cities [3], recommender systems [4], medical tourism [5], acceleration of energy efficiency [6], and information extraction [7].

Supply chain management (SCM) is a set of firms that pass material forward with declared steps [8]. Two or three available firms are secure for gathering a product and

getting it to the end client. These make up an agile chain of material and section markers, product-building subject matter experts, wholesalers, retail carriers, and transportation affiliations, which are, for the most part, individuals from production organizations [9].

Traditional supply chain management systems face difficulties such as the absence of detectable quality from upstream to downstream, the absence of versatile responsiveness to unanticipated incidents and to cost control, the absence of partner trust relative to security, and an absence of cutting edge innovations [10]. A supply chain is a network that connects a company's suppliers to manufactures and distributes a particular product or services, and supply chain management is the management of products or services full manufacturing flows, from raw material to the delivery of the end product to the customer [11,12].

SCM requires the coordination of numerous gatherings, cycles, and resources. Therefore, the permission of Blockchain provides security, authenticity, and ownership to save time [13].

The Internet of Things (IoT) is widely known to clients. IoT is a group of interconnected devices that share data among users, for example, automation or monitoring. The data is shared in a private or public network [14]. The IoT can quickly help in malware detection and DDoS attacks in the network [15].

The combination of IoT and Blockchain provides an environment for easy transactions, security, lower cost, and expendable and reusable elements. Security is the primary concern for any industrial application through Blockchain [16].

Machine-learning-based approaches have also been successfully applied in medical sciences to diagnose various diseases [17–22]. Instruments of this sort can be used for continuous following and for alarms in checking temperature and moistness, providing excellent procedural chains for pharmaceuticals and food while incorporating ERP and supply chain solutions. Machine learning and Blockchain are used to solve security attacks in industrial IoT [23].

Blockchain-based IoT gives advantages to the supply chain: information progression and detectability; information accessibility; the link between information stream and material stream; and a decrease in implicit rules infringement and misrepresentation [24,25].

Our objective was to find current technical research topics, intelligent devices, and future exploration issues in Blockchain-based IoT related to supply chain management systems.

To our knowledge, there is no such study related to Blockchain IoT in terms of the supply chain. Blockchain-based IoT devices in the supply chain are the focus of this paper, structured as follows: In Section 2, we address a foundation of blockchain-based IoT instruments in the production network. Section 3 presents the exploration technique by characterizing research questions, consideration/avoidance measures, and search paths to gather compelling examinations applicable to the blockchain-based IoT gadgets in the inventory network area and zeroed in on various distribution stations. In Section 4, we present the exploration of the tables by orchestrating the chosen papers. Furthermore, the examination of some themes in IoT-based blockchain procedures for store networks, the board framework, sensors/gadgets, and future bearings are introduced in this part. Section 5 presents the conclusions of the article.

2. Literature Review

We discovered 14 investigations that looked into the condition of incorporating Blockchain with the IoT supply chain. The research, SLRs, and planning focuses of comparative themes are mentioned in Table 1. Ten of the papers focused on a single aspect of blockchain data management, specifically smart contracts and consensus protocols. One paper focuses on the plans' security properties, while the other focuses on estimating usage events. These related works are divided into five groups based on their centrality: security, smart contract, consensus, agreement estimation, use cases, and a Blockchain-based IoT applied in the supply chain.

Blockchain development is a publicly available report that allows completed trades to be recorded in blocks. With the addition or expansion of a new square, the chain of

squares grows longer. Public key cryptography and appropriated understanding plans guarantee customers and insurance issues of IoT. In addition to cost ampleness, various Blockchain advancements in data security assurance join decentralization, indefinite quality, persistence, and suitability [26].

Blockchain innovation and IoT are disconnected advancements based on their unique methods of reasoning. The authors embraced a review of methods for incorporating these two trends into an innovative enterprise, focusing on securing decentralized design. The standard IoT strategy is insecure, and its implementations are vulnerable to threats to safety and security. Using collaborative planning to handle sensitive data opens the door to validation possibilities [27].

Once more, there are specific instances of unapproved access, unlawful use, and data offers. An epic degree relationship of IoT in applications is impossible. In any case, Blockchain development is expected to be at the forefront of IoT solution development. Blockchain progression's dependability and credits of infinite nature may be used to eliminate superficial security flaws in the IoT. Indeed, Blockchain progression's decentralization strategy property may be used to guide data and contraptions in stuff associations [28,29].

There are guarantees with Blockchain innovation in countering security shortcomings, expanding information honesty, and changing the way toward performing exchanges into a permanent, straightforward, and decentralized design. Further works need to develop security norms and dangers as bearings on square-based frameworks security [30].

Things produce information that is fundamental and delicate when it comes to stating details. IoT-based systems have recently been vulnerable to security threats and mechanized attacks, necessitating further research. The IoT's center points are low-controlled in most cases, with a lower cutoff for complex computational tasks. With the advancement of the Internet of Things, devices/center points should self-oversee essential functions within applications. Traditional security conventions are unsupportive of low-fueled IoT because of anticipated computational intricacy. Blockchain innovation can protect the IoT clients' security in a much-decentralized setting, as indicated by [31].

All in all, IoT gadgets have lesser computational abilities, gigantic security imperfections, and are exceptionally powerless to digital assaults. Customarily, IoT accumulates touchy individual data concerning their proprietors, which is halfway overseen by endeavors raising grave information trustworthiness and security issues. Blockchain runs a circulated record of exchanges whereby hubs arrive at a participatory agreement without an outsider's interruption and contribution. It limits the single purpose of disappointment and outsider trust [32].

The real IoT devices are arranged in weak spots, making them unprotected against developers. Upon this, there are high chances of changing the information broadcast across these associations. To be sure, endorsements of things and beginning information blend are significant concerns [33].

The IoT economy has begun sending sensors and things to perform cash-related trades as a compromise for organizations in a trustless circumstance, for instance, Machine-to-Machine (M2M) and Peer-to-Peer (P2P). Following the improvement of 5G, a great deal of trades could successfully happen across an electronic association. It is advantageous for any sort of charging or portion structures for apportionment. Blockchain is a making Distributed Ledger Innovation (DLT) using a decentralized plan to engage strange, secure, and invariable trades. According to these, Blockchains could be an excellent game plan for IoT portions. Be that as it may, a couple of challenges prosper [34].

IoT advancement has become an integral part of people's day-to-day lives, especially enabling cycle monitoring and control. Smart devices have changed, implying that people's relationships with the natural world have also changed [35]. IoT is far from perfect, owing to apparent roadblocks and fundamental inadequacies that necessitate squeezing thinking. Blockchain advancement offers multi-faceted cycles and decentralized designing, which are huge for keeping an eye on an enormous number of the issues torturing IoT.

Regardless, utilizing the Blockchain for IoT will require a veritable change to the substantial computational weights, delays, and movement speed of overheads of the past [36,37].

The recognized consuming Blockchain and Internet of Things (IoT) problems incorporate the accompanying: hefty asset uses of encoded hub information, unified engineering prompting the single purpose of disappointment impact, the synchronization of gadgets, the board of information volume produced, the similarity of the IoT, and Blockchain innovations. Nonetheless, sensor information put away on the Blockchain through exchanges could require lesser assets for shields because the Blockchain foundation is skilled in giving complete security answers for the whole IoT framework. Hypothetically, the Blockchain-based frameworks are less vulnerable to hazards due to their shared record approach for ensuring data [38].

They zeroed in on astute arrangement and declared that the joining of keen understanding and the IoT system could carry new game plans to the current structures and improve current working cycles [39]. The inspection of the particular understanding is being applied in IoT. Blockchain can energize various IoT circumstances summarized and explored in the examinations of [40]. The discussion use model and improvement pattern of an existing game plan on IoT interfacing blockchain give suggestions on updating a couple of points of view (system plan, cryptographic count, and message time venturing) of the current courses of action [41–45].

Traditional IoT data quality challenges are not resolved by using Blockchain in food supply chains [46]. A blockchain's data could simply be immutable rubbish. In response, the paper presents two solutions for data integrity and trust in the Blockchain and IoT-enabled food supply chain [47].

The answers are to minimize the potential of arbitrary claims on IoT data performance and to encourage supply chain behaviors that increase the likelihood of desirable future states being realized through mechanism design [48–54].

Our proposed study addresses a deliberate composing review by coordinating an audit of Blockchain-based IoT progress and their current use topics in effortlessly chaining the board structure. We talk about the keen gadgets utilized in this framework and which gadget fits SCM. It likewise examines the future exploration themes in blockchain-based IoT alluded to as the executives' framework's flexible chain.

Table 1. Scope of related works.

	BlockChain/ IoT SC Management	Smart Contracts	Consensus	Use Cases	Security
Survey/Reviews	[24,32,40–42,47,55]	[30,37,38,54]	[16,36,38,39]	[10,50,51]	[33,34,43,49]
SLR	[40,55]	[39]			[35]

3. Research Methodology

Systematic Literature Review (SLR) has been selected for the study strategy for this paper. To the most fantastic aspect of our insight, no SLR has been published in the field of Blockchain-based IoT devices in the supply chain.

The SLR method in this article, as recommended by [40,55]. The technique used for this SLR is shown in Figure 1.
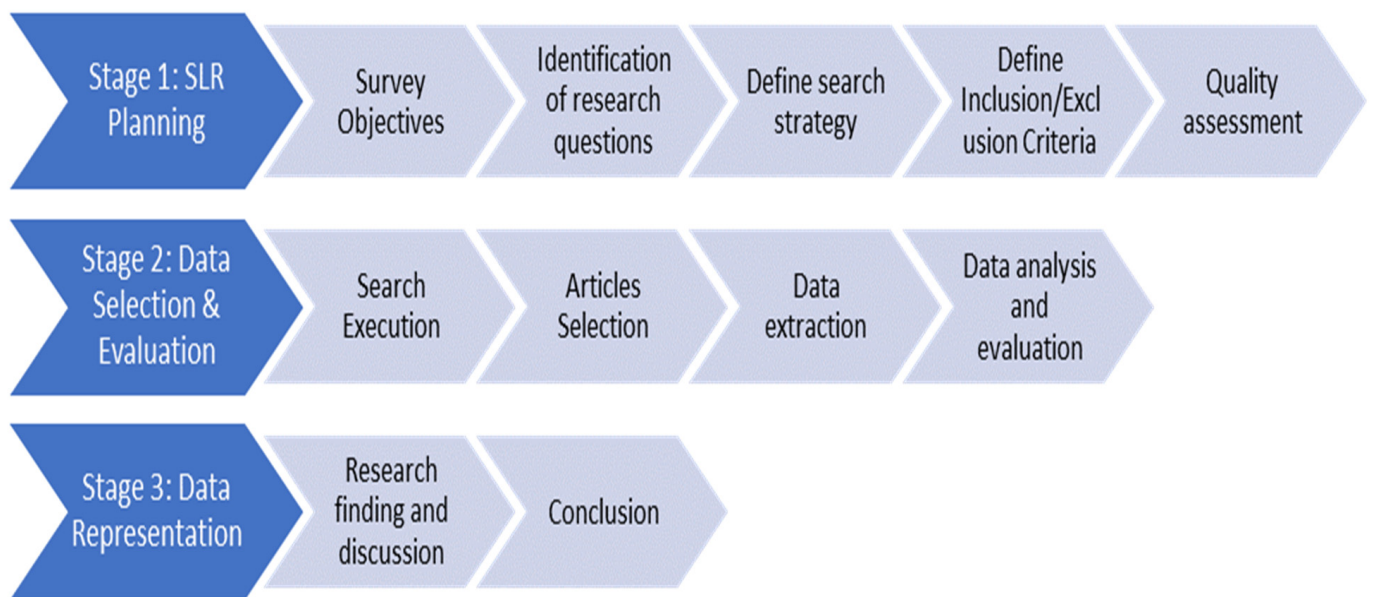
Figure 1. Systematic literature review process.

3.1. Research Objective

A comprehensive mapping study's primary goal is to provide an overview of research areas, the effects of IoT devices, favorable devices, and future directions in Blockchain IoT base supply chain Management:

- ➢ To address IoT-based Blockchain techniques concerning Supply Chain Management;
- ➢ To describe the effective use of Blockchain-based IoT devices in SCM;
- ➢ To discuss the Blockchain-based IoT device is the most appropriate in SCM;
- ➢ To address the future research directions in Blockchain-based IoT in SCM.

This paper wants to provide a comfortable environment for the researchers to see the publication frequencies with trends. The research procedure for this detailed planning study is shown in Figure 1.

3.2. Research Questions

The second stage of the systematic study is the definition of research questions. It is compulsory to write primary research questions. The research's main target is to overview research areas, favorable IoT devices, and future directions. This SLR contains five research questions in Table 2. These questions will enable us to categorize the existing research in Blockchain and the IoT-based supply chain and give us future domains for the research field.

Table 2. Research Questions.

	Research Question	Major Purpose
RQ1	What research topics have been addressed in IoT-based Blockchain techniques concerning Supply Chain Management?	To identify which topics are discussed in previous research papers.
RQ2	How effective is the use of Blockchain-based IoT devices in SCM?	To investigate which devices were used in the last documents.
RQ3	Which Blockchain-based IoT device is the most appropriate in SCM?	To recognize the device's importance relative to time.
RQ4	What are the future research directions in Blockchain used IoT in SCM?	To identify current issues and challenges for future research directions.

3.3. Search Strategy

These articles were retrieved from the following databases: IEEEXplore, ACM Digital Library, Science Direct, Springer Link, Wiley Online Library, Sage Journals, Taylor & Francis Online, and also used Google Scholar to seek knowledge. The efficient use of Google Scholar is to find the bibliometrics for papers. The search strings used to find the results from the selected digital libraries appear in Table 3.

Table 3. Search strings for databases.

Database	Search Strings
IEEE Xplore	(((("All Metadata": BlockChain) AND "All Metadata": IoT) AND "All Metadata": Supply Chain)
ACM Digital Library	[All: Blockchain] AND [All: iot] AND [All: "supply chain"]
Science Direct	BlockChain AND IoT AND ("Supply Chain")
Springer Link	'BlockChain AND IoT AND ("Supply Chain")'
Wiley Online Library	"BlockChain AND IoT AND ("Supply Chain")"
Sage Journals	[All Blockchain] AND [All iot] AND [All "supply chain"]
Taylor & Francis Online	[All: Blockchain] AND [All: iot] AND [All: "supply chain"]

3.4. Inclusion/Exclusion Criteria

The fundamental goal of this part is to distinguish the most critical articles that add to our SLR. When the same articles appeared in research, they were to be considered as a single article. The first step that has been applied to the article is inclusion and exclusion criteria as described in Table 4.

Table 4. Inclusion/exclusion criteria.

Number	Inclusion Criteria
IC1	Papers that are focused on Blockchain, IoT-based supply chains
	Exclusion Criteria
EC1	Papers do not include IoT
EC2	Papers that are not focused on supply chain
EC3	Papers discussing only Blockchain

3.5. Quality Assessment

The studies have been published in recognized and stable publication sources. To rate this answer, we need to consider the ranking of conferences, which will be CORE A, CORE B, and CORE C. The journal ratings can be found using the Journal Citation Report (JCR). The possible answer to these questions has been explained in Tables 5 and 6. Duplicate titles were removed. Which inclusion/exclusion criteria apply to any article depends upon the abstract. The reasonable response to these inquiries has been clarified in Table 5.

Table 5. Quality criteria.

Source	Grading	Rating
Journal	Q1	2
	Q2	1.5
	Q3	1
	Q4	0.5
	If papers are not in JCR grading	0
Conference, Workshop	Core A	2
	Core B	1.5
	Core C	1
	If the paper is not in a Core grading	0

**Table 6.** Primary selection process for retrieved articles.

S Stage	Procedure	Criterion	IEEE Xplore	Springer	Science Direct	ACM Library	Wiley Library	Sage Journals	Taylor & Francis	Total
1	Search	Keyword	60	686	413	94	132	17	78	1480
2	Screening	Title	32	41	45	25	5	0	10	158
3	Screening	Removal	29	37	45	18	3	0	7	139
4	Screening	Abstract	23	6	11	3	1	0	0	44
5	Inspection	Full Article	23	6	11	3	1	0	0	44

The papers do provide a contribution towards Blockchain IoT concerning supply chain management: "Yes (+1)" or "No (+0)". The study presents a straightforward solution to the problem in Blockchain IoT concerning the supply chain. The possible answer was "Yes (+1)", "Partially (+0.5)" and "No (+0)".

Different articles have referred to the distributed investigations. The questions have the following answers:

(a)   If there is no citation, then the answer will be "No (0)";
(b)   If citation count is between 1 to 5, then the answer will be "Partially (+0.5)";
(c)   If citation count is more than five, then the answer will be "Yes (+1)".

The ratio of journal to conference papers is shown in Figure 2 in the form of a pie chart. Appendix A is about the classification with a quality evaluation score.
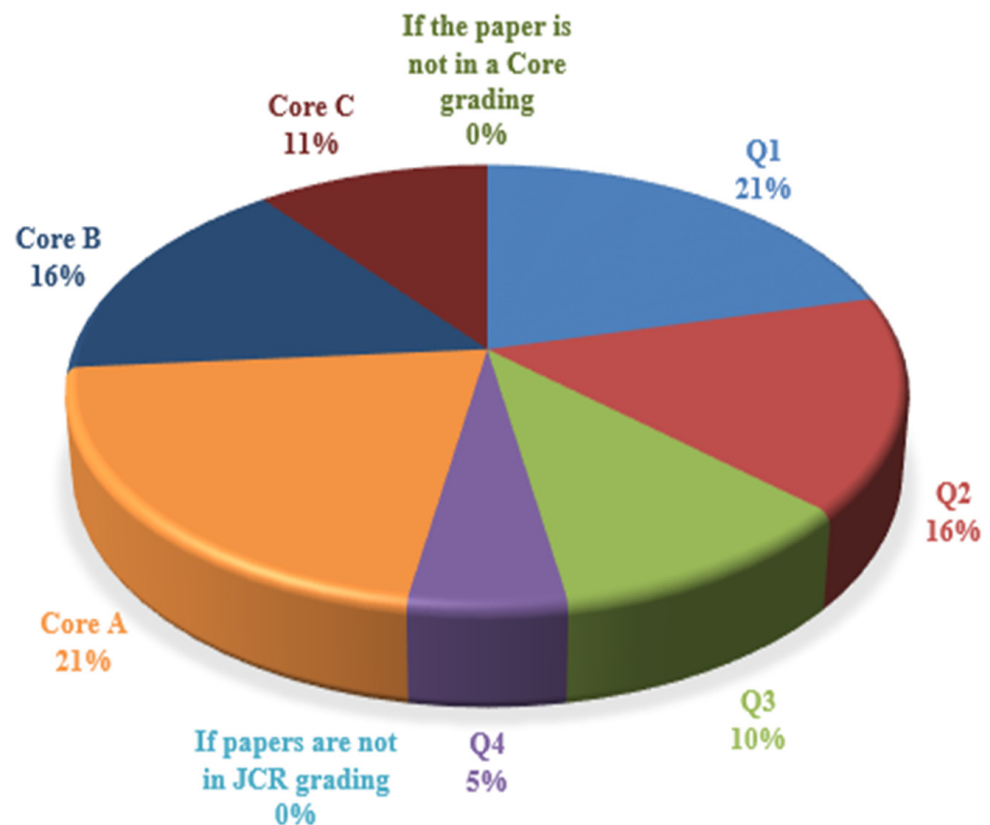
Figure 2. Quality criteria of journals and conferences paper pie chart.

3.6. Study Selection Process

Table 6 shows the option and search steps applied on chosen vaults to obtain 1480 outcomes. A screening interaction has been applied based on the rejection rules, catchphrases, titles, edited compositions, and complete articles of recovered papers. In this way, we chose 158 papers. We dispensed with the duplicate titles and the titles that do not apply to this examination from that point onward. In addition to examining the completely changed works of the picked 139 papers in the duplication stage, we have picked 44 depending on their altered creations. At last, 44 examinations were picked out of 1480.

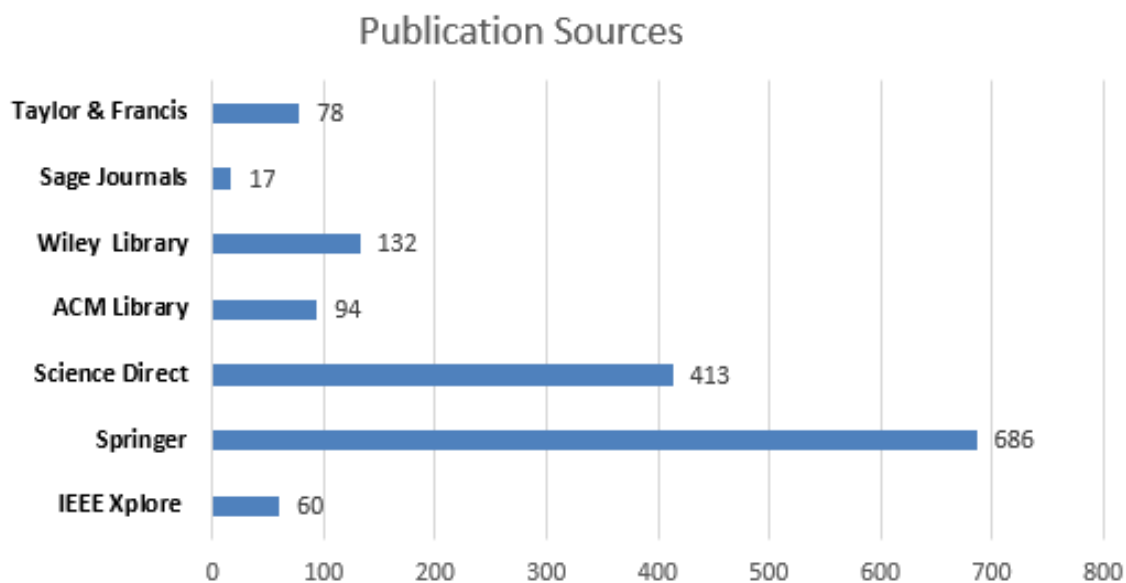Figure 3 shows the bar chart of the number of publications against the research databases counts.

Figure 3. The primary selection process for retrieved articles.

4. Results and Discussion

In this segment, the discoveries identified with the SLR addresses introduced in Table 8 are portrayed. Following the screening period's selection, examination concentrates used to outline each exploration question answer to make a fundamental commitment to the Blockchain-based IoT store network area. The data extraction scheme provides a game plan of possible responses to the research questions.

4.1. RQ1. What Have Research Topics Addressed in IoT-Based Blockchain Techniques Concerning Supply Chain Management?

4.1.1. Pharmaceutical Industry

In a traditional pharmaceutical supply chain, they come to face challenges of wellbeing, trust, shortcoming, traceability, and invisibility of pharmaceutical products and devices in the supply chain. However, the IoT devices such as radio frequency identification (RFID), sensors, locators, and QR codes remove all these problems. Simultaneously, with the assistance of Blockchain-dispersed record innovation, the information is straightforward and detectable, and the information is not altered, offered, or stored at each connection of the supply chain. The Blockchain provides privacy and the personal requirement for valuable data [56–60].

4.1.2. Food Supply Chain

The food chain with a discernibility framework has been set up with enhanced features. The system uses IoT devices to track and trace items to collect data and update each

product's movement. There are two algorithms, Hyperledger Sawtooth and Ethereum, primarily used in the food supply chain. In some cases, Ethereum has high latency of scalability and reliability, and it also represents a barrier for computationally limited devices. Hyperledger Sawtooth is suitable for tiny devices. The Blockchain applies to supply chain management based on IoT devices for traceability and provides security, timely data delivery, and efficient multi-hopping in a low-cost implementation. Many architectures proposed in different papers use Oracle's network, smart contracts, and the lightweight consensus for IoT (LC4IoT) protocol for IoT sensor devices, especially RFID, etc., [61–69].The details domain-wise of the publications are described in Table 7.

Table 7. Publications' research topics.

Research Topics	Reference
Pharmaceutical Industry	[56–60]
Food Supply Chain	[61–69]
Healthcare, Automotive, Manufacturing	[70–75]
Humanitarian Aid	[76–79]
Government Sectors	[80,81]
Applications in Shipping, Transportation, Logistics	[82–88]
Industrial and Academic Area	[89–94]
Authenticity and Cyber Security	[34,90,92–94]

4.1.3. Healthcare

Blockchain innovation can change over the IoT, and the medical services supply chain the executives by its eccentric component's ethical quality. Blockchain innovation features momentum requests and distinguishes potential exploration holes that could profit the business [70–72].

4.1.4. Automotive

Blockchains make the supply chain resilient using a smart contract, genuinely dispersed shared frameworks, and furnishes the capacity to cooperate with peers in a trusted, auditable way. The assembling plant has fundamental needs of conveyance of parts gracefully at the perfect season of insect outsider coordination, transportation organizations, multipliers, etc. The contraptions in the IoT climate give a second territory and material permission to the real things in the production network that are for the most part confined through fake news [73–75].

4.1.5. Humanitarian Aid

The scrutinized cover is related to disseminating and disseminating blockchain-based shrewd agreements in the compassionate segment. The improved transparency of any technology automatically increases time and cost. A few obstructions to embracing innovation in compassionate guide supply chains are isolated into authoritative, mechanical, and natural.

The hierarchical obstruction comprises obliged money-related assets, deficient help and duty from the board, and the requirement for fundamental changes in measures.

The technological barrier consists of four obstacles: immaturity of the technology, unwieldy prerequisites, deficient framework in calamities, and the immutability of the transactions.

The natural hindrance included guideline issues, barely any pilots in the division, various orders, standards, and targets.

Blockchain and the IoT offer many chances for versatility and security under a cost-adequacy viewpoint. Subsequently, the lifesaving and rebuilding of everyday environments passed to the fiasco [76–79].

4.1.6. Government Sectors

Electronic government (e-government) constructs administrations around residents and occupants makes taxpayer-driven organizations more reachable, ingests social perspectives, shares data, and uses assets adequately. Governments have an incredible enthusiasm for actualizing and improving their e-taxpayer driven organizations by adopting blockchain technology. Blockchain technology provides security and defeats limitations and improves running services. The United Arab Emirates (UAE) has also made progress in establishing a Global Blockchain Council to promote blockchain use among its organizations, such as the e-greater part manages framework, and so on.

The first and most extensive approved blockchain network is now working in different activities, supporting e-government and applications in the European Network [80,81].

4.1.7. Applications

Since IoT innovation considers the creation and usage of utilizations in an ongoing observing climate, it is expected that 50 billion gadgets will be associated by 2020. A few applications, such as protection, inventory network frameworks, shrewd urban communities, and keen vehicles, now work with IoT gadgets. Nevertheless, the external user's trust is the main issue; the architectonics of any application can be a centralized or decentralized system. The decentralized system provides trust, stores digital transactions, and provides authentication through hashing and digital signature [82–84].

4.1.8. Logistics

Logistics are the implementation phase of complex operations in any organization. The smart contract is a prominent part of the business logic and is amalgamated by Blockchain architectonics. A smart contract is an autorun program activated by tags, IoT sensors, actuators, etc. [85–88].

4.1.9. Industrial and Academic Area

Blockchain in 5G-empowered IoT gadgets of conversation is isolated into three sections: the foundation of Blockchain, IoT, and individual modern 5G applications. The Blockchain maintains security and faster data flow in industrial and academic areas. The essential of this innovation is a circulated stockpiling framework dependent on cryptography and agreement calculations. Presently, numerous applications were executed in finance, horticulture, payment, and medication territory. This blockchain technology application is used in air traffic controllers (ATCs) to lessen fracture, failure, and ungraceful activities in the air terminal industry [89–94].

4.1.10. Authenticity and Cyber Security

Network modernization has expanded the arrangement of savvy web-associated energy innovation conceivably defenseless against digital dangers. Obtaining these gadgets and acknowledging new NERC CIP consistency prerequisites keeps testing energy utilities, particularly associations that do not have the essential assets. Inventive arrangements were required because of these complex and advancing digital difficulties. This paper investigated other freedoms and difficulties in applying Blockchain-circulated record innovation to improve and obtain the intricate programming and equipment store network that makes up current energy utilities [95–99].

4.2. RQ2. How Effective Is the Use of Blockchain-Based IoT Devices in SCM?

The devices are dumb if human beings cannot involve them in communicating real-time data. Human beings use devices, the IoT makes the small world around us more modifiable and reactive to integrating the electronic and corporeal universe. Nevertheless, the IoT has some security and privacy challenges which can be overcome by merging blockchain technology.

The Blockchain system protects data integrated into the billions of corporeal devices worldwide. The devices are connected by the Internet and share data using a secure Blockchain structure. Blockchain-based IoT devices have transformed SCM. They progressively follow the area of merchandise, amount, and other helpful data, improving assembling plants, arranging a creation plan, and improving material and data stream frameworks [100,101].

In practice, there are a few global positioning frameworks accessible through GPS (Global Positioning System), RFID (Radio-Frequency identification), Barcode Readers, QR code Reader, Temperature Sensors, Healthcare Data Gateway (HGD), Electronic Medical Record (EMR) systems, GPS tags and chips and mobile phones, the web of IoT sensors, wireless-enabled devices, Wireless Sensors, HACCPs (Hazard Analysis and Critical Control Points), and Near Field Communication (NFC) [64,102–118].

Figure 4 shows the ratio of papers related to IoT devices.
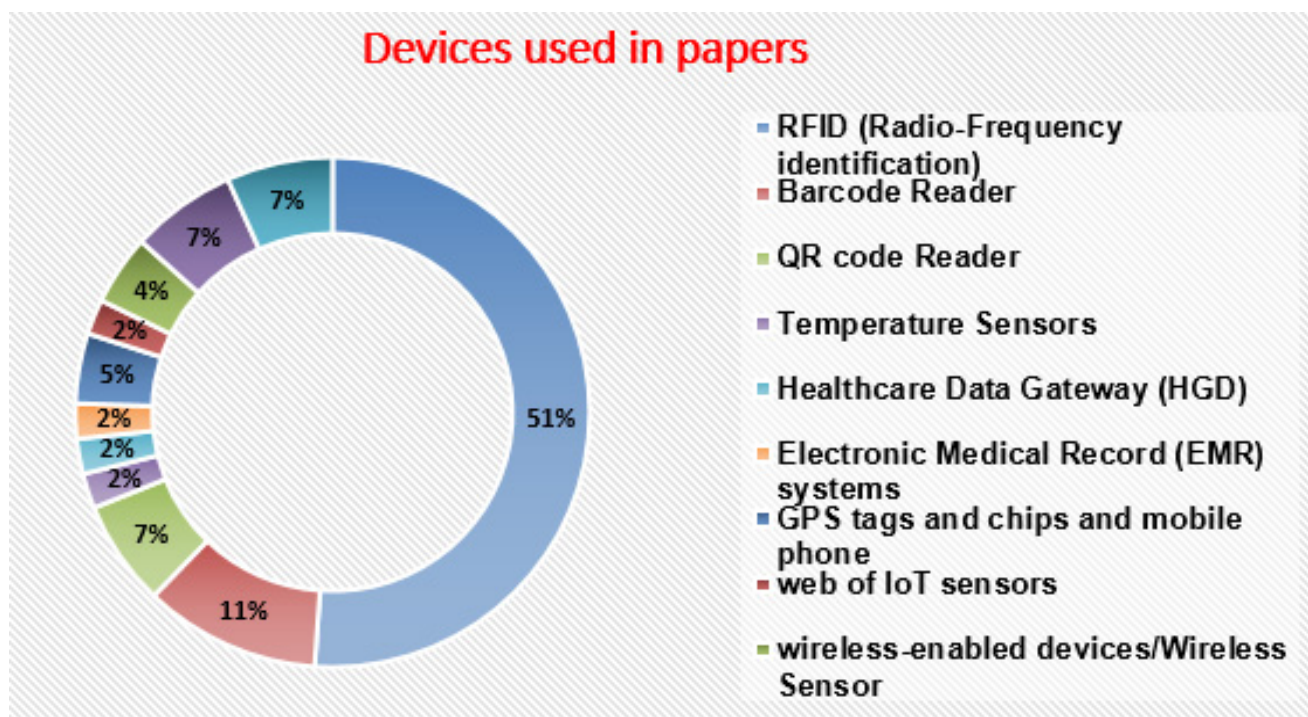
Figure 4. Comparison of IoT devices in research literature.

4.3. RQ3. Which Blockchain-Based IoT Device Is the Most Appropriate in SCM?

The most appropriate device used in Blockchain base SCM is RFID (Radio-frequency identification) to use radiofrequency waves to track the items. There are two techniques to perform functions of RFID, i.e., Transmitter and Receiver.

Table 8 shows that there are many devices to read about in the literature, but the highest ranking device used in many papers is radio frequency identification (RFID).

Table 8. Present research on devices in the literature review.

Infirmity	Sensor/Devices Operations
RFID (Radio-Frequency identification)	RFID gives the personal ID of labels to follow the item and take it essential information, which helps in continuously observing. The well-known RFID gadget, which utilizes a 900 MHZ recurrence coordinated sensor, was exemplified for continuous sensor information accession [103].
Barcode Reader	Barcode Reader is assisting with mechanizing information assortment, preparing, and approval. This information will be put away on the edge gadget in squares secured consecutively (time course of action), and afterward will be sent to the cloud [104].
QR code Reader	QR code is a mobile-based application that identifies the details of the product. This is global recognition of "items" detail. A QR code is similar to an RFID device but differs in size [105].
Temperature Sensors	The temperature sensor contraption checks the temperature of the enveloping of decayable products. Especially, RFID temperature sensors self-tune between 902 MHz and 928 MHz, working in the RFID UHF band, as the temperature rises up or drops out a particular doorstep [106,107].
Healthcare Data Gateway (HGD)	Healthcare Data Gateway (HGD) depends on progressively comprehensive security to reach the patients of data to empower the patient to claim information effectively controlled and offer to a concerned specialist. HGDs are more controlled than Medical Records as they depend on progressively severe security [108–110].
Electronic Medical Record (EMR) systems	Electronic Medical Record (EMR) is the patient record that persistently screens the patient and checks the doctor's medication portion suggestion, particularly the patient with coronary illness and disease. These clinical records exhibit to be an excellent assistance for patients and the concerned specialist. These clinical records need greater security and protection to restrict the break and abuse of information [111,112].
GPS tags and chips and mobile phones	An analysis of actual noteworthiness usage reveals that such a tracker, operated by a single coin cell, is compelled by the breaking point's size about the reported signs rather than the centrality use. The pre-owned 2 Gb streak putting away can store 65,600 1-millisecond sign depictions.This equates to 683 days of quarter-hourly orchestration. Our model GPS tracker weighs just 1.3 g and has 23 × 14 mm measurements. This allows it to be concealed for weight-sensitive applications such as fowl tracking and links it to very critical items such as wallets, sacks, or bikes [113].
Web of IoT Sensors	The advancements create constant information streams and have a few attributes: (1) high-speed absorb memory data storage, (2) distributed architecture scalability. (3) real-time query interactive data, etc. A buffering framework controls the information stream and guarantees continuous presentation between the information maker and the information buyer [114,115].
Wireless enabled devices/Wireless Sensor	Wireless Sensor Networks (WSNs) give the "cells" for information assortment and circulation of IoT empowered gadgets and setting mindful applications for sharing various sorts of intensity sources and keeping up power self-governance for enormous periods, these gadgets sharing and making sure of the information in the network [116,117].
HACCP (Hazard Analysis and Critical Control Points)	Hazard Analysis and Critical Control Points (HACCP) give a detectability and security framework to the food gracefully chain centers around straightforward [64].
NFC (Near Field communication)	Near Field Communication (NFC) are gadgets that obtain completely clear and ongoing data to produce legitimately on the related office, permitting constancy using a robust, cloud-based database [118].

The tags are also used in this system to transmit signals of id systematically. The tag attaches with items, and every tag has a frequency band for signaling between the Transmitter and Receiver.

The sensory system tracks and monitors of the items at various retailers, coordinations, or capacity stages inside the supply chain, and information is refreshed in a Blockchain framework. The related persons check the record book to acquire the information concerning the specific item.

Integrating Blockchain, RFID-based SCM provides towering data protection, glassiness, trustworthiness, and management costs compared with the conventional decentralized database system. This is a secure method for communication with the RFID tags of items with Blockchain nodes.

5. Future Work and Limitations

RQ4. What Are the Future Research Topics in Blockchain Used IOT Based SCM?

Blockchain-based IoT in SCM as a future research direction is not comprehensible, but fitter away time mainly notion and orchestrations understandable and move to the work. On the other hand, the extension of hardware architecture under the suitable proposed framework for implementations comprising real IoT gadgets and gateways will obtain the highest performances in the future for different industries prospective of big data [119–127].

The correlation and examination between the two engineering to investigate the edge's presentation gains as far as idleness, I/O, CPU, IoT gadgets utilization, and Blockchain processing cost and to find efficiency in results for the future.

Our study's limitations are that the Blockchain intelligent contracts certify the correctness of transaction data in supply chain management through IoT not appropriately addressed. Secondly, the modern times' advancement of technology, security, and challenges are the main topics of future research direction because, with time, security requirements are towering and face unalike challenges, for example, traceability, data provenance, and cyber-attacks.

Lowering CPU requirements to operate blockchain code on moderate IoT smart objects and building fault tolerance in the interchange between devices and networks are two aspects of deployment. Another area of investigation will involve lightweight network protocols for device-to-device communication infrastructure propagation and algorithms for achieving network consensus.

In future work, recently, the deep learning models [128–135] inspired through images have performed good results. We could use the literature of IoT solutions of supply chain images with the help of convolutional neural networks and other models.

The strategy entails creating an architecture for an intelligent contract management framework for logistics and implementing an adaptable yet straightforward system for testing fundamental logistics activities.

6. Conclusions

This paper presented an orderly composing review that presents a conversation on unequivocal high-quality research articles passed on in the space of Blockchain-based IoT, suggesting inventory networks to the executives. Our SLR screened 44 potential papers. These are detailed analyses of research topics, future research topics, and IoT smart devices and also discuss the most appropriate devices in terms of supply chains.

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Appendix A

Table A1. Classification and Quality Evaluation Score.

Reference	Year	P. Channel	Method of Investigating	Primary Focus	Gadgets	a	b	c	d	Score
[10]	2019	Conference	Framework	Solutions provided to those problems of industries with Blockchain IoT-based supply chain	IoT Sensor and Devices	1	1	1	0	3
[103]	2019	Conference	Tool	To improve recognizability in the pharmaceutical supply chain utilizing IoT edge gadgets and Blockchain.	IoT Sensor and Devices, RFID, barcode, GPS tracker, Temperature sensor	1	1	0	0	2
[101]	2019	Conference	Model	Summarized the issues of the delivery model	IoT Sensor and Devices, RFID	1	1	0	0	2
[68]	2019	Conference	Architecture	The utilization of a protected IoT (BC) engineering for a food inventory network's usage occasion was depicted.	IoT Sensor and Devices	1	1	0.5	0	2.5
[59]	2020	Conference	Tool	Blockchain and RFID are utilized in the drug supply chain to improve the recognizability and permeability of medications.	RFID	1	1	0	0	2
[55]	2019	Article	Proposed System	Proposed to incorporate fluffy rationale into the absolute detectability period of usability of the executives' framework	IoT Sensor and Devices	1	1	1	2	5
[62]	2019	Conference	Proposed System	The following framework with the utilization of IoT devices and store information and dealing with each node of data	RFID, Barcode, QR code	1	1	0.5	0	2.5
[63]	2018	Conference	Implementation	Tracking and tracing system in agriculture food-chain system	RFID, IoT sensor and devices, NFC devices, HACCP	1	0.5	1	0	2.5
[77]	2019	Conference	Guideline	The idea of complementary technologies for complete digitization of supply chain	IoT Sensor and Devices	1	1	0.5	0	2.5
[90]	2019	Conference	Proposed System	The idea of blockchain innovation gives trust among all the related nodes	IoT Sensor and Devices	1	0.5	0	0	1.5

Reference	Year	P. Channel	Method of Investigating	Primary Focus	Gadgets	a	b	c	d	Score
[14]	2019	Conference	Architecture	A blockchain design committed to being utilized in a supply chain that involves distinctive disseminated IoT elements	RFID	1	1	0.5	0	2.5
[69]	2019	Conference	Guideline	The combination of IoT and Blockchain can create elite Humantrain help supply chains	No	1	1	0.5	0	2.5
[92]	2018	Article	Tool	Blockchain conveyed record innovation to advance and secure the mind-boggling programming and equipment supply chain	No	1	0.5	1	0	2.5
[86]	2019	Conference	Implementation	The role of IoT and Blockchain in the digital disruption of logistic and supply chain	IoT Sensor and Devices, RFID	1	0.5	0.5	0	2
[74]	2018	Conference	Framework	A fundamental system for building a model or recreation utilizing existing technologies and protocols	IoT Sensor and Devices	1	0.5	1	0	2.5
[93]	2019	Conference	Guideline	The Blockchain overcomes the supply chain problems, such as eliminating expired food, equal distribution of revenue, etc.	RFID	1	0.5	0	0	1.5
[70]	2018	Conference	Architecture	A blockchain-based plan for the unique ID of edge contraptions through the enlistment of hashed PUF characteristics of a given device at making.	IoT Sensor and Devices	1	1	1	0	3
[78]	2018	Conference	Framework	The writing is checked on for structures and uses cases that completely understand Blockchain's appropriateness past money-related applications and digital forms of money.	IoT Sensor and Smart Devices, Healthcare Data Gateway (HGD), Electronic Medical Record (EMR) systems,	1	0.5	1	0	2.5
[46]	2019	Article	Architecture	A blockchain enlivened web of-things design for making a straightforward food supply chain.	RFID	1	1	1	2	5
[14]	2019	Conference	Architecture	A blockchain design devoted to being utilized in a graceful chain that contains distinctive circulated IoT elements.	RFID	1	1	0.5	0	2.5
[64]	2019	Conference	Implementation	To execute, we presented "Supplier Consumer Network"—a hypothetical start to finish food detectability application.	RFID technology, HACCP	1	0.5	0	0	1.5

Reference	Year	P. Channel	Method of Investigating	Primary Focus	Gadgets	a	b	c	d	Score
[60]	2017	Conference	Guideline	Blockchain-based arrangements to diminish organization, sparing expenses, and utilized in non-money-related territories.	IoT Sensor and Devices	1	0.5	1	0	2.5
[87]	2019	Conference	Guideline	A decentralized calculated and supply chain system to cares for all offices and elements of any association	Smart sensors, IoT devices, RFID	1	1	0	0	2
[82]	2019	Conference	Architecture	We proposed an architecture coupled with a non-volatile storage system to give IoT information preparing to supply chain	sensors, IoT devices	1	0.5	0	0	1.5
[71]	2019	Conference	framework	A nonexclusive structure for characterizing granularity levels dependent on the item's one-of-a-kind attributes, supply chain procedures, and partners' commitment.	Electronic Product Code (EPC), RFID	1	1	1	0	3
[67]	2019	Conference	Model	The design principles of the business model and technical specifications to work them	No	1	0.5	0.5	0	2
[72]	2019	Conference	Proposed System	A tale approach for forestalling such fake copycat practices is introduced.	No	1	0.5	0.5	0	2
[65]	2020	Article	architecture	The engineering incorporates Blockchain, IoT, and colossal information investigation to permit venders to screen the supply chain productively and viably.	RFID	1	1	0.5	2	4.5
[116]	2020	Article	Proposed System	Proposes a pilot project to create a cloud-based entry for ongoing collaboration and supply chain tracking.	RFID, barcode, IoT and Tracking devices	1	0.5	1	2	4.5
[91]	2020	Article	Implementation	For Industrial IoT trustless applications, the implementation of a moderate, stage logical thinker, and stable Blockchain tokenizer.	No	1	1	0.5	2	4.5
[75]	2020	Article	Framework	A blockchain structure and its advancement forms are introduced in detail, and calculations for smart contracts are produced for the model usage.	No	1	1	0.5	2	4.5

Reference	Year	P. Channel	Method of Investigating	Primary Focus	Gadgets	a	b	c	d	Score
[83]	2019	Article	Guideline	The exchange cost hypothesis to make a superior comprehension of how Blockchain may impact supply chain relations	No	1	0.5	1	2	4.5
[84]	2020	Article	Guideline	The significant ramifications of blockchain innovation for tasks the board emphasize the dynamic procedures in the supply chain the executives from the point of view of manageable execution.	No	1	1	1	2	5
[81]	2020	Article	Proposed System	A depiction of bleeding-edge ideas from start to finish; 5G-empowered IoT fills in as a spine for Blockchain-based mechanical robotization in applications such as savvy urban areas, brilliant homes, medical services 4.0, and shrewd agribusiness.	RFID, NFC, IoT devices (sensors)	1	1	1	2	5
[80]	2019	Article	Guideline	The progress in deliberately examining the worries identified with disseminating and appropriating blockchain-based brilliant agreements in the humanitarian sector.	No	1	0.5	0.5	1	3
[88]	2019	Article	Guideline	The strategic stage is dependent on Blockchain innovation ideas to tackle supply chain issues with disseminated network nodes.	RFID	1	1	0.5	0	2.5
[66]	2020	Conference	Guideline	The chronicles of data sciences, supply chain, and essential advancements have been applied for bringing down cost and facilitating security and accommodation	RFID, sensors, GPS chips	1	1	0.5	0	2.5
[56]	2019	Conference	Tool	The ongoing state procurement and programmed stock of drug items to utilize IoT innovation and store information in a decentralized framework.	RFID, sensors, QR codes	1	1	0	0	2
[67]	2020	Article	Proposed System	Proposes an IoT-based anticipation framework to handle the issue for safe cultivating.	Barcodes, QR codes, GPRS.	1	1	0	1.5	3.5

Reference	Year	P. Channel	Method of Investigating	Primary Focus	Gadgets	a	b	c	d	Score
[89]	2019	Conference	Guideline	The essential attributes of Blockchain include its use in conveyance, transportation, partnerships, and inventory networks and how these main characteristics are implemented.	RFID	1	0.5	1	0	2.5
[61]	2019	Article	Guideline	Essential for finishing prominence frameworks in two exceptionally excellent endeavors, cobalt mining and drugs	No	1	0.5	1	2	4.5

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