Application of Blockchain in Supply Chain Management: A Review

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ABSTRACT

Purpose: This study aims to probe the systematic literature about blockchain in the supply chain management context and suggests an agenda for future research. The aim is to investigate the recent trends in blockchain and its application in the supply chain.

Design/ Methodology/ Approach: To help build a deep understanding of the blockchain developments that led to the transformation of the supply chain, we have conducted a systematic and extensive literature review to address the various benefits and challenges while applying blockchain technology and what are the various elements of the supply chain that gets affected due to its application.

Findings: Blockchain has the efficiency as well as the flexibility that it can be applied to different SCM practices. Blockchain can be used to solve the various problems of supply chain management related to issues like trust, security, and transparency. Blockchain application in supply chain management is still in the naive stage. Blockchain can meet the requirements of information flow in the supply chain.

Originality/Value: The application of blockchain in the supply chain is restrictively reported based on the papers reviewed. The study shows that there are numerous benefits of blockchain adoption like transparency, fewer chances of fraud, exchange of information in real-time information, etc. Indeed, the benefit doesn't come without challenges. There are various challenges that the firms face while adopting blockchain technology. . Hence, blockchain will be beneficial only if it is utilized properly according to the company's strategies otherwise there will always be a risk that large investments don't create any meaningful value.

Paper Type: Theme Based Paper

KEYWORDS: Blockchain | Supply Chain Management | Internet of Things (IoT) | Real Time | Computer Network

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Introduction

Blockchain functions as a logbook that records all the digital transactions, and information that can easily be shared among all computer networks (M. Queiroz et al., 2019). In the blockchain, all parties share a secure and common platform through the internet or networks of computers to access the ledgers (records) of transactions (Pilkington, 2016). The information is copied on all the computers in the network (Manners-Bell & Lyon, 2019). So, a person in quest of any type of information can now easily access it with the help of this technology. Blockchain is a transfer system that helps in recording a particular transaction on a public ledger (Pilkington, 2016). Blockchain includes the passing of information from one party to another without the involvement of middlemen and the party who will finally receive the information has direct access to complete the transaction and trace it back from its original point (Apte & Petrovsky, 2016). In the blockchain, all the transactions are not recorded on a single database system i.e. it is not centralized and also no intermediary is involved (Zheng et al., 2017). There is a high level of decentralization in blockchain (Pilkington, 2016; Yli-Huumo et al., 2016; Casado-Vara et al., 2018; Christidis & Devetsikiotis, 2016). In this, all the data are decentralized on various computer networks that share the intermediary data and if a transaction takes place then that got updated in all the networks. In Blockchain, all transactions are kept in blocks and if any new transaction takes place then this chain goes on increasing (Zheng et al., 2017). Each block has its unique ID and it contains the information of the previous block (Queiroz & Wamba, 2019). Each new block contains all the new information related to current transactions as well as the information of the previous block. This information is validated by each computer in the network (Queiroz & Wamba, 2019) and once a transaction is recorded in the blockchain it becomes difficult to make changes to it (Zheng et al., 2017; Queiroz & Wamba, 2019) because of the linking of the blocks (Treblmaier, 2018). A transaction can't be altered once affirmed in the blockchain except if each computer or the majority of them in the system, all consent to do as such simultaneously (Manners-Bell & Lyon, 2019). Hence, if any new transaction takes place then this chain goes on increasing (Zheng et al., 2017). Consequently, the records maintained in the blockchain are identical on every computer and cannot be changed easily. The parties involved can access either the whole ledger or a particular portion (Felin & Lakhani, 2018). With the help of blockchain, the members involved in the transaction can easily gather the required information as and when needed. By providing the information digitally blockchain has made it a stress-free task.

This study is divided into 7 sections. Section 2 states the rationale behind conducting this study. Section 3 shows the research gap and section 4 highlights the research objectives. Section 5 consists of an extensive review of literature in which an overview of blockchain and blockchain in the supply chain is discussed. In section 6 we highlighted the various elements of the supply chain that get affected due to the application of blockchain in the supply chain. Section 7 states the research methodology adopted while going through various articles published in reputed journals. Section 8 consists of research findings/ conclusion whereas section 9 states the implication and future direction.

Rationale of the Study

A blockchain can be described as a "digital ledger" stored in a distributed network. The benefit here is that digital information can be shared, but not copied. The blockchain simplifies the supply chain and engages consumers with data in real time. The data is reliable and verifiable. Data is being provided with open access. A blockchain helps a supply chain track the product in real time. It reduces the overall cost of moving items in a supply chain. Cryptocurrencies are used to process payments by customers and suppliers. This helps in minimizing the role of real data interchange which is prone to be copied.

Blockchains can be used in the supply chain for Payment processing and money transfers. Blockchain allows stakeholders to inspect how products performed as they traveled from their point of origin to the point of sale i.e. the retailer. It can give motivation to consumers to return to a certain store or chain to do their shopping by storing incentives. Blockchain could act as a go-between to utilize unused data in organizations to improve a host of industries. It can help in Copyright and royalty protection. The blockchain makes it possible to vote digitally, with a transparent and non-changeable network. The blockchain helps in reducing the paper trails in Real estate, land, and auto title transfers. Blockchain has applications to be used as a backup source for cloud data centers that are prone to hackers.

Blockchain could be used in tracing food from its origin to your kitchens; hence it can be used in food safety. A blockchain-based application is underway that would monitor the Internet of Things (IoT) networks. Further uses of blockchain in a supply chain include tax regulation and compliance; workers' rights; medical recordkeeping; weapons tracking; maintenance of wills or inheritances; equity trading and tracking prescription drugs.

Thus it becomes an interesting field to work in the area of the application of blockchain in supply chain management.

Research Gaps

1. The existing literature focuses on blockchain technology in the context of cryptocurrency but there are limited studies on blockchain and supply chain.

2. There is a scarcity of research on challenges faced by supply chain partners while adopting blockchain.

3. Most of the studies stressed a few benefits of blockchain and too not in the context of the supply chain.

Research Objectives

Based on the research gaps, the following objectives have been identified in the context of blockchain:-

1. To get an overview of blockchain and various challenges while adopting the blockchain.

2. To examine the relationship between blockchain and the supply chain.

3. To identify the various elements of the supply chain and how blockchain can be applied to it.

Review of Literature

Blockchain technology puts an end to the double-spend problem as here each agent is allotted a private key and a public key (Zheng et al., 2017; Casado-Vara et al., 2018; Christidis & Devetsikiotis, 2016). The double-spending problem means that transactions and assets can be copied multiple times (Bross, 2018). There are three types of blockchains; private blockchain, public blockchain, and consortium blockchain. In a public blockchain, computers are not managed by one party or corporation (Manners-Bell & Lyon, 2019). This computer system confirms verify and records the transaction autonomously, giving trust through accord. There is no authority involved that controls the authenticity of the transactions. The only proof of work and proof of ownership is used to check its authenticity (Agarwal, 2018). This blockchain is known as an un-permission blockchain (Chakrabarti & Chaudhuri, 2017). Private blockchain expects members to be enlisted and fit with the principles built up by the owner of the blockchain (Manners-Bell & Lyon, 2019). There is a central authority that governs the rules of transactions and their authenticity (Agarwal, 2018). Therefore, in a private blockchain, the system is centralized and every transaction is supervised by the central authority so there are fewer chances of fraud. This blockchain is known as the permission blockchain (Chakrabarti & Chaudhuri, 2017).

The consortium blockchain built by way of many companies is moderately decentralized considering that solely a little part of hubs would be chosen to decide the consensus (Zheng et al., 2017). It is quasi-centralized which means there is control of authorities to some extent. Some parties are allowed to make changes only by taking permission from the concerned authority (Agarwal, 2018). There are three types of keys involved in the blockchain namely public key and private key. These keys are necessary to access information regarding a particular transaction, order tracking, asset tracking, and data related to the partners involved. In the private key, only the organization involved in the transaction can have access to the information through its private key (Zheng et al., 2017). No other person has access to it as the information is confidential and can be seen only by the parties involved. Any data can be seen by the public through the public key (Zheng et al., 2017). It applies to all data that is open to the public. A private key is kept confidential and a public key is shared with all other agents (Pilkington, 2016, Zheng et al., 2017). There are two phases signing phase and the verification phase. A person can encrypt his data through his private key and send that data to another person this is the signing phase. In the verification phase, the person receives the encrypted data and validates the same through a public key (Zheng et al., 2017). Thus, using the same digital currency for more than one transaction becomes difficult for people with blockchain technology. A transaction is started when the future owner of the digital currency sends his public key to the actual owner so that he can transfer the currency from his cryptographically generated address to the address of the future owner (Pilkington, 2016). So, it becomes easy to digitally transfer the currency from one owner to another. A transaction got finalized when it is included in the blockchain (Pilkington, 2016).

Blockchain helps in making the process faster as there are no intermediaries to a transaction as well as it also reduces the risk of database hacking (Casado-Vara et al., 2018). That means a transaction can be processed and executed much faster than maintaining and recording transactions manually by each person involved in executing it. There are two types of participants involved in blockchain. First, those who are small in number and take active participation in transactions second, those who are large in number and don't get actively involved in the transaction but they can audit the ledger as and when they feel to do so (Ramkumar, 2018). Both the participants are important in the blockchain whether they are active or passive.

Challenges in Adopting Blockchain

There are various challenges in applying blockchain in the company. It requires a lot of storage space to record huge data as new and new transactions will lead to an increase in the number of blocks and hence slow the network (Zheng et al., 2017). The utmost number of transactions a block can handle depends upon the size of the block and the size of each transaction (Zheng et al., 2017).

•   **SCALABILITY**- It helps in improving the system performance as the number of transactions or the user increases (Sadouskaya, 2017) due to its feature of recording a large number of transactions at a time by numerous clients. But blockchain can process only a few blocks but in the new era, the number of transactions is increasing day by day making it much more difficult

to store so much data on the blockchain (Yli-Huumo et al., 2016; Zheng et al., 2017). As the number of transactions increases the size of the blockchain grows thereby increasing the time required for verifying it and also the large space required to store the transactions (Agarwal, 2018). Therefore, in this era where everything is getting digitalized, there is a need to expand the scale of blockchain.

- **HACKING-** The blockchain is not free from fraud. There can be chances of uncertainty or events involving less or no security as can be the case in the public blockchain which is open for any person to read or write any information must be avoided (Agarwal, 2018). So, hackers can gather the information and can misuse it to make fraud or to do any scam.

- **DATA QUALITY-** It is the ability to gather accurate data as nearest to the source as possible. Sometimes, this becomes a bigger problem for the persons involved in the transaction. They need to conduct regular audits to check the quality of information gathered (Manners-Bell & Lyon, 2019). It aids in avoiding the entering of any false information in the system that will disrupt the whole scenario.

- **ADOPTION OF BLOCKCHAIN TECHNOLOGY-** Blockchain is a technology that is endlessly growing. But every company is not interested in using blockchain to solve its database management problems due to the lack of any regulating authority or sometimes application of blockchain may not improve their system (Casino et al., 2019). Also, the use of blockchain requires the internet and a good IT infrastructure which every company won't be able to afford (Kouhizadeh et al., 2021). Due to the lack of involvement of any authority or government, there is always a fear in the minds of the company applying blockchain that their data may get hacked or misused by any other person.

- **PRIVACY ISSUES-** Besides providing numerous benefits regarding security and trust there are still some weaknesses while using blockchain technology. It means control over some other person's information (Bross, 2018). Privacy and confidentiality are still a problem as most of the information is publicly available (Casino et al., 2019) and can be seen using the public key that is open to all. Thus, organizations find it difficult to trust blockchain technology as sometimes it could lead to the leakage of their secret information.

Owing to these problems, it would be prudent to use blockchain technology thoughtfully (Manners-Bell & Lyon, 2019) to avoid any disruptions in its use. Hence, blockchain will be beneficial only if it is utilized properly according to the company's strategies otherwise there will always be a risk that

large investments don't create any meaningful value (Felin & Lakhani, 2018). Therefore, if used cautiously blockchain will provide an edge over its competitors in various ways. It can help in reducing transaction costs and makes payment much more transparent and automated (Felin & Lakhani, 2018). The blockchain can be used by companies uniquely depending upon their capabilities. Companies can create value if they can solve the problems of various stakeholders using blockchain (Felin & Lakhani, 2018). Therefore, companies having distinct strategies can create value for the company by efficiently using the blockchain. Companies should look at their current resources and how these can be utilized efficiently along with the blockchain (Felin & Lakhani, 2018). Companies should understand their strengths and weakness and how they can make use of them to the maximum extent possible for the implementation of blockchain.
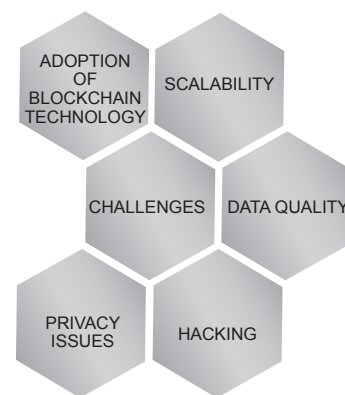

Figure 1: Challenges in Adopting Blockchain Technology

Blockchain and Supply Chain

Blockchain has the efficiency as well as the flexibility that it can be applied to different supply chain management practices (M. Queiroz et al., 2019). With the growth of the e-commerce sector, traditional supply chain companies are facing difficulties (Manners-Bell & Lyon, 2019). Blockchain can be used to solve the various problems of supply chain management related to issues like trust, security, and transparency. Blockchain adopted by supply chain partners helps in improving the trust of customers as now they can access the information related to their goods (Queiroz & Wamba, 2019). Therefore, customers get satisfied as they can easily track the movements of goods ordered from the time they have ordered it until it will get delivered. It helps the supply chain partners to track the goods whether have reached the destination or not or why they are in transit for so long (Sadouskaya, 2017; Kshetri, 2018; Treblmaier, 2018). With the help of this, any member can be held accountable for their reactions (Manners-Bell & Lyon, 2019). This information is relevant for them to take necessary actions and can act accordingly. Blockchain can be utilized in the supply chain network to realize who is performing what activities (Kshetri, 2018). Supply chain management (SCM) firms must reframe their strategies to embody blockchain in their businesses

(Korpela et al., 2017; M. Queiroz et al., 2019) so that they can easily manage the information and can easily track it. Blockchain has a clear impact on the supply chain. This can be seen through trust between the partners, participation, and learning (Queiroz & Wamba, 2019). Blockchain application in SCM is in its infancy stage (M. Queiroz et al., 2019). Its application in SCM will transform the way the supply chain partners are interacting and track the information making it much more efficient and useful for all members.

Traditional contracts have no impact on the Internet of Things (IoT) (Zhang & Wen, 2016). There can be chances that the terms and conditions of the contract can be altered or manipulated by any party but smart contracts based on blockchain once recorded becomes difficult to modify. Smart contracts will lead to enhancement in SCM in various ways like reduction in transaction cost, enhanced transparency, more security, and trust (M. Queiroz et al., 2019). These are the documents that comprise various contracts that are recorded digitally and can be used in offline mode by the parties (Yoo, 2017) to gather and check the information at any point in time. These are the contracts that work autonomously of any centralized control and have their own set of rules. The smart contract is controlled automatically and not by any third-party authority (Sadouskaya, 2017). Whenever a smart contract gets uploaded to a blockchain network it gets updated on every computer connected to it (Chang & Chen, 2020).

Once it is entered into the blockchain, it can't be altered (Manners-Bell & Lyon, 2019). It helps in making the execution of contracts easier and more efficient (Sadouskaya, 2017). In this, all the terms and conditions are mentioned digitally and no third party is involved. The parties can execute the whole transaction without actually getting involved (Agarwal, 2018) i.e. the authentication and settlement of the whole contract take place without human interference. These contracts are very advantageous for the supply chain partners as they can easily see the rules in the agreement and the parties involved can hold each other answerable for their actions. With the involvement of this contract, the parties have to comply with the conditions and rules mentioned in the agreement. Due to the long chain of supply partners, it is very difficult to track the status of tasks and payments but smart contracts have made it an easier task (Wang et al., 2018) by automating the whole process from coming into a contract to its execution. Due to the difficulty in scrutinizing the accountability of illegal events going on in the supply chain, various problems supply chain partners are facing like duplication, constraint work, and poor conditions in industrial facilities (Sadouskaya, 2017). Parties can seek help from the court if there is any breach of contract. This legal procedure is cumbersome and time-consuming (Agarwal, 2018). Consequently, this contract is enforceable in the court and any party involved can be held accountable for what they do and why they do it.

With technological development, the use of the internet and the internet of things is being increased continuously. The Internet of things (IoT) combines the internet and smart devices to offer the customer a variety of services (Zheng et al., 2018). Blockchain plays a vital role in handling, monitoring, and safeguarding IoT devices (Khan & Salah, 2018). Blockchain has the efficiency to solve various challenges easily. It helps the users to trace their goods in transit, gather information and can transact digitally. Blockchain can be used to improve IoT security to trace transactions and make them much more transparent (Banerjee, 2018). Blockchain helps in tracing the product from its point of origin to the point of consumption and helps in identifying the users with the help of IoT (Kshetri, 2017). IoT helps in detecting the IoT devices which will help the supply chain partners to track the goods or any asset or information moving along the supply chain easily. It plays a significant role in tracking the sources of uncertainty in the supply chain and provides solutions to solve various issues (Kshetri, 2017).

It helps in ensuring the safety and security of the supply chain partners. Blockchain aids the supply chain partners to access the data from IoT devices that are attached to any product moving along the supply chain (Christodoulou et al., 2018). Such information can be used for shipment tracking as well as can act as proof of delivery. This helps in minimizing product delays. There are problems of privacy and security that the internet of things suffered from. Traditional approaches to these privacy issues don't cope with the ever-changing world and don't solve the problem of IoT (Dorri et al., 2016). Hence, blockchain aids IoT technology to solve these challenges. Blockchain along with smart contracts can provide authentication to an IoT device (Khan & Salah, 2018). It helps in validating any transaction, IoT devices, or any IoT software as it contains all the stated conditions that the parties have to abide by. The smart contract contains the rights and responsibilities and tells who has the right to upgrade an IoT software or hardware or who can reset the IoT devices (Khan & Salah, 2018).

There are various benefits of adopting the blockchain by the supply chain partners. Some of these could be:-

- **TRANSPARENCY**- Transparency is very important in the supply chain due to the involvement of various parties in the chain (Christodoulou et al., 2018). Transparency in the context of the supply chain refers to the information available to all the members involved in the supply chain (Francisco & Swanson, 2018). It aids to comprehend the consequences of introducing a particular product (Abeyratne & Monfared, 2016). Blockchain helps in providing transparency as there are no intermediaries involved and also they can now easily track goods, transactions, or any kind of information. It helps the supply chain partners to better forecast their demand and can use real-time information to

act according to the unpredicted incident (Apte & Petrovsky, 2016; Sadouskaya, 2017; Treblmaier, 2018; Manners-Bell & Lyon, 2019; Yadav & Singh, 2020). It helps in tracing the origin of any material (Kouhizadeh et al., 2021), product, or information that was shared on blockchain networks. The supply chain partners can not only use the information to know the demand for their products rather can make use of this information as an opportunity to be the first mover in this dynamic world.

- **DECENTRALIZATION**- It means that no single organization controls the transaction processing, while the dissemination identifies with computational work that is shared among several computers (Treblmaier, 2018). It relieves the supply chain partners from depending on others (Chang & Chen, 2020). In the blockchain, all the transactions are not recorded on a single database system i.e. it is not centralized and also no intermediary is involved (Zheng et al., 2017; Agarwal, 2018). In this, all the data are decentralized on various computer networks that share the common data and if a transaction takes place then that got updated in all the networks.

- **PERSISTENCY**- It is very difficult to make changes once a transaction is recorded in the blockchain so if there is any invalid transaction it can easily be detected with the help of blockchain technology (Zheng et al., 2017). Thus, this could be helpful for the firms as there are fewer chances of fraud in the company.

- **AUDITABILITY**- Any transaction needs to allude to the past unspent transaction. When the present transaction is recorded in the blockchain, the condition of those alluded unspent transactions transfers from unspent to spend. So transactions can be effectively checked and traced (Zheng et al., 2017). This feature of blockchain will be very advantageous for supply chain partners as they can easily check any transaction at any time.

- **REAL-TIME INFORMATION**- Blockchain helps the supply chain partners to get real-time information about their products in transit. It helps them in getting information about whether their goods have reached the customers or not i.e. they keep track of the movement of goods (Kshetri, 2018; Treblmaier, 2018; Queiroz & Wamba, 2019) This information is beneficial for them so that they can decide their next course of action accordingly.

- **SECURITY**- Trust is important in maintaining good relationships among supply partners (Wang et al., 2018) that will help in improving their communication as well as their bond which has a direct or indirect impact on their business. Blockchain helps in improving trust and security (Korpela et al., 2017; Sadouskaya, 2017; Kshetri, 2018; Zheng et al., 2018). Blockchain provides the security of the information through public and private keys. No person without these will be able to access any

kind of information and will not be able to misuse it. Blockchain aids in providing data security to customers through the use of cryptography technology (Agarwal, 2018) i.e. it helps to safeguard the sharing of personal data of the customers thereby reducing the chances of scams by hackers. Blockchain removes the need for the third party to execute the transaction or to interfere between two parties involved in the transaction thereby reducing the time needed to complete the transaction. The consensus of any transaction is provided by the network and not by any mediator. Whenever the parties entered the transaction they need the safety of their information which is provided by the blockchain (Manners-Bell & Lyon, 2019). Blockchain technology through encrypted ensures the user that their data is safe and cannot be shared with any person. The data can only be gauged by the parties who have the private key to access that information.
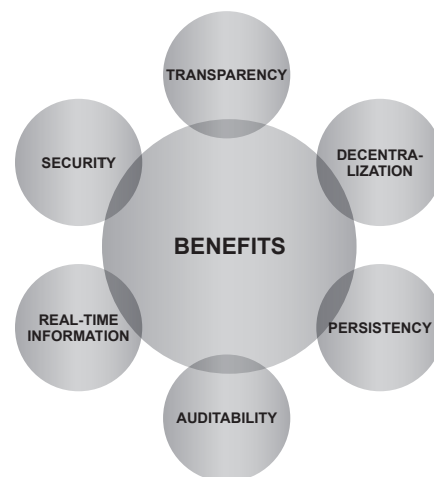

Figure 2: Benefits of Adopting Blockchain Technology

Application of Blockchain in Supply Chain

The application of blockchain in the supply chain helps in making the whole process much faster (Apte & Petrovsky, 2016). Therefore, blockchain would be beneficial for the supply chain partners to not only trace the goods or assets but to get real-time information on time making the overall procedure much faster. Various elements of the supply chain get affected by the application of blockchain. These could be cost, speed, dependability, risk reduction, sustainability, and flexibility (Kshetri, 2018). Blockchain through delegation, privacy, and persistence helps in cutting costs and increasing effectiveness (Zheng et al., 2017). These could be:-

- **COST**- Blockchain helps the supply chain partners in reducing their costs in many ways like reducing the cost of maintaining the physical records, cost of shipping, and tracking goods (Korpela et al., 2017; Kshetri, 2018; Yadav & Singh, 2020). It also helps the customers as

now supply chain partners won't be able to provide low-quality products. Blockchain helps to keep a check on the quality of the raw materials used by them (Kshetri, 2018). It helps the transactions to get settled efficiently as there are no intermediaries (Agarwal, 2018) thereby reducing the cost of executing the transaction.

- **SPEED**- Blockchain helps in reducing the paperwork and thereby the time needed to gather the information. Hence, it helps in increasing the speed of doing work by digitizing the work (Apte & Petrovsky, 2016; Kshetri, 2018).

- **DEPENDABILITY**- It helps in the substantiation of transactions by confirming the user identity (Agarwal, 2018). Blockchain helps the firm to hold supply chain partners responsible for the quality of goods supplied by them and they are answerable for their actions (Kshetri, 2018). Hence, it is beneficial for the supply chain partners to hold any party responsible for their actions.

- **RISK REDUCTION**- Through blockchain, only the persons involved in executing a particular transaction are allowed to access the network thereby reducing the risk that external parties can utilize that information (Kshetri, 2018). So, only the parties involved can access the information related to a transaction. Another aspect related to risk reduction is the decentralization system in the blockchain. Due to decentralization, there is a tendency for less risk as an attack on any transaction will affect only that part of the blockchain and not the entire blockchain like in a centralized system (Agarwal, 2018).

- **SUSTAINABILITY**- It helps to maintain and regularly update the information related to the partners of the supply chain (Kshetri, 2018). Any new information will get easily updated and can be shared among all the computer networks so that every person in the supply chain would know the other person in the chain.

- **FLEXIBILITY**- Blockchain helps the supply chain partners to have access to real-time information thereby reducing the lead time of the supply chain and hence improving flexibility (Korpela et al., 2017; Kshetri, 2018). It means how quickly the supply chain partners will be able to take advantage of real-time information in the dynamic environment.

These elements can be summarized in table 1 which shows the blockchain's application in supply chain management and how much-supported works of literature come across while going through the review of various papers.

Table 1:- Various Elements of the Supply Chain and How Blockchain can be Applied

S No.	Supply Chain Elements	Blockchain's Application	Supported Literature
1.	Cost	Blockchain aids in reducing the cost in many ways like reducing the cost of maintaining the physical records, the cost of shipping and tracking goods, etc.	Korpela et al., 2017; Kshetri, 2018; Agarwal, 2018
2.	Speed	Blockchain assists in reducing the paperwork and thereby the time needed to gather the information.	Apte & Petrovsky, 2016; Kshetri, 2018
3.	Dependability	Blockchain helps the firm to hold any partner responsible for the quality of goods supplied by them and they are answerable for their actions.	Kshetri, 2018; Agarwal, 2018
4.	Risk Reduction	Due to decentralization, there is a tendency for less risk as an attack on any transaction will affect only that part of the blockchain and not the entire blockchain like in a centralized system.	Kshetri, 2018; Agarwal, 2018
5.	Sustainability	It helps to maintain and regularly update the information related to the partners of the supply chain.	Kshetri, 2018
6.	Flexibility	It means how quickly the supply chain partners will be able to take advantage of real-time information in the dynamic environment.	Korpela et al., 2017; Kshetri, 2018

Research Methodology

To help build a deep understanding of the blockchain developments that led to the transformation of the supply chain, we have conducted a systematic and extensive literature review to address the issues related to blockchain. The study is based on secondary sources and no primary data is collected. We have reviewed various journals that helped us to get an overview of blockchain technology and its status in the last 6 years. Then we gather information regarding the challenges that the supply chain partners face while applying blockchain. We can find 8 articles, 1 thesis, and 1 book that talked about the benefits that an organization gets through

the application of blockchain. Numerous journal articles talked about the various elements of the supply chain that gets affected due to the use of blockchain technology in the current system of an organization. The review analyzed recent papers in peer-reviewed journals and some theses published in this regard. We have selected the paper based on the period that is to get an overview of the recent face of the blockchain we have selected the papers for the period of 6 years from 2016 to 2021.

Conclusion/ Findings

The blockchain is appealing to the attention of various organizations and supply chain partners as a pioneering technology. This technology has a significant impact on the functioning of the business and how supply chain partners are conducting and managing their functions throughout the supply chain. This can be used by the supply chain partners to trace their goods and assets moving along the chain. They can also gather real-time information through the application of blockchain technology. The blockchain aids the supply chain partners in determining the quality of goods and also assists in tracking the goods from their point of origin. In this respect, we first provided an overview of the blockchain in which what is blockchain technology means and how it functions is described. Then, the blockchain and supply chain is discussed i.e. how blockchain can be used by the supply chain partners to improve their performance. Thirdly, we deliberated the literature on the application of blockchain in various elements of the supply chain. It can be seen through the review of literature that there are numerous benefits that a supply chain partner will enjoy by integrating blockchain technology into the firm.

These could be transparency, decentralization, security, real-time information, persistence, and auditability. Transparency aids the supply chain partners to gather the information to know the demand for their products and can take this opportunity as the first mover in this ever-changing world. In the same way, through decentralization, all the data are delegated on several computer networks that share the mutual data and if a transaction takes place then that got updated in all the networks. Blockchain aids in reducing the chances of fraud as once the transaction got recorded in the block it will get uploaded on all the computers which make it difficult to make changes afterward. Blockchain assists the supply chain partners in the auditability of the transactions recorded as whenever the present transaction is recorded in the blockchain, the condition of those alluded unspent transaction transfer from unspent to spend. This helps in tracking the status of the transaction in the chain. It helps them in getting the information about whether their goods have reached the customers or not and thereby getting real-time information about their goods moving along the supply chain. Nevertheless, an important factor while transacting online is the security of the participant's information. They

always have a fear of leakage of their personal information which sometimes can lead to their exploitation. So, Blockchain is the right technology that offers the security of their information through public and private keys. No person without these will be able to access any kind of information and will not be able to misuse it.

Thus, while going through a review of the literature we can conclude that blockchain has the efficiency as well as the flexibility that it can be applied to different SCM practices. Blockchain can be used to solve the various problems of supply chain management related to issues like trust, security, and transparency. Blockchain application in supply chain management is still in the naive stage. Blockchain can meet the requirements of information flow in the supply chain.

Limitations of the Study and Future Direction

From an academic perspective, this study provides the researchers an extensive literature on the blockchain. It also offers literature on the various elements which get affected in the supply chain by the application of blockchain. Blockchain can be used by supply chain partners in any situation to solve their problems related to their day-to-day issues. We have conducted an extensive literature review but the list is not exhaustive. The literature review could have been more extensive as it is limited to recent publications in the last 6 years. The application of blockchain in the supply chain is restrictively reported based on the papers reviewed. The application list is thus not exhaustive.

Various elements are not encountered in the review of papers that could be an interesting future topics. Also, various organizations have implemented blockchain technology in their various fields which too can be the area that can be looked upon. Another area for future research can be the various sectors like education, health; insurance, etc. where the supply chain partners have applied blockchain technology and how they have effectively used it to improve their performance. While blockchain technology is extensively utilized various issues are needed to be addressed. Since blockchain is based on developments in technology with its advancement there must be some innovation in the usage of blockchain and how it will going to affect the business in the dynamic environment.

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The Editorial Board had used the Ouriginal – a Swedish anti-plagiarism software tool which is a fully-automatic machine learning text-recognition system made for detecting, preventing and handling plagiarism and trusted by thousands of institutions across worldwide. Ouriginal by Turnitin is an award-winning software that helps detect and prevent plagiarism regardless of language. Combining text-matching with writing-style analysis to promote academic integrity and prevent plagiarism, Ouriginal is simple, reliable and easy to use. Ouriginal was acquired by Turnitin in 2021. As part of a larger global organization GJEIS and Turnitin better equipped to anticipate the foster an environment of academic integrity for educators and students around the globe. Ouriginal is GDPR compliant with privacy by design and an uptime of 99.9% and have trust to be the partner in academic integrity (https://www.ouriginal.com/) tool to check the originality and further affixed the similarity index which is {6%} in this case (See below Annexure-I). Thus, the reviewers and editors are of view to find it suitable to publish in this Volume-14, Issue-1, Jan-Mar 2022.

Annexure 14.3

Submission Date	Submission Id	Word Count	Character Count
23-Jan-2022	D59080107 (Ouriginal)	7074	45359

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Reviewers Memorandum

Reviewer's Comment 1: The study is planned in a systematic manner and with the disruption of technology the choice of topic is very appropriate. The study will help researchers and practitioners quickly give an overview of the research state of blockchain in supply chain management.

Reviewer's Comment 2: The authors have done comprehensive work in the area primarily based on secondary data. The study further leave the scope of more extensive literature review as the study is limited to publication in the last 6 years.

Reviewer's Comment 3: The findings of the study are valuable to understand the current state of research in the area from both academia and industries. From an academic perspective, this study provides the researchers an extensive literature on the blockchain and its application especially in supply chain management.

Editorial Excerpt

The article has 6% of plagiarism which is the accepted percentage as per the norms and standards of the journal for publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the authors (Gunjan & Anurag), and accordingly, all the corrections had been incorporated as and when directed and required to do so. The comments related to this manuscript are noticeably related to the theme "**Application of Blockchain in Supply Chain Management: A Review**" both subject-wise and research-wise. Blockchain functions as a logbook that records all the digital transactions, and information that can easily be shared among all computer networks. The present study focuses on the recent trends in blockchain and its application in the supply chain. The study finds that blockchain can be used to tackle the issues like trust, security, and transparency in supply chain management. Overall, the paper promises to provide a strong base for further studies in the area of supply chain management. After comprehensive reviews and the editorial board's remarks, the manuscript has been categorized and decided to publish under "**Theme Based Paper**" category.

Acknowledgement

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