YAŞAR UNIVERSITY
GRADUATE SCHOOL
MASTER THESIS

USE OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT AND LOGISTICS: A CASE STUDY IN LOGISTICS COMPANY

ONUR EPER

THESIS ADVISOR: ASST. PROF. DR. PERVİN ERSOY

DEPARTMENT OF INTERNATIONAL LOGISTICS MANAGEMENT

PRESENTATION DATE:17.01.2022

BORNOVA / İZMİR

January, 2022

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Jury Members:	**Signature:**
Asst Prof. (PhD) Pervin ERSOY Yaşar University	....
Asst. Prof.(PhD) Gülmüş BÖRÜHAN KARACA Yaşar University	....
Assoc. Prof. (PhD) Işık Özge YUMURTACI HÜSEYİNOĞLU Izmir University of Economics	....

Prof. (PhD) Yücel Öztürkoğlu

Director of the Graduate School

ABSTRACT

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Eper, Onur

MSc/ International Logistics Management

Advisor: Asst. Prof. Dr. Pervin ERSOY

January 2022

In recent days, the interest in the new technology blockchain is increasing. Blockchain technology (BCT) has attracted the attention of both academia and industry due to its open-source, decentralized, immutable, transparent, auditable features. Information and communication technology (ICT) is becoming increasingly important in supply chain management (SCM). BCT is used with Internet-of-Things (IoT), cloud computing, wireless sensor network systems that can increase supply chain management (SCM) efficiency. The logistics sector has gained even more importance around the world with its recognition in recent years.

This study explains how blockchain technology is used in the supply chain and its benefits, why blockchain is preferred, and what are the challenges. We used a qualitative study method application in our study. We asked how the Maersk Company uses blockchain technology and examined the advantages, disadvantages, and benefits of this technology. Then, we analysed the information we obtained with the MAXQDA program. Finally, the logistics sector, supply chain management, traceability, transparency have been obtained significant results.

Key Words: Blockchain Technology, Supply Chain Management, Logistics, Transparency, Traceability

ÖZ

BLOK ZİNCİRİ TEKNOLOJİSİNİN TEDARİK ZİNCİRİ VE LOJİSTİK SEKTÖRÜNDE KULLANIMI: LOJİSTİK ŞİRKETİNDE VAKA ÇALIŞMASI

Eper, Onur

Yüksek Lisans Tezi, Uluslararası Lojistik Yönetimi

Danışman: Dr. Öğr. Üyesi Pervin ERSOY

Ocak 2022

Son günlerde, yeni teknoloji olan blok zincirine ilgi artmaktadır. Blok zinciri teknolojisi (BCT) açık kaynaklı, merkezi olmayan, bilgilerin değiştirelemediği, şeffaf, denetlenebilirlik özellikleri nedeniyle hem endüstrinin hem de akademinin dikkatini çekmiştir ancak yeni gelişen bir teknoloji olmasından dolayı tedarik zinciri, lojistik ve blok zinciri konularında çok az bilgiye ulaşılabilmektedir. Bilgi ve iletişim teknolojisi, tedarik zinciri yönetiminde giderek daha da önemli hale geliyor. Blok zinciri teknolojisi, Nesnelerin internet (IoT), bulut bilişim sistemleri, kablusuz sensor ağları ile bilirkte kullanıldığında tedarin zinciri yönetiminin verimliliğini arttırabilir. Son yıllarda, lojistik sektörü dünya genelinde bilinirliği artmasıyla daha da önem kazanmıştır.

Bu çalışma, tedarik zinciri ve lojistik sektöründe blok zinciri kullanımını, neden tercih edildiğini, zorlukların neler olduğunu ele almaktadır. Çalışmamızda nitel bir çalışma yöntemi uygulaması kullanılmıştır. Maersk şirketinin blok zinciri teknolojisini nasıl kullandığını ve bu teknolojinin avantajları, dezavantajları ve faydaları hakkında incelemeler yaptık. Daha sonra, MAXQDA programı ile elde ettiğimiz bilgilerin analizini yaptık. Sonuç olarak, blok zinciri teknolojisinin tedarik zinciri yönetimi, izlenebilirlik, şeffaflık hakkında önemli sonuçlar elde edilmiştir.

Anahtar Kelimeler: Blok zincir, Tedarik Zinciri Yönetimi, Lojistik, Şeffaflık, İzlenebilirlik

ACKNOWLEDGMENTS

Firstly, I would like to thank to my mother and for her support during this period, helping me with the patience and support.

I am thankful to Assist. Prof. Dr. Pervin ERSOY, my dissertation advisor, for her support and contribution during the research.

In addition, I am grateful to all of my lecturers at Yasar University's International Management Logistics department for sharing their knowledge and experiences.

Special thanks to İpek Ece Öztürk for the motivational valuable support.

Thanks to Volkan Demireli for his valuable support.

Onur Eper

İzmir, 2022

TEXT OF OATH

I honestly declare and confirm that my study, titled "USE OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT AND LOGISTICS: A CASE STUDY IN LOGISTICS COMPANY" has been written myself, without any help from anyone, with my own knowledge, experience and efforts. Each information quoted in the study is provided with bibliography and references. I declare and confirm that no information that is not my own effort and work is included in the thesis with honor.

Onur Eper

January, 2022

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SYMBOLS AND ABBREVIATIONS

IBM: International Business Machines

BCT: Blockchain Technology

SC: Supply Chain

SCM: Supply Chain Management

RFID: Radio Frequency Identification

ID: Identification

DLT: Distribution Ledger Technology

CPS: Cyber-Physical System

IT: Information Technology

ICT: Information Communication Technology

BDA: Big Data Analytics

ADEPT: Autonomous Decentralized Peer to Peer Telemetry

ICT: Information communication technology

PEU: Perceived ease of use

PU: Perceived Usefulness

VAT: Value Addex Tax

TAM: Technology Acceptation Model

CHAPTER 1

INTRODUCTION

In recent years, technology is developing very fast and also has gained a lot of value. Most people do almost all their work using technology, and people want to reach information non-stop and fast. This situation enables the technology to develop further from past to present. Technology, which is used in most of our lives, has become a part of our lives. There is hardly any place where technology is not used technology. The use of technology gives us a lot of advantages in homes, workplaces, trade areas, logistics sectors, and supply chains. While there were no smart technological devices in our homes in the past, but now refrigerators, vacuum cleaners, etc. even got smarter.

The fact that both the seller and the buyer did not know each other caused great problems in trade. Otherwise, in trade areas, using of technology strengthened communication between sellers and buyers.

The whole world experienced a major financial crisis in 2008. After the crisis, a group had to develop a new financial method and has wanted to apply this system. It contained decentralized, transparency, traceability and etc. Moreover, this method was not influenced by particular "too big to fail" organizations, and one that was not influenced by any institution at all.

Recently, blockchain technology becomes the most popular technology that provides decentralized, peer-to-peer transactions, immutability information to all users. The idea was inspired by Satoshi Nakamoto's 2008 Bitcoin cryptocurrency.

The first cryptocurrency is Bitcoin. Bitcoin was found in 2009 as both a payment method and totally digital money. After two years, the first alternative cryptocurrency appeared, and at the start of 2018, there were about 1300 of them, along with around 500 tokens.

Blockchain technology is a disruptive technology that is currently recognized as one of the most important technologies of Industry 4.0. On the other hand, Blockchain's various characteristics features such as decentralized, smart contract, transparency, traceability, immutability as well as consensus process, make it suited for use in today's complex supply chains. In the long run, these variables enhance manufacturing processes and current supply chains more flexible, robust, and responsive. Blockchain adds a component of sustainability, which corresponds to the trend of circular economy (Magla et al., 2021).

Sustainability of supply chains today depends on how well they use technology or, in particular, blockchain technology and how much they incorporate blockchain technology into their processes.

Furthermore, Blockchain technology is not a fully developed technology yet. This technology is developing every day to reach its current potential. Technological improvements have induced a reconsideration of sustainable methods. It is an example of technology that can be applied in every area. Supply chains are one of the most common blockchain technology implementations.

This notion may be used to a variety of fields, including healthcare, the Internet of Things (IoT), industry, and SCM. The primary focus has been on examining the technical application of Blockchain in many application areas from an academic standpoint, as well as some recent developments by various organizations to utilize Blockchain technology in various industries.

Blockchain application has applied and is current being developed in the logistics and supply chain industries. The supply chain applications are using numerous other technological tools to track products such as Radio Frequency Identification (RFID), barcode, Internet of Things (IoT), and sensors technologies. Nonetheless, until recently it did not reach its fully potential since the underlying data was either available within a corporation or was only shared with a small group of trusted partners. Basically, each supply chain member has their own information system, but their biggest problem is that the information systems are not connecting with each other. Members are experiencing a lack of information in the system.

With blockchain technologies, supply chains become more reliable, secure and traceable. This enables companies to monitor their processes quickly and transparently. Based on these capabilities and the overall advancement of blockchain technology, the pace of new supply chain implementations is growing (Dujak and Sajter, 2019).

Blockchain applications may use in a SC to track who is doing what. Moreover, system knows time and place of the movements. The Blockchain allows for the accurate and efficient assessment of critical supply chain management (SCM) process outputs and performance. The data in the system can never be changed. Other supplier members may be tracked shipping actions, deliveries and progress. In this approach, this system gives a trust among suppliers.

Efficiency can be enhanced while expenses are reduced by removing middlemen auditors. Indıvidual providers may perform their own checks and balances in real time (Koetsier, 2017).

Furthermore, BCT may make it easier to obtain a product or service, impacting the customer's perception of the product's or service's worth (Morkunas et al., 2019). Regarding the tamper-proof nature of blockchain and the potential influence it might have on logistics and SC (Viryasitavat et al., 2018), blockchain adoption in this industry is projected to increase in order to improve supply chain performance.

Secondly, detailed information about the history of Blockchain technology, where it is used and how it contributes to the industry is given. In the third part, detailed information was shared under the headings of supply chain, supply chain management, transparency and traceability. In the fourth part, in which sectors blockchain technology is used and the advantages it provides to these sectors are discussed. In the fifth section, our case study, findings and results in detail, and in the sixth section, the results and limitations of the study are included.

1.1 Research Strategy and Method

Generally, when internet technology first emerged, we could not have known that it would be so effective, rapidly developing, and widespread. We do not know how much the usage area will expand and this situation is currently valid in BCT. Today, there are many curious issues in terms of the SCM of blockchain technology, and these are due to the lack of information and not fully using the technology.

Moreover, the concepts of transparency and traceability are crucial for logistics and SCM. The biggest challenges in the supply chain are significant losses and reducing costs. We must use the innovation of technology to prevent significant losses.

In addition, blockchain technology should prevent human mistakes that may occur in the logistics industry. BCT should be integrated into the SC and logistics operations and find solutions to problems. As a result, blockchain is both decreases costs and increases customer satisfaction.

For these reasons, it was decided to conduct such a thesis study. In the study, an interview was held with an international logistics company operating in Turkey and fully implementing blockchain processes, and these interviews were analysed with qualitative research methods. In the study, the interview questions created based on the literature were coded and analyzed with the help of the MaXQDA analysis program.

CHAPTER 2

BLOCKCHAIN

2.1 Blockchain

First of all, Blockchain Technology (BTC) concept appeared in 2009 and Nakamoto was the first to discover this innovation. Blockchain technology is the beginning of the trend framework for administering Bitcoin, digital money. This new technology concept develops data structure and encodes the transaction of information and it uses data mining and bitcoin techniques while performing these operations (Nakamoto, 2009).

Moreover, Blockchain's decentralized and immutable nature, together with its identity protection function, allows various nodes of the network system to record, utilize, and validate information on this public ledger while maintaining their anonymity (Esmaeilian et al., 2020). The benefits of BCT include transparency; reduce fraud risk, rapid transactions, privacy and security, and financial data guarantee, and no exchange charges (Sharma et al., 2017; Crosby et al., 2016).

The concept of smart contracts appears at a period when several contracting methods and standards, such as electronic data interchange for the exchange of structured data between trading partners' computers, were already well established. Additionally, smart contracts have legally binding since these codes used are the only valid evidence of the contractual agreement between the parties. Basically, a smart contract's code, in general, refers to contractual terms that take the form of conditional logic, with both antecedent circumstances and subsequent effects explicitly stated. Although currently in the testing phase, smart contracts on permissioned blockchain technology are likely to find a long-term role in logistics and SCM in the near future (Dujak and Sajter, 2019). Furthermore, a smart contract is already included in the supply networks and logistics all listed areas of blockchain application. One of the key properties of blockchain is that there is no need for a third party (e.g. bank, lawyer, or broker) thus transactions are much faster most significant for SC and logistics) and much inexpensive, and there is a fewer chance of errors.

Basically, the information and data on the blockchain are immutable. Immutability refers to the fact that records cannot be updated or altered without the agreement of all network members. Participants could rest certain that the records' history is accurate and unaltered on the blockchain system (Kouhizadeh and Sarkis, 2018). In addition to these, the characteristics of the BC are shown in Table 2.1.

Table 2.1 Characteristics of Blockchain

Characteristics of Blockchain	
Decentralization	Data on the system can be reached, saved, and updated on various platforms.
Transparent	All data is saved and stored on the network and is reached and traceable through network lifetime.
Immutable	The blockchain system is used timestamps and check systems to understand immutability.
Irreversible	Every transaction made within the system is original and precise and original records are kept in the blockchain for each transaction.
Autonomy	Every node on the system can safely access, transfer, save and modify data without the need for a third party.
Open source	Blockchain gives everyone on the network a feeling of hierarchy open-source access.
Anonymity	As data is sent between nodes, the individual's identity stays hidden.
Ownership and uniqueness	Every document traded on the blockchain has a unique hash code that records who owns it.
Provenance	Every product has a special record document that verifies its validity and origin in the blockchain system.
Contract automation (i.e., smart contracting)	A computer program that executes the contract. It fulfills the terms of the contract by providing safer and less costly transactions. Moreover, smart contracts contain conditions that include rules, penalties, and actions that will apply to everyone involved in the transaction. Smart contracts support fast response operations to the supply chain.

Source: Adapted from Li et al., 2019

BCT is a distributed ledger or database running simultaneously on numerous nodes that may be distributed among numerous organizations or individuals (Swan, 2015). Imagine a platform that confirms and manages transaction confirmation between independent parties, permissions requested for the service, automatic contracts and contract processes among all participants, payment transaction and all these transactions.

Blockchain features include transactions, peers and ledgers, transaction validators, consensus algorithms and cryptography (hash system), communication channels, and smart contracts (Irannezhad, 2020).

Based on the new technology blockchain, it is a distributed database or digital ledger that contains all the transactions made by the participants in the network and all the records resulting from the events of the participants (Crosby et al., 2016). In addition, recorded network transactions are loaded into blocks, the cryptographic hashes in the network are systematically interconnected. For this reason, the blockchain is created with all registered transactions (Bogart and Rice, 2015). Before adding a block to the previously created blocks with a new transaction, the transaction must be approved by the majority of the nodes in the block, according to the consensus-based transactions that have been fully verified (Zheng et al., 2017). After the verification process, the information in the new block created cannot be changed (Nakamoto, 2008).

The blockchain technology is growing by adding new blocks to the chain in each ten minutes.The transactions in the system are followed by the miners. Additionally, all transactions made in the blockchain are listed chronologically. Each node is registered to the Blockchain network, which is automatically downloaded when a miner joins bitcoin's system network. Blockchain stores information about all transactions made (Swan et al., 2015). The input can't be removed or modified the information is recorded. Therefore, the blockchain technology is safe and easy to use, and this system is both network and database. Blockchain allows transactions to be built based on mathematically defined and mechanically enforced rules (DTCC, 2016). The essential point is that blockchain does not have a single definition due to a lot of dimensions, involve technology, various operational, legal and regulatory.

All transaction codes, transaction variables, or transaction results can be recorded. All transactions made can be monitored or encrypted by anyone, and these transactions can be seen by peer-to-peer nodes.

The peers in the system must be in the network system and have a public key for encryption and a private key for decrypting passwords in the system. While the public key is made public within the network, the encryption of data and the distributed network nature of the blockchain make it impossible to identify who is behind this public key. Every participant involved in the transactions and procedures is considered a peer in this sense.

Moreover, blockchain is a technology that can track transactions through previous blocks, thanks to the transparency and security of transactions. As a result, blockchain addresses the "who" dilemma, such as "who owns the data?" "Who is authorized to edit/change/delete the data?" and "who creates and maintains the database?" (Irrannezhad, 2019).

In the Blockchains, each block is orginal and has its own unique identification number (ID) and has a hash of the previous block so that it has high transaction security. Every transaction is confirmed by the users on the network and the transaction is recorded. In addition, timestamps and transactions are sorted chronologically. Transactions are linked to the previous block and recorded transactions cannot be changed. This structure used by the blockchain makes it a "reliable technology" (Queiroz et al., 2019).

Validators and endorsers use a consensus method to verify and endorse a transaction and then do one of three actions: deploy, invoke, or query ledgers.

Blockchain has an infrastructure where every transaction is verified, tracked, immutable and tamper-proof. The most important point that distinguishes the system from other technologies is that it uses decentralized distributed ledger technology (DLT). In addition, all transactions are verified and stored by distributed consensus, without the need for a centralized structure. For example, the "Consensus mechanism" is one of the most important features that make BCT trustworthy, reliable, and transparent. While each record is stored in blocks that are connected by hash values and the consensus method is used to decide new attach a new block to the system. An example "workflow" for using blockchain for a transaction is shown in Figure 2.1. It's important to note that this workflow is (Min, 2019; Fu and Zhu, 2019).

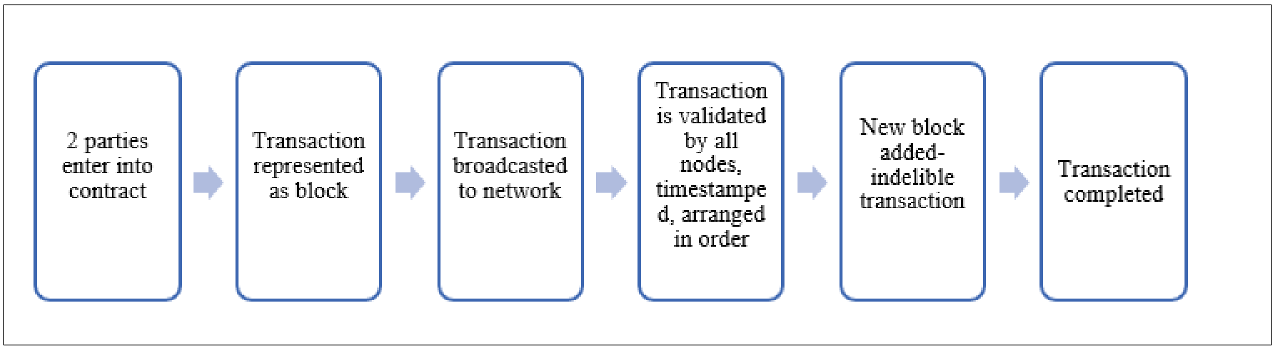

Figure 2.1. Blockchain workflow

On the other hand, to the "consensus mechanism" that blockchain uses, transactions made are safer, more transparent, and more trustworthy. Records made in the system are linked to each other with hashes and adding new blocks to the system is done by a consensus mechanism.

While all transactions are encrypted within the system, a special fingerprint is assigned to the transaction block by using hashing or cryptography method. While anyone can see the transaction, detailed information is encrypted inside each block and cannot be changed, and this transaction remains there forever. Only the mutual freight operators who have signed the transaction will have access to a copy of the ledger via interfaces like a mobile app, web-based service, or computer-based. Figure 2.2 shows how hashing establishes the link between current and past transactions (blocks) (Irrannezhad, 2019).

The first stage in designing a blockchain-based application is determining whether or not the blockchain is appropriate for the use cases. The process of determining if blockchain is suitable for use consists mostly of seven questions that must be answered and are referred to as white decision nodes. Grey decision nodes represent subquestions generated from the primary questions. Table 2.2 shows the formation of decision nodes.

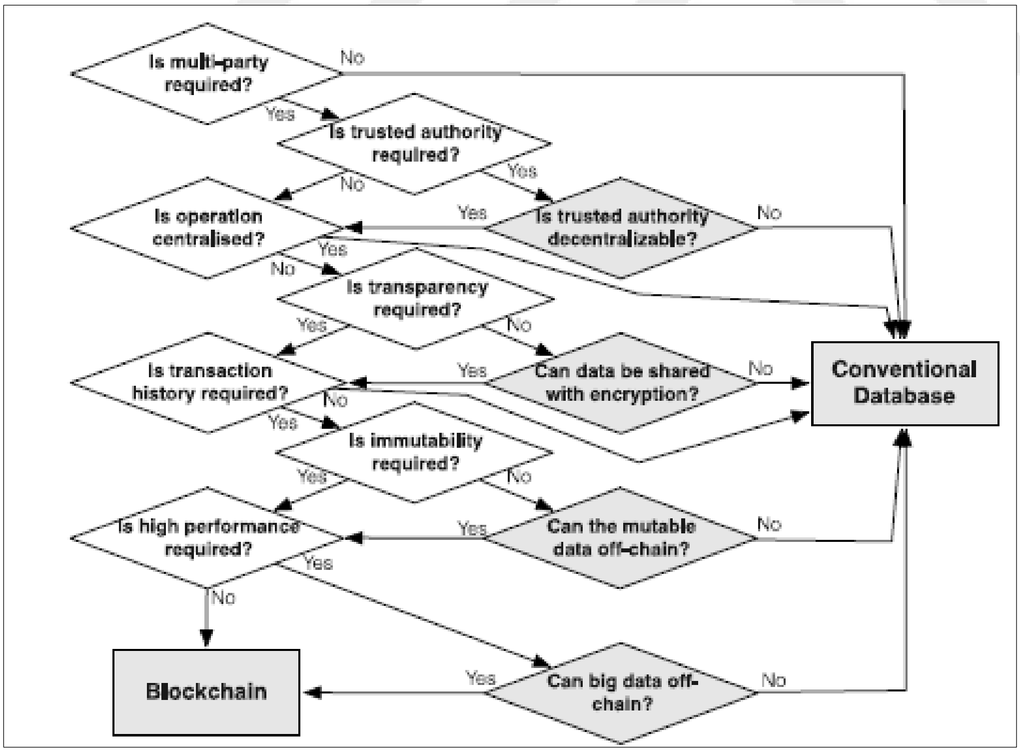

Figure 2.2. Evaluation of Blockchain Sustainability

Table 2.2. The formation of decision nodes

Multi-Party	The first issue is if the scenario involves many participants. Blockchain creates a common infrastructure with a natural stance that is not imposed by any of the participating organizations. As a result, blockchain is well suited to scenarios involving several participants, including those in which conventional systems may contain intermediaries (Lo et al., 2017). It will also make the process faster and cheaper.
Trusted Authority	The second consideration is that situation necessitates the use of a trusted authority. A trusted authority is a person or organization that has been given the authority to carry out a certain operation or change a policy or configuration of an activity. The bank and the government are the most important examples of trustworthy authority. Furthermore, if the trusted authority has a problem, it will affect all users who use its services. Blockchain is referred to as a "distributed trust" since it eliminates the need to rely on a single particular third party to keep track of a transaction's ledger.

Centralized operation	The application's activities are centralized, which is the third question. Smart contract systems are more difficult to implement than normally distributed systems in blockchain-based systems. This is due to the fact that smart contracts are made up of that govern interactions between mutually distrusting parties; confidence is generated from the knowledge that the code cannot be easily modified. By using a blockchain-based system, no single entity maintains power over the system, but users retain ownership over their own data and assets, which create governance difficulties. As a result, the existing blockchain setup is unsuitable for a system that requires a centralized operation.
Data transparency vs confidentiality	The fourth consideration is whether data confidentially or transparency is essential. Blockchain technology creates a neutral platform where all parties can see the data that has been released. The transaction may be checked by all processing nodes using all of the public data. Encrypting data before putting it on a blockchain can improve security, but it can also decrease performance, transparency, and independent auditability.
Data Integrity	The fifth question is whether transaction history integrity is necessary. The system is developing provenance, which may be used to monitor physical objects through changes in ownership and treatment, data integrity transactions are critical in previous transactions. When compared to alternative persistent systems, using blockchain to ensure integrity might be costly. Blockchain systems can be used to ensure system integrity but it is more expensive than other systems.

Data Immutability	The sixth point to consider is if data immutability is required. A key benefit of blockchain systems might be their strong support for immutability and non-repudiation in economies where third-party service providers are not necessarily trustworthy. The immutability of previous transactions is supported by the connecting of blocks in a chain of cryptographic hashes. In actuality, data on blockchain cannot be readily modified since it is constantly duplicated across many distinct places and organizations; efforts to modify it in one area would be regarded by other participants as an attack on integrity, and will be denied. Finally, Blockchain ledgers may be less adaptive than traditional systems governed by trustworthy third-party entities that allow for reversal due to their immutability.
High Performance	The seventh point is whether a high level of performance is necessary. Blockchain is not yet scalable but could be solved in the future. Due to enormous amounts of data and high-velocity data, blockchain is unsuitable for storing Big Data. Because a large number of processing nodes each retain a complete copy of the distributed ledger, this is an inherent shortcoming of blockchains. The current approach is to store significant amounts of data off-chain in order to avoid data duplication across all linked peers.

On the other hand, with the blockchain application, trust, transparency, and responsibility have become important and it is recommended to use new generation technology transactions, this technology is managed by smart contracts. Furthermore, the smart contract has special rules and used different policies. It is a software program that stores agreements between parties. Automatically confirms the terms of the contract between the parties and automatically executes the transactions (Delmolino et al. 2016). If the public or private contract network conditions are satisfactorily met, the contract executes its code and modifies the ledgers accordingly when it receives a message from a participant or other contract in the network appropriately (Peters and Panayi 2016).

Blockchain is an open global database and anyone with an internet connection can access the system anywhere. It's not similar to the traditional database. It is not owned by central parties such as banks, financial business and governments. Blockchain does not belong to anyone.

With in-network system cannot be prepared fake documents, cannot be made cheating and cannot use other information. These are impossible in the blockchain system.

In addition, Blockchain information is permanently recorded in the system. This not only decentralizes but also distributed information. Within the blockchain system, nodes are updated regularly, each block must be consistent with each other, and the system maintains a local copy of each block. The basic architecture of BC is represented in Figure 2.3. Every user is connected to other nodes. Also, all nodes are connected to the regularly updated list of blockchains, and a copy is available. A node can execute a variety of tasks, including initiating transactions, validating transactions, and mining. (Mohanta et al., 2019)

Figure 2.3. Architecture of Blockchain

2.2 Basic Elements of Blockchain

The most important 5 basic elements of Blockchain are shown in Figure 2.4.

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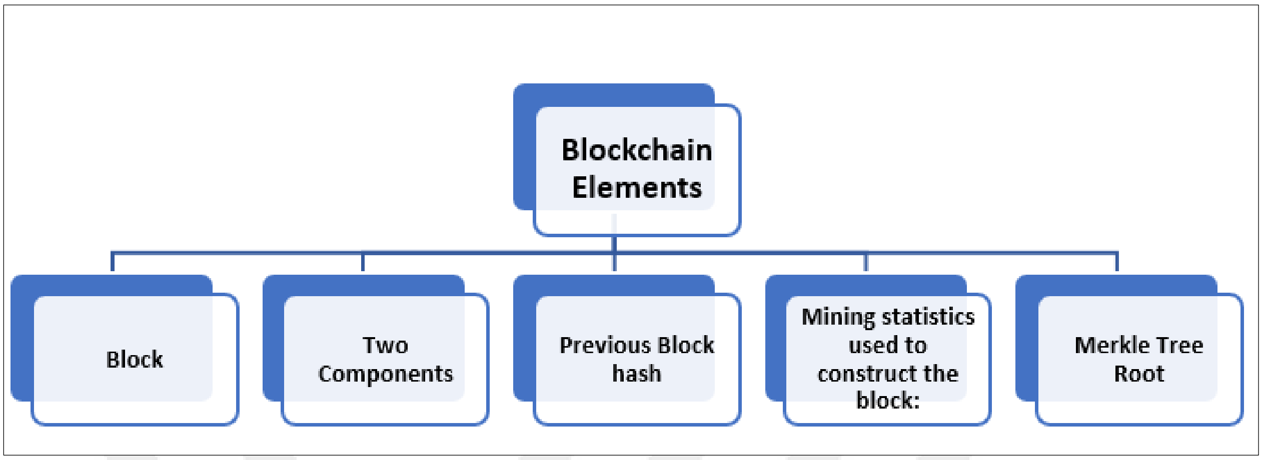

Figure 2.4. Elements of the BCT

Block:

In Blockchain, blocks allow for the gathering of valid transactions. Any node initiates a transaction that is broadcast to all other nodes in the network. Network nodes confirm the transaction after checking the old transactions and after that accept in the blockchain system. The number of transactions that happened during that time period is collected into a block and recorded in the blockchain bock. "A block might include than 500 transactions on average in Bitcoin, and a block's typical size is about 1 MB (Satoshi Nakamoto suggested an upper bound in 2010)". It has the potential to expand up to 8 MB in size or perhaps more (as of March 2018). Large blocks can speed up the processing of a significant number of transactions. Figure 2.5 shows the Blockchain technology in full (Mohanta et al. 2019).

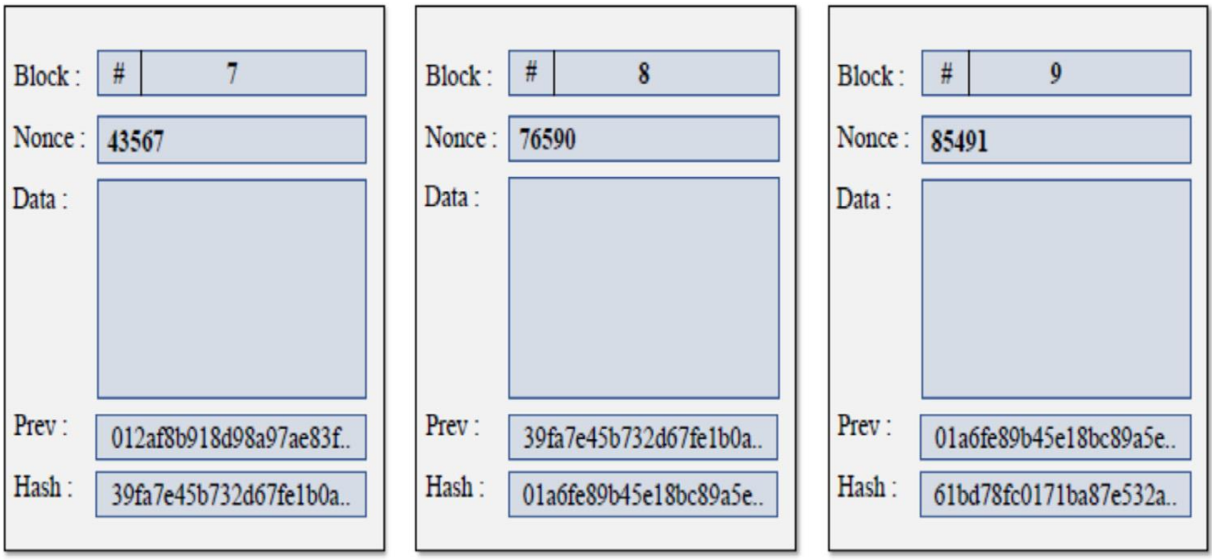

Figure 2.5. Detailed representation of the blockchain system

Two components: The block header as well as the list of transactions.

The metadata about a block is contained in the block header:

- **Previous Block hash:** Every block takes information from before block. Also, blockchian hash system utilise previous blocks to produce a new block hash, and this system makes the blockchain more powerfull.

The purpose of blockchain technology is to focus on information rather than economic and monetary, that many new and more popular token-free blockchains are based in the system. A hash function is a mathematical method that converts one input into another (Pilkington, 2016)

- **Mining statistics that were utilized to build the block:** The technique must be complex enough, to build the BCT tamper-proof for Bitcoin Mining.

$$H\,k = Hash\,(H\,k-1\,|\,T\,|\,|\,nonce\,|)$$

Additionally, the hash of the previous block hash value, the transaction root hash value T, and the nonce acquired by solving the consensus method are used to produce the current block hash.

- **Merkle Tree structures:** Merkle Tree structures are created transactions organized. All transactions are confirmed at the root of the Merkle Tree. If you want to modify a transaction, you must modify every subsequent block hash. The difficulty of tampering with a block in a Blockchain is determined by the difficulty of the mining algorithm (Mohanta et al. 2019). Figure 2.6 shows a diagram of the Merkle Tree structure

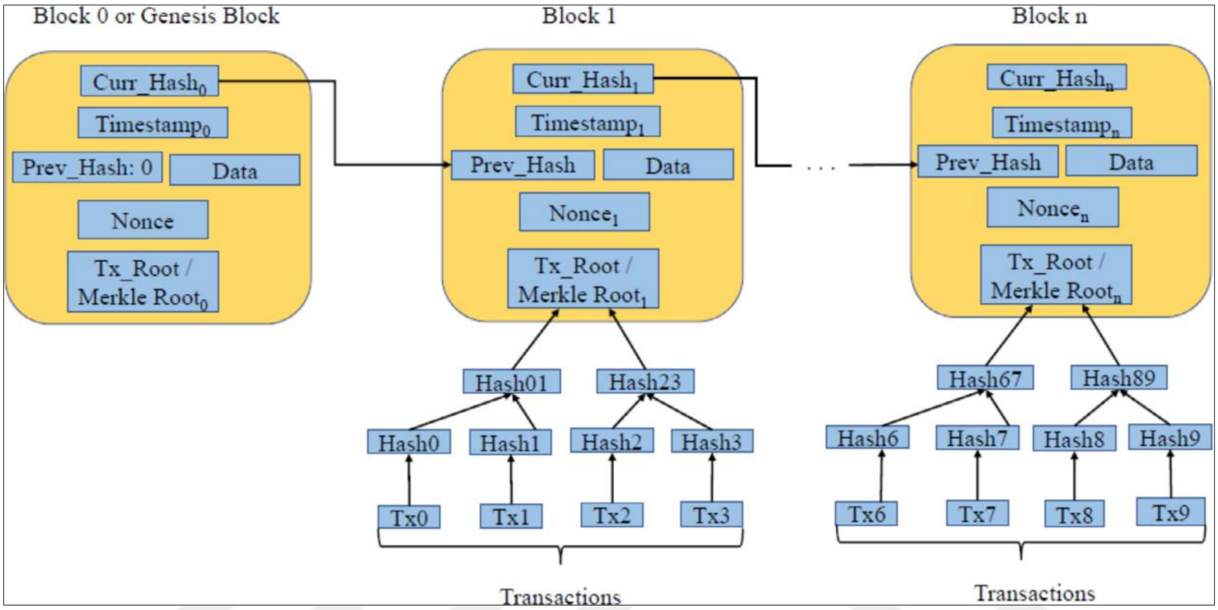

Figure 2.6. Diagram of Merkle Tree Structure

2.3 Types of Blockchain

Write-permissions are managed by a central hub of decision-making in a totally private ledger. There are two types of reading permissions: Public and restricted (Buterin, 2015). Public and private blockchains are important features in the system. The extent to which public and private blockchains are decentralized, or secure anonymity, is the difference between them. Partially decentralized blockchains also referred to as "consortium blockchains" (Buterin, 2015), are a mix of low-trust (public blockchains) and single highly trusted entity models (private blockchains).

There are 3 types of blockchains available such as private, public, and consortium in Figure 2.7.

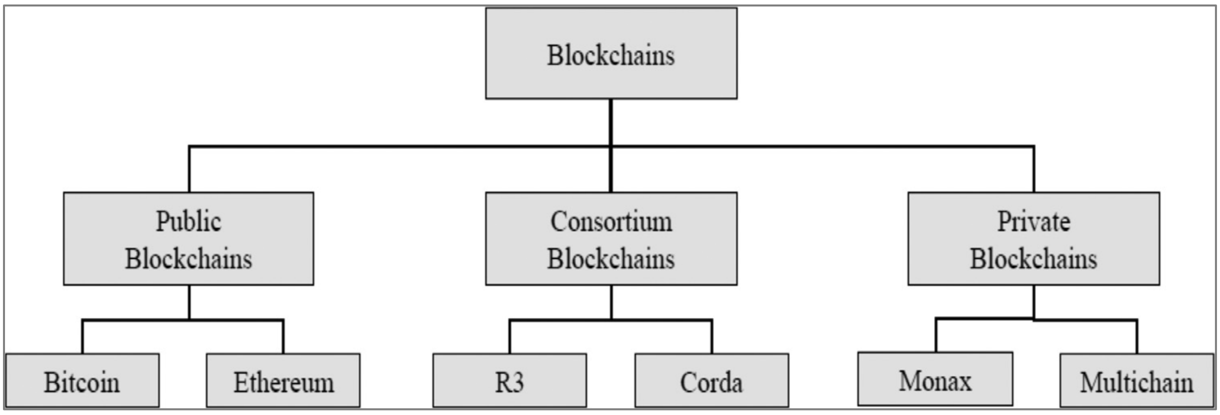

Figure 2.7. Types of Blockchain

- **Public Blockchain:** Everyone can access the ledger and can confirm the transaction via the internet, and anybody may verify and contribute a block of transactions to the BC (Xu et al., 2017).
- **Private Blockchain:** Private Blockchain enables only selected person within an organization to verify and create transaction blocks, but anybody with access to the internet may view them (Dinh et al.,2017).
- **Consortium:** Only a specific group of organizations (banks) may check and add transactions to the ledger, however, the ledger can be opened or restricted to a certain category.

Blockchain Groups Categorized

The blockchain concepts have 3 groups categorized in Table 2.3.

Table 2.3. Blockchain Groups Categorized

Permissionless Blockchain	• Permissionless blockchain, is a decentralized, independent, open public peer-to-peer network. It is a system that provides access without the need for the permission of other members. (Bitcoin, Ethereum)
Permissioned Blockchain	• In a permissioned blockchain, new members can only join with the consent of the current members. This is similar to the concept of a federation.
Private Blockchain	• Private blockchains are those where write and/or read permissions are maintained centralized to one entity, and as such are disputed as blockchains.

There are several forms of Blockchain

The BCT term (literally, a "chain of blocks") initially appeared in the scientific world in 2008, as part of the Bitcoin effort (Nakamoto, 2008; Lischke and Fabian, 2016). The goal was to send internet payments directly from one party to another without the need of middleman. In this case, the BCT served as the underlying ledger, documenting Bitcoin transactions, and ensuring payment verification and non-repudiation through cryptographic processes. Despite the fact that Bitcoin is the most well-known cryptocurrency, it is not the only one. In reality, over 1300 cryptocurrencies have been generated since 2008 (https://www.coinmarketcap.com/), which are utilized as trade tokens in a variety of blockchain-based applications.

Transactions: Represents a digital money transfer transaction between parties A and B. Cryptocurrency is the outcome of incoming and outgoing transactions, not a physical or software entity. As a result, the BCT keeps account of all transactions from its inception.

Blocks: All transactions organization into groups called blocks. Each block gathers all transactions that occur within a specified timeframe and maintains a reference to the previous block.

Nodes: Network machines (the "nodes") store the blockchain instead of being kept in a central database. Each node has its own copy of the complete blockchain.

Majority Consensus: There is no central authority, network decisions are determined by consensus. Updates local copy of BCT after each node update.

Mining: Cryptocurrency nodes can either passively keep a copy of the BC or actively participate in its maintenance, known as "mining". Nodes analyze past transactions to see if a subject is authorized to spend a certain amount of bitcoin and then solve a complicated computationally expensive mathematical problem each time a block has to be joined to the chain. This issue was created to reduce the chances of a hostile party manipulating the blockchain by fabricating transactions. Since joining a new block to the chain or changing a previously added block would need the control of a majority of network nodes, assaults are highly unlikely (to persuade them to accept the change).

Wallet: People use wallets to transfer bitcoin. In contrast to physical memory, cryptocurrency is the product of prior transactions. This means that a blockchain user's wallet only maintains references (unchanging combination of automatically given numbers and characters) that allow them to send and receive bitcoins. Each wallet has one (or more) unique addresses linked with it. The recipient's address and amount must be specified, and the user's credentials are used to validate the transaction. This is essential because if a user's credentials are lost, his or her bitcoin will not "vanish", but the user will no longer be able to spend it. As a result of this, it is confirmed that the user was the one who initiated the transaction by validating it with his/her credentials.

The advantages of blockchain technology are diverse and have suggested its use in many industries.

-Government (Ølnes, 2016), it uses it to transparently record citizens' votes or to verify whether politicians are keeping their promises to citizens (Huckle, 2016).

-Intellectual property (Rosa et al., 2016), to prove the authenticity and authorship of a document.

- Internet (Lee, 2016), which uses the immutability of data stored in the BC to eliminate censorship.

-Finance (Treleaven et al., 2017), transfer money between the parties without using the bank,

-Commerce (Kim and Laskowski, 2016), to register the properties and ownership of luxury brands' products, thus preventing counterfeiting and theft,

- Internet of Things (IoT) (Christidis and Devetsikiotis, 2016; Liu et al., 2017), for example, by using smart contracts to automatically analyze data from sensors, allowing intelligent devices to communicate with one another (Hong et al., 2017) and autonomously take actions when certain conditions arise.

- Education (Sharpes and Domingue, 2016), a person's education information can be written to the blockchain by schools and universities, thus reducing application fraud. Human resources personnel can easily access the documents obtained by the applicant and information about the diploma.The benefits of blockchain technology adoption are not restricted to a particular industry or situation. Furthermore, depending on the many parties involved, their business strategies, and demands, blockchain might have a variety of effects even within a single industry (Gatteschi et al., 2018).

A SWOT analysis has been conducted that summarizes the advantages and disadvantages of blockchain technology in Table 2.4. The aim here is to provide an analysis that can be helpful in various sectors.

The cost of money transfers can be reduced by eliminating intermediaries. Transfers are also quicker since bitcoins are sent straight from one wallet to another without the need for intermediaries (as is common, for example, in international money transfers). Moreover, smart contracts provide for a great deal of automation. Transparency is also assured since the blockchain may be accessed from anywhere in the globe. Furthermore, because anybody may theoretically write on the ledger, the BCT might get the repository of a massive quantity of data that could be utilized for data analytics in a variety of industries (medicine, education, and other fields not necessarily connected to insurance and money). The cryptographic technique ensures that data isn't tampered with and that transactions can't be reversed. To sum up, the blockchain's replication on each network node assures that it will withstand unforeseen occurrences (Gatteschi et al., 2017).

Table 2.4. Blockchain SWOT Analysis

SWOT Analysis of blockchain		
	Strengths	**Weaknesses**
Internal	Fast and low-cost money transfers	Scalability
	No need for intermediaries	Low performance
	Automation (by means of smart contracts)	Energy consumption
	Accessible worldwide	Reduced users' privacy
	Transparency	Autonomous code is "candy for hackers"
	Platform for data analytics	Need to rely to external oracles
	No data loss/ modification/ falsification	No intermediary to contact in case of loss of users' credentials
	Non-repudiation	Volatility of cryptocurrencies
		Still in an early stage (no "winning" blockchain, need of programming skills to read code, blockchain concepts difficult to be mastered)
		Same results achieved with well-mastered technologies
	Opportunities	**Threats**
External	Competitive advantage (if efforts to reduce/hide the complexity behind blockchain are successful, or in case of diffusion of IoT)	Could be perceived as unsecure/unreliable
	Possibility to address new markets (e.g., supporting car and house sharing, disk storage rental, etc.)	Low adoption from external actors means lack of information
	Availability of a huge amount of heterogeneous data, pushed in the blockchain by different actors	Governments could consider blockchain and smart contracts "dangerous"
		Medium-long term investment
		Not suitable for all existing processes
		Customers would still consider personal interaction important

Once the information is in the blockchain, it cannot be changed and anyone can access it, so it can harm the privacy of other users and be a weakness of the system. For instance, everyone in the system can control the amount of money and incoming transactions belonging to a person. This topic will become even more relevant if other types of information are stored on the blockchain. In order to deal with privacy-related problems within the system, some studies are carried out to anonymize payments and transactions (Saberhagen and CrytoNote, 2017; Ober et al., 2013).

Firstly, it is impossible to get help if identity information is lost within the blockchain system. Another factor is the volatility of cryptocurrencies, which might hinder the adoption of blockchain-based payment systems in the future. Given the speculative nature of cryptocurrencies and the fact that the technology is still in its early stages (bugs abound), their value fluctuates dramatically (Gatteschi et al., 2017).

In order to use blockchain effectively, it is necessary to know some technical features (knowledge of the concept of a block, setting up a wallet, etc.). At the moment, several efforts are being made in order to reduce/hide the technology's complexity (For example, the creation of browser extensions that allow users to readily check the ledger (MetaMask, 2017), the development of wallets that are user-friendly (Status, 2017), etc.). A competitive advantage might be gained by firms who provide blockchain-based apps and services (and, in the insurance industry, those that offer blockchain-based policies). For example, smart contracts might be designed to automatically make choices based on sensor data as IoT spreads more widely (Cristidis and Devetsikiotis, 2016; Liu et al., 2017).

Threats are related to a variety of external factors. First and foremost, due to bugs, cryptocurrency volatility, and other factors, the market may continue to distrust this technology, perceiving it as insecure or unreliable (Gatteschi et al., 2017).

The basics of blockchain-based applications

The blockchain core is based on a distributed database (ledgers) (Kano and Nakajima, 2018) that operates in a synchronized and shared environment (chain), with users validating data (Aste et al., 2017). This suggests a decentralized system in which transaction validation does not result in any changes (Chen, 2018) and where the tamper-proof feature of blockchain is continually used. Furthermore, all transactions can be traced, allowing organizations to reach the genesis node. Each block contains information from a previous block, which is stored in the current block (Li et al., 2018).

Blockchain transactions only work in a peer-to-peer network (Chen, 2018). Additionally, transactions are confirmed and held by distributed consensus. It is not important to have a centralized entity approving transactions. Figre 2.8 states that each block is linked (chain) to the previous block, and this integration facilitates the recovery of the information history by simply discovering the previous blocks. Every block has its own hash with original identification and is linked to the hash of the previous block, thus providing greater system security. Furthermore, the blocks include a series of transactions that are recorded and validated by other computers on the network. The transactions are assigned a unique sequence and time during this procedure (timestamp). The transaction cannot be changed once it has been verified. Moreover, the reason of transactions is broadcast across the network along with any valuable information, the operations' transparency is enhanced, allowing all network players to be kept up to date on everything. At the same time, this creates a sense of trust. Supply chain blockchain integration has the potential to improve efficiency and reduce transaction costs (Queiroz and Wamba, 2019).

Considering the content of the supply chain, such as participant trust, collaboration, information, information sharing, and etc. There is a clear implication about the traditional structures involved.

Supply chain blockchain has been investigated in recent research. Product traceability problems (Biswas et al., 2017; Chen, 2018; Lu and Xu, 2017), Cost, quality, risk reduction, and flexibility (Kshetri, 2018), and anti-counterfeiting (Biswas et al., 2017; Chen, 2018; Lu and Xu, 2017) have all been highlighted (Toyoda, et al, 2017). Furthermore, product traceability may be greatly enhanced (Biswas et al., 2017), allowing consumers to track a product's complete path and improving logistical service levels. As a result of all of this, transaction costs can be significantly reduced, especially when an intermediary is no longer required (Kim and Laskowski, 2017).

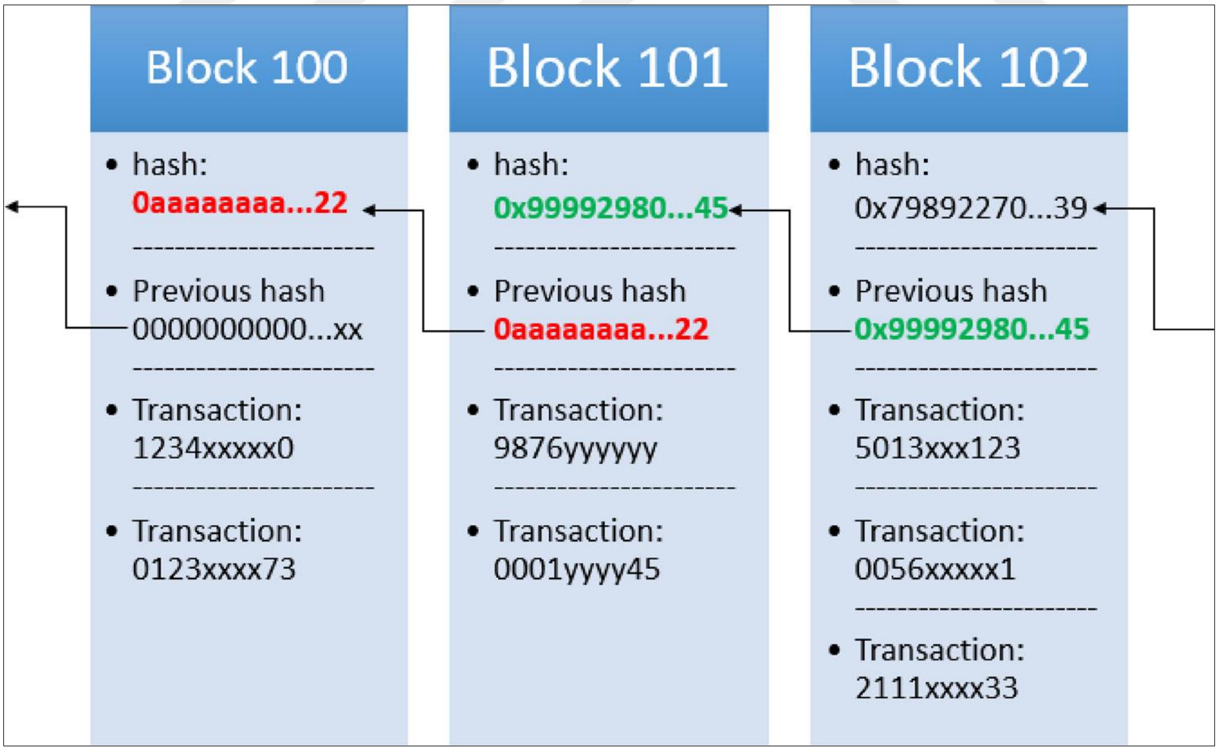

Figure 2.8. The main features and operating method of blockchain.

The security of the blockchain is a key feature (Aste et al., 2017) since it has the ability to change the way all supply chain interactions are managed. Another way to make use of blockchain is through the Internet of Things (IoT); Cyber-Physical Systems (CPS), and Big Data Analytics (BDA) (Banerjee et al., 2018; Yin et al., 2017; Li et al., 2018).

Blockchain is not just about digital money. Besides, BCT is a new concept and data flow paradigm for wide transactions for future occurrences in SCM and logistics sectors (Abeyratne and Monfared 2016; Tian 2016; Maurer 2017). The information contained in the created blockchain will be stored forever and using better transparency and high security (Li et al., 2018). Moreover, BCT includes several different characteristics features, and it is different from other information system technologies. For example, blockchain characteristics features: decentralization, transparency, smart contract, auditability (Steiner and Baker 2015).

Additionally, BCT has a wide implementation area and will be applied to most platforms: Blockchain application can be used not only in cryptocurrency and capital markets but in every field. Alternatively, Blockchain technology is used in many areas such as government, power energy, Internet of things (IoT), healthcare, e-business, intelligent transportation system, shipping industry, construction sector, agriculture, and food sector. Moreover, in BCT areas of interest smart contracts, network security, and privacy and different implementations and sectors (Lu, 2018). Internet of Things (IoT) is developing and BCT applications can assist businesses in developing collaborative services (Da Xu and Viriyasitavat, 2019). Due to BCT's rapid development, the service architecture has also been modified in this circumstance (Viriyasitavat et al., 2019).

Logistics blockchain applications: advantages and challenges

Decentralized tracking solutions for goods and containers can be used by businesses in the logistics and manufacturing industries. Comprehensive technical solutions are necessary to meet the demand for greater supply chain transparency, which enables for traceability from start to end. For information technology systems that rely on centralized solutions with complicated access permissions, this is frequently a difficulty. Due to the reason these concerns have already been addressed, BC or related concepts can provide a solution (Rauch et al., 2016, Petersen et al., 2016).

Some supply chains, such as the start-up UbiMS (A Global Supply Chain Revolution), are already employing BCT (UbiMS, 2017; Dobrovnik et al., 2018). A 3D (three-dimensional) supply chain process system, UbiMS is first patented cloud-based meta-platform for linking numerous suppliers of commodities to worldwide customers and for completely reinventing the global SCM chain process. As a result of this, UbiMS will be built on top of BCT. Additionally, the UbiMS 3D process platform combined with BCT has the potential to disrupt the all global supply chain sector (UbiMS, 2017).

International Business Machines (IBM) has tried to make the use of BC in SCs more efficient (Dickson, 2019). IBM and Samsung collaborated to create ADEPT ("Autonomous Decentralized Peer to Peer Telemetry"), a technology that builds a distributed network of devices, or decentralized Internet of Things, using parts of bitcoin's core architecture. BitTorrent (IBM, 2017) (for file sharing), Ethereum (for Smart Contracts), and TeleHash are the three protocols used by ADEPT (for P2P Messaging).

Consequently, the blockchain, food goods may be digitally tracked and authenticated from a supply chain to shop shelves and eventually to consumers. IBM, Walmart, and Nestle all want to use blockchain to make the global food supply chain more transparent, authentic, and trustworthy (IBM, 2017). Several established applications combine blockchain technology with food technology, with the primary goal of addressing food safety concerns. Their goals in creating a food supply chain are to provide motivation, trust, sustainability, and transparency (Mao et al., 2019).

The IBM blockchain platform, which is hosted in the cloud, provides clients with end-to-end capabilities to fastly activate and effectively create, run, govern, and protect their own commerce networks. All parties engaged in shipping may benefit from blockchain technology by increasing sustainability, reducing or eliminating fraud and mistakes, improving warehouse management, reducing transportation costs, delays caused by printed documents, waste, and identifying concerns sooner (World Economic Forms's, 2018).

Hackius and Peterson did research on the subject of the research blockchain in logistics (Hackius and Peterson, 2017). Many logistics professionals have participated in this online survey. In this survey, questions were asked about the following topics in the field of SC and logistics: barriers, facilitators, and general prospects. Many of the survey participants who accepted blockchain technology suggested having positive effects. As a result, information communication technology (ICT) solutions have to create more carefully and needs more resource like logistics, related in the blockchain.

Furthermore, encryption techniques and distribution data storage safeguard data in the system (Wu and Tran ,2018). Finally, below is Figure 2.9 about the potential of blockchain for logistics.

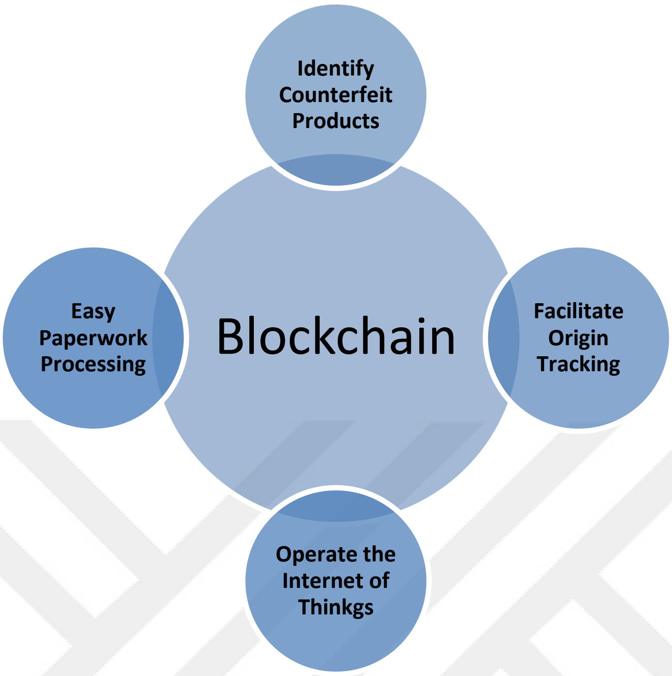

Figure 2.9. Blockchain technology potentials in logistics

1- Easy Paperwork Processing (there is a lot of documentation involved in worldwide container shipping, which takes time and money. Freight papers can be lost, manipulated, and fraud).
2- Identify Counterfeit (Counterfeiting is a huge problem for private items in supply chains. For example, cancers drugs are very expensive in the pharmacy industry. Pharmacies must ensure that they are selling the right medicine to consumers).
3- Facilitate Origin Tracking (foodborne outbreaks are problems for retailers in the food supply. They have to quickly check and where food comes from, what products it comes into contact with it, and finding and removing it from the stores).
4- Operate the Internet of Things; sensors are used that create data about the status of a shipment in the supply chain. Should be preserved in a convenient manner.

Researchers of the study described the business management processes are part of the logistics activities. In this case, the authors demonstrated the current state of BCT in supply chain and logistics. The study and analysis focused on the perspectives of owners and employees in the logistics business on the use of BC. According to the result of the analysis, collected data, the blockchain technology used in logistics activities turned out to be a very positive effect (Hackius and Peterson, 2017).

Blockchain technology plays a main role in improving logistical operations and reducing difficult issues. This will be especially evident when blockchain technology is increasingly used to create smart contracts. Such contracts have the potential to digital commercial services while also improving underlying business processes. ShipChain (ShipChain, 2019) was one of the first marine logistics businesses to implement smart contracts.

Generally, blockchain technology has some weaknesses and threats. Scalability and performance problems plague the BCT. All nodes must record all transactions in the chain, and this demonstrates a problem with big and especially worldwide scale rollouts. All nodes have a full copy of the ledger and there is no central authority to notify in the event of a security breach, users' privacy may be compromised. Additionally, the technology is immature because it is newer. It is difficult to master the concepts in the system and intervention is needed even in the simplest application. Threats to blockchain deployment are the flaws that have been found. The main problem with technology is that players within the system are also reluctant to adopt it. Technology can be understood as insecure and unreliable for a variety of reasons (Tijan et al. 2019).

Blockchain technology has various scarce limitations and implementations in the industry of literature (Beck et al. 2017; Du et al. 2018). For this reason, the limits of blockchain technology are understood by the information received from the success or failure of their projects. The failure rate of projects done so far has been high and only 8% of the 26,000 blockchains were successful in 2016 (Browne, 2017).

Some of the organization and supply chain networks suggest blockchain' advantages such as, include growing online data and money transactions, security and realiability advantage of shared data, digital assets, and decrease number of members in the chain. In this way, the intermediaries can be eliminated by using a smart contract. Smart contracts are used through autonomous contracts. It enables the trading of digital assets or rights of tangible or intangible assets in the form of tokens (Buterin, 2014).

Blockchain implementation project has many advantages such as; make automating transactions and many contracts, and using fewer members, general supply network, and logistics activities involving numerous actors are seen to be the ideal application case for blockchains (Du et al. 2018; Pawczuk, et al., 2018). Blockchain implementation projects should propose a set of decision rules to be considered. These rules:

1- Implementation teams should seek more efficient innovations.

2- Use cases involving large amounts of data and most transactions should be avoided, and as too much will slow down the BC and decrease its efficiency.

3- Creating a sandbox for testing blockchain ideas and gaining a better understanding of their risks (Pournader et al. 2019).

As it was mentioned a blockchain system is made up of computing nodes, that share a similar data structure and have reached an agreement on consensus. The most important examples system is Bitcoin that created a distributed network of private accounts and transactions, where reviews or tampering is reorganization difficult because of the algorithm combined with economic consensus (Nakamoto, 2008).

The data structure system supports a blockchain system and is distributed because it's repeated the system between the nodes. New blocks of last transactions are joined the new distribution data structure; they constituted the new reference back the code of the previous block and comprise back blocks code. Moreover, nodes can describe the entity of the data structure. Ultimately, these transactions are blockchain systems (Idelberger et al., 2016).

On the other hand, transactions are not cost-free on the blockchain. The miners must expend computational power and energy so that, transactions incorporate blocks into the blockchain. The bonus, if a miner "discovers" a new alternative of the issues to comprise a block, the miner gets a financial bonus in the new bitcoins and transactions cost. However, it is currently unclear how the algorithm will work when the specified number of bitcoins is reached. The trade cost is a bonus for the miner who comprises this transaction. The fee may also cover the cost of the computing processes necessary to run the transaction in sophisticated blockchain systems, especially when the transactions are related to extra instructions.

The blockchain technology was originally developed to serve as a distributed ledger for crypto-currency transactions (namely Bitcoin transactions) it may be used to manage smart contracts and related transactions (Idelberger et al., 2016).

Blockchain technical concepts take into account various architectures to understand such as security, performance, privacy, and regulations respect. There are a number of Blockchain-based solutions that have been created to solve various challenges. As a result, different technologies are less or more usable for particular purposes (Kakavand et al., 2016).

Furthermore, blockchain technology is a digital area that maintains a temper and revision-proof record of all transactions between users on a network. Additionally, blockchain is a database that provides transactions currencies such as bitcoin and ethereum. Cryptographic algorithms examine all transactions made between users or counterparties, and then they are organized into blocks and uploaded to BC. Moreover, all blocks are chained to each other blocks and the information cannot change. Each node in the Bitcoin network has its own copy of the Blockchain, which is connected with other nodes through a P2P protocol. This situation shows the futility of a central authority and many of the players can lose faith in the integrity of any one institution (Bitfury Group, 2015). Lastly, without the use of third parties, blockchain allows diverse transactions to be processed and safe consensus to be reached.

CHAPTER 3

LITERATURE REVIEW

The definition of the blockchain is the "digital ledger in which permanent, resistant and unchangeable records are created in the digital environmental, where the transactions are recorded in a decentralized, transparency, traceability, distributed ledger, the transactions are recorded in a chronological order daily" (Treiblmaier, 2018).

Some of the areas where it is used effectively include real estate (Spielman, 2016, Veuger, 2017), supply chain (Burger et al., 2016), healthcare (Mettler, 2016), the energy sector (Mengelkamp et al., 2018), and government (Ølnes et al., 2017). The advantages of using BC include security, irreversibility, distribution, transparency (Chiaroni et al., 2019), and correctness (Iansiti and Lakhani, 2017).

Blockchain supports all transactions, and system users' access more efficient, secure, cost-effective, and transparent. This technique is widely assumed that blockchain's distributed nature benefits in mitigating supply chain risks (Zhang et al., 2020; Arza et al., 2020) such as vulnerability, privacy, hacking, cost compliance with government requirements, and contractual disputes (Min, 2019).

The blockchain enhances interactions with all systems in the supply chains, and these are not only increasing efficiency and lowering costs between all stakeholders (Queiroz et al., 2019).

On a global scale, when commodities are moved from one destination to another, there is a need for time and a lot of printed documents, as well as a lot of people. All of these procedures have a direct influence on the producer and retailer in terms of high costs, product damage/loss, time consumption, fraud cause, and last but not least, tax losses to the government (Popper and Lohr, 2017).

In today's world, digital data travels from one end to the other over an untrustworthy transmission channel. Privacy and confidentiality are important concerns here. Blockchain technology enables peer-to-peer communication that is both safe and private. Transactions are open to the world for reading in Blockchain technology, but no one can change them once they have been recorded (Mohanta et al., 2019). There are a few common properties of blockchain technology. The combination of these features separates blockchain from other information systems. Blockchain technology, unlike other commercial information systems, has a unique data structure that keeps data as a chain of blocks. When a new transaction is entered into the system, it creates a block that is linked to the blocks before it, creating a new chain (Nakamoto, 2018). Therefore, blockchain technology gives trust, provides transparency, more fastly, and removes intermediaries.

Blockchain is offered as a means to coordinate records in a distributed manner through a consensus mechanism (Beni et al., 2019; Gao et al., 2018) in the Industry 4.0 age (Fernández-Caramés et al., 2019). Transparency, trust, security and authenticity, cost reduction, disintermediation, efficient operations, and decreased waste are some of the qualities that have the potential to change SCM (Gurtu and Johny, 2019; Philipp et al., 2019). Consequently, the use of the blockchain application, all of the transactions are more realiable, safer, efficient and transparent (Queiroz et al., 2019).

In addition, BC's contract implementation simplifies order placement and operation automation (Sheel and Nath, 2019). As a result, the ripple effect in SC is minimized by utilizing blockchain technology (Ivanov et al., 2019).

As a result, the integration of BC with SCM will be a need. These systems help to smart contract implementation (no use all blockchain in the system for a smart contract), and blockchain-based applications make more fields in the SCM. Smart contracts can manage money transfer between a supplier and a customer as soon as the purchased goods are delivered (Swan, 2015), or transfer ownership rights once money transfer has been made (Wang et al., 2017).

Additionally, the developing blockchain in SCs not only improves efficiency and reduces cost but also all stakeholders improve relationships. It also increases confidence and simplifies the associated business processes (Queiroz et al., 2019). Blockchain has lightened the burden on international ports by integrating the entered information (Tan et al., 2018). The blockchain integration changes the SC's structure by ensuring collaboration among all stakeholders through the use of digitization and smart contracts (Saberi et al., 2019).

As shown in Figure 3.1, blockchain technology has two major features that are critical to its deployment and practical usage in logistics and supply chains/supply networks.

- Safe, verifiable, and trustworthy transmission of information over blockchain in real-time that makes them available to all chain members of the supply network,

- If specific conditions are satisfied, smart contracts—implementations that live on the blockchain—can automatically verify and execute agreed transactions (Christidis and Devetsikiotis, 2016).

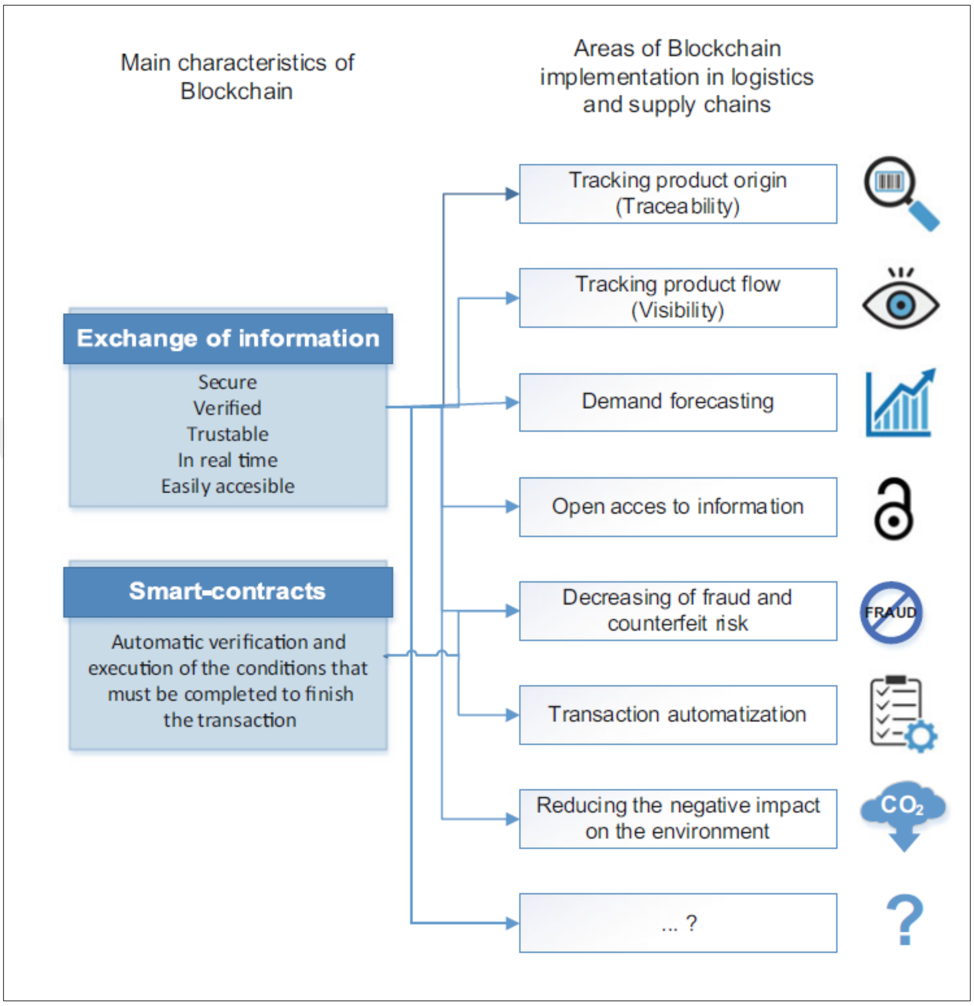

Figure 3.1. Important Features of BCT in SC and Logistics / Supply Network

In addition to tracking the production of products, which is one of the most significant areas of blockchain in the logistics industry and SC operations, it also provides product demand forecasting, reducing counterfeiting and fraud of products, reducing negative effects on the environment and tracking transactions through smart contracts. In many situations, blockchain implementation areas are merged in SCM, and blockchain is utilized for monitoring product origin and movement, as well as reducing fraud risk and providing more accurate demand predictions (Dujakand and Sajter, 2019).

3.1 Blockchain - Supply Chain Management

A supply chain (or, supply network) is made up of many entities by the actual movement of resources. These many businesses are involved in the conversion, logistics (shipping, warehousing, etc.), or selling of materials (raw materials, in progress, inventories, and finished items), with the materials reaching ultimate buyers in some desired shape and amount (Mentzer et al., 2001).

The Supply Chain (SC) is a system that enables all the actions and information flows involved in delivering goods or services from a supplier to a consumer. The administration of operations and information connected to sourcing, procurement, conversion, and all logistics is referred to as supply chain management. SCM may provide a variety of financial, environmental, and social advantages, such as better resource usage, shorter order to delivery cycles, and early issue identification (Wu et al., 2019).

There are several factors contributing to the complexing of SC such as human error (Finch, 2004), servis disruption, and climate change (Halldórson and Kovács, 2010). In addition to these, the IT industry has problems with cyber security threats, talent shortage, cloud computing, remote workplace, risk of outsourcing, and government rules of different countries. In this investigation, researcher discovered that 66 percent of the mistake was attributable to human error (data loss) (Sullivan, 1999). All these problems cause a decrease in performance and lead to financial losses of companies (Punter, 2013).

When the situations are supply chain management and logistics management, classic difficulties such as raw material, product damage, incorrect data input, and order mishandling still exist in logistics and SC management problems. The correct involvement and participants of many stakeholders contain global logistics companies, operational efficiency, maintenance cost, big data management, and IT support, would be required for simple running of blockchain in the supply chain system. Aside from these, government existing rules on cryptocurrencies, data warehousing, scalability, and high-speed internet access with significant processing capacity are also key difficulties. Infrastructure problems of countries may prevent the efficient use of blockchain. Therefore, technology cannot be used efficiently (Min, 2019).

Supply chain management is always a very important issue that needs attention. The definition of the SCM is a concept that manages the flow and planning of materials to raw materials, storage, and end-users (Cooper et al. 1997).

The supply chain has various challenges and needs to be defined. Additionally, the SC refers to a collection of procedures involved in the sourcing, processing, and distribution of products and services, and involves numerous required phases.

Moreover, SCM allows for the availability of the right item, in the right quantity, at the right time, at the right location, and at the right price, while also considering the right circumstances for the right consumer/customer (Susan, 2010). New product creation, sourcing production logistics demand management, coordination and integration are the most essential supply chain operations. In this respect, logistics is an element of SCM (Vitasek and CSCMP, 2013).

Furthermore, SC performance has many dimensions: cost reduction, quality, safety, risk reduction, speed, flexibility, and sustainability (Kshetri, 2018). These are the characterizing dimensions of the SC performance dimensions. The biggest problem for managers are getting the product manufactured and delivered on schedule at the lowest feasible cost while maintaining the product's quality during transportation (Flint 2004). Another major element of SCM is the rise of counterfeit and forgeable items, which results in market share and confidence losses among SC members (Chen et al. 2017). As a result, in order to maximize SC profitability, transparency, social responsibility, and accountability must always be a part of SCM (Anantadjaya et al. 2007).

Most of the organizations began to visualize the whole supply chain to maximizing customer value and the possible advantages via a division of labor based on each other's core competencies. Therefore, firms began to rely more heavily on supply chain partners, especially end customers, altered their approach to coordinating functional operations not only inside individual companies but through the SC (Min and Mentzer 2000).

On the other hand, the creation and distribution of a product to the final consumer frequently includes numerous independent organizations. There are raw materials sales, wholesalers, product assembles, retailer traders, and logistics operations in the supply chain (La Londe and Masters 1994). To use an alternative definition, a supply chain is a network of companies who are associated with diverse processes and activities that generate value as products or services provided to an end-user, via upward and downward connections (Christopher 1992). A supply chain is made up of numerous businesses, both up (supply) and down (distribution), as well as the consumer (Mentzer et al. 2001).

Logistics services are often essential to a company's ability to give value to consumers (Mentzer, et al., 2001). An effective logistics operation in SCM is to deliver goods on time and at a low cost as much as possible (Flint, 2004). Quality, speed, reliability, cost, and adaptability are some of the criteria that are commonly used to measure supply chain management performance (Meyer and Hohmann, 2000; Goldbach and Back, 2003; Rao and Holt, 2005)

In the late 1990s, a greater interest in globalization began to emerge and market power evolved from manufacturers to retailers. Along the SC, customers have come to demand "more advantages for less money" (i.e., raising customer value). Therefore, a higher degree of customization was necessary for the demands and goals of their specific.

Companies seek to integrate upstream and downstream among SC members to stay ahead of their competitors in the global market. Global sourcing and marketing need increased supply and demand uncertainties about lead time and quality due to geographical, temporal, and cultural constraints.

3.2 Supply Chain Management Flow

Suplly chain management plays a significant role in decreasing operational costs in the worldwide market (Gunasekaran et al., 2004). It's the goal of every company to get their products into consumers' hands at the lowest cost possible. There are several advantages of using BC over SC, including the ability to decrease costs (Catalini and Gans, 2016) and improve product quality (Catalini and Gans, 2016).

BC should be included with SCM. Securing data and transactions, as well as the dispersed nature of and transactions in peer-to-peer networks, were their main concerns (Korpela et al., 2017).

SC procedures must be efficient in terms of performance, quality, and prices in order to survive in the market (Christopher and Towill, 2001). Therefore, impacting SCM is the growing need for openness, accountability, and social responsibility from customers throughout the world (Lee and Pilkington, 2017). Customers' requirements want transparency; therefore, SC procedures must become visible.

In addition, Figure 3.2 shows the available supply chain. In this scenario, may be financing by assuming some of the risk and providing financial advice, third-party logistics(3PL) provider running logistics activities between two companies; the market research firm supports the supply chain well to provide information about the end customer. Ultimately, complex supply chains can have a lot of functions and do perform (Mentzer et al. 2001).

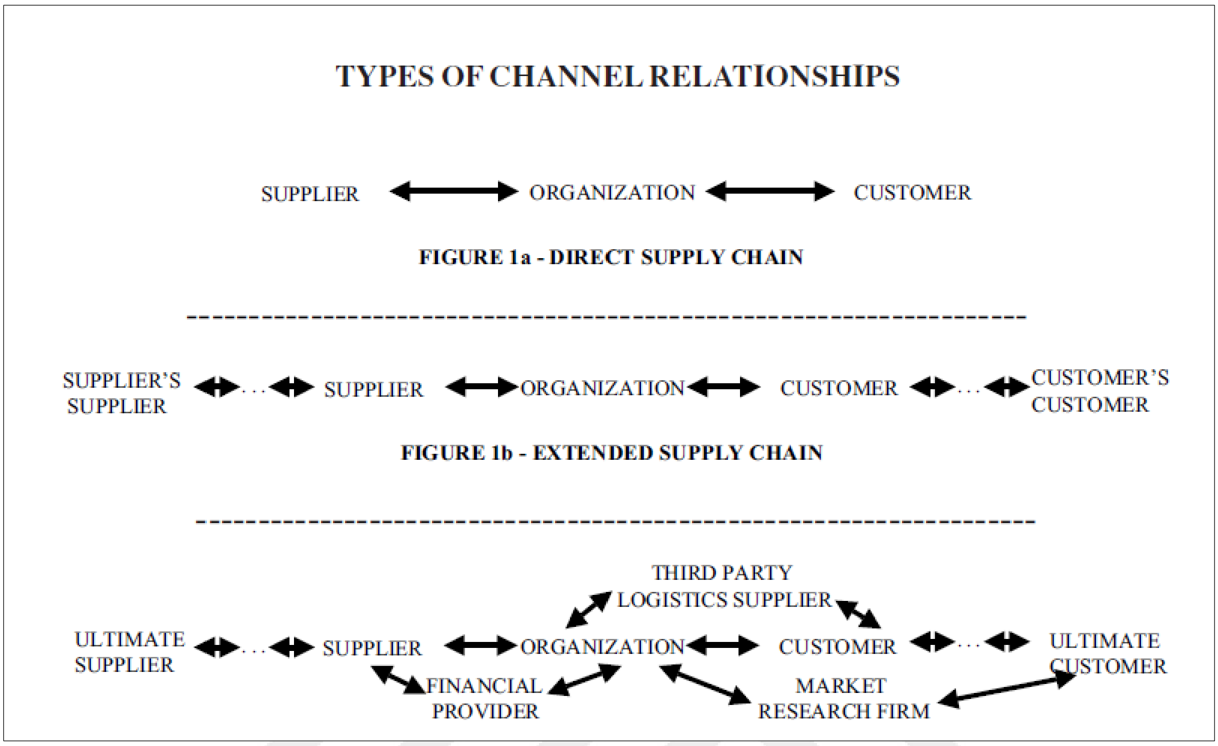

Figure 3.2. Available Supply Chain

Resource flow operations and movements of the product, information, members and money are performed and managed by SCM design. Consequently, it allows the integration of diverse resources across numerous organizations. For this reason, as businesses create and market their funds, people, goods, and information are all resources that are combined with others (Mallick et al., 2018).

SCM is always coordinate flows on both the supply and demand sides by linking all of these resources. Customers are concerned about concerns such as product availability and condition, punctuality, the quality of order-based information, interpersonal communication, and the discrepancy-handling procedure, according to research on logistics service quality. To put it another way, retails or end-user /consumer are worried about these components since having the correct items accessible when needed not only meets their own requirements but is also a prerequisite for servicing their clients farther downstream.

The BCT is seen as a digital innovation and an emerging enabling technology by SCM (Buer et al., 2019). SCM is described as the systematic, strategic coordination of traditional business operations and strategies inside a firm and between companies within the SC in order to enhance the long-term efficiency of personal business and the supply chain benefit of the entire (Mentzer et al., 2001). Furthermore, the blockchain has unique technological properties such as immutability, automaticity, pseudonymity, and non- reputability (irreversibility), which might lead to unprecedented SC reliability, transparency, and efficiency (Treiblmaier, 2018).

Supply chain provenance is secured by giving product information that is certifiable, traceable, verifiable, and traceable, as well as a guarantee of authenticity, and entirety across the whole SC (Tang and Veelenturf, 2019). The public ledger is creating irrefutable records that blockchain is a distributed consensus mechanism that participants aware from information (every event and every transaction.

As a result, blockchain technology is being used across a variety of supply chains, including banking, transportation, electricity, agriculture and food (Groenfeldt, 2017; O'Marah, 2017). Indeed, the IoT, sensors, barcodes, chips, RFID and GPS tags have a substantial impact on SCM, such as in all operations connected to identifying items and monitoring packages and shipping containers (Kshetri, 2018). All participants in the SC may know which activities are being done and who is executing them thanks to blockchain technology (Alam, 2016), as well as the time and location of these actions, according to blockchain technology.

There are several advantages to the use of blockchain technology, including the possibility of identity management (Alam, 2016) and the ability to evaluate the results and performance of critical SCM operations accurately and efficiently (Koetsier, 2017; Kshetri, 2018).

Digital technology improves demand responsiveness capacity flexibility during the proactive and reactive stages of the process, improves supply chain visibility, and allows improved data coordination in ripple effect control. Monitoring is an area that can be used to prevent and minimize risks that may occur in SC. Appropriate, coordinated response and information recovery efforts at the right time are vital in reducing disruptions (Wong et al, 2020).

BCT may be utilized to develop the scale and range of breadth of tracing and tracking and provide larger visibility for state maintenance and communication (Ivanov et al., 2019). Effective information flow is a very important fact for SCM, and this situation is utilized within organizations and without organizations (Tatoglu et al. 2016).

Traceability, efficiency autonomy is the main features of SCM and BCT was suggested as the best approach for improved decision making (Omran et al. 2017). The single-truth version method of recording in a transparent environment and makes record-keeping and tracking simple in blockchain and supply chain management. Information is updated in real-time, which improves information availability and lowers the total cost of tracking and moving objects in supply chains (Wong et al, 2020).

3.3 Transparency – Traceability

Blockchain technology has special and important features such as traceability applications. There are many actors in the SC, and between the actors involved, the goods and related documents are transferred to different actors in the system. During these transfers, these goods are exposed to counterfeiting or theft. Therefore, to avoid negative situations, BCT implementation includes digital "token" that is associated with physical elements. Once the item is delivered, the ultimate receiver may validate the token, which can track the item's history back to its place of origin.

In addition, end-users have more trust in the information they get since no one person or collection of individuals may one-sidedly alter the information contained inside blockchains (Francisco and Swanson, 2017). The main purpose of the SC is the process of verifying information about the origin of the product and the route through which products travel from the place of origin to the end-users, and this is the most common use of blockchain. Traceability and visibility have always been a key challenge when it comes to providing customers with exceptional logistics service. The most important key feature of blockchain is that it provides customers with reliable information about product origin and route information (Dujak and Sajter, 2019).

Transparency is used in SC traceability to coordinate organizational purposes linked to raw material sources and offer context to a finished good or service. By nature of the protocol, blockchain technologies enable enhanced supply chain transparency, but it also provides an immutable and distributed element of the custody record, which lends itself well to tracing applications (Francisco and Swanson, 2017).

Traceability and source mean the same thing, from French referring to "the origin of anything". It is described as the capacity to recognize and verify the components as well as the sequence of events in a process chain (Skilton and Robinson, 2009).

By nature of the protocol, blockchain technologies enable enhanced supply chain transparency, but it also provides an immutable and distributed element of the custody record, which lends itself well to tracing applications. The transparency concept is the heart of establishing sustainable supply chains (Carter and Rogers, 2008) and it can be a success if the proper tools and procedures are used to manage them from end-to-end (Beske-Janssen et al., 2015).

In the context of the SC, transparency may be described as "the manner in which supply chain information is conveyed to stakeholders" (Morgan et al., 2018). BCT can increase transparency and accountability in the SC networks (Lu and Xu, 2017; Kshetri, 2018). As a result, blockchain transparency may improve the collaboration of SC network participants, resulting in major changes in the industry and society at large (Aste et al., 2017). Supply chain transparency encourages suppliers to socially responsible practices in order to influence customer purchasing behaviour and produce conditions to follow actions, especially for executives with valuable, high-profile brand names (Awaysheh and Klassen, 2010).

Additionally, there are several difficulties with traditional supply chains today, including product traceability, transparency, and accountability (Min 2019). In this perspective, BCT will become a promising technology for the future. Over and above this technology will bring enormous improvements in SC operations (Pazaitis et al., 2017; Kamble et al., 2019).

Moreover, participants in the blockchain network that are authorized keep the same copy of a ledger that comprises a list of transactions. The most recent approved transactions are updated in the ledgers. The network participants may see the entire history of transactions, which allows for auditability and traceability (Underwood, 2016). The blockchain's high level of openness improves network fairness and data access (Swan, 2015). Transparent information eliminates the need for middlemen in the process, improves efficiency, and lowers risks (Nofer et al., 2017).

Information easily accessable to final users and companies in a supply chain is referred to as SC transparency (Francisco and Swanson, 2018). Moreover, supply chain transparency main focuses on social sustainability then the second focuses on traceability of logistics and production (Venkatesh et. al., 2020). Blockchain's main features can help business' structure which includes multiple parties, require trust transparency, as well as efficiency in an inter-party transaction, contracts, and data management (Irrennezhad, 2019). A transparent and traceable product life cycle may help governments, stakeholders, and user's close product life cycle loops, reduce waste and reduce emissions while also engaging governments, stakeholders, and users. On the other hand, the integration of information flows across the product lifecycle is achievable with blockchain, as shown in Figure 3.3.

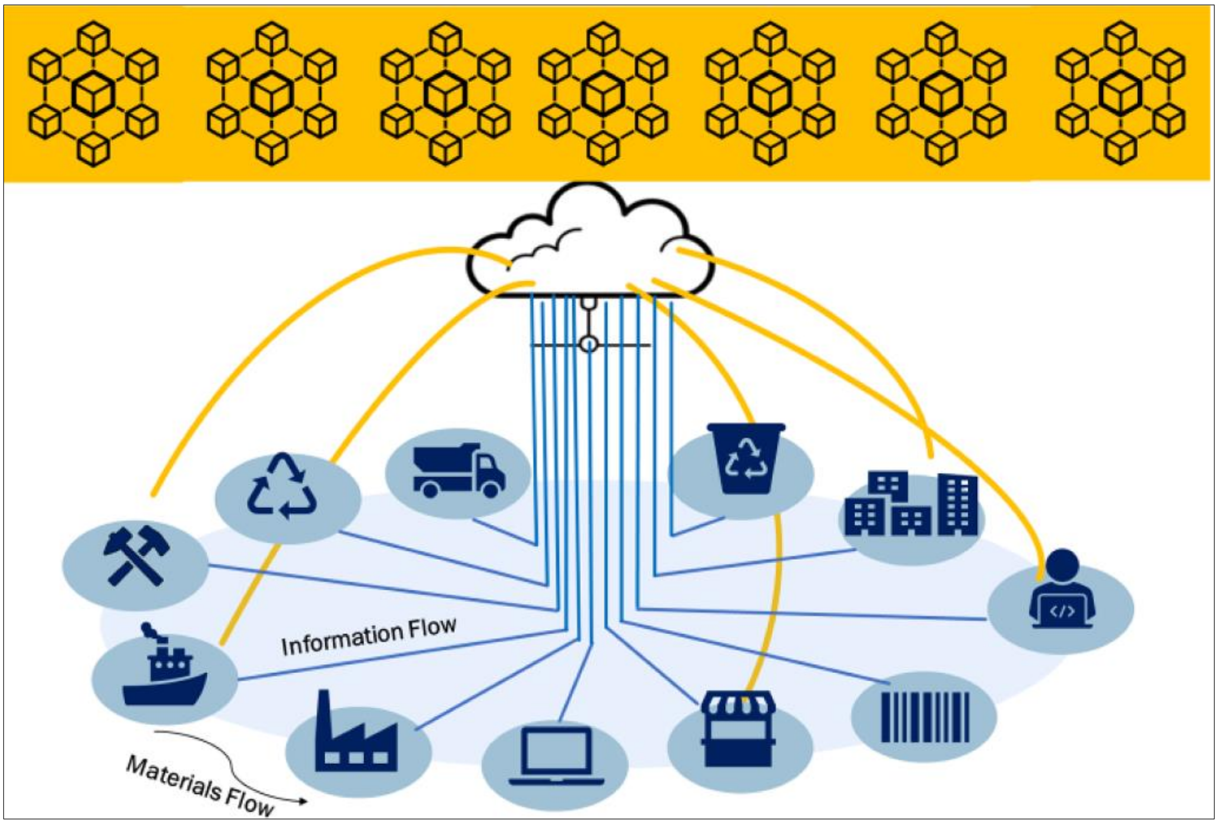

Figure 3.3. Product Lifecycle with Blockchian

Similarly, the supply chain idea of transparency contains information that is easily available to consumers and companies in a SC, similar to supply chain traceability. According to Lamming, there are many levels of supply chain information sharing (also known as "visibility") inside the supply chain. Supply chains must publicly provide knowledge to all participants, standardizing information leverage during negotiations, and giving greater information about component origins and procedures (Lamming, et al., 2001).

SC managers should use BCT in most operations because each transaction is more transparent, safer and transactions monitoring and more efficient (Kshetri, 2018). Moreover, supply chain participants' collaboration is increasing (Aste et al., 2017), resulting in cost reduction and enhanced supply chain efficiency. In addition, blockchain adoption can increase customer trust, allowing them to confidently examine the whole route of goods across the supply chain. In the meantime, the blockchain's traceability (Biswas et al., 2017) procedures will help in reducing the risk of product fraud and counterfeiting throughout the supply chain (Chen, 2018).

The first is increased worldwide competitiveness, which is being driven by increasing globalization and the geographical development of production networks (Ferdows et al., 2016). In order to be in the global market in the future, it is becoming increasingly necessary to optimize supply chain procedures in terms of performance, quality, and cost (Christopher and Towill, 2001).

On the other hand, a worldwide movement impacting SCM is the growing costomer request for transparency, reliability, accountability and social responsibility (Lee and Pilkington, 2017). Lastly, supply chain procedures must become transparent in order to meet consumer's demand. At the present day, blockchain technology has become important and has become a technology that seeks answers to existing problems in different sectors.

Companies have started to use this technology to stay ahead of their competitors. Furthermore, all businesses from financial to medical to aviation, want to use blockchain technology to improve the process traceability and transparency (Mougyar, 2016).

Improving transparency in the blockchain might show reliable, agreeing, and immutable data to associated stakeholders. Stakeholders may obtain data from the blockchain network systems in real-time, unlike traditional approaches to data exchange. For this reason, logistics transaction data can be easily accessed by end-users (Tan, 2020).

Generally, blockchain technology is provided transparency, traceability, authenticity, security, and trust to all supply chain participants. For example, real-time monitoring allows companies to know exactly coordination of the product and delivery time of the product, and all companies in a supply chain can access and track the same data and same information (Loop, 2016; Kim and Laskowski, 2016).

The blockchain can provide transparency and ensure that transportation contracts are fulfilled. There are a number of blockchain elements that can help improve the logistics sector, including:

-Give easy access to information about supply chains operations (Baker et al., 2015).

-Before making a choice, customers can assess the goods, service, supplier, carrier, and etc. (Baker et al., 2015).

-Customers may get the information they need about origin of the product and shipping routes from this service (Ho-Hyung, 2013).

-Reduces the possibility of fraud or counterfeit products (Hancock, 2016, 15).

-Allows for the tracking, monitoring, and tracing of transportation (Baker et al., 2015).

-Allows for more efficient commodities trade and financial transactions (Nakamoto, 2008, 7).

-Lack of transparency for logistics is not the only challenge. In addition, there are a number of critical issues that influence this business (Lieber, 2017).

-Companies do not reveal their important information to other participants, so companies want to hide the information from them.

-Large volume of product and documentations can easily be lost in the supply chain system.

-None of the parties can reach any information about the production place of the product and the quality of the product.

Blockchain technology guarantees that each node in the network has an identical copy of the transaction, which allows for real-time examination and enhances transparency in the chain. Moreover, supply chain data in real-time is exactly available to all parties, allowing for maximum transparency (Lu and Xu 2017; Bai and Sarkis 2020). Thus, blockchain technology increases the transparency transactions, and these transactions help new designing supply chain network systems. This functionality also eliminates the requirement for a trusted middleman and minimizes the risk of fraud in the chain (Cai and Zhu 2016).

Due to the linear movement of most items from material origin to the final customer, blockchain is an appropriate solution for supply chain traceability. These operational aspects contribute to maintaining anonymity, as the goods contained within the Blockchain, as well as the "tokens" with them, are not traded between competitors. Consequently, participant anonymity may be preserved (Francisco and Swanson, 2017).

While the concept of traceability within the SC aims to seek answers to the "when/when/where" questions regarding inventory transfer, the concept of transparency aims to seek answers to the "how" question such as how it is processed and how it is processed by the suppliers (IBM, 2017).

With the globalization and expanding networks of developing supply chains, it has been invaluable for developing transparent operations, ensuring environmental sustainability and increasing social responsibility (Garcia-Torres et al. 2019; Mol 2015).

Using RFID tags and online verification codes in SCs at the beginning of the supply chain has been claimed to improve sustainability and transparency in supply chains. Cryptographic characteristics of blockchains, on the other hand, must be used to verify that the data is valid and secure. BCTs will be the central enabling technology for guaranteeing SC traceability, and therefore transparency by recording social and environmental conditions throughout supply chain levels (Adams et al., 2018). As a result of utilizing blockchain technology, permanent records may be tracked back to the major polluting sources, allowing them to be removed from supply chains (Charlebois, 2017).

Greater efforts and resources are being increased to manage the SC data utilizing blockchain in order to assure full traceability of items (Scott, 2017). In this aspect, a growing IoT network system will help blockchain, since it will likely make monitoring easier and more precise. According to a 2015 research from Cisco and DHL, IoT in logistics and SC will produce $1,9 trillion in value over the next decade (DHL Research, 2015).

Supply chains become more transparent and traceable thanks to BCT, the implications for research can be numerous. It helps blockchains in store and capacity management and can help reduce the inventory fluctuations. In order to reduce inventory fluctuations in the supply chain, it can be effective to share the inventory information and stock information provided by blockchain technology with other supply chain members (De La Fuente and Lozano 2007). The use of advanced analytics (Baryannis et al. 2018) to blockchain data can lead to improved forecasts of imminent hazards in supply chain and transportation networks, as well as the capacity to develop more potential plans to reduce any disruptions to these networks. Moreover, blockchains are also expected to be used in sustainable supply chain and transportation network systems, where the data collected on the blockchain can report on supply chain partners' social and environmental sustainability (Saberi et al., 2019).

Finally, the import/export supply chain is intricate, requiring several handoffs from supplier to buyer, as well as testing and shipping through worldwide distribution networks. The transparency offered by blockchain can help to avoid counterfeits, embedding unlawful items, and ensuring the right order of operations is followed (Irannezhad, 2019).

3.4 Theoretical Background

3.4.1. The Technology Acceptance Model (TAM)

First of all, the Technology Acceptance Model (TAM) is a theory that models the decision-making process. It is an information system theory that models the decision-making of users whether or not they will use new technology. It was first used in a doctoral dissertation (David, 1986) and was later used in the MIS Quarterly article (David, 1989).

MIS Quarterly article is offering different perspectives (Davis, 1989), and subsequent articles in Management Science (Davis et all, 1989), two different ideas are discussed. The first idea subject is businesspeople, accept email communications and developed this theory. The second idea suggested by business master's students, is to use a menu interface with graphical software.

TAM was formed as a result of these investigations, and its principles state that the adoption of a particular technology is dependent on two key factors: perceived ease of use and perceived utility by the intended user.

Perceived ease of use (PEU)

Davis (1989) defines perceived ease of use (PEU) as "the extent to which the employee feels that utilizing the system would be effortless." Bandura thought "assessments of one's ability to carry out plans of action in response to potential problems". Davis supports this idea with self-efficacy studies.

Perceived Usefulness (PU)

Davis (1989) defines perceived usefulness (PU) as "the degree to which the person feels that employing a specific technology would increase her/his work performance." This attitude influences a person's behavioural intention, which leads to a real system person or person's relative level of technology adoption.

TAM wants to explain why people choose to use or not use a specific technology when accomplishing a task. The technology acceptance method has been developed and implemented by a number of experts to a variety of technologies; include spreadsheets (Mathiassen, 1991), voice mail technology (Straub et al., 1995), and object-oriented techniques (Hardgrave and Johnson, 2003).

According to TAM, if new technology and innovation improve a person's work performance while not important increasing the amount of work necessary to complete a function, the technology, labour, or behaviour is regarded as helpful and simple to use, and the person is more likely to implement it. The high amounts of researches have supported the validity and reliability of the perceived usefulness and perceived ease of use factors in TAM (Subramanian, 1994; Adam et al., 1992).

Many other studies have looked into the possibilities of using TAM to improve software adoption and have found positive outcomes (Condori and Pastor, 2006; Moodly, 2001). As a result, many researchers believe TAM is a valid hypothesis on which to build a study of software measuring adoption.

BCT is a new technology that has emerged recently. This technology has brought many innovations with it. Several SCM objectives were evaluated, including quality, cost, speed, reliability, risk reduction, sustainability, and adaptability.

The purpose of BCT is to facilitate the work of the parties in the system and to accelerate their transactions. This technology enables parties to prefer blockchain by increasing profitability, providing transparency of transactions and eliminating intermediaries.

Computer security is as important as any other transactions for blockchain. There is no way back to the error made in the system. For this reason, the transactions made by the parties within the system play an important role both for themselves and for their customers.

The cost of the vulnerability issue is quite high and can lead to unpleasant consequences for the parties. Moreover, Blockchain methods provided secure transactions and have gained the trust of supply chain members and new projects have started to emerge with the security it provides. The transparency and traceability provided by the system attracted the attention of supply chain members more and more. They considered it an advantage that Blockchian provides ease of use and that transactions occur quickly.

Participants discovered that they did not have to use intermediaries using the system. Each member will be able to monitor and trust each other's without any doubt in the SC.

BCT is being developed to transfer documents and payment transactions faster. Due to the convenience and speed provided by blockchain technology, the activities of supply chain members will be more efficient by spending less time.

Every member in the supply chain benefits from technology, increasing the efficiency of global trade. Technologies those are easy to learn and increase the performance of employees gain value. Companies that are in competition with each other have started to give more importance to technological investments in order to make a difference. Blockchain technology has not escaped the attention of those in the supply chain, as it is both easy to use and increases the speed of transactions.

Moreover, the benefits and conveniences of BCT to the market support the adoption and investment of this technology. Increasing the efficiency of the personnel working with the use of BCT increases the adoption rate of the technology and accelerates the adoption of the technology.

Consequently, the Technology acceptance model theory supports the use of BCT in the SC. The information provided by the theory supports that the use of this technology is innovative and usable and beneficial.

3.4.2. Stakeholder Theory

Firstly, Freeman's foundational book (1984): Strategic Management: this is new approach to marketing. Researcher has done studies using the descriptive, normative and instrumental perspectives (Donaldson and Preston, 1995) of stakeholder approach theory, which is a new method and subsequently developed this theory Friedman and Miles, 2002).

Researchers attempt to categorize stakeholders in order to better understand how stakeholders impact a focus company and the overall stakeholder ecosystem (Mitchell et al., 1997).

According to stakeholder theory, stakeholder characteristics are defined by three different methods (Waxenberger and Spence, 2003):

1- Power

It is an advocate's capacity to influence, generate, or have an impact on behaviour, attitudes, processes, goals, or direction. The US Department of Defence, Walmart, Boeing, and others are major actors in their own supply chains. As these organizations have positions of power, they can adopt aggressive (e.g., the RFID mandate) instead of cooperative partnering methods with their trade partners.

2- A stake is legitimate (L)

If it conforms to established institutions, attitudes, beliefs, conventions, and rules. The RFID requirements were not beneficent efforts on the part of the advocates to advance the RFID business. The necessity of RFID technique to improve SC performance is based on concrete facts. For instance, Before Walmart announced it would use RFID; it did extensive testing with its retailer Dallas-Ford for a year. Walmart expects increased workforce productivity and on-time deliveries after using the RFID system.

3- Urgency (U)

Suggests that the stake is important and time-sensitive to stakeholders. RFID/EPC installation costs for major retailers are projected to be $400,000 per distribution center and $100,000 per shop, according to A.T. Kearney and Kurt Salmon Associates (2003). Whether large companies like Walmart will deliver the predicted benefits from their investment depends on their cooperation with their trade partners.

Moreover, big companies invest in technology to improve themselves. Today, investments are rewarded in the future. Supply chain members began to give importance to the software field. Blockchain technology is at the forefront of these software systems. Those in the system can be defined as competitors. Competitors are like players competing with each other in the system. As the players in the system increase, the race gets better and the competition increases. Blockchain technology will provide users with a competitive advantage.

Additionally, BCT used in the supply chain will facilitate the work of companies and help them make quick decisions. This situation will positively affect other stakeholders and unnecessary waste of time will be prevented.

After all these results, it will be understood that BCT is a useful and investable technology for SC members.

Supply chain members want to know everything in detail with their investments. Big companies want to make big investments and get a return on their investments. The stakeholder theory supports this study positively. In addition, companies that start using blockchain technology may ask their companies to switch to this technology.

If there are companies that do not accept the same technology, they may stop doing business and make business deals with other companies in the market. Moreover, supply chain members may use this system and benefit from technology. In this way, parties facilitate their transactions, save time, provide transaction transparency, etc. Thus, supply chain members using Blockchain technology can request the system to work with other members they work with.

As a result, it is expected that the investments made by the stakeholders will affect every party in the system. We can see that the decisions made by the stakeholders affect every part of the ecosystem.

CHAPTER 4

APPLICATION OF BLOCKCHAIN TECHNOLOGY

4.1 Application of Blockchain Technology

Begin with, Blockchain technology to produce from Bitcoin cryptocurrency, and after this technology is modified different domains. Blockchain applications are used in almost lots of areas such as, government, power grid, Transportation system, E-business, supply chain, commercial world, cloud computing, and IoT.

Intelligent transportation systems: As mentioned, ITs occurs in seven steps (Yuan and Wang, 2016). Each layer is connected with certain hardware devices or application services, which helps in the provision of intelligent service. When used with Blockchain technology, device security, and data privacy are improved (Kang et al., 2017). Blockchain technology can create a safe, trust, and decentralized ITS environment. Secure key management (Lei et al., 2017) is one of the most significant challenges in the heterogeneous network, according to ITS. The physical layer is made up of numerous physical sensors that are integrated into the vehicle. Figure 4.1 shows Blockchain based ITS architecture. The data layer is made up of a series of linked blocks, as well as encryption and hashing methods. It connects the peer-to-peer (P2P) model with the blockchain-based ITS at the Network layer. In the consensus layer, many types of consensus algorithms are used for data validation in order to achieve mutual confidence among peers.

Then, according to the consensus method, some incentive is provided, and the smart contract is completed. Consequently, the application layer delivers intelligent services and smart management to the system (Fujihara, 2019).

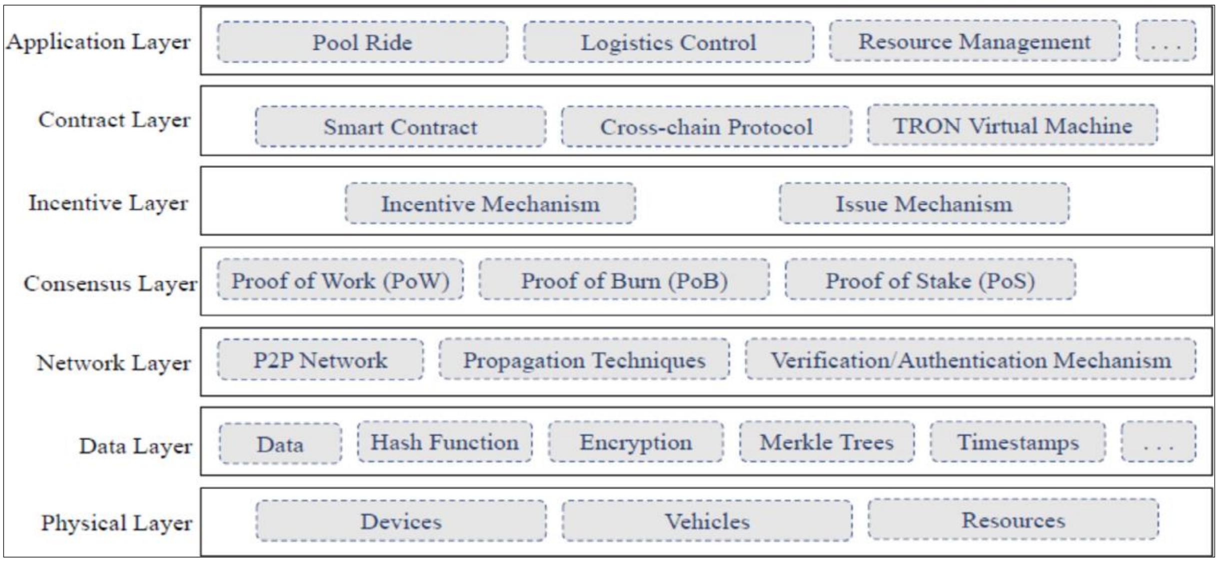

Figure 4.1. ITS Architecture

Government: The first big data domain was first set up in Chancheng District in 2016. Chancheng government and 21ViaNet China Inc. formed a team to create the first e-government service platform and used BCT in China. Finally, the Chancheng government has started using blockchain technology to increase trust and transparency among government services, business services and Chancheng citizens (Hou, 2017).

This project started to be implemented in the city of Chancheng District in 2014. The purpose of the project is to collect the services of various government agencies of a citizen on one platform and was built to make service applications under a single platform. The implementation of BCT in Chancheng's e-government is focused on two aims, according to the Strategic Cooperation Agreement:

The digital identity system is building solving a problem for individual credit. The government of Chancheng thinks that preserving all system records of modifications and trade on a cloud system utilizing blockchain technology may verify the provenance and validity of data throughout transmission. (Hou, 2017) In this approach, a trustworthy personal identity system may be established. At the moment, the Chancheng government is employing BCT to improve food safety through an app called Smart Farmers Market. It works with 73 farmers' markets, uploading and releasing product testing data throughout the manufacturing, shipping, and marketing stages to ensure the quality and safety of consumable agricultural goods.

The Chancheng government uses blockchain technology for identity, credit, and information disclosure problems. The Chancheng government project uses a blockchain technology-based innovation to enable businesses to learn more about their background through the transparency provided by blockchain and businesses to learn about customers and supplier demands.

Estonia government started in November 2015 that it is cooperating with Bitnation, one of several new blockchain-based initiatives that are especially designed for traditional, national governing structures (https://bitcoin.org); Bitcoin is a virtual peer-to-peer currency and payment system that allows users to deal without the need of a traditional middleman such as a bank or government department or agency. BCT is the technology that supports Bitcoin. This technology seeks to create a new method to vouch for the honesty of identification outside of government structures. Moreover, bank and business processes could use contractual agreements for the traditional finance sector and new payment methods in their fullest application. As a consequence, identity is created utilizing a distributed ledger on a worldwide open-source platform, rather than traditional authentication sources such as government data and authentication intermediates such as banks (Sullivan & Burger, 2017).

4.2 Technology Sector and Internet of Things

A blockchain is defined “a growing collection of documents (called blocks) that are linked (connected) using cryptographic techniques". Every blockchain blocks has specific cryptographic hash that these are linked previous block, as well as timestamp and specific transaction data. Moreover, this technique used in different application areas, including identity management system (Lin et al., 2018) and Industry 4.0 (Lin et al., 2018). In the future standard of cryptographic protocol will need to security measure and so that discover the blockchain technology (Dorri et al., 2017). On the other hand, heterogeneous smart devices are connected to the Internet of Things as well as too many systems. IoT is used in many different areas, and some of the usage areas are shown in Figure 4.2. The majority of applications are built on centralized system and are connected thanks to central system. The centralized system has many problems such as, single point failure, trustworthy management system, and security problems. Also, the system is durable and tamper-proof thanks to the combination of IoT and BC technologies (Mohanta et al.2019).

Cloud technology, Industry 4.0 is widely used in many different industries, but its centralized nature makes them vulnerable to cyber-attacks. The combination of blockchain technology with cloud technologies would improve the cloud network's security and scalability. However, IoT platforms are becoming more centralized, the danger of a single point of failure is rising.

Blockchain system support robust, intelligent technology and decentralized IoT systems where both systems complement each other (Lin et al., 2019). In additionally, there is a need for an independent system that can facilitate real-time data exchange with total transparency due to several causes such as globalisation, human error, and regulatory inefficiencies.

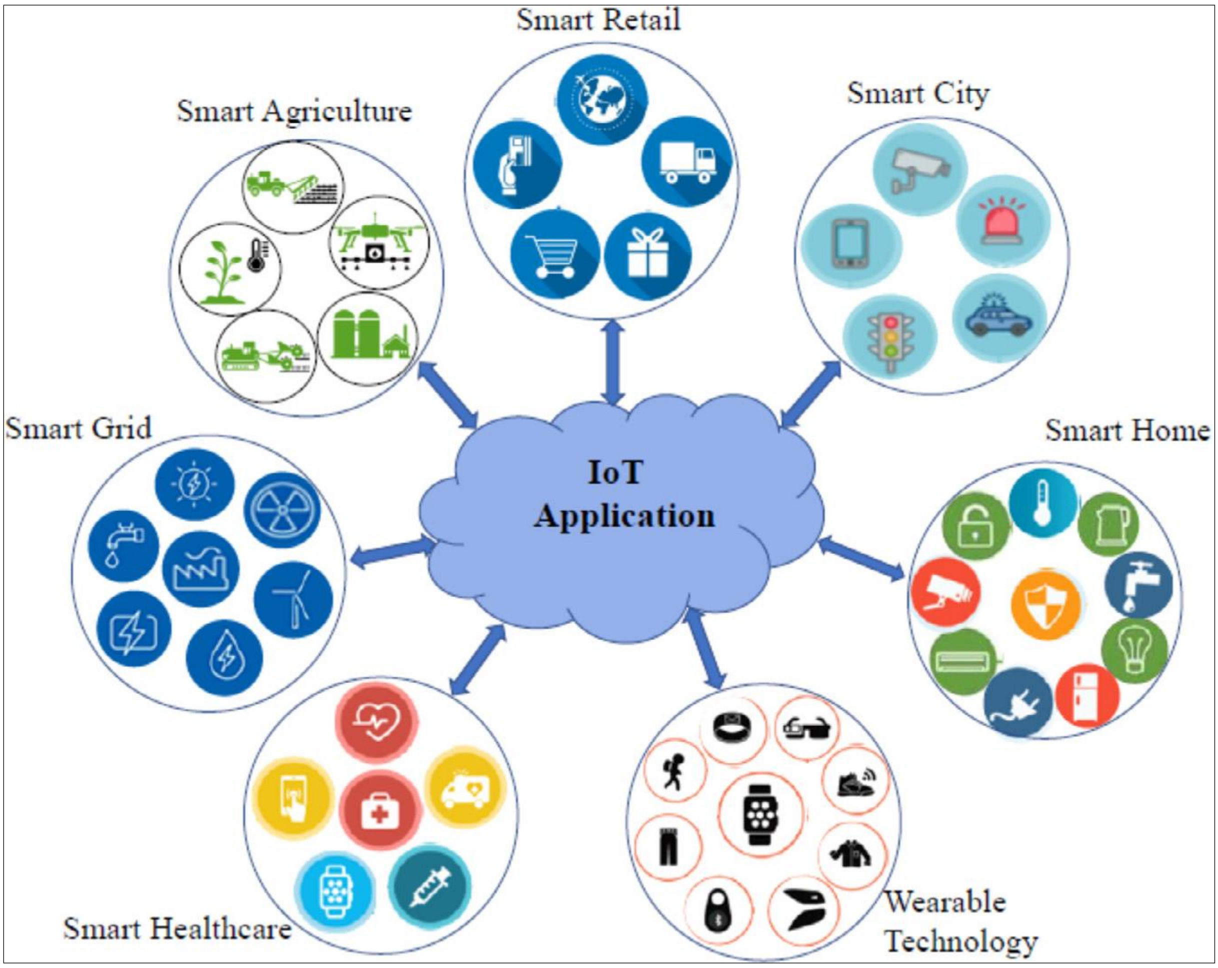

Figure 4.2. Different usage areas of Blockchain technology

4.2.1 Healthcare Sector

The healthcare industry is confronted with a number of barriers and problems, including fragmented SCs, inaccurate data management, unsecured data sharing, data privacy concerns, medicine counterfeiting, and so on. Unfortunately, the data management techniques in the healthcare sector tend to result in longer treatment times, worse health management, and a great reaction of the public. Recently, these issues might be addressed by adopting blockchain technology to improve data management skills. BCT may be utilized to develop patient outcomes, save cost, increase compliance and assure security, transparency, and better use of healthcare data (Mattke et al., 2019). Thus, blockchain will be used more efficiently in the healthcare sector.

Moreover, Blockchain technology can be used to create a vaccination traceable BC and increase transparency, which would help institutions and patients gain confidence (Yong et al., 2019; Jamil et al., 2019). BC provides transparency, reduces vaccine counterfeiting, and access all information for vaccination traceable. Furthermore, Blockchain provides safe and easy data storage and exchange; BC search to solve the global trade of counterfeit medications (Mackey and Nayyar, 2017). Blockchain system records a medical data so medication information cannot be changed, and everybody can access the medication history. Private cloud-based blockchain solutions have the potential to be quick and dependable, ensuring complete visibility of the blood supply chain and reducing fraud (Kim and Kim, 2018).

4.2.2 E-Commerce

In recent years, the fast expansion of internet purchasing has resulted in a massive increase in E-business. Customers' interest in the E-Business approach is raised with Trusted Data Marketplaces (Roman and Stefano, 2016). Moreover, blockchain technology will support in the transformation of the e-commerce by resolving challenges such as payment systems, risk management, supply chain management, and data security. Additionally, blockchain enhances the e-procurement process by making it safer and more efficient. BC decreases the barriers around e-procument transaction and developed security, reliability, data management and transparency (Isikdag, 2019).

4.2.3 Energy Sector & Power grid

BC has the ability to revolutionize the energy sector by making electrical transactions more transparent, secure, and efficient. Energy trading (Peck, 2017), solar power systems, smart metering (Rottondi and Verticale, 2017), and microgrid energy (Mengelkamp et al., 2018) are some of the topics covered. These are sub-sectors of the electricity grid. The usage of blockchain technology benefits the provision of intelligent services to end consumers. A Blockchain is made up of short messages and time-stamped blocks that are sent to all nodes in network nodes. The public or private key combination may be used to sign messages by all nodes in the network and is defined by pseudonym. Each node signs a transaction before processing other nodes in the network.

Regularly, the mining process starts with a new transaction, which is then uploaded to the BC. A transaction made in a block becomes permanent and irrefutable. The architecture of Blockchain in various power grid systems is given in Figure 4.3.

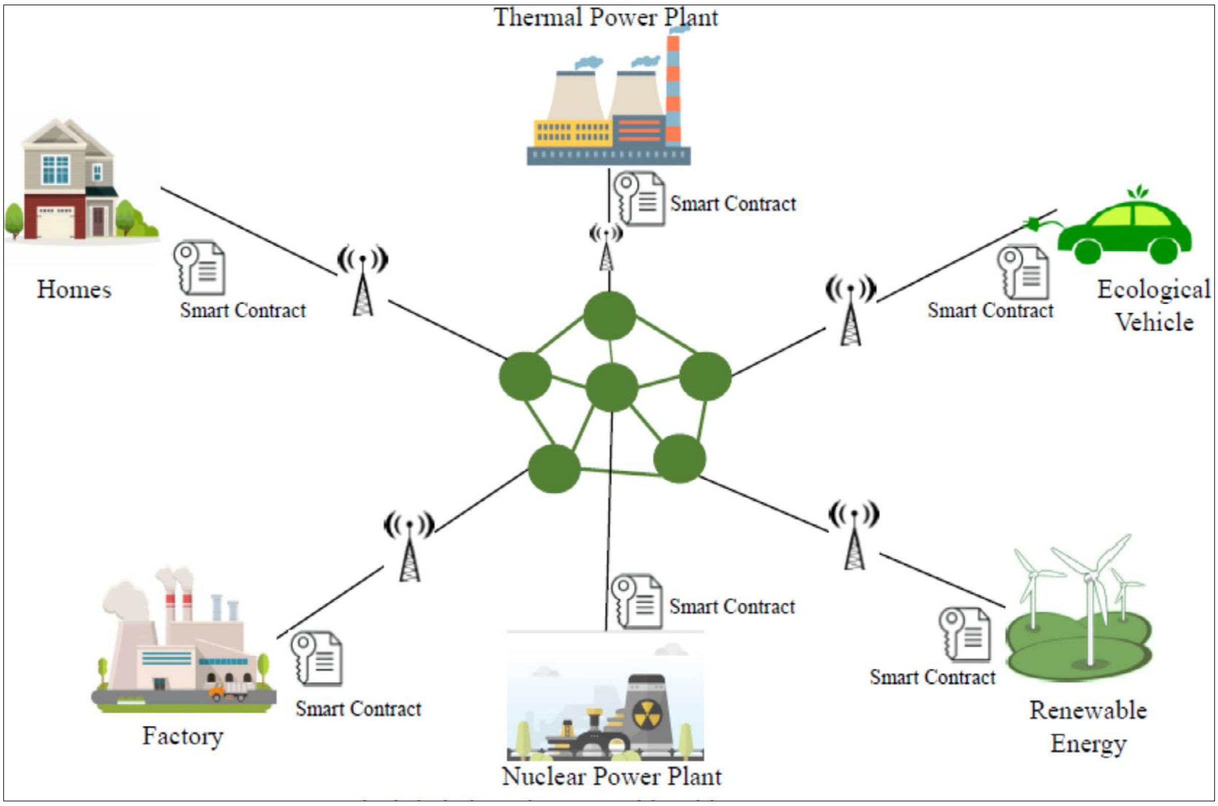

Figure 4.3. The design of a blockchain-based power grid

4.2.4 Agriculture and Food Sector

At the present time, the agricultural SC is a complex system that is still developing and includes many stakeholders. There is a possibility of the data tampering with the existing traceability process in the place. The dual-chain blockchain structure is used to increase transaction transparency, transaction security, private corporate information, and the efficiency of the agricultural sector. Moreover, the system's general improves efficiency, makes company development easier, and improves the efficiency and credibility of the linked platform (Hasan et al., 2019). Thus, users' trust in the system increases, and the speed of the work did increases. In additionally, customers' have a problem of trust in organic products and SCs and users use blockchain and IoT-based systems to reduce these problems (Khare and Mittal, 2019). Users aim to use the system efficiently by taking advantage of the benefits provided by the system.

On the other hand, efficiency and product monitoring also contribute to the maintenance of a fair relationship between the small farmer and large customers as well as democratization of the supply chain (Kshetri, 2019; Mondal et al., 2019).

Blockchain technology, which allows for end-to-end traceability, can assist to solve this problem (Behnke and Janssen, 2019). In case of a problem, it will be possible to monitor the history of transactions and transparency will gain importance. For example, coffee manufacturing is a good example of blockchain integration with food SC. Coffee and blockchain SCs can provide automatic payment transfers, data record at each stage of the coffee production process, and data management across the SC (Thiruchelvam et al., 2018). It is a successful implementation method and using blockchain can protect both buyer and seller. Another successful application and supports Supply chain application is AgUnity. This application uses Malaysian market. If that application is used efficiently, it is aimed to increase both transparency and traceability of food products in the Malaysian market (Chan et al., 2019). Due to the importance of food safety in many aspects of life, blockchain has the potential to immediately enhance social welfare.

4.2.5 Shipping Industry

The cargo shipping industry may use blockchain to develop a verified and distributed shipping system that integrates and connects all business operations (financial, banking, IoT, SC, manufacturing, insurance) in the context of a shipment (Dutta et al.,2020). Blockchain implementation decrease cost, save time and money, this situation increase efficiency. In maritime SCs, blockchain guarantees lower transaction costs, enforcement costs, and disintermediation. Merchant ships are integrated into the system and share real-time information. Thus, the reliability of the information sent by the ship to the system, the transparency of the transactions, data confidentiality and fraud are taken under control (Komathy, 2018). Additionally, BC implementation has the potential to revolutionize the marine sector by allowing projects, people, information, payment, and communication to be organized in a safer smarter and more efficient way. In addition, the transparency provided by the BC, helps to reduce fraud within the system and make transactions more secure (Gausdal et al., 2018). All transactions made within in Blockchain implementation are traceability, transparency, immutable. Its helps reduce the risk of corruption.

4.2.6 Aviation Industry

Aviation sector may work digitization and security sectors that combine RFID technology with their SC which can support in port tracking and process improvement. Moreover, RFID technology can be combined IoT and blockchain more enhancements the security and provide more transparent and immutable RFIDs data management. The greater example of this situation can be seen in Airbus which is among those combining SCs with RFID. There is a lot of field of activity for BCT to be integrated into the present aviation SC (Santonino et al., 2018).

On the other hand, BC may potentially be utilized for risk analysis assessments in the field of air logistics (Choi et al., 2019). Additionally, the use of the BC in the aviation industry may help with air logistics and transportation.

4.3 Blockchain-enabled management and accounting systems

Cryptography-provided credit transactions improve security, decrease tracking time and costs, automate credit monetization, and make the execution, verification, and recording of the credit journey visible and searchable. According to reports, the "Belt and Road Blockchain Consortium" has utilized blockchain to move cash across borders for China's One Belt One Road plan, which spans more than 56 nations (Pournader et al., 2020). It was understood that this process was faster and more secure. Another example is AgriDigital platform, which is a most valuable, faster and more secure post- delivery payment that "closed blockchain application"(Tönnissen and Teuteberg, 2019).

- Asset management and trade finance: Blockchain provide tamper-proof security and asset transactions, avoiding the needs of financial intermediaries such as payment systems, inventory exchanges and money transfer services, and allowing for efficient asset management (O'Leary, 2017; Wang et al., 2019b). The system eliminates intermediaries and transactions are carried out faster and more transparently. Thus, it is more efficiently, more fastly and timesaving. Another example is trade financial tools, blockchain may be utilized to automate processes and speed up transaction processing.

- Value added tax (VAT): Indirect tax systems based on blockchain can be developed, which would record tax receipts at each and every stage of the value chain, giving more transparency and legitimacy the the whole tax structure (Alkhodre et al., 2019). A tax system can be established blockchain technology. Moreover, indirect tax system would record tax collections at every point of the value chain, bringing the entire tax structure closer to transparency and legality (Alkhodre et al., 2019). Furthermore, this system helps to minimize arguments and makes computations easier for VAT. This process will have a very significant societal impact.

4.3.1 Tokens

The world is becoming increasingly globalized, and the commercial enterprises in the existing market, as well as the business method by which these operations are carried out, are becoming increasingly multinational. Today, the economy issue is very significant for all countries to reach success on the world stage. On the other hand, currency cannot be disregarded. Various ways have been developed in recent years to build simple and quick payment solutions.

E-money and e-commerce are new methods and have been used in the market for many years. The rise in popularity of mobile wallets, the necessity to transfer money via mobile application, has brought in the current technological era. Therefore, a variety of currency that can be quickly transferred and utilized in commerce would be beneficial. Participants can send faster money transfers with this method. Blockchain-based has different currencies such as Litecoin, Bitcoin, Z cash, Dash, and Ripple. Blockchain has advanced at an incredible rate to give users with transparency. Furthermore, blockchain technology provides security and transparency to its user, and the system protects against attacks by hackers.

The following are some of the significant challenges that internet transactions and cryptocurrencies transactions face:

Payment Information, Spooning and Phishing: This issue the biggest problem is theft. Even if the user has copied their wallet address accurately, malware can substitute the address in the user's clipboard with another address while sending money. Users can be duped into uploading crypto wallets and entering the special passport on a fake website using e-money.

Hacking of payment gateways: Hackers prefer social engineering techniques to gain the trust of the host by appearing as legal domain owners. After getting access, they might begin monitoring cash flow.

A Problem with the user address: There are many errors in cryptocurrencies. There are errors in money transfer addresses, and this causes significant money losses. In Ethereum transactions, if only a single number is not written, the money transmitted vanished. This system is both safe and risk. Also, every transaction must be checked.

A wallet file is lost: All information is recorded on a hard disk, although hackers might get information or steal valuable documentation.

4.3.2 Investing in blockchain tokens

Blockchain is using new token economy, and this situation has become interested of investors Beck, 2017; Grayscale, n.d.). BC tokens are essentially global, extremely liquid, and quickly transferable, investor prefer this investment. Despite, blockchain tokens appealing by investors are also hazardous, owing to inherent unpredictability and information asymmetry (Sehra, et al., 2017). When investor in blockchain tokens, investor must measure and assess the risk, after investor decide inviting.

4.3.2.1 The advantages of buying blockchain tokens

In general, blockchain tokens have provided investors with highly appealing returns. Blockchain tokens markets must need some time to nature. Although, many investor are still interested in blockchain tokens because they provide high returns and strong investment diversification potential. Furthermore, investors are drawn to blockchain tokens because they provide equitable access to all investment possibilities, democratizing venture capital investments throughout the world (Chen, 2018).

Additionally, blockchain available tokens are completely global, making them available to all investors throughout the world (Jackson, 2017). All investors can purchase or sell tokens, and place or time is unimportant for this process. The reason for this situation is to increase the number of people who have access to opportunities all across the world. On the other hand, most traditional venture investments are extremely localized, limiting access to opportunities. Investors may invest in projects all around the world and exchange BC tokens with other investors all over the world due to BC tokens.

4.3.2.2 Blockchain tokens investment risks

Blockchain tokens have some risk in investing at the beginning times, and this situation can produce ambiguous results in the early stages (Fama and French, 2004). Many ambiguous ventures are sold to investors at the beginning project. Investors gain highly profitable profits when a project is successful, but investors can lose all of their money when their own project fails.

Blockchain tokens have a number of risks, including uncertainty and information asymmetry. Investors find it difficult to analyse a project due to information asymmetry (Akerlof, 1970). Given the popularity of scams and frauds, investors must exercise caution when investing in fake tokens. As a result, investors must be careful to buy tokens

4.3.3 The top ten cryptocurrencies by market capitalization:

4.3.3.1 Bitcoin (BTC)

Bitcoin is used in a decentralized virtual space and is an anonymous currency that is not tied to any government or individual (Lam, 2014). Satoshi Nakamoto announced a text that "Bitcoin: a Peer-to-Peer Electronic Cash System" in 2008, and it is very important to Bitcoin history (Grinberg, 2011). This text and the principles presented gained value and Bitcoin concept develop quickly. The fact that it is still uncertain if Satoshi Nakamoto a real person, a nickname or gang of hackers emphasizes to Bitcoin's anonymous character (Goodman, 2014).

Bitcoin works with a PoW consensus technique. Bitcoin has some problem, and the biggest problem is "mining" process in the system. Moreover, this system which is entirely open-source software - comprises people willingly making their own computers available to the Bitcoin network in order to solve complicated mathematical problems (Kaplanov, 2012). If the computers problem is solved, it will earn bitcoins as a reward (Kaplanov, 2012).

The total amount of Bitcoins that may be made by mining is limited: Bitcoin system was designed and it was designed to never have more than 21 million Bitcoins. Bitcoins is increase automatically and it limited by system itself. It does not need a central authority / entity to mine Bitcoins (Kaplanov, 2012). All transactions are done automatically. As a result, there is a limited number of Bitcoins. The small amount of bitcoin, along bitcoin conversion rates are controlled by supply and demand, with no government authority able to intervene, leads in extreme volatility in Bitcoin values (Bollen, 2013).

4.3.3.2. Ethereum (ETH)

Firstly, Ethereum was created in July 2015 (https://www.ethodocs.org), and it is a decentralized system for executing "smart contracts". Smart contracts are "self executing" contacts or programs that execute exactly as designed without the risk of interruption, obstruction, theft, fraud (BC is never offline; system is constantly active) (https://www.ethereum.org).

Ethereum is significantly more capable than a pure peer-to-peer digital currency like Bitcoin. In basic terms, it's similar to a smartphone operating system that can be used to develop software apps (Houben and Snyers, 2018).

The Ethereum platforms are not a cryptocurrency. However, Ethereum, like other permissionless, open blockchains, requires some sort of on-chain value to encourage transaction validation inside the network (i.e., a form of payment for the network nodes that execute the operations). "Ether" (ETH) is the currency of Ethereum. Ether is not only used to build smart contracts on the Ethereum, but it also serves as a means of trade (Hileman and Rauchs, 2017). Ethereum currently is using PoW consensus technique like Bitcoin (https://ethereum.org/ether). Ethereum's creators was build non-profit organization “Ethereum Foundation" in Swiss and they promoted and assisted the development of Ethereum (https://ethereum.org/foundation).

4.3.3.3Ripple

Ripple is an open-source, peer-to-peer digital payment technology that enables near-instantaneous financial transactions in any form (Bitcoin, Yen, Euro, Dollar, etc.) The private business Ripple (Labs), Inc. created it in 2012 (https://www.bloomberg.com). Ripple (Labs) Inc. was the first institution to receive a "BitLicense" to advance the Ripple protocol (https://www.ripple.com). Moreover, a number of major financial services companies, including Bank of America Merill Lynch, Santandar, and others, are also supporting it (https://www.riple.com).

In reality, Ripple's payment network does not require a bridge currency to function. Ripple claims that XRP can process over 1,500 transactions per second. Ripple (XRP) uses its own consensus technique to validate transaction rather than using PoW or PoS technique (https://www.ripple.com).

4.3.3.4Bitcoin Cash (BCH)

Bitcoin Cash (BCH) is a peer-to-peer (P2P) digital currency (http://www.bitcoincash.com). Bitcoin Cash was launched on August 1, 2017 and is based on Bitcoin's original SHA-256 PoW method, but with minor modifications to the code. Bitcoin Cash is a "hard fork" of the Bitcoin blockchain, as it is called in the crypto community (Natarajan et al., 2017).

Consequently, some Bitcoin engineers decided to improve the block size limit from 1MB to 8MB (Buchko, 2017) in order to lower transactions fees and speed up confirmation times, while other had alternative ideas. Bitcoin Cash was established because the community was unable to achieve an agreement (https://www.eyfinancialservicesthoughtgallery.ie).

4.3.3.5 Litecoin (LTC)

Litecoin (LTC) offers an open-source decentralized peer-to-peer cryptocurrency similar to Bitcoin (https://www.litecoin.com). It was established in October 2011 and based on the Scrypt Proof-of-Work algorithm, which is based on Bitcoin's fundamental SHA256 Proof-of-Work algorithm (Rosic, 2017). Litecoin is generally known as the "silver" equivalent of the Bitcoin virtual currency (Hileman and Rauchs, 2017). Besides, this method utilizes a different algorithm, it differs from bitcoin in two aspects.

First of all, Litecoin has a substantially quicker transaction speed than Bitcoin, successful implementation of the Scrypt PoW algorithm. Bitcoin creates a block in ten minutes (Buchko, 2017); Litecoin creates a block in 2.5 minutes (Martindale, 2018).

Second, Litecoin's overall production limit is 84 million coins, which is significantly greater than Bitcoin's supply limitation of 21 million coins (https://www.litecoin.com).

4.3.3.6 Stellar (XLM)

Stellar utilize a distributed payments network that is open source like Ripple. Stellar was launched in 2014 by one of Ripple's creator (Adams, 2017). Its mission is to prevent corruption and help it reach its full potential by providing cost-effective financial services. Stella can be preferred to produce smart contract (https://www.stellar.org). Stella cannot use Pow and PoS consensus method, but it has own consensus procedure.

Additionally, the cryptocurrency Lumer works with Stellar (XLM). Lumer currency is used to pay on the Stellar system. They help to make it easier to move money throughout the world and to perform cross-currency transactions rapidly and securely (https://www.stellar.org).

4.3.3.7 Cardano (ADA)

Cardano was established and was improved as a technique for using smart contract and decentralized apps like Ethereum. Cardano project started in 2015 (https://www.cardano.org), and was made public in September 2017 (https://www.medium.com). Cardano project is using Ouroboros PoS algorithm (Kiayias et al., 2017).

In brief, Cardano's first and most important goal is increase scalability, security, transparency, and interoperability with established financial systems and laws by learning and building on experiences acquired in the Bitcoin and Ethereum organizations (https://www.medium.com). Cardano is (one of the first) blockchain projects to be researched and constructed from a scientific mind-set by a team of prominent academics and engineers, which sets it apart from Ethereum and many other cryptocurrencies (https://www.cardano.org). Another major difference is that Daedalus is private digital wallet to Cardano and the cryptocurrency Ada (ADA) can just saved in Daedalus (https://www.cardano.org).

4.3.3.8 IOTA (MIOTA)

IOTA, which was established in 2016 (https://www.iotasupport.com) allows humans and machines to exchange data or money in an unauthorized, untrusted domain (https://www.iota.orgIOTA currency offers better transaction speed than other digital currencies and IOTA only uses DLT.

4.3.3.9 NEO (NEO)

NEO like Ethereum and Cardano, are open sources BCT that can be utilized executed decentralized applications and smart contracts. At the beginning time NEO known as the "Chinese Ethereum" (https://www.cryptolate.com) was first announced in February 2014 under the name "Antshares" (https://coincenteral.com). However, in June 2017, the project name was changed "NEO" (Levenson, 2017).

In briefly, the NEO aims to digitize assets and automate digital asset management in order to build a "smart economy" (https://www.www.neo.org). Simply, GAS is a cost that must be paid to use NEO's network system. What makes the NEO platform original (and what sets it apart from the Ethereum and Cardano platforms) is that owning the digital currency "NEO" creates GAS automatically over time (https://www.biance.com).

4.3.3.10 Monero (XMR)

Monero (XMR) is a peer-to-peer (P2P) cryptocurrency that focuses on "private, censorship-resistant transactions." (https://www.getmonero.org). It was created in April of 2014, and it uses the CryptoNote PoW algorithm.

Monero makes all transactions made by users anonymously. Monero utilizes cryptography to protect both sending and receiving addresses (also known as "keys"). Monero (XMR) is a completely fungible cryptocurrency.

4.4.4 Short Summaries of the Chosen Instances

The supply chain consists of numerous points involved in the production and delivery of communities, beginning with the procurement state and ending consumer. Today, the supply chain has many various specific features and locations. As a result, tracing activities are the much biggest problem in the all-chain Furthermore, the biggest problem is the lack of transparency in the SC, so many buyers and customers cannot be certain of the real value of products or services (Dickson, 2016). The supply chain management can prefer blockchain for transparency, security as finding a good solution. Even the most basic deployment of BCT might provide significant benefits to the supply chain.

4.4.4.1 Provenance

Provenance company is a London-based company that aims to make the SC more transparent by using blockchain, which make businesses more disciplines in their operations, including the environmental effect of where items are manufactured and who made them (Allison, 2016).

Moreover, Provenance will utilize blockchain for minimizing labour exploitation or other bad situations and other unethical acts because the information collected in a blockchain ledger might be diversified (Dickson, 2016).

In the global logistics sector, there are various issues such as a lack of openness or misunderstandings between agents on different layers of the SC. As a result, there are a lot of transportation issues such as transportation procedure and product provenance (Williams et al., 2015). This situation goes against the interest of the customers.

The transparency method is critical regarded as the most important business method. All parties may benefit from sharing information to better their relationships and increase efficiency in the SC (Lamming et al., 2001). Before blockchain technology, it was extremely difficult to access the right transparency. Therefore, blockchain create transparency and ensure that transportation contracts are fulfilled. There are various blockchain properties that might be beneficial to the logistics industry:

- Allows customers to analyse products, services, suppliers, carriers, and other factors before making a decision (Baker et al., 2015).
- This technology provides information related to the supply chain activities and participants provide access to information in a clear way Baker et al., 2015).

- When a customer requires information, the system gives the product sources and shipping routes to customers (Ho-Hyung, 2013).
- Decreases the danger of fraud or counterfeit items (Hancock, 2016).
- Enables transport monitoring, tracking, and tracing (Baker et al., 2015).
- This method makes it easier for products trade and payment systems (Nakamoto, 2008).

Nevertheless, lack of transparency is not only problem in the logistics sector. There are also a number of critical problems that have an impact on this business (Lieber, 2017).

- Other participants do not access all necessary information from organizations; they prefer to keep it hidden.
- A significant quantity of data related to items or records might simply be lost within the supply chain.
- Parties do not share the asset's origin information for the purpose of determining asset quality. However, blockchain technology is capable of resolving these issues

According to IBM Institute's latest expert report, Blockchain has been identified as a technology that will be used in numerous supply chains to improve visibility, optimization, and forecasting. (Lieber et al., 2017).

4.4.4.2 Everledger

Everledger is a company that the first goal to decrease risks opens the market and ensures a decrease fraud. It makes use of blockchain, smart contracts, machine vision, and other reducing technology. Eventually, this company both have placed emphasis on transparency and increasing transparency in the diamond SC and eliminate the use of forced labour in Africa (www.everledger.io). All participants may use blockchain records at any moment, as well as parties include defining features, history, and ownership in the supply chain (Dickson, 2016)

On the other hand, Everledger has created a hybrid technology approach that includes both private and public blockchain. This method helps companies should provide greater services to the industry. This company has a deserved position in the Hyperledger community, as it is dedicated to improving creative supply chain systems (www.everledger.io).

4.4.4.3 Walmart

Walmart Company applied a program build with IBM to monitor products in the United States and pigs in China in late 2016. The first step involves following products from Latin America as they may their way to the United States. The second step was transporting pigs from Chinese farmers to Chinese supermarkets. The two IBM pilots were finished in February 2017. According to a report, Walmart is certain that a final model will be available "within a few years." (Popper and Lohr, 2017).

BCT allows for the digital monitoring of individual pig products in a matter of minutes rather than days in the past. In addition to that, a lot of information can be accessed on the blockchain. Blockchain helps in examining information about the manufacturer, farm, serial number, storage temperature, and shipment. This information helps to determine the validity of items, as well as the expiry date. In the case of food infection, it is possible to determine which products are defective (Yiannas, 2017).

The objective is to increase food safety. This tracked information contains vegetables or pigs came as well as their operation procedures. Some tracking systems are used for products. RFID tags, sensors, and barcodes, that are all currently widely utilized in many supply chains, offer the necessary information (Kharif, 2016).

Furthermore, Walmart revealed the findings of the food safety and traceability protocol test that began in October 2016 in China and the United States on May 31, 2017. According to Walmart, blockchain helps reduce the time it takes to track food to minutes (Higgins, 2017).

Blockchain has significant cost-cutting potential for the company. In the case of an expired product crisis, Walmart would be able to quickly identify the cause and implement selective product removals rather than recalling the entire line. Blockchain allows for a more efficient reaction if expired products are identified. Consequently, the firm can maintain buyer trust in other goods while avoiding the risk of consumers getting ill (De Jesus, 2016).

Alternatively, the relevance of blockchain in packed verification and tracking has been emphasized by Walmart, which has stated its intention to use the technology to authenticate customers and a courier, who takes a temperature reading measurements from containers and goods and compares them to approved standards, among other things.

4.4.4.4 Modum

This start-up from Switzerland Modum collaborated with the University of Zurich to develop a method that ensures pharmaceutical medications are delivered safely. Most medications must be delivered at specific temperatures, humidity levels, and light levels to guarantee usage. Modum's sensors are continually monitoring these conditions on medications in transit. In the existing system, cargoes include a lot of personnel and a lot of documentation to the transactions (Allen, 2017). Modum's company solutions seek to solve these concerns.

The transportation refrigeration method is the most important method for drug distribution and would be preferred refrigeration trucks. This transportation type is four to eight times the price of standard logistical services (Campbell, 2016).

According to reports, medications can be maintained at three different temperatures: cold (20 °C), cool (2°–°C), and ambient (15°C–25°C). Nevertheless, every drug contains " stability data", with specifies that the medicine " can stay in temperature range Y and X hours, normally 72 hours between 2 °C and 40 °C” (Campbell, 2016). Modum is working on the ambient product. In addition, a Modum sensor is used to track non-refrigerated medical product shipment and follow the temperature of the drugs. This eliminates the need for a cold chain vehicle. When the drug has arrived at its destination, the data is sent to the Ethereum BC. A smart contract of Solidity is compared data to multiple regulatory criteria (Campbell, 2016). If every criterion is true, the product is sold in the market. If the criteria conditions are not true, this agreement will be void and participants may terminate the contract. Modum applied first pilot applicants in June 2016 (Campbell, 2016).

4.4.4.5 Bext360

Denver-based new start-up Bext360's application uses Stellar blockchain to collect time stamps and transaction values in real-time. Most of the participants, firms, farmers, and co-ops among the transactions make data transparent. Firstly, the system keeps track of coffee beans' history and source. Then system keeps a record of all transactions and who participants paid what amount. As a result, it is planned to offer total transparency to the coffee supply chain. This technique is likely to implement in other communities like cacao (Kolodny, 2017)

Bext360 has found a new project with kiosk, and farmers will be able to sell beans at Bext360. The method examines the crops that are presented to producing facilities using intelligent image recognition technology. Machine learning is used by the system to classify the grade and give a price. Coffee purchasers may examine the quality and quantities of a farmer's produce in the area using a mobile robot. A smartphone app allows the parties concerned to negotiate a reasonable price (Scott, 2017). It also establishes the identity of the product's seller. Farmers use a smartphone application to pay (Clancy, 2017). Wholesalers and retailers may use Bext360's API tool to integrate the technology with company websites, marketing, point-of-sale, and SC systems.

In the Stellar system, each farmer is assigned a digital wallet. Moreover, farmers can make purchases with a digital wallet. When farmers' products are evaluated and sold, Stellar's program provides safe and transparent payments to them. It helps in the correct processing of payment and credits, among other things. Farmers receive their payments in real-time.

CHAPTER 5

CASE STUDY

5.1 Case Study

A case study is one of the types of social science study and it examines a problem, organizations and seeks deep objective subsequently, provides an explanation of relevant connections (Yin 2014). A case study is one of several methods for doing social science research. Interviews, documents, direct observation, archival data, participant observation and tangible artifacts are all probable resources of evidence for the case study. Experiments, surveys, histories, and archival data analysis are some of the other methods. Moreover, a case study uses only one analysis unit. This can be a company; however, can be used in many group analysis units. For instance: a case study may be conducted on the implementation of management in a specific country. Case studies allow us to better understanding the structure of management in practice, including the methodologies, processes, systems, and other tools that are employed, as well as how they are often used.

The case study is a common research approach in psychology, sociology (Gilgun, 1994), political science, social work, business (Ghauri and Gronhaug, 2002), and community planning, which is not unexpected. The case study technique allows researchers to preserve the holistic and significant qualities of real-world events including human life cycles, organizational and management processes, neighborhood transformation, international interactions, and industry maturation.

Research Design Components

Five components of a study design are very necessary for case studies.

1- A set of research questions: The case study technique is more likely to be useful for "how" and "why" inquiries, first step should to define the nature of the research questions in this respect.

2- If it has any proposals: This is the situation in which a topic is a subject of "exploration," which might occur through trials, surveys, and other research methods. An exploratory study's design should identify this objective, as well as the criteria by which an investigation would be demanded, successful, rather than propositions.

3- It’s metric of measurement; it is about defining what the main problem is.
4- The reasoning that connects the evidence to the hypotheses; and
5- The standards for evaluating the results:

This description covers both headings four and five. These elements give notice to the data analysis processes in case study research, and a firm basis for this analysis should be put out in the research design.

There are important criteria for assessing the quality of research designs. Data dependability, credibility, trustworthiness, and confirmability are some of the concepts that have been proposed for these tests.

Giving a preliminary idea of the preferred target group and forms of reporting serves as a good start for creating the case study. It can be applied in other fields as well as in the academic field; it can be applied in politics, social science research, and thesis.

Additionally, identifying the report's audience, defining the compositional structure, and following particular protocols are all phases in the case study composition process, regardless of the report's format.

Consequently, the case study can be concluded after it's been written, or it can be combined with data obtained through other methods as part of a larger, multimethod research. Case study research can benefit from such investigations but may also provide a new problem.

IBM (International Business Machines)

It is the biggest IT Company in the world and its headquarters is located in New York, USA. It is the biggest information technology company in the world. IBM Company was established in 1911 by Herman Hollerith and J. Watson and operates in more than 170 countries. IBM Company first started its activities in 1938 in Turkey. In addition, 405 alphabetical accounting machines were purchased by Ziraat Bank in 1935. IBM Turk was founded in Ankara as Watson Business Machines Turk Limited Company in 1938. The first computer was purchased by the General Directorate of Highways in 1960. In 1962, the work in Turkey was the cover of the IBM magazine IBM World Trade New. Ayla Taşpınar, Turkey's first female system specialist, started working at IBM Turk. Moreover, IBM PC started to be sold in Turkey at the first time in 1983. Corporate social responsibility project

KidSmart started in Turkey in 2008. Kidsmart project is pre-education program, and its primary targets are kindergarten students. The company carried out projects on improve water quality in undeveloping countries such as Ghana, Romania, Tanzania, Philippines and Vietnam in 2008.

After the new regulations, the IBM Company remains one of the world's largest computer companies and system providers. Additionally, it holds the most patents of any other IBM-based technology firm and has twelve research laboratories.

Consequently, IBM has also played a role in various industries such as food services, time records, military products and medical instruments.

Maersk

Maersk, one of the biggest logistics companies in the world, and was founded in 1904 in the city of Svendborg. The company entered the logistics sector by purchasing a second-hand-ship. They continued to grow rapidly by establishing a new company in 1912. They were positively influenced by the developments in the maritime sector during the First World War. Moreover, in 1919 they opened their first overseas company in New York. Maersk Line Company began monthly sailing and regular liner services in 1928. The company's first liner services route is between the USA and the Far East, and the first cargo they carry is the cargo of Ford Motor Company. In the mid-1960s, standard container trade developed and the world trade revolution began. Since starting container shipping, Maersk Line has invested in terminal facilities around the world. In addition, it acquired Sea-Land in 1999 and has significantly expanded its terminal portfolio. This led to the establishment of APM Terminals. The company has set a new name: A. P. Møller - Mærsk A/S and formed a new partnership in 2003. In 2009, Maersk Logistics and Damco combined their logistics brands under the Damco brand.

TradeLens is an open and neutral supply chain platform powered by BCT. It ensures accurate information sharing and cooperation within the SC, thus promoting more global trade. The TradeLens platform was co-developed with IBM and GTD INC.

In Additional, TradeLens is an interconnected ecosystem of cargo owners, land and sea shippers, freight brokers and logistics providers, ports and terminals, customs authorities, and other supply chain, partners. IBM and Maersk announced their desire to develop a commercial relationship to build a digital platform in conjunction with the shipping sector at THINK '18 in San Francisco. In August 2018, TradeLens was officially announced to the world. TradeLens processes more than one million shipping operations per day.

The TradeLens ecosystem supports the world's four largest logistics companies, TradeLens, and gains new members with the participation of Maersk. Furthermore, TradeLens can track critical data in every operation in the supply chain and maintains an unalterable record among all involved participants. Additionally, TradeLens is the result of collaboration between Maersk and IBM companies.

TradeLens offers a view of reliable shipping data, which is sourced from participating sources. Reliable information for logistics operations can be difficult to reach and it is important to deliver the right documents to the right people. Otherwise, there may be problems in operations.

The TradeLens platform publishes more than two million events daily and includes more than 175 unique organizations within the ecosystem. TradeLens platform, less paperwork is done, increasing accuracy and efficiency, and guaranteeing the traceability of documents. In addition, security and transparency increase, and costs decrease.

Nowadays, the maritime industry handles 90% of transport operations. The supply chain management is not fast by complexity, and road forwarders have slowed and unregulated systems such as ports, ocean carriers, governments, customs brokers (Lieber, 2017). Maersk Company and IBM are using BCT to develop the worldwide tamper-proof system, optimize trade operations, and trace shipments from beginning to finish, removing friction such as expensive point-to-point connections. The partnership will begin with the capacity to track millions of container movements every year and integrate with customs officials on chosen trade lanes (Armonk, 2017).

Maersk shipping company is a Danish firm and is the biggest container carrier, accounting for %18 to %20 of the world market (Groenfeldt, 2017). Maersk Company is a well-known example of an international business that successfully examined blockchain technology in international logistics. Maersk utilizes the technology to follow its shipping containers across the world, including GPS coordinates, temperature, and other variables (Jackson, 2017).

Moreover, Maersk has been seeking for the best way to track the goods its transport throughout the world for a long time. The main major issue was "mountains of paperwork" required with every cargo for Maersk. For example, Maersk's storage facility in Mombasa, Kenya's coast, was said to have upon shelves of paper documents dating back to 2014 (Popper and Lohr, 2017).

Maersk Company and IBM began developing a version of their software that would be accessible to all parties engaged in the shipping of containers. When customs officials sign off a paper, they may submit a copy with a digital signature right away. This situation included everyone in the system, covering Maersk and the government officials, to see that everything was done correctly. In addition, if there were any disagreements later, everyone could go to the record and be certain that no one had changed it. The cryptography used makes it difficult to change virtual signatures (Popper and Lohr, 2017). All transactions are visible in the system.

In 2014, the Maersk Company tracked a trade between West Africa and Europe to better understand manual procedures and regulated paperwork (Baipai, 2017). However, the ship can wait in port for several days due to lacking documentation. Basically, a simple shipping of refrigerated products from East Africa to Europe, a single container needed stamps and clearances from up to 30 personnel, including customs, tax officials, and health officials. There are more than 200 different contacts and communications among procedures (Groenfeldt, 2017).

It is possible that the goods can be spoiled in the containers. Transferring and maintaining track of all the needed documentation may cost as much as moving the containers physically. Unfortunately, the biggest problem in the global supply chain is theft and fraud. For example, the bill of lading is frequently altered with or duplicated. The goods are stolen from the containers by criminals. Criminals also spread counterfeit goods, resulting in billions of dollars in global maritime.

Consequently, in September 2016, IBM and Maersk Company applied a proof of concept (POC) that followed containers from Mombasa to Rotterdam. The transportation cost was $2000 in the POC, and the paperwork was projected to be around $300 (15 percent of the cargo's worth) (Groenfeldt, 2017). The POC was seen as a success. Maersk Company tracked a container leaving Colombia using this technology (Popper and Lohr, 2017).

The popularity of blockchain technology is increasing day by day. Today, this technology has become an ever-evolving state. Although its development has not been completed yet, it has managed to attract attention with its usability. In addition to these, it has been seen that the great developments and conveniences provided by Blockchain technology to the Industries have beneficial benefits to the industry.

The effects of this intriguing technology are being noticed day by day. Its usability in every sector allows both sellers and customers to be preferred. Every company using BCT facilitates their business with customers, and stays one step ahead of rival companies. The transparency provided by technology makes transactions even easier for customers. With the smart contracts made between the parties, the problems in payment are prevented.

The fact that the document cannot be changed over the system prevents forgery. Blockchain technology is using traceability at the maximum level. Thus, system members can never change the product information. Blockchain technology is a new and developing technology and its importance for the logistics industry is increasing day by day.

In this study, an interview was conducted by asking specific interview questions over Maersk, a maritime transport company, using the qualitative research method. The reason why there is only one company in the study is that it is the only company that actively uses Blockchain technology in the logistics sector in Turkey.

5.2. Research Design

Two qualitative research methods were used in this study. First of all, a detailed literature review was conducted in order to determine the interview questions. In the literature review, searches were made according to keywords. Keywords used for the literature review are logistics and blockchain, SC and blockchain, SCM and BC.

In the literature review, searches were made according to keywords. Keywords used for the literature review are logistics and blockchain, SC and blockchain, SCM and blockchain. As a result of these searches, 1759 articles were identified in the web of science database and the keywords in these articles were analyzed (as shown Table 5.1.). The literature map according to the keywords found is as shown in the Figure 5.1. below.

Table 5.1. Key words

id	keyword	occurrences	total link strength
5	3d printing	5	23
17	access control	6	20
21	accountability	5	16
22	accounting	5	11
35	additive manufacturing	8	30
38	adoption	9	27
61	agri-food	7	26
66	agri-food supply chain	7	17
81	agricultural supply chain	5	22
85	agriculture	17	72
89	agriculture supply chain	8	24
137	applications	6	23
140	architecture	5	16
146	artificial intelligence	22	75
182	authentication	5	19
212	barriers	11	30
233	benefits	7	23
239	bibliometric analysis	12	36
244	big data	26	71
247	big data analytics	6	18
261	bitcoin	27	88
263	block chain	9	23
267	blockchain	954	2200
276	blockchain applications	7	24
318	blockchain technology	153	258
338	blockchains	18	68

366	business	5	22
380	business model	8	19
421	case study	9	22
435	challenges	12	40
452	circular economy	19	59
474	cloud computing	15	63
502	collaboration	6	21
556	consensus	15	49
557	consensus algorithm	6	26
568	consortium blockchain	5	15
601	contracts	8	50
633	counterfeit	7	23
635	counterfeit drugs	5	9
640	counterfeiting	5	24
646	covıd-19	33	116
666	cross-border e-commerce	6	10
684	cryptocurrency	20	69
690	cryptography	14	59
705	cyber security	5	14
715	cybersecurity	15	64
723	data analytics	5	15
734	data management	6	19
739	data privacy	5	26
746	data security	6	26
747	data sharing	5	12
766	decentralization	14	32
796	deep learning	7	18
811	dematel	10	20
823	design science	5	11
877	digital supply chain	10	29
881	digital technology	9	24
886	digital transformation	8	21
888	digital twin	5	19
894	digitalization	25	77
896	digitization	9	23
911	disruptive technology	7	23
925	distributed ledger	40	129
926	distributed ledger technologies	7	19
927	distributed ledger technology	47	151
930	distributed ledgers	5	21
958	drug supply chain	5	17
972	e-commerce	5	14
1045	encryption	5	21
1084	environmental sustainability	5	14
1097	ethereum	50	195

1100	ethereum smart contracts	5	25
1154	finance	6	17
1172	fintech	5	14
1183	food	5	19
1192	food industry	7	20
1208	food safety	23	84
1210	food security	10	43
1213	food supply chain	43	122
1217	food supply chains	5	11
1221	food traceability	12	32
1290	game theory	8	11
1369	health care	6	23
1379	healthcare	23	89
1423	humanitarian supply chain	5	14
1434	hyperledger	20	66
1435	hyperledger composer	5	12
1437	hyperledger fabric	24	67
1465	industry 4	9	38
1466	industry 4.0	7	12
1481	information sharing	5	16
1495	innovation	8	26
1535	internet of things	13	47
1604	literature review	23	76
1617	logistics	60	190
1624	logistics management	5	17
1650	machine learning	24	64
1670	manufacturing	8	36
1722	medical services	8	59
1777	monitoring	8	40
1824	network analysis	7	23
1916	operations management	7	15
1992	peer-to-peer computing	10	62
2003	performance	5	16
2018	permissioned blockchain	8	24
2034	pharmaceutical supply chain	8	13
2055	platform	6	7
2105	pricing	7	11
2109	privacy	24	94
2116	privacy protection	6	16
2144	product traceability	6	17
2146	production	5	23
2187	provenance	14	49
2206	qualitative	7	18
2293	resilience	9	34
2309	resource-based view	5	16

2326	review	7	23
2331	rfıd	17	52
2361	safety	7	40
2369	scalability	10	32
2403	security	59	263
2447	shipping	6	18
2466	smart cities	8	28
2467	smart city	5	15
2472	smart contract	110	314
2476	smart contracts	98	339
2484	smart manufacturing	9	33
2527	social sustainability	7	18
2528	social welfare	5	7
2560	stakeholders	14	89
2600	supply chain	293	806
2623	supply chain finance	21	36
2629	supply chain integration	5	16
2633	supply chain management	151	400
2634	supply chain management (scm)	6	15
2644	supply chain performance	9	21
2648	supply chain resilience	11	36
2651	supply chain risk management	5	20
2659	supply chain transparency	8	18
2661	supply chain visibility	5	20
2664	supply chains	55	243
2671	supply-chain management	5	20
2679	survey	8	26
2683	sustainability	75	227
2691	sustainable development	5	18
2702	sustainable supply chain	6	15
2704	sustainable supply chain management	10	15
2721	systematic literature review	20	54
2723	systematic review	14	33
2751	technology	19	46
2755	technology adoption	13	27
2769	technology management	5	22
2789	testing	5	38
2831	traceability	115	409
2837	traceability system	10	30
2848	tracking	6	24
2861	transaction	6	18
2879	transparency	38	138
2890	transportation	6	17
2896	trust	33	132

2945	utaut	7	15
2954	value chain	5	14
2987	visibility	10	31
3051	ındia	5	17
3060	ındustries	15	87
3061	ındustry 4	32	125
3062	ındustry 4.0	28	82
3079	ınformation sharing	9	28
3081	ınformation systems	6	19
3086	ınnovation	9	23
3118	ınternet of things	70	229
3119	ınternet of things (ıot)	16	48
3125	ınteroperability	6	16
3140	ıot	57	184
3153	ıpfs	8	29

According to the results of the literature review, our interview questions were determined. The questions developed based on the literature were coded and analyzed with the MAXQDA program, which is used to encode and categorize qualitative data. MAXQDA is a qualitative data analysing software which used for analyzing all fields of data (Marjaei et al., 2019).

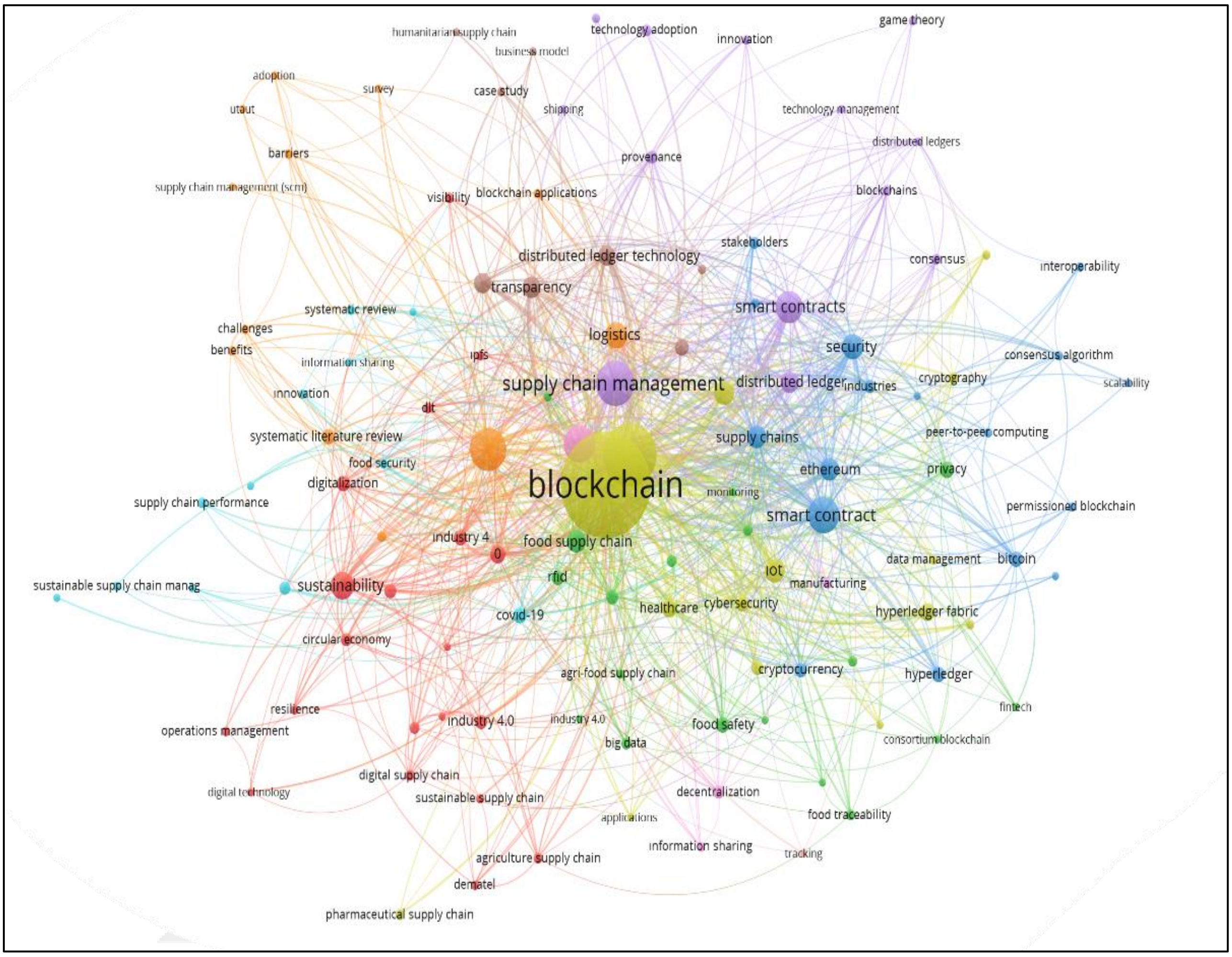

Figure 5.1. Literature Review Map

First of all, the managers who manage the blockchain processes at the Maersk Company were contacted. Afterwards, a meeting was arranged for a suitable day and time for the company managers. Since it is the only company using blockchain technology in logistics industry in Turkey, a different company was not included in the meeting.

The meeting was held on Microsoft Teams and took approximately 75 minutes. In the meeting, interview questions created according to the literature were asked to the employees, respectively, and the meeting notes were recorded.

Two Maersk seland employees who manage blockchain processes and supply chain processes attended the meeting. One of the workers is a woman and the other is a man. The female employee manages the supply chain processes, while the male manager manages the blockchain processes. The male employee has 10 years of logistics, supply chain and information technologies, and the female employee has 3 years of supply chain management work experience.

In general, at the meeting, we talked about how blockchain technology contributes to the industry. As Maersk, they explained what kind of changes the blockchain technology has brought. The questions we asked to the company officials at the meeting are listed below.

Interview Questions

1. How did the partnership between IBM and Maersk begin?
2. What was Maersk's decision on switching to this technology / how did you make this decision?
3. Why preferring blockchain technology?
4. What were the positive/negative effects of BCT in terms of SCM?
5. How did blockchain technology affect the relationship between producers and consumers?
6. How did smart contracts affect the relations between the parties?
7. What are the contributions of BCT to the logistics industry?
8. How did the blockchain technology affect customer satisfaction?
9. Has it affected your costs after the use of blockchain technology? How did it affect it?
10. How was the procedure before blockchain technology and how the new procedure provided benefit afterwards?
11. How do you think Blockchain technology has affected the logistics industry?
12. How and in which way Maersk differentiate from other companies? How was the impact?
13. How did traceability affect the relationship between the parties in terms of security, transparency, energy efficiency, resource efficiency and cost?
14. What impact does this technology have on Maersk's efficiency and latency?
15. How was the result on digital data management and documentation processes with blockchain technology?
16. How the BCT and SC members coordination can be ensured?
17. How did blockchain technology improve your logistics (technological) operations?
18. What are the risks of BCT?
19. Considering the initial investment cost of blockchain technology, do you think it’s worth taking the risk?
20. What is the most important contribution and most important problem of blockchain technology? What’s your opinion?

21. What is your expectation from blockchain technology, for what purpose did you start using this technology?
22. Which feature(s) of blockchain technology do you think provides the most benefit to your company?
23. Apart from blockchain technology, are there any different technologies that you use as Maersk?
24. Are there any companies in the industry that use blockchain technology other than Maersk?

The information recorded during the meeting was typed electronically. Later, this recorded information was divided into main categories and subcategories according to the keywords in the literature. These categories were processed into the MAXQDA program. Figure 5.2 shows an example of how categories and subcategories are made.

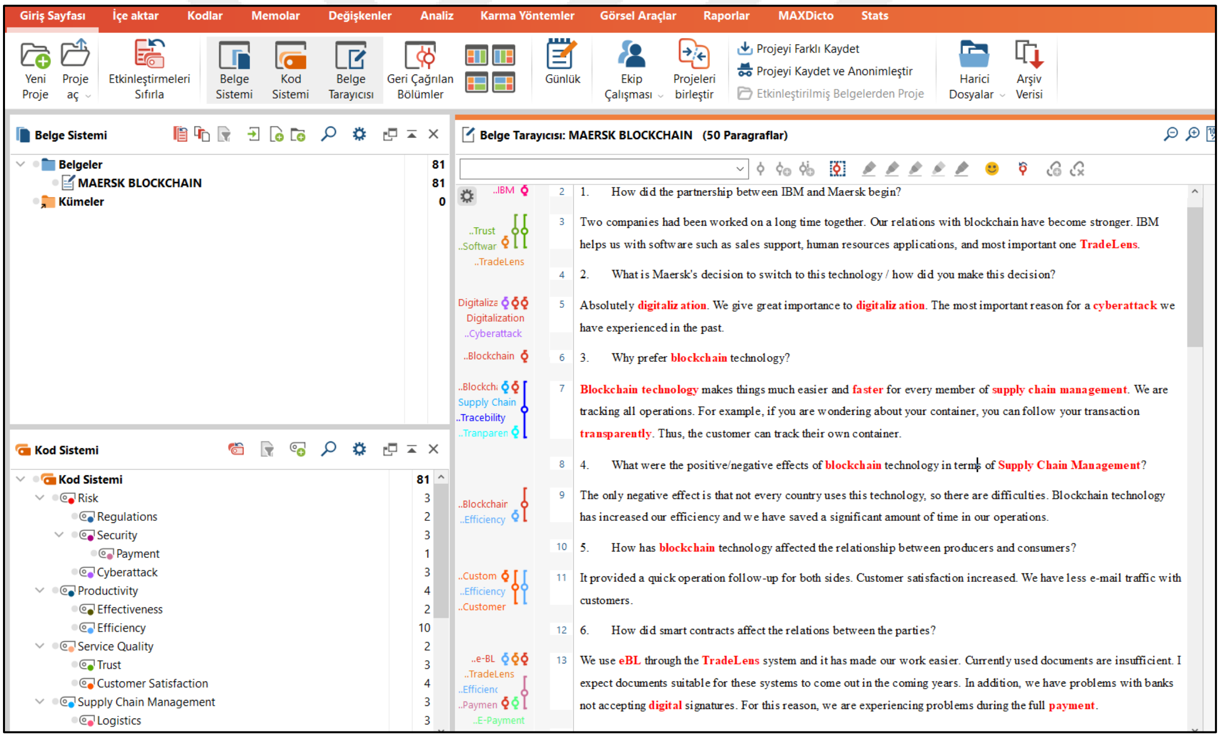

Figure 5.2. MAXQDA Coding Example

The maps created as a result of the coding made in the MAXQDA program are shown in Figure 5.2 and Figure 5.3.

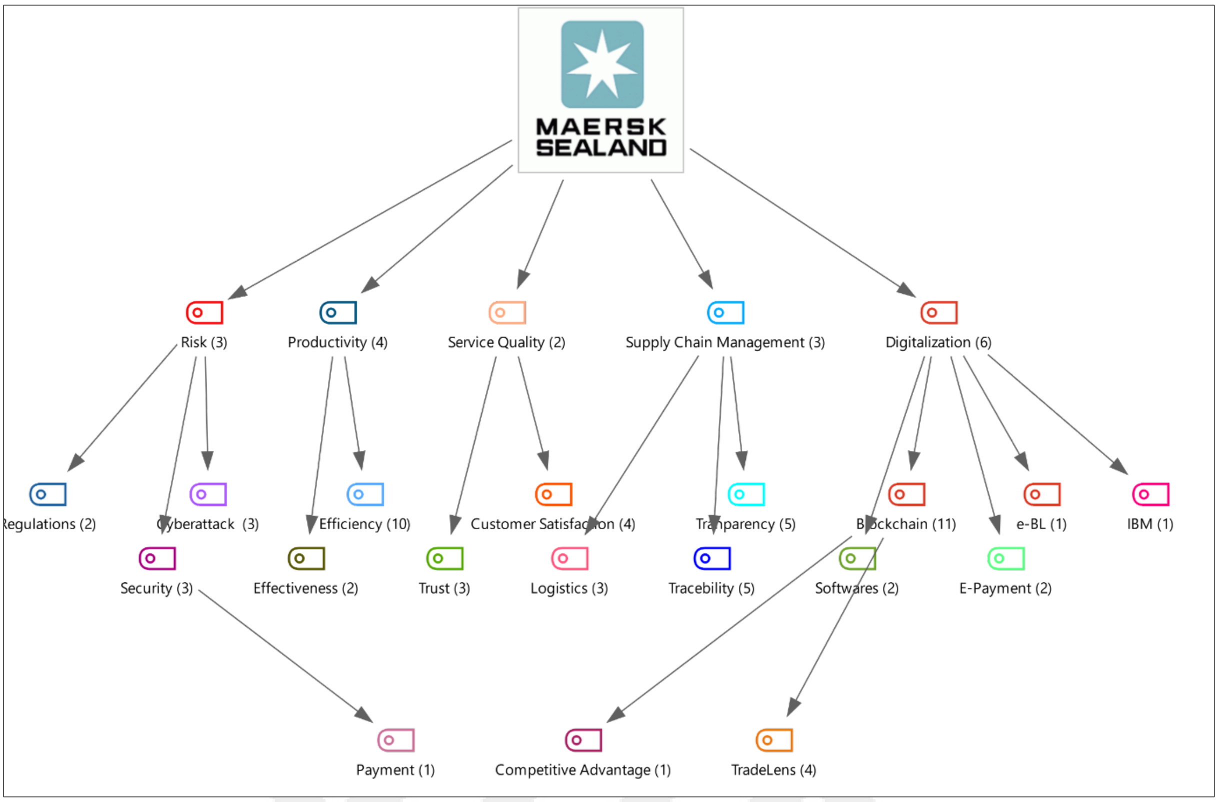

Figure 5.3. Categories and Sub-Categories of the Meeting

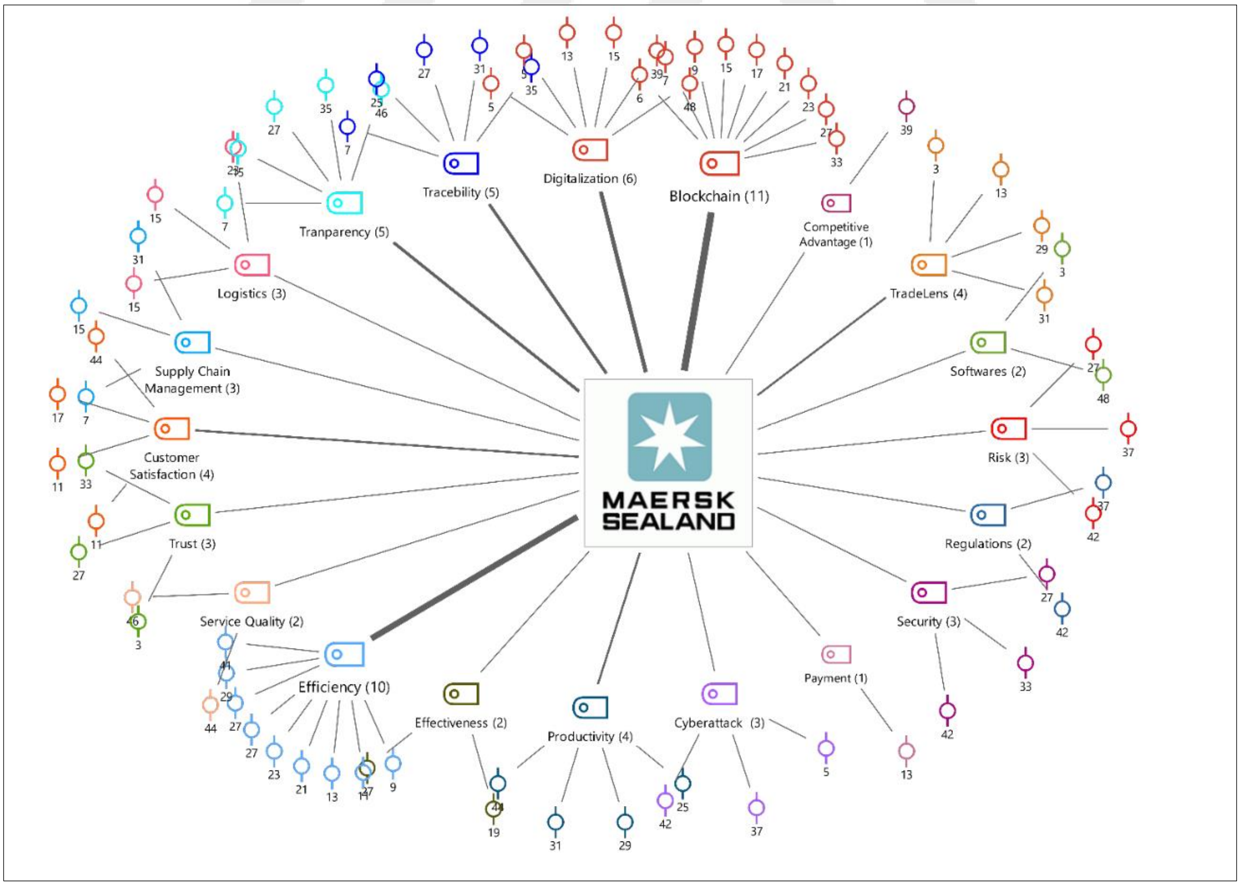

Figure 5.4. The map of codes and categories

5.3. Findings

In the visual map, line thickness indicates the frequency of the word. According to our meeting, there are 4 categories that are important in blockchain technology. These categories are efficiency, digitalization traceability and transparency (as shown Figure 5.4). The importance of these categories is explained in the findings section.

Efficiency: Blockchain technology was initially created and released in 2008 (Xu et al., 2019), it took many years for various businesses to see its potential worth and utility in increasingly high efficiency and eliminate waste (Upadhyay et al., 2021). Although BCT is in its infancy, it is developing rapidly in different sectors. Organizations are willing to take advantage of cost and time savings. As an example of this situation, the Maersk Company has reduced problems to a minimum by using technology efficiently. In addition, companies using the system efficiently reduced costs and time. Supply chain management is always working to decrease waste and improve efficiency (Upadhyay et al., 2021). Applying blockchain technology to connect distributed ledgers, information, and stakeholders throughout the supply chain may improve efficiency and save money and time. Similarly, Maersk emphasized that blockchain technology has increased their efficiency by providing time and cost benefits to their companies.

Digitalization: Digitization should be one of the areas that companies should give importance to use digitalization to the work of companies. For example, in decision-making practice; it provides maximum speed in responding to requests quickly. In addition, companies can maintain their leadership in the market and increase competition with the right digitalization policy. Thus, it provides a positive return materially and spiritually. Maersk emphasized that companies that want to exist in the future should invest in digitalization with great importance. According to the company, he emphasized that companies that do not complete their digitalization or do not digitize in the next ten year will disappear.

Traceability: Furthermore, another finding is traceability. The supply chain gives great importance to traceability. Blockchain technology can provide reliability, transparency, and traceability while minimizing losses. By using blockchain technology to provide traceability, stakeholders, including internal and external players, can be tracked along the chain (Mangla et al., 2021). Maersk Company offers traceability services to customers and every transaction can monitoring in the system. Thus, this service increases the customer's confidence.

Transparency: Finally, the most important aspects in developing supply chain transparency are data and knowledge sharing, as well as industrial infrastructure (Narwane et al., 2020). Transparency is allowing companies and customers easy access to information. Moreover, BCT provides transparency transactions in the SCM and all transactions can be tracked from start to finish.

In addition, it was stated that these four parameters have a big impact on the trust and customer loyalty of the company. The fact that the company and its customers followed the process immediately had positive effects on the company in terms of activating the process, reducing the error and reducing the costs associated with them.

In general, blockchain technology has many positive effects on industries. The investments made by companies in technology, it makes a difference both in the field of competition and in the field of institutionalism. Investments in BCT play a key role in the future of companies. If these findings are given importance, companies will be more advantageous than their other competitors.

After learning the answers to the questions, we asked at the meeting, we got first-hand information about how blockchain technology is used in the industry. We have seen that the convenience provided by blockchain technology provides efficiency for all system users, increases transaction speeds, and strengthens trust between buyers and sellers. Finally, they think that blockchain technology will develop faster and make things easier in the future.

Finally, during the meeting, we asked questions about blockchain technology, including how it is used by both service providers and customers, and its advantages and disadvantages. We have received information about how Blockchain technology will affect the industries in the future.

5.4. Results

We used the VOSviewer program to perform content analysis for the keywords mentioned in these articles and created an analysis map as shown Figure 5.1. When we asked the questions, we created according to the literature review to Maersk company officials and analyzed them in the MASQDA program, the most important benefits of blockchain technology were found as follows: digitalization, traceability, transparency and efficiency. According to the results of our analysis, the most used words in the literature were: blockchain and traceability. The traceability, security and transparency of blockchain technology will be the most important factor for companies to prefer this technology in the future.

This study gives an idea to those who are considering using blockchain technology in the future. Moreover, it is one of the studies examining how BCT may contribute to SCM, and we recommend further work in this area.

CHAPTER 6

CONCLUSION

Blockchain emerged from the Bitcoin currency type and its founder is Satoshi Nakamoto. The major use of blockchain is to record the usage and transactions of the cryptocurrency bitcoin (Upadhyay et al. 2021). There are more than 2000 cryptocurrencies today, and cryptocurrency usage is not widely used in the world.

Moreover, Blockchain technology has expanded further in the course of time, and blockchain applications have expanded to a wide range of finance and banking and accounting sectors. Blockchain is used in the health sector, supply chain management, patents and copyrights, marketing, insurance, etc. (Upadhyay et al., 2021). Every sector uses technology in various fields through blockchain technology.

The features behind blockchain, particularly peer-to-peer sharing, tamper-resistant security, distributed storage capabilities, and the possibility for safe automation make it different from other technology.

SCM is the right product, the right time, the right place and the right price to perform the operation at the lowest cost. Supply chain management has been known of as a method of transporting products and materials.

Meanwhile, Supply chain management is not just a method used to carry products to a place, but also this method used to increase the performance of companies. The aim of SCM is to strike a balance between high-cost end-users service and low-product management.

Blockchain technology has many advantages and disadvantages. The advantages of blockchain to its users are transparency, traceability, decentralization, visibility, etc. Blockchain technology can monitor all transactions and increase efficiency with the transparency it provides in the system.

Blockchain technology will be a huge technology to users and in sectors with the efficiency, it provides. Transparency and traceability are very important facts for all supply chain members, especially logistics sectors and manufacturers. Blockchain's decentralized, traceability, and transparency aid to reduce system fraud and counterfeit transactions while putting the system under control.

Furthermore, it has been critical to incorporate BCT into a SCM in order to develop a framework that allows for product monitoring and to discover answers to supply chain big data concerns (Govindan et al., 2018; Choi and Luo, 2019; Choi et al., 2020b). For this reason, blockchain technologies are required to enable transparency, traceability, quality services control enhancement, and fraud prevention in supply chain management (Mangla et al., 2021). Consequently, increasing the supply chain management and thus reducing waste of time may be successful by enhancement transparency; applying blockchain technology to the supply chain management can help with this.

Finally, blockchain technologies in supply chain and logistics have a significant influence on sectors.

The effect can be used from the purchase of products to the distribution of products at every stage of supply chain management, and every transaction can be traced in the system.

BCT has occurred a significant benefit to the logistics industry such as more trust, more service quality, more customer satisfaction, more efficiency, etc. It provides convenience in payment methods as well as the system eliminates the middlemen in the payment method system. Another important advantage of the system is that it is secure, reliable and protected.

The purpose of the study is to show the usage of the technology is of vital importance for the logistics industry. Blockchain technology has brought several advantages to the logistics industry. In addition, the logistics sector began to progress more rapidly. To sum up, it has revealed that blockchain technology provides benefits in the logistics supply chain and the advantages it provides to the sectors.

For future research, although blockchain technology is difficult to suffer from cyber-attacks, the system should invest more in security. Researchers can examine the security problem issues between supply chain members and logistics areas of blockchain technologies. Thus, there will be a decrease in the number of customers who do not trust blockchain technology.

6.1 Contributions of the study

Blockchain technology is an extremely large and developing technology. As it continues its development, it has not yet fully gained the trust of governments and sectors. As a result of the research, we have gained a lot of knowledge and when the blockchain technology is completed, it will become a technology that everyone can trust and use. Blockchain technology provides many features and convenience to the sectors.

In addition, the importance of transparency, which is one of the most important features and conveniences of Blockchain technology, for the supply chain was emphasized. Thanks to its transparency feature, it provides the opportunity to track transactions.

Another feature of blockchain is traceability. In this way, it provides the opportunity to learn at what stage the supply chain operations are, without the need for intermediaries. The contribution of the study provides the opportunity to monitor all transactions in the system with traceability and transparency, so that it can see every transaction made and save time. It provides important information to industries that want to use blockchain.

This study demonstrates that in today's World, new and inoovative solutions with technological tolls have vital importance for industries and their performance. Technology reflects significant impacts on industries. For example, it provides fast payment opportunities, transaction speed, and time savings. Companies which are using technology effectively are working more efficiently and working faster. Recently, we aimed to reveal the multiples that blockchain technology, which is a fresh technology, provides to logistics and supply chain.

Blockchain which has become a popular technology has attracted the attention of many sectors and how this technology affects logistics industry is significance of the study. The number of sectors which prefer blockchain is very small because the industries do not have all the knowledge about the use of blockchain. When Blockchain technology will be fully developed, it will be indispensable with the vital effects it provides to its users. After the research we have done, we have seen many beneficial effects of blockchain. Finally, our study gives ideas to companies and governments that want to use blockchain technology.

6.2 Managerial Contributions

This thesis focuses on the use of blockchain technology in the supply chain management and logistics industries. When examined in more detail, it is clear that the study has many contributions to both the supply chain and logistics. It provides many features and conveniences that Blockchain Technology provides to the industries.

Moreover, this technology significantly increases transparency and traceability, thus positively affecting customer satisfaction. Additionally, it increases trust, visibility and traceability between parties by reducing transaction times and risks. One of the big and impressive advantages of blockchain is easy access to the system. The user can access the original information in the system from anywhere and at any time. Another advantage is to eliminate middlemen. Blockchain provides the opportunity to do all transactions without intermediaries, as it provides ease of transaction. In this way, since there are no fees to be paid to intermediaries, there will be a decrease in costs and an increase in profits will occur.

Although blockchain has many disadvantages. In order to use this new trend in the most efficient way, it is necessary to attach importance to new technology. Therefore, companies and governments should improve their technological infrastructure. Also, they can use the full performance of the blockchain. Blockchain technology can be used at every stage of the supply chain and they can track every stage of product and service history. If companies use blockchain technology to its full performance, they can increase their efficiency and reduce the extra costs and risks.

Furthermore, governments and companies should trust the digital payment system that blockchain provides. Thus, companies can perform their transactions faster and without intermediaries.

This technology is currently in its infancy, but when it is fully developed, it will be a huge technology. Moreover, companies that do not use this technology when it is fully developed, may come to the stage of bankruptcy. Since access to the system is fast and easy, the parties should trust the system.

6.3 Theoretical Contributions

It takes quite a long time for governments and companies to accept new technology. Although there are many critical advantages of new technology, it also has disadvantages. Additionally, Blockchain technology provided more beneficial effects with transparency and traceability. Since the information entered in the system cannot be changed, the trust problem between the parties can be eliminated. The fact that the information entered into the system is original and unchangeable which has increased the trust of the parties to each other. Although it is a short-term disadvantage for governments and company employees to adapt to new technology, shortening the processing times will provide many benefits when viewed from a long-term perspective. Moreover, the advantages of new technologies make it easier to accept.

Furthermore, the government and companies get more efficiency by employing fewer personnel in the companies by using this technology. This technology plays a strategic role for stakeholders and it is an important factor for other companies to stay ahead of the competition.

As a result, stakeholders who have started to use the many benefits of the new trend blockchain technology will benefit from their significant contributions in the long run and will be ahead of the companies they compete with.

6.4 Limitations

Blockchain technologies have many advantages like decentralized, transparency, traceability secure, and easy payment system. However, many countries and many companies do not know these features. They cannot use it because they haven't got any information about blockchain, and they have insufficient infrastructure.

Companies are nervous about using blockchain technology because they don't know digital payment methods. In addition, companies do not prefer this technology because they have a problem with trust in payment. That is why companies use traditional methods.

There are not many companies using BCT in Turkey. Currently, only Maersk Company uses complete blockchain technology in turkey. Therefore, we chose that company and asked them our interview questions. But we think that many companies will start to adopt this technology in the future and different studies can be done with other companies.

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