THE EFFECTS OF USING BLOCKCHAIN TECHNOLOGY ON LOGISTICS INDUSTRY

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PLAGIARISM

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ABSTRACT

Today, companies in the logistics sector manage very complex processes for customer satisfaction. One of the most important parts of this complex process is traceability. In today's technology, block chain technology, where data security and traceability meet together, is a golden boon for logistics companies and supply chain. In recent years, information technologies have been used extensively in order to manage complex structures and increase performance in the supply chain. It is predicted that traceability and secure information flow, which are the main features of blockchain technology, can provide a significant benefit to the logistics industry. Almost every logistics company has experienced that they get the return of the right investment they will make here by increasing their information technology resources. Therefore, in this study, the benefit provided by logistics companies investing in blockchain technology has been investigated. As a result of the research, it has been seen that the traceability and secure information flow of blockchain technology benefits all companies investing in this technology. Keywords – Blockchain, Logistic, Blockchain Applications

ÖZET

Günümüzde lojistik sektöründeki şirketler, müşteri memnuniyeti için çok karmaşık süreçleri yönetmektedir. Bu karmaşık sürecin en önemli kısımlarından biri izlenebilirliktir. Günümüz teknolojisinde veri güvenliği ve izlenebilirliğin bir araya geldiği blok zincir teknolojisi, lojistik şirketleri ve tedarik zinciri için altın bir nimettir. Özellikle son yıllarda tedarik zincirinde karmaşık yapıların yönetilmesi ve performansı arttırmak için bilgi teknolojileri çok yoğun şekilde kullanılmaya başanmıştır. Blok zincir teknolojisinin temel özellikleri olan izlenebilirlik ve güvenli bilgi akışının lojistik sektörüne önemli bir fayda sağlayabileği öngörülmüştür Hemen her lojistik şirketi bilgi teknoloji kaynaklarını arttırarak buraya yapacakları doğru yatırımın geri dönüşünü misliyle aldıklarını tecrübe etmişlerdir. Bu nedenle bu çalışmada blockchain teknolojisine yatırım yapan lojistik firmalarının sağladığı fayda araştırılmıştır. Araştırma sonucunda blockchain teknolojisinin izlenebilirliği ve güvenli bilgi akışının bu teknolojiye yatırım yapan tüm şirketlere fayda sağladığı görüldü.

Anahtar Kelimeler – Blok Zincir, Lojistik, Blok Zincir Uygulamaları

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1. INTRODUCTION

The speed, traceability and information security of the logistics sector, which is of great importance for the survival of our lives today, especially after COVID 19, has become more important than before, and has become directly related to customer satisfaction. After a product is manufactured, it goes through very long and complex logistics processes until it reaches the end user. Sometimes, until a product reaches the end user, it may involve more than one country, logistics company, brokerage firm and with it too much paperwork. In some cases, more than one person or company can follow the logistics of a product for weeks. This process, which is difficult to follow, affects the speed and performance of logistics.

Developments in information technologies in recent years have also affected the logistics capabilities of companies. Using information technologies in the logistics sector in the best way has increased customer satisfaction and reduced costs. That's why logistics companies have integrated blockchain technology into their infrastructures and started to use blockchain-based logistics applications.

Blockchain-based logistics applications offer end-to-end decentralized processes where all stakeholders can confirm correct information. The blockchain technology, which was first handled by Satoshi Nakamoto as the electronic money system Bitcoin on 31 October 2018, is expected to develop in many areas, especially in the supply chain, in the future (Nakamoto, 2008).

Blockchain promises some deep-rooted solutions to problems that traditionally exist in logistics and supply chain and become more complex with globalization. With

the transparency and accessibility of blockchain transaction records, it is aimed to trust business transactions.

This thesis consists of five chapters. In the first chapter, under the title of logistics, the history of logistics, components of logistics, digitalization in logistics are examined. In the second part, by giving information about the history and basic features of blockchain technology, reconciliations of technology, network diversity and application areas are discussed. In the third part, information about the research question and research management is given. In the fourth section, companies that apply block chain technology in the logistics sector are discussed and the cases are analyzed. In the last section, results and findings were written and the study was completed.

2. LOGISTIC

In this section, the concept of logistics and its development are discussed by making a literature review. Then, the logistics management and its objectives are discussed and information is given about the logistics management components. Finally, information was given on the effects of integration and digitalization in logistics management.

2.1. Logistic Management and its Development

In this section, the definition of logistic,basic logistic activities and logistics management is discussed, Finally, this section is completed with the processing of logistics management.

2.1.1. Definition of Logistic

It would be more correct to define logistics before defining the logistics management. In its beginning phases, logistics was often connected only with its two functions of transport and warehousing. Literature reviews have shown that logistic is "the process of strategically managing the movement and storage of materials, parts and finished inventory from suppliers, through the firm and on to customers" (Christopher, 2016).

Another literature scan shows that "Logistics involves getting, in the right way, the right product, in the right quantity and right quality, in the right place at the right time, for the right customer at the right cost" (Mangan et al., 2008, p. 9).

One of the logistics definitions in the literature is that "Logistics concerns the efficient transfer of goods from the source of supply through the place of manufacture

to the point of consumption in a cost-effective way whilst providing an acceptable service to the customers" (Rushton et al., 2022, p. 6).

Different logistics activities are carried out by businesses to deliver the requested products and services to the customers. A logistics process in which these activity elements are planned effectively and in harmony will create added value. Logistics activities, which were only transportation and storage services in the early days, have been diversified to cover more areas as a result of the expansion of the global competitive environment. These activities are nowadays; It consists of transportation, storage, handling, order management, demand forecasting, warehouse location selection, purchasing, and customer service.

2.1.2. Basic Logistics Activities

Transport: The most important element in logistics activities is transportation. Companies must have a planned and scheduled transportation system in order to deliver the requested product or service at the desired location and at the desired time. Although transportation is one of the most important activities of logistics, the mode of transportation, the level of the distribution operation, loading and route plan are among the most important elements of this group.

Storage: The storage factor, which is included in the logistics activities, is a factor that plays an important role in the competitive advantage of businesses against other businesses. Storage activity until a few years ago; While it is known as an area where parcels, packages and products are stacked, it is seen as a new tool in providing competitive advantage for today's businesses.

Handling: The processes that involve the movement of goods inside the warehouse without changing the physical appearance and technical characteristics of the products temporarily kept in the warehouse area are called handling. These processes are detailed below**.** (Koban & Keser, 2008, p. 93-94).

Order management: Order management, which includes the negotiations of buyers and suppliers based on their orders, is a very important element for the information management systems of logistics companies. The importance of order management is increasing especially for the on-time delivery criterion, which is the expectation of every customer. In order for the order management, which is an indicator of customer service quality, to provide the service at the level requested by the customers, communication, inventory and documentation processes must be done completely during the planning, receipt, transfer, processing, preparation and sending of the relevant order (Gürdal, 2006, p. 23).

Demand Forecasting: Demand forecasting is defined as planning by determining how much demand will come against which product and service in the next time period and what level of service will be needed by which customer. Knowing the amount of demand for products and services before in terms of logistics; It is important for all aspects of the work carried out by companies in areas such as marketing and manufacturing.

Purchasing: There are more than one definition of purchasing activity in the literature. Some of them are listed below (Tanyaş & Hazır, 2011, p.120).

"Procurement is a systematic process consisting of deciding what, when and how much to buy, performing the purchasing process and ensuring that the determined quality and quantity are received on time."

"The purchasing function is to provide the right equipment, materials, equipment and services with the right quality, the right amount, the right price, the right source."

Customer Service: Depending on the developments and technological innovations in the logistics sector, customer requests and needs are changing day by day. In such an environment, reaching customers more effectively, understanding customer demands and providing products and services in line with these expectations constitute the most important function of customer service. Factors related to services such as logistics operations, behaviors and documentation during the period from the receipt of the order to the delivery of the product position the company in the mind of the customer and are effective in increasing the quality of customer service and continuity of customer (Gürdal, 2006, p.13).

2.2. Logistic Management

Logistics Management; It is the management of all supply chain activities covering the forward and backward flows and storage of goods, services and related information between the production point and consumption points in an effective and efficient manner in order to meet customer needs.

In this section, we will examine the activities of logistics management in detail.

We can define all activities within the supply chain other than production as Logistics Activities.

- Inventory Management
- Transport Management
- Warehouse and Warehouse Management
- Packaging and Handling Management

- Distribution Management
- Customs

2.2.1. Inventory Management

The management of inventory, which is almost the biggest asset of many companies, directly affects profitability. (Filiz,2016). Inventory decisions, which are among the very risky decisions affecting the logistics management, provide significant support to the logistics activities to be made. Without a proper inventory classification, customer dissatisfaction occurs. (Bowersox, et al.2002). Accuracy, traceability and fast handling of the inventory kept, as well as collecting date records and presenting strategic reports are among the most crucial points of inventory management. For this reason, inventory planning is very critical.

2.2.2. Transport Management

The role of transportation in logistics activities is well developed (Bowersox, p.328). Transport today; It is of critical importance in the distribution of products from source to production sites and from these locations to market centers (Langford, 1995). Transportation costs account for about two-thirds of the amount spent on all logistics activities (Langford , 1995).

2.2.2.1. Functions of Transportation Management

Transportation is a very common and popular part of logistics. Consumers are used to seeing trucks and trains carrying goods or a truck parked in front of the firm. Transportation offers two important services: transportation and storage of products.

2.2.2.1.1. Product Transportation

Whether raw material, semi-finished or finished product, the basic value provided by transportation; It is to move the inventory to the next process. The performance of the transport is crucial to procurement, production and market distribution and plays a key role in reverse-logistics performance. Without a good transportation, many commercial activities become impossible.

2.2.2.1.2. Product Storage

Product storage is a less noticeable part of transport. While the products are in the transport vehicle, they are stored at the same time. Although the transportation vehicles in the center or at the destination can also be used as a warehouse, this is quite expensive compared to the other option. However, it can be decided to keep the products in the vehicle by comparing the unloading, storage and reloading costs of products that will go to a different place in a short time (Langford ,1995).

2.3. Transport Types

In passenger and freight transportation: economy, speed, safety and comfort are features that should be sought in all types of transportation. In addition to these, the least pollution of the environment, the use of existing energy resources in the country and the low energy consumption per passenger-km or ton-km are other factors that should be taken into consideration in the preference of the first facility and the ease of maintenance and repair.

2.3.1. Highway

Since the production and consumption societies are on the land, it is the most preferred mode of transportation in every stage of supply chain management. Among the most important reasons for preferring the highway are its low cost, being the most flexible mode of transportation and providing door-to-door transportation. It competes with maritime transportation due to the size and weight limitations in land transportation. Transportation is made via extensive road networks. With a scheduling that is not based on strict timelines compared to other modes of transport operation is performed. Unlike the railway transportation mode, businesses do not have to use their own equipment. Road transport, which is the type of transport with the most intense competition, is generally used in the transport of final products rather than raw materials is preferred.

2.3.2. Maritime

It is the most reliable and most economical mode of transportation in intercontinental transportation. 90% of world trade is carried out by maritime transport, although it is slow. In cases where shipping times can be ignored, it is the most advantageous means of transportation compared to other transportation modes. Large amounts of dry cargo, liquid and containerized materials can be transported by sea, which is more advantageous than by road.

2.3.3. Airway

It is the fastest and most costly mode of transportation used when the products need to be transported quickly. Compared to other modes of transportation, air transportation is preferred for the transportation of smaller volume and valuable

products, since the transportation cost is calculated over the weight of the product. The transportation costs are also high because of the high initial investment and operating expenses, but the speed advantage it provides is also a factor that reduces the storage cost for businesses.

2.3.4. Railway

It is a low-cost mode of transportation of heavy and high-volume products on long distances. Unlike the highway, the market area it covers is limited. Since it can transport the products of many different businesses at the same time, its costs are low, but it cannot respond to urgent shipments as it is not as common as road transportation and is used infrequently. It is the mode of transportation with the highest initial investment and return on investment. because

If a rail line is installed between locations, it is impossible for another enterprise to establish a parallel rail line, and this gives the enterprise a competitive advantage. The market share of European Union countries in freight transportation by rail is 13.4%. However, due to the fact that there are fixed routes, the products cannot be unloaded at any other point on these routes, and the flexibility is restricted, railway transportation is much less preferred in our country than in Europe.

2.3.5. Pipe Line

This mode of transportation, which is mostly used in gas and oil transportation, is also used in the transportation of oil, water and liquid products. Compared to other modes of transport, it is not affected by weather conditions, but it is a slow and inflexible mode of transport because it is used only for the transport of certain products.

2.4. Integration and Technology in The Logistics Industry

Logistics software technologies aim to achieve a faster and safer logistics process by ensuring the effective and efficient use of logistics resources. With the acceleration of trade both inside and outside the country, the competition between companies has increased and both the production of products and the delivery of these products to the relevant places have started to gain importance. At this point, logistics new technologies come into play and deliveries are carried out quickly and reliably. With the software technologies used, the production phase of the products can be followed, the products can be easily separated, the stock quantities can be tracked instantly, they can be packed and shipped to be delivered to the required places. Thanks to advanced technology, the position of these products during shipment can also be tracked. Thus, in case of any problem, it can be intervened quickly and easily.

2.4.1. Processes That Technology Affects in Logistics Industry

Transportation technologies are developing day by day and keep up with new types of transportation. Automation and cognitive technology, which take their place among transportation systems and technologies, make logistics more professional and practical. Many transportation stages such as shipment, delivery, planning and arrangement of product movements, route planning, vehicle and load tracking are carried out smoothly with smart applications and specially developed software. With the use of these information technologies, it is observed that customer satisfaction also increases by ensuring the management of operation processes. In addition, the use of drones in warehouse counts, the use of virtual glasses to have an idea about the

dangers on the road, the continuation of work on autonomous trucks and autonomous ships can be listed as other technological traces in the logistics industry.

2.4.2. Internet

As in every field, the Internet significantly changes the activities of businesses. The Internet has an important role in increasing the communication of businesses with their current or potential suppliers, intermediaries and customers. For this reason, internet-based innovations in logistics industry are important for companies.

Thanks to the benefits of using the Internet, logistics firms can gain competitive advantages in their own markets. logisti industry-based business competition is becoming an important reality in many markets. In order to develop this capability, individual companies, as well as the entire logistic companies, must learn new behaviors and ensure that these new behaviors are implemented through the use of appropriate technologies.

2.4.3. Electronic Data Interchange

Electronic data exchange; It refers to the data transfer between computers through standard formats created for documents belonging to business processes. Information between companies; e-mail, courier, fax, etc. It defines sharing electronically instead of traditional methods (Chase & Aquilano, 1998).

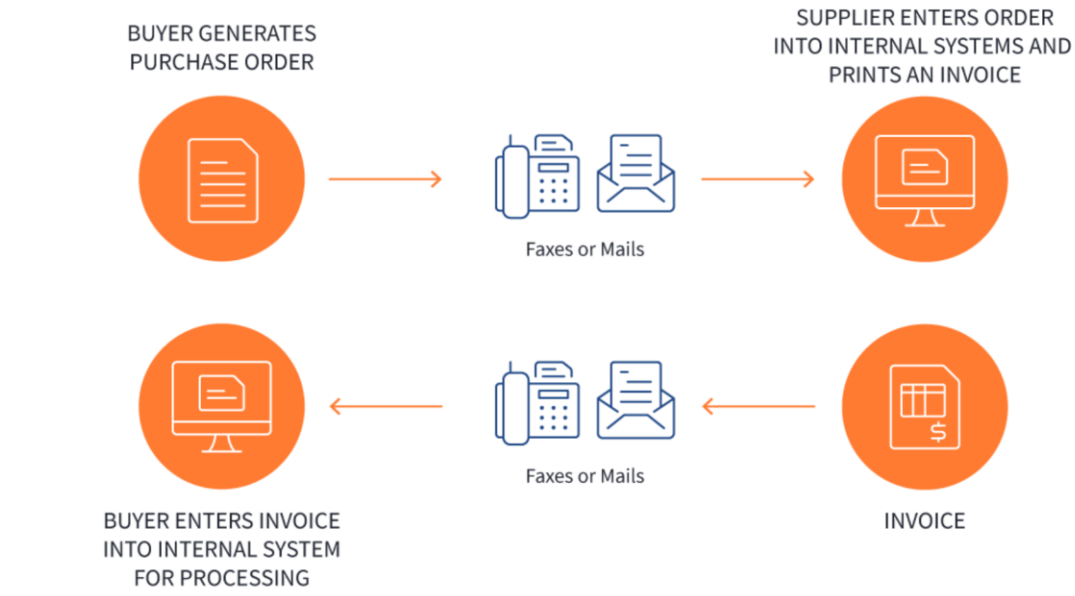
Electronic data exchange; It allows easy access to information and better customer service, reducing the number of documents based on paper usage and increasing productivity due to better communication. The benefits of electronic data exchange can be seen in the shortening of the time for the documents required for

companies and customers to reach their destination and, accordingly, the order times. Minimizing any human factor-induced errors that may occur is also ensured by this system.

Eletronic Data Interchange allows for the setting of standards among trading partners in order to consistently achieve benefits for large organizations. Compliance with EDI offers smaller organizations the opportunity to better integrate with larger firms with large budgets and strong influence.(see Figure 1).

Figure 1

The EDI Process



2.4.4. E-commerce

Transactions in electronic commerce are carried out through electronic data exchange, electronic mail, electronic fund transfer (EFT), electronic bulletin board, database sharing, barcode, fax, automatic voice message, internet, websites, etc. Telephone, fax, television, electronic payment and money transfer systems, Electronic Data Interchange (EDI) and the internet are counted as six basic tools that enable electronic commerce to be done (Chase & Aquilano, 1998).

Companies have the ability to automate processes that enable information to move electronically between 3pl logistic firms and customers. This saves both labor and time. Among the advantages of digitalization in the logistic for companies; There is an increase in transparency in competition, a decrease in costs due to the rapidity of implementation, transparency and a healthy data bank in the market, sharing of relevant documents with all participating companies, equal approach to all participating companies and ease of auditing. The advantages of digitalization in the logistic industry for companies are; facilitating opening to new markets, reducing sales costs, creating a transparent competitive environment, increasing the freedom of action of companies due to the transparency created, and equal access to all relevant data. Blockchain technology is used for digitalization in logistic industry, this technology is examined in the second part of the thesis.

3. BLOCKCHAIN TECHNOLOGY

Blockchain technology has been a subject of great interest since the virtual currency Bitcoin was introduced to the markets in 2009. Due to the fact that it is a new technology, many people are skeptical of this virtual currency. This technology, which is widely used in Bitcoin transfer today, is blockchain technology and can be defined as a distributed record management system. Blockchain technology, which is essentially a ledger, is a digital environment where each link in the chain is called a miner, and accurate and distributed information flow can be provided to the next miner. Records entered in this environment cannot be changed or deleted. This ensures that accurate information can be accessed by each miner. Blockchain enables the use of a peer-to-peer network to perform financial transactions, instead of a central authority such as a central bank (Meng et al, 2018).

For this reason, leading organizations operating in many fields such as the retail sector, public institutions, insurance companies, especially financial companies, show great interest in blockchain technology and they are trying to develop applications on this subject.

In this section, first of all, the history of blockchain technology will be discussed with a literature review. Afterwards, subjects such as the basic features and working mechanism of blockchain technology, application areas and benefits were discussed and those for the logistics industry will compiled and presented.

3.1. The History of Blockchain Technology

The idea behind blockchain technology is described by scientists Stuart News and W. Scott Stornetta in 1991 as a computational solution in which digital documents

cannot be modified retrospectively in time. The system uses a secure encrypted blockchain for storage and timestamped documents, and with the inclusion of Merkle trees in 1992, several blocks are consolidated into a single block, making the system more efficient. However, this technology was not used and the patent expired in 2004, four years before Bitcoin was introduced.

In late 2008, the whitepaper introducing the decentralized peer-to-peer electronic money system called Bitcoin was posted to a cryptography mailing list by an individual or group using the name Satoshi Nakamoto. Then, the deployment of cryptocurrency in the first cash-related applications took place in 2011-2012. Later, between 2012 and 2013, blockchain technology was discussed as foreign exchange transfer and digital payment systems. In addition to cash transactions, financial markets are among the applications using blockchain until 2014. Finally, blockchain technology is currently being developed and researched across industries, with the evaluation of smart contracts and the creation of permissioned blockchain network solutions (Heutger, 2018)

Blockchain technology has been developed by many scientists after Nakamoto's research. Bitcoin is a product of the system; this system can also be described as visualizing the blocks placed on top of each other as a vertical stack based on the first block (Antonopoulos, 2014).

Blockchain technology is carried out in a distributed manner without being tied to any center. The purpose of this system is based on ensuring the flow of information between the securely chained blocks, as well as sharing this information with new participants and not changing the information. In this way, transactions are performed faster by users without using any intermediary (Vara et al, 2018).

Other sources in the literature also show that; A blockchain is a decentralized database where information and transactions are time-stamped, stored in blocks, and linked together in chains, distributed over a peer-to-peer network. Once a new transaction is created and added as a "block", it must be verified and approved by the majority of the network before it is secured by a cryptographic hash and stored in the network's decentralized nodes. Then, each block has the hash of the previous block, so the blocks are linked by those hashes. In the resulting chain, information can no longer be changed due to verification, and the immutability of previous transactions represents the past. At the same time, a new block cannot be placed between two existing blocks in a blockchain (Block & Marcussen,2020). This helps to maintain the sequential flow of information.

The definitions made differ in details.Tian as a general definition; He states that "the core of the blockchain is a technical blueprint of a reliable database that is collectively maintained in decentralized and trusted methods"(Tian, 2016).

3.2. How Blockchain Technology Works

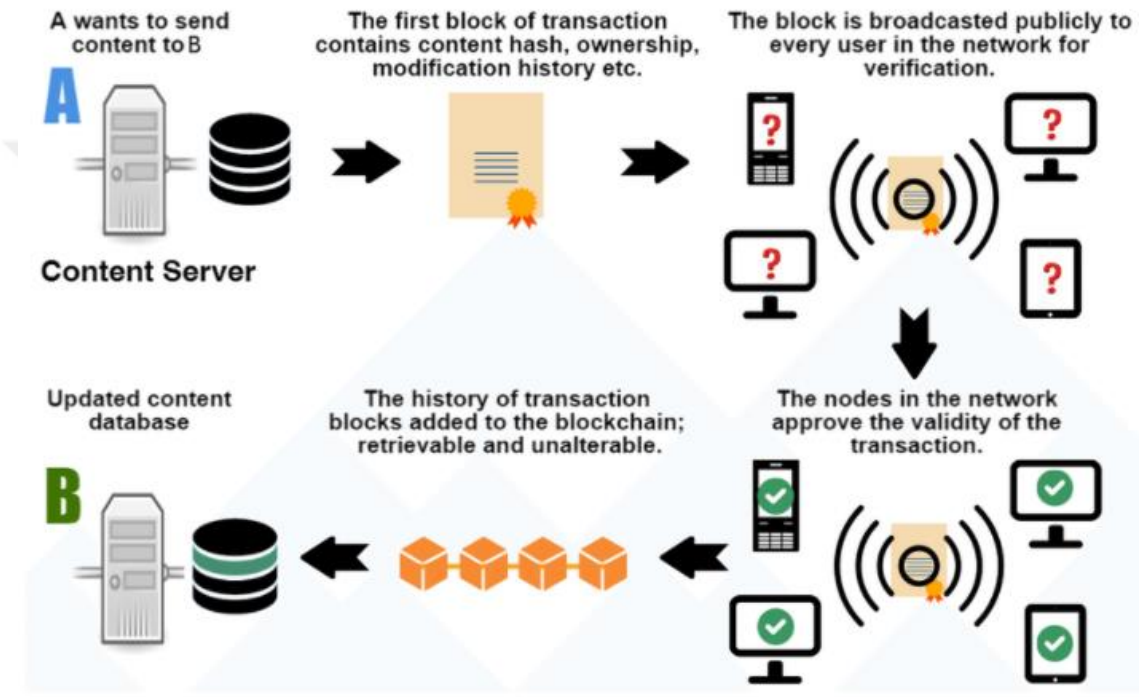
We can examine blockchain technology in 5 steps. (Step 1) When a transaction is about to take place between two parties, a proposal is first prepared in the registry. (Step 2) This offer includes basic information such as proposed transaction date and time, sender information, recipient information, asset type and quantity. The proposed process is provided with a unique cryptographic signature that ensures the integrity and authenticity of the record, (Step 3) then broadcasts to distributed network computers for processing and authentication. (Step 4) These computers process and verify the transaction, (Step 5) and once authenticated, the transaction is added to the digital ledger completing the asset transfer between the two parties.

Each new transaction is linked to previously recorded transactions, ensuring that all transactions made on the blockchain have a complete, irreversible and verifiable history (Morkunas et al, 2018).

The basic working logic of the Blockchain is as below (see Figure 2).

Figure 2

Overview of the blockchain working principle



Overview of the blockchain working principle.

Within each block, there are the block title summary, the block order, the title summary of the connected and previous block, the time stamp of the time the block was created, the difficulty value, the random value and the values of the transfer operations. All transactions can be followed by other stakeholders in the network.

After the validity of the transactions made is approved by other stakeholders, the transactions are combined and new blocks are created. After the processed block is

associated with the previous validated block, all stakeholders in the network synchronize by adding this new block to local databases.

3.3. Blockchain Data Flow

Blockchain technology has a distributed database structure (Apte & Petrovsky, 2016) (Tian, 2016), but first of all, existing database structures were examined. Previous studies show that today there are three different types of databases called centralized, decentralized and distributed.

Central Database; It is a database where all data is collected in a single logical center. In this way, it becomes physically widespread between computers and data communication methods. However, having the data in a single center is very risky in terms of cyber security.

Decentralized Database is a database where data is stored by dividing it into different databases according to a certain classification. Various routings are used to reach the data and therefore it is a type that is both safer and less workload compared to the central database.

Distributed Database ; It is a database in which data is divided into parts and hosted on different servers. Distributed structures are the most efficient database type because more data can be processed at the same time and meet requests faster. In terms of security, distributed structures are one step ahead of other types because all servers must fall into the hands of malicious people in order to capture all of the data.

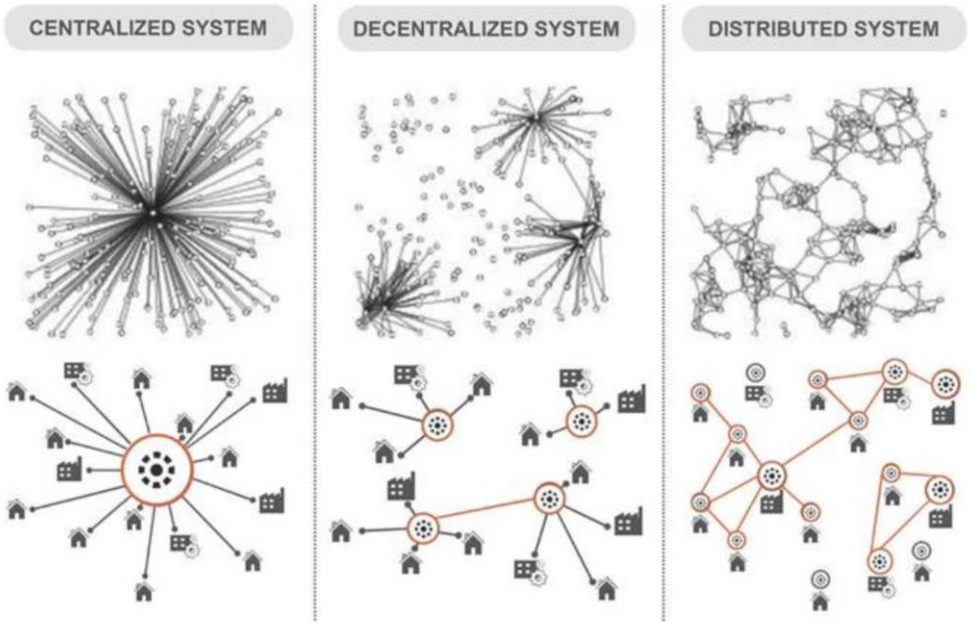
In the blockchain network, which is not connected to a central system, miners can continue to exist and share data under equal conditions within the framework of the rules that the system is connected to. Incorrect or incomplete data entered by any

miner in this chain does not affect the whole network. If the majority acts according to the rule structure of the network, the system continues undisturbed.

Blockchain infrastructure is open source and not managed by any central system. There is no reliable intermediary in the system and the transaction confirmation mechanism is distributed. Computers on the blockchain network are called nodes and are connected end-to-end with each other. None of the nodes in the network have to be reliable and they do not have any advantage over each other(see Figure 3).

Figure 3

Blockchain Data Flow



3.4. Key Features of Blockchain Technology

The most important features of blockchain technology are; It has a transparent and traceable structure, an end-to-end structure that is not dependent on the central authority, and provides sequential information flow with its secure structure.

Blockchain technology, which is an immutable chain of transactions, is cryptographically signed and ensures that data is not denied (Sultan et al, 2018).

Thanks to data integrity and open access, all participants in the network can access the information on the chain in a transparent manner and equally have the ability to process the blockchain. Interaction between nodes on the blockchain network ensures that the chain is reliable. Unlike the central authority, without the need for any third party, the entire blockchain is trusted and transactions are made by taking the common opinions of the people on the network.

3.4.1. Transparent and Traceable Structure

If this established chain is not restricted, everyone can access all the data in it. Anyone can log in to the system and make transactions whenever they want. Of course, not every blockchain technology provides a public database. According to the established chain infrastructure, only authorized persons can log in and mining can only be done by the authorities. This supports the transparent nature of blockchain technology.

Characteristically, transparency can be interpreted as one of the main advantages of blockchain innovation (Apte & Petrovsky, 2016). The fact that the data in the blockchain can be found in all miners and requesters makes this chain transparent. This transparency is achieved by the technical fact that the block has a copy of all transactions and cannot be changed (Salah & Khan, 2018).

If the information is not wanted to be in the hands of everyone, the chain can be encrypted and access can be made by restricted people. E.g; In the food sector, the ability of stakeholders to see the journey of a food in the entire supply chain has the

feature that can increase both quality, sustainability and flavor profile (Galvez et al, 2018).

One of the most important features of blockchain technology is that the recorded information cannot be changed. If any miner wants to delete or change data, it will break the integrity of the chain. The integrity of the information ensures that the information is protected from unauthorized changes, that is, the received data is correct. The integrity of the information is closely linked to the verifiable public opinion. If a system provides general verifiability, anyone can verify the integrity of the data; otherwise, integrity can only be achieved if the central system is not compromised.

The increase in transparency mentioned above provides easier traceability. It should facilitate product traceability by making information and origin more easily accessible, thereby increasing product safety and quality.

3.4.2. End-to-End Structure

By design, blockchain technology is a decentralized and distributed ledger that allows transactions to be recorded across a set of nodes. It can be implemented in a peer-to-peer network without the need for a trusted third party.

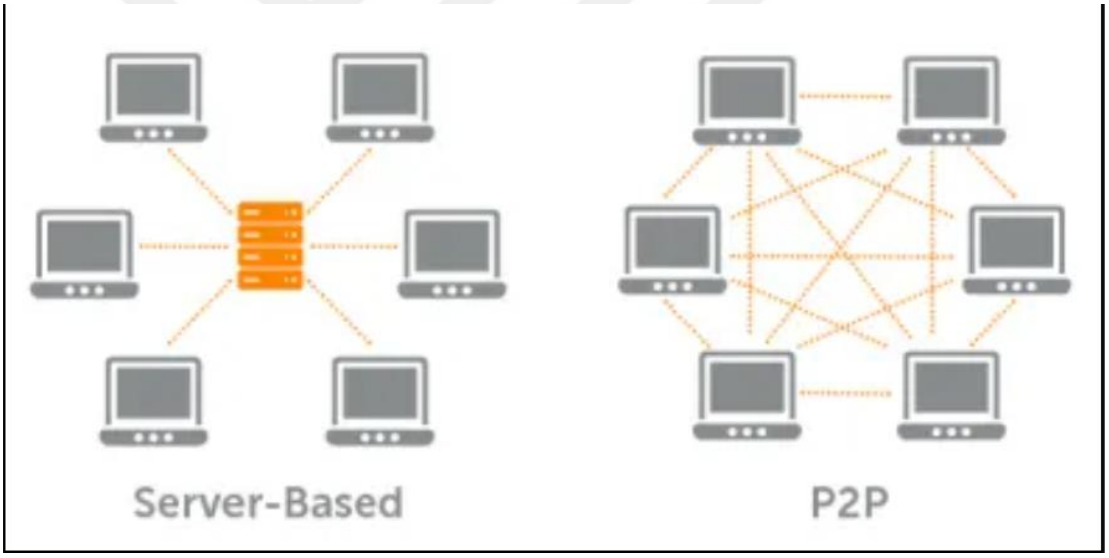
Rather than using any centralized structure to communicate between parties, individual nodes can directly transmit and store information to each other in a peer-to-peer network.

Due to the consensus in this technology, there is no need for any central authority. This is because the computers on the network are not connected to a server.

Instead, each computer has the addresses of other computers on the network. A computer that wants to get service on the network goes around the computers in the list and finds the service it wants and completes its job. Once a new transaction is created and added as a "block", it must be verified and validated by the majority of the network before it is secured by a cryptographic hash and stored in the network's decentralized nodes (see Figure 4).

Figure 4

End-to-End Structure



3.4.3. Sequential Information Flow Structure

Each data on the blockchain is recorded in sequential order and is interconnected. The data order on the chain cannot be changed. The user can see the data from the previous and even from the beginning of the chain in order. It is not possible to make any changes to the previous data, because each data is processed

depending on the data entered by the previous user. This is why the system is called the blockchain.

3.4.4. Safe Structure

Tracking and verifying information securely is one of the most important advantages of a blockchain. All transactions are timestamped i.e. a payment, contract, transfer of ownership etc. Details about the issue are transmitted publicly to the entire network at a specific date and time. This makes it particularly useful for different parties to check when and who took a particular action, or to document the existence of data at a particular time.

Also, depending on the security aspect, privacy is also guaranteed. Thanks to encryption, actions are performed anonymously, so participants do not know who they are interacting with.

In addition, greater security in transactions can provide companies with a competitive advantage and new participants can also benefit from innovation. In this way, advantages can be provided within the logistic industry.

3.5. Block Chain Agreements

In order for transactions to be valid in blockchain technology, they must be accepted by the blocks in this transaction and the system must work within the framework of certain rules determined in the infrastructure of the system. There are some agreements for the system to work in this way, the most used consensus mechanisms are Proof of Work, Proof of Stake and Byzantine Fault Tolerance approaches.

3.5.1. Byzantine Fault Tolerance

As with other blockchain consensus methods, the aim of Byzantine Fault Tolerance is to reach a common consensus among everyone in the network without a central authority, to provide the right consensus against malicious participants, and to allow the system to tolerate itself in case of failures. This model is based on the solution basis of the story of the Byzantine feds describing the Byzantine war strategy. Each device in the system checks whether this data is correct when there is a new data entry into the system, and if it is approved, it signs this transaction and shares it with the chain. If this process is approved by the majority of devices in the network, it becomes valid. Having a validation approval of 51 percent is sufficient for the transaction to take place. Unlike proof-of-work and proof-of-stake agreements, in Byzantine fault tolerance, the resource owner is isolated in the flow, regardless of its share and hardware elements, and in this way, even the smallest participant has a say in the structure of the network he is involved in.

3.5.2. Proof of Stake

Although it is the most preferred Proof of Work in the block generation and verification mechanism in the current situation on blockchain platforms, alternative mechanisms have been produced due to the prolongation of block production times, high energy consumption and the need for special hardware. Therefore, in the resulting Proof of Stake mechanism, the approval of new blocks depends on the share of the block producing peer in the relevant blockchain network. The more shares a person has in the existing blockchain system, the higher the chance of being selected as a block validator. However, this situation causes the high shareholder to continuously produce more blocks and the share ratios in the system gradually

increase after each block produced. As a solution to this existing problem, the concept of age has been developed to be used in calculations in the flow. In this way, the age values of cryptocurrencies within the scope of the share used for any block production are reset and only after a certain period of time begins to gain age value.

3.5.3. Proof of Work

In order for users to add blocks to the system, they need to solve the required algorithm with the proof-of-work mechanism. The right to add the block to the chain belongs only to the user who solved the algorithm. The factors that should be considered in the current algorithm are the processing power and the number of miners. Because the increase in processing power and the number of miners makes the algorithm theoretically more secure. The main purpose of this system is to prevent adding blocks to the existing chain system from being done by every user.

3.6. Smart Contract

A smart contract is an agreement or set of rules governing a business transaction; These contracts are stored on the blockchain and are executed automatically as part of a transaction.Smart contracts can contain many contract clauses that can be partially or fully self-executing, self-executing, or both. Their aim is to provide higher security than traditional contract law while reducing the costs and delays associated with traditional contracts.

In another source, they defined smart contracts as follows; A smart contract is a solution that uses blockchain technology to create contracts between two or more participants (Park & Smolander, 2016).

Previous studies show that a decentralized smart contract system could be a promising approach and worthy of further research and development. Because contract partners often do not fully trust each other, blockchain technology is suitable for this application if the parties do not want to trust a trusted third party, because it can simplify unreliable protocols between multiple parties. If the details of the contract should remain confidential and the contract only concerns a limited number of known participants, a private blockchain is best suited.

Contract partners can interact (the contract may send messages containing information to other components or vice versa). This interaction may be initiating a transaction or in the form of sending/receiving information. When the conditions determined while preparing the contract occur, smart contracts automatically ensure that the contract conditions defined in it are executed.

3.7. Blockchain's Challenges

Considering an immense technology network, it has been stated that blockchain technology faces some technical challenges (Park, & Smolander, 2016). These difficulties are; throughput, latency, size and bandwidth, security, resource consumption, availability, release, hard forks and multiple chains, and privacy. These limitations can be interpreted as a concern for the adoption of blockchain technology, but it is thought that the technology can overcome these limits. These limitations are mainly attributed to the Bitcoin implementation.

While VISA, the electronic banking transaction that provides money liquidity flow between international businesses, has a structure that can provide 2000 transactions per second, the current block chain technology can process 7 transactions in 1 second. Since financial transactions are transactions that need to be completed

instantly, it takes about 10 minutes for a Bitcoin transaction to create a new block, which can be considered a long time compared to current transaction times. The size of the entire Bitcoin blockchain is over 100 GB. Each block is approximately 1MB in size and considering that blocks are added every 10 minutes, the current bandwidth infrastructure limits processing capacity. Due to its nature, large amounts of energy are consumed every day to ensure consistency in the database with proof-of-work mining, which reveals the excess of resource consumption.

3.8. Types of Blockchain Networks

According to the blockchain access status; It is divided into three as public blockchain, semi-private blockchain and private blockchain.

3.8.1. Public Blockchain

This system, also known as Double Permissionless, is a system where network participants have access to all information and all participants can create new blocks. Since the open blockchain system has open source codes, anyone can join the network at any level. Everyone participating in the network is the approval authority for the transactions to be recorded and for the validity of the blocks created. All participants on the network have access to the ledger where the records are kept, so there are as many identical copies of the ledger as the number of users. Keeping a copy of the data on more devices is one of the factors that prevents it from being changed. If they request, the participants in the network can hide their real identities by using their profiles anonymously.

With Bitcoin, the most important example of blockchain technology, Ethereum has an open blockchain network. Bitcoin and Ripple are digital currencies. Ethereum is a payment method that allows smart contracts to be made.

Since transactions are publicly visible on the open blockchain network. There are doubts about the reliability of the source, but on the contrary, since it is an encrypted network structure, personal data cannot be easily accessed.

As a result, in the open blockchain system, participation in the network and access to all of its information on the network are open.

In the Consortium Blockchain system, open blockchain. As in the system, participation in the network is free, but the participants' access to data and participation in the consensus process must be subject to permission. For example, a consortium blockchain can be created between 10 companies, each of which is connected to the blockchain network. If company 1 wants only companies 4, 5 and 7 to have access to its invoices, it can be decided to give permissions to read the shared data only to these companies. Blockchains allowed by the consortium, international trade widely used in the field. The Fast Track Trade platform is an example of consortium Blockchain implementation. Blockchain technology has been used on this platform to create a digital trading network for micro, small and medium enterprises (MSME) in Singapore and the system is open to all interested companies. However, only companies can participate in this system (Ganne, 2018).

3.8.2. Semi-Private Blockchain

In a semi-private blockchain network, participants are subject to certain permissions to be included in the system, but they can directly participate in the consensus process. All participants on this network can enter data and access all data. Therefore, it differs from the private blockchain network in that accessing and entering new data is not subject to permission. One of the blockchain platforms, Ripple has a semi-private network structure. In a remittance system involving banks,

Ripple requires permission to participate in the network. All banks that receive this permission and are included in the system are automatically included in the reconciliation process.

3.8.3. Private Blockchain

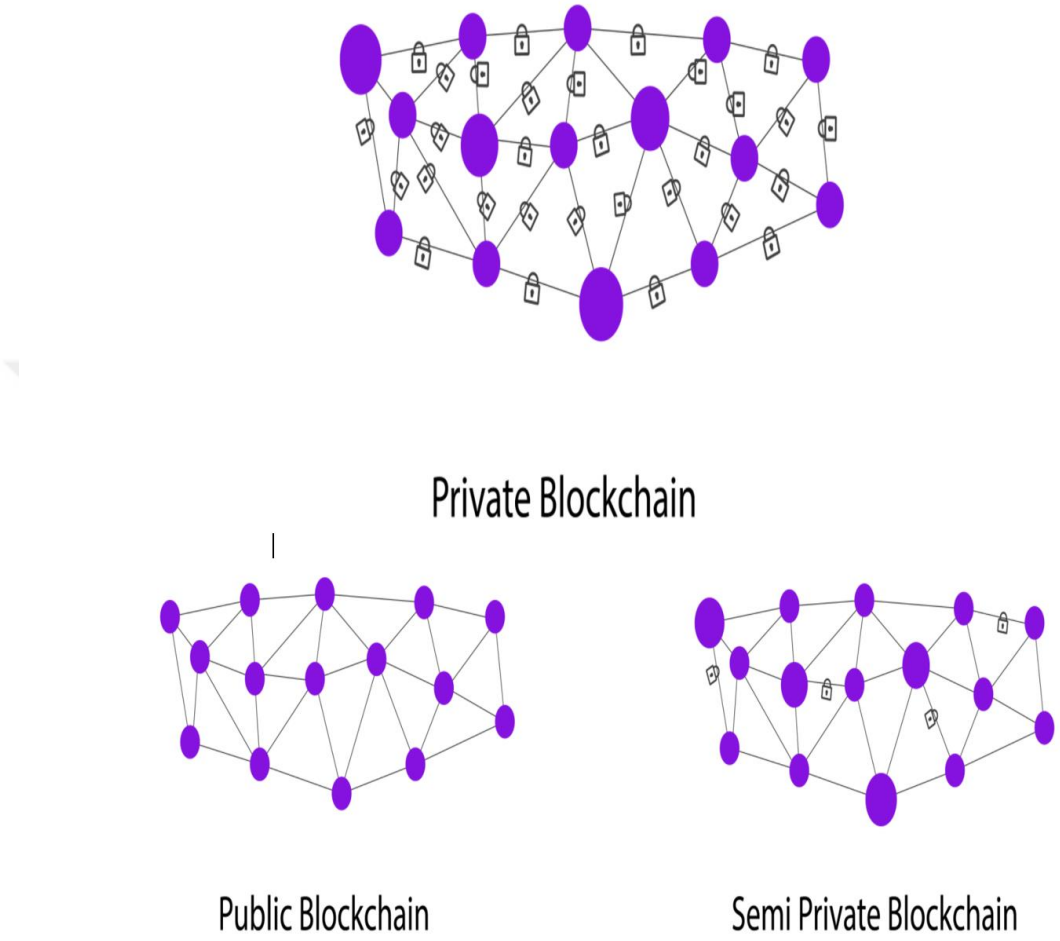
The Private Blockchain system is the most limited blockchain network in terms of network participation and access to data, so it is smaller than other blockchains. Unlike other blockchain networks, participation in the private blockchain network, access to data, and participation in the consensus process are permission-based. Providing access to data the authorization of the requested persons and the right to make adjustments on the data are completely under the control of a single authority. In fact, this network type, which is completely opposite to the idea of establishing consensus without central governments, that is the idea of the emergence of blockchain technology, is used by public institutions, which should be kept at a high level of confidentiality.

It is preferred by military and police organizations responsible for ensuring security, international financial and regulatory institutions. The most widely known closed blockchains are Hyperledger Fabric, Corda channels.

Hyperledger Fabric, managed by IBM, is a core project that enables the development of high-scale blockchain applications(see Figure 5).

Figure 5

Types of Blockchain Networks



3.9. Areas of Application of Blockchain Technology

Although the blockchain technology is primarily handled with the crypto money solution Bitcoin, this technology has different application areas besides financial solutions.

3.9.1. Financial Applications

The first to come to mind and the first to come to mind in literature research is the use of blockchain technology, financial markets. Starting with Bitcoin, this technology has become popular with hundreds of crypto currency applications. Its main purpose is; This technology, which is to eliminate intermediary institutions and the central authority, is of great importance in the transition to a cashless life with its capacity to accelerate the digitalization process of money, to spread banking and financial services related to money, and to make it more accessible to everyone. Many banks and financial institutions use blockchain technology first in international money transfer and international trade finance applications, and then in other applications such as payment transactions, money transfers, buying/selling platforms, insurance, clearing management, authorization, verification, digital identity management, document management. evaluated in the areas of financial use.

In addition; The global payment system market reached a size of approximately 630 billion dollars in 2017 and shows an average annual growth of 5 percent. When the current global money transfer structure is examined, money transfers originating from the financial intermediary institutions take a long time and are realized with high costs. For example, time and transfer cost are two important topics in freights paid by logistics companies to overseas agencies for bill of lading delivery. In such cases where it is aimed to save both time and extra cost; By using a smart contract-based blockchain technology, real-time payments are made, and it is brought to a structure that can be easily controlled by the relevant institutions in a less costly manner with fewer participants.

3.9.2. Identity Applications

With the rapidly developing technology, digital services that adapt to human life need to be a digital copy of the concept of identity in the physical world. In the current situation, a solution has been found to this need in the form of storing identity information in a central structure and serving it to external services in a controlled manner. However, this solution raises suspicion that the desired level of confidentiality is achieved. For example; When an identity check will be made in an entertainment center, all identity information will be shared with the other party if the person shows his/her identity. However, the only parameter to be checked is the year of birth for this example. By establishing blockchain technology and a decentralized identity registration and verification system, all or only a certain part of the identity information can be shared, depending on the approval of the identity holder. In this way, we can only provide our age information to the entertainment center in a safe and verified manner.

3.9.3. Government Applications

Commercial enterprises have to act under the supervision of financial advisors for tax declarations and payments related to commercial and personal activities. Thanks to smart contracts offered with blockchain technology, tax calculations can be made in real time and even collection can be performed in the same way. Such solutions speed up the tax collection processes while helping to eliminate the informal economy.

The name of the public blockchain, which has been implemented by the People's Republic of China, one of the most developed economies in the world, since October 2017 is "Gachain". China is implementing public blockchain technology,

taxation and electronic invoice system to speed up tax collection and prevent tax evasion. Such technological arrangements in the data system facilitate the implementation of more equal and fairer policies in tax distribution.

In elections held by the state, blockchain technology provides a solution to collect votes and keep records. Among the entrepreneurs working to improve the blockchain infrastructure to create a secure voting system is a Virginia-based company called FollowMyVote. Stating that there is a widespread misunderstanding that voting cannot be done securely online, company CEO Adam Ernest argues that this misconception will disappear with blockchain technology. This company has created a voting prompt that allows the game used to be placed in the candidate's digital wallet and permanently recorded on the used game blockchain.

4. RESEARCH QUESTION, SCOPE AND METHOD

In this section, the research question was stated and the scope and objectives of the research were emphasized. Afterwards, the constraints and method of the research were discussed and information about the case study was given.

4.1. Question

RQ: What benefits does blockchain technology bring to businesses to solve their logistics problems?

Ensuring coordination between the parties in the logistics industry; By facilitating the management of logistics, it ensures that the final outputs can be obtained correctly for all components. Therefore, in this study; In order to ensure the coordination of the logistics parties, the blockchain technology applied by the companies was examined.

Considering the features of blockchain technology, it is thought that it can help solve the logistics industry problems and the research question ‘What benefits does blockchain technology bring to businesses to solve their logistics problems?’ was created.

Due to the distributed network structure of blockchain technology, sharing all information with the participants on the chain creates a transparent and traceable structure, and it is anticipated that the transparent and traceable structure in blockchain technology will be beneficial for the solution of logistics industry problems. In this way, it is thought that all kinds of information about the product subject to logistics can be accessed more easily and product traceability can be increased.

One of the key advantages of a blockchain is the ability to securely track and verify information. In this technology; In order to create a new data entry or block,

approval must be obtained from all participants on the network and all data is cryptographically encrypted. Therefore; It is predicted that the secure structure in blockchain technology will be beneficial for the solution of logistics industry problems.

The fact that the data entered in the blockchain technology cannot be changed and is in the form of sequential records connected to each other ensures the formation of a sequential information flow. It is not possible to make any changes to the previous data because each data is processed depending on the data entered by the previous user. It is predicted that the sequential information flow structure in blockchain technology will be beneficial for the solution of logistics industry problems.

Thanks to the end-to-end structure in blockchain technology, any new information or new block to be added on the network must be verified and approved by the majority of the network. In this way, information flow can be provided in blockchain technology without the need for a central authority. Therefore; It is predicted that the end-to-end structure in blockchain technology will be beneficial for the solution of logistics industry problems.

The cases examined were evaluated within the scope of the benefits mentioned above.

4.2. Scope and Objectives of the Research

Case study study has not been conducted for a single company regarding the application of blockchain technology in the logistics industry. Therefore, a multiple case study was conducted by examining companies with different sizes and roles in the logistics industry. Logistics companies have been determined as the target

audience, so the scope of the research is limited to companies that implement blockchain technology in the logistics industry. However, since it is not possible to reach all companies that apply blockchain technology in the logistics sector, it is limited to the cases listed here.

In the research, the reports of the companies, company websites were examined and the data that companies announced to the public about the results of their cooperation with technology companies were taken into account. It is aimed to set an example in logistics processes with coordination problems by examining the cases that benefited by applying blockchain technology in logistics.

4.3. Limitations of the Research

The focus of the study is to examine the impact of the blockchain application on the logistics industry and the recently published literature, as well as the companies applying this technology in the current situation.

Since blockchain is a developing technology, this technology has been newly adopted by companies in recent years. Therefore, the number of studies in this area is limited.

Financial data could not be analyzed because companies using this technology did not publish any data on technology investments and earnings. In the following years, the financial gains, losses and investments obtained with the spread of technology can be analyzed.

The most important limitations of this study are that it is a very new technology, has a high initial investment cost, that this technology has not yet been fully adopted by all logistics companies, and that it is difficult to access studies in this field.

4.4. Research Method

There are two main research methods in business research. These; it is classified as quantitative research and qualitative research. Quantitative research is also called numerical method, and this method is a repeatable, objective research approach based on observation and measurement.

Qualitative research, on the other hand, tries to reach information by using inductive methodology, unlike quantitative research based on statistical data analysis. First of all, after the sample selection, qualitative data are created. In qualitative research, data is collected by conducting interviews, observations and document reviews, and this research includes the analysis and interpretation of the collected data.

In this study, case studies were conducted using a qualitative research method. For the benefit results created from the research questions, the results of different cases in the same situations were examined and it was interpreted whether case studies benefited from blockchain applications in logistics.

As a result; In the qualitative research technique, the data collected by performing document analysis in the case study were analyzed using descriptive and content analysis techniques.

In quantitative research; the facts are objective, the main thing is the method, and the researcher looks at the events from the outside and develops an objective attitude. But in qualitative research; reality is created, the main thing is the situation studied, and the researcher develops a participatory attitude by watching the events closely. The purpose of quantitative research; While generalization is to explain the relationship of estimation and causality, the purpose of qualitative research is to describe in depth, to interpret and to explain the perspectives of the actors. While

approaches in quantitative research begin with theory and hypothesis, the approach ends with theory and hypothesis in qualitative research.

The role of the researcher; While in quantitative research it is neutral and objective, apart from events and facts, in qualitative research it is subjective and empathetic, including events and facts(see Table 1).

Table 1

Differences between Qualitative and Quantitative Research

	Qualitative Research	Quantitative Research
Focus	Quality (features)	Quantity (how much, numbers)
Philosophy	Phenomenology	Positivism
Method	Ethnography/Observation	Experiments/Correlation
Goal	Understand, meaning	Prediction, test hypothesis
Design	Flexible, emerging	Structured, predetermined
Sample	Small, purposeful	Large, random, representation
Data Collection	Interviews, observation, documents and artefacts	Questionnaire, scales, tests, inventories
Analysis	Inductive (by the researcher)	Deductive (by statistical methods)
Findings	Comprehensive, description detailed, holistic	Precise, numerical

1: Differences between Qualitative and Quantitative Research

4.4.1. Multiple Case Study

According to Creswell (2007), case study; It is a qualitative research approach in which the researcher examines one or more limited cases over time with data collection tools (observations, interviews, audio-visuals, documents, reports) that includes multiple sources, and defines situations and themes depending on the situation.

A case study is a methodological approach that involves in-depth examination of a limited system by using multiple data collection to collect systematic data about how it works (Subaşı & Okumuş, 2017).

In case study research, analysis is made and valuable results are obtained by evaluating the cases related to the research questions. Case study research with multiple cases is effective for intensively understanding issues and analyzing background developments. Using more than one case collection method in the same research, collecting data from different samples, collecting data from different times and places are called diversification (Yıldırım & Şimşek, 2005).

It is important for the researcher to maintain the methodological ground for the selected cases. Cases previously selected and cited in the research may be chosen for utilitarian reasons, but on the other hand, there is a possibility that it may lead to deceptive results. In the case selection process, it is aimed to reach the data through the cases that provide important variables from the large sample, but it is not possible to analyze with a large number of cases (Yıldırım & Şimşek, 2005).

One of the biggest disadvantages of using the case study method is related to internal and external validity. Using the case study method, the researcher usually does not have control over certain variables and events and therefore the researcher cannot control them as he might in a lab experiment.

Analytical results are derived from a case and are intended to support hypotheses by correlating them with alternative cases and theories based on previous work. The approach of this study can be defined as creating a framework by analyzing different case studies due to the nature of our research questions focusing on how and why.

As a case selection method, "multiple case selection" is followed in this thesis. Therefore, statistical analysis is not used in this study, but focuses on contextual analysis.

Multiple case studies is the strategy chosen to analyze the experiences of several companies on blockchain technology to find overall conclusions based on findings from different cases.

4.5. Data Collecting

In qualitative research, data collection methods that serve the purpose are observation, interview and document analysis. The document analysis method preferred in this study includes the analysis of written materials containing information about the facts and cases that are aimed to be investigated (Yıldırım & Şimşek, 2005)

Document analysis is a qualitative research method used to analyze the content of written documents meticulously and systematically (Wach, 2013). Document analysis is a systematic method used to examine and evaluate all documents, both printed and electronic materials. Like other methods used in qualitative research, document analysis requires the examination and interpretation of data in order to make sense of it, to form an understanding about the subject, and to develop empirical knowledge (Corbin & Strauss, 2008).

Researchers generally review previous research, review the literature, and incorporate this information into their research. This includes an analytical method. It includes finding, selecting, interpreting and evaluating and synthesizing data found in documents. Document analysis helps to classify the data subject to the research by

organizing them into main themes, categories and case examples, especially through content analysis (Labuschagne, 2003).

First of all, previous academic studies on the same subject were examined and a literature review was made. In the research, the reports of companies and company websites were examined as secondary material, and the data that companies announced to the public about the results of their cooperation with technology companies were taken into account.

Since the operational processes in the logistics sector are long and complex, ensuring the correct flow of information is very important for both companies and customers. In order to save time and cost, logistics companies have implemented blockchain technology.

4.6. Case Study Resources

Case study research with multiple cases is effective in understanding the problems intensively and analyzing the developments in the background or where they are. Therefore, in this thesis, research has been carried out on 4 cases and it has been interpreted whether the blockchain technology, which is applied as a solution to the specified problems, is beneficial. Case studies and sources are as shown in Table.2. A total of 4 global companies applying blockchain technology in logistics were examined and data were collected from multiple sources for each company(see Table 2).

Table 2

Cases and Sources

Cases	Sources
MAERSK	(Godbole, 2017) (Haswell, Linnet, & Wagner,2018) (Lal & Johnson, 2018) (Moller & Maersk, 2018)
DHL	(Aces & Kleeberger, 2018) (DHL, 2020) (Utikad, 2018)
CARGO X	(CargoX, 2018) (Petersson & Baur, 2018) (Twenhöven & Petersen, 2019)
ZIM INTEGRATED SHIPPING	(ZIM Brining Blockchain Technology into Shipping, 2017) (Wikipedia, 2019) (Gardner, 2018)

Descriptive analysis and content analysis techniques are used for qualitative research data. In descriptive analysis, the data is not analyzed in depth, while in content analysis, the data is examined more closely and the concepts and themes that explain the data are reached. Descriptive analysis is a more superficial technique than content analysis. It is used in studies where the conceptual structure of the research has been revealed before. The data obtained according to the descriptive analysis are interpreted according to the previously determined schemes. The main purpose of this analysis technique is to present the findings by interpreting and editing. For this reason, data are first described in a systematic way. Then, these descriptions are

interpreted and explained. Results are reached by using the cause-effect relationship (Taşdöğen, 2019).

The content analysis technique, on the other hand, allows the in-depth examination of the data collected by data collection techniques and the revealing of the previously unknown dimensions. Its main purpose is to reach concepts and relationships in order to explain the collected data. Data summarized using descriptive analysis is subjected to more in-depth processing in content analysis. Concepts that cannot be noticed with descriptive analysis are revealed with content analysis. These processes are the bringing together of similar data around certain concepts and making them understandable. As a result, understandable data are interpreted (Taşdöğen, 2019).

In this study, the collected data were first summarized and interpreted with descriptive analysis, and then subjected to an in-depth processing with content analysis, and new concepts or relations between concepts were explained. In content analysis, it is essential to gather similar data within the framework of certain concepts and themes and organize them in a way that the reader can understand.

In the next section, while describing the cases of blockchain used in logistics, the data obtained by summarizing with descriptive analysis from the relevant sources, focusing on the origin of the phenomenon investigated with an inductive approach in accordance with the nature of content analysis, namely the blockchain technology, and the benefits of this structure for companies using blockchain technology are interpreted.

Table 3

Categories and codes for Theme of Information Security In Blockchain

Theme	**Information Security In Blockchain**		
Categories	**Trust**		**Reduce Risk**
Codes	**Immutable Data**	**Sequentia Information Flow**	**Distributed Network**
Text	Data order on chain cannot be changed. The fact that the data entered in the blockchain technology cannot be changed. Records entered in this environment cannot be changed or deleted. Blockchain technology, which is an immutable chain of transactions, is cryptographically signed and ensures that data is not denied.	Each data on the blockchain is recorded in sequential order and is interconnected. The fact that the data entered in the blockchain technology cannot be changed and is in the form of sequential records connected to each other ensures the formation of a sequential information flow. The sequential information flow in logistics has advantages for both the components in the system and the end customer. Traceability and sequential information flow in the supply chain are important for companies and customers.	This technology, which is widely used in Bitcoin transfer today, is blockchain technology and can be defined as a distributed record management system. Due to the distributed network structure of blockchain technology, sharing all information with the participants on the chain creates a transparent and traceable structure. The distributed network structure of the blockchain system also allows transactions to be concluded faster and costs are lower. With the distributed structure of this technology, accurate information was

		By drawing attention to the importance of sequential information flow between ship owners, agencies and customers, smart bills of lading were created with blockchain technology	shared with all logistics parties, provided that it could not be changed. Blockchain technology is carried out in a distributed manner without being tied to any center. In terms of security, distributed structures are one step ahead of other types.

Table 4

Categories and codes for Theme of Advantages of Transparency

Theme	**Advantages Of Transparency**		
Categories	**End To End Process Tracking**		**Communication**
Codes	**Chains**	**Information Sharing**	**Traceability**
Text	Sharing each data with all the chains in the chain in blockchain technology It is an advantageous technology for companies and customers as it can be	Accurate information sharing is vital for the existence of the logistics system. Thanks to information sharing, uncertainties in demand are reduced. Promoting knowledge sharing and transparency and fostering industry-wide innovation.	Competitive advantage can only be achieved with a well-designed information management structure and traceability in supply

	monitored by all chains in the chain. All transactions can be followed by other stakeholders in the network. After the validity of the transactions are approved by other chains, the transactions are brought together. All chains in the network are synchronized by adding this new block to their local databases. Chains can see their journey in the supply chain part. It can be recorded observable by all chains.		chain management. The said increase in transparency provides easier traceability. The traceability function has a positive effect on various purposes. The relationship between transparency and traceability cannot be defined simply and linearly because more transparency leads to better traceability.

Table 5

Categories and codes for Theme of Time And Cost Effects Of Blockchain Technology

Theme	**Time And Cost Effects Of Blockchain Technology**	
Categories	**Finance**	**Time**
Codes	**Save Costs**	**Faster**
Text	When the current global money transfer structure is examined, money transfers originating from the financial intermediary institutions take a long time and are realized with high costs. Time and transfer cost are two important topics in freights paid by logistics companies to overseas agencies for bill of lading delivery. In order to save time and cost, logistics companies have implemented blockchain technology. This will not only help companies cut costs, but also reduce documentation efforts.	It is observed that companies apply to various new technologies in order to make information flow both faster and more accurate. In this (Blockchain) way, transactions are performed faster by users without using any intermediary. It is observed that they integrate blockchain technologies into the supply chain system so that they can access this information quickly. Distributed structures are the most efficient database type because more data can be processed at the same time and meet requests faster. It offers the opportunity to make cooperation even faster with the instant transfer of bills of lading.

	All parties that need to send the bill of lading before via courier services can benefit from cost and time savings through the blockchain solution. Automation of processes helps save costs in the long run.	

5. BLOCK CHAIN APPLICATIONS IN LOGISTICS INDUSTRY

Since there are multiple actors and stakeholders in end-to-end logistics, and there are many physical flows and information flows, the confusions that may occur in logistics have been mentioned in the previous sections of this study. Blockchain technology can be a solution to many problems in the logistics sector with the transparency and traceability it provides. At the same time, thanks to its end-to-end structure, all transfers and transactions in logistics can be made without being dependent on the central authority and can be recorded in an observable manner by all stakeholders.

In the previous parts of this study; It is mentioned that it will be possible to increase the traceability of the products in logistics from the point of origin to the point of final consumption and to increase the transparency of the processes with the blockchain technology. To this end, companies have successfully tested and implemented blockchain data tables to track how a product moves through the range of origin and final destination.

The data obtained with this technology can be permanently stored at distributed points within the network, thus providing monitoring and control to a greater extent than ever before. In this way, consumers or users can safely see information about a product's authenticity, place and date of manufacture, and the standards to which it is subject to shipping and other processes.

In this section, some case studies of companies using blockchain technology in the logistics industry are discussed.

5.1. MAERSK

Maersk is a Danish shipping company with a majority market share of 15.8%. It has operations and offices in more than 130 countries and employs approximately 80,000 people worldwide (Moller & Maersk, 2018).

On August 9, 2019, it was announced the creation of TradeLens, jointly developed by A.P Moller – Maersk (MAERSKb.Co) and IBM to apply blockchain to the global supply chain. TradeLens is the result of a collaborative agreement between Maersk and IBM, a blockchain-enabled shipping solution designed to promote more efficient and secure global trade, bringing together various parties to support information sharing and transparency and foster industry-wide innovation. IBM and Maersk announced in 2019 that 94 organizations have agreed to participate in the TradeLens platform, which is built on open standards and actively participates. Participants in the TradeLens blockchain platform; It is targeted as global port and terminal operators, sea crossings, global container ships, customs administrations, cargo owners, logistics and shipping companies (Ünlü, 2018).

Maersk and IBM cooperation enables other logistics companies to find the information they are looking for online, this information provided by the TradeLens platform cannot be changed. All documents are digitized, so it is aimed to increase efficiency as less paperwork will be used. The platform provided to participants in the TradeLens network provides auditing and registration functionality. Regarding reconciliation activities, recording transactions and activities in the blockchain logbook, both internally and externally, is an important task. With the integration of the internet of things into the blockchain platform, Maersk and other logistics companies can perform audit and reconciliation activities.

The TradeLens platform has the ClearWay module, which enables the digitization of procedures and logistics-related documents. The commercial document module is released under a beta program and is called ClearWay. It enables importers/exporters, customs brokers, customs and other government agencies and other agents to conduct cross-organizational business processes and information exchange with trusted third parties. All are backed by a secure and recognized audit trail (Turkishtime, 2018). This system helps to keep data sharing activities online and auditable so that documents can be viewed online, approved or rejected in seconds. It prevents delays due to paperwork procedures. This simplicity is realized by the smart contract feature of the blockchain technology, which takes the entire ecosystem one step further into the digital world. Using blockchain smart contracts, TradeLens enables digital collaboration between many parties involved in international trade (Godbole, 2017).

Over the past year, IBM and Maersk have studied the technology and tested the system with other supply chain ecosystem participants to prevent mismanagement of logistics, defects and disruptions. Blockchain technology can reduce the time to send materials to the production line by 40%, thus allowing a clear understanding of each statement with end-to-end transparency, minimizing unnecessary processes and reducing costs (IBM, 2018).

By drawing attention to the importance of sequential information flow between ship owners, agencies and customers, smart bills of lading were created with blockchain technology. In this way, the risk of extra cost to companies by incorrect information being written on bills of lading, which is an important document that helps determine the owner of the cargo, is eliminated. In addition, due to bills of lading that cannot be delivered on time, companies have to pay a warehouse fee for

their products waiting at the port, and this expense is avoided thanks to smart bills of lading that are delivered instantly with this technology. For this reason, it has been seen that the transparent and traceable structure in blockchain technology is beneficial for solving supply chain problems thanks to the sequential information flow.

In addition, blockchain technology is helping some supply chain participants to optimize their business processes. Supply chain companies are promised digital in the sense that their data is secure and the documents they share can be viewed online wherever another business partner is. This will not only help companies cut costs, but also reduce documentation efforts. The main purpose of the TradeLens blockchain platform is; is to gather all supply chain companies on a single platform in order to benefit from this data flow, in accordance with globally accepted standards, on a reliable platform where valuable data transfer is possible (Lal & Johnson, 2018).

During the 12-month trial, Maersk and IBM worked with dozens of ecosystem partners to identify opportunities to avoid delays caused by documentation errors, information delays and other barriers. He shows, for example, that TradeLens can avoid thousands of dollars by reducing the time it takes to ship packaging materials to a production line in the United States by 40%. With better visibility and more effective communication tools, some supply chain participants aim to reduce it to one step and one person with TradeLens, while 10 steps and five people are needed to answer basic operational questions such as “where is my container” (Turkishtime, 2018).

Until now; More than 154 million shipping events were carried out, including data such as the arrival times of ships, container “door-to-door” and documents such as customs services, commercial invoices and bills of lading. These data are growing at a rate of close to one million per day. Traditionally, some of this data is shared

through EDI systems commonly used in the logistics industry, but these systems are inflexible and complex as they cannot share data in real time. Often times, companies still need to share documents by email attachment, fax, and courier. TradeLens can monitor critical data about every shipment in a supply chain and provide an unchanging record among all interested parties (Turkishtime, 2018)

Peter Levesqus, CEO of Modern Terminals Limited, a container terminal operator in Hong Kong, stated that TradeLens will use blockchain technology to securely digitize supply chain documents around the world, increasing global supply chain security, and over time will provide huge savings for the shipping industry. (Haswell & Wagner, 2018).

The main purpose of the blockchain platform is to unite all supply chain management companies through an ecosystem, thereby removing barriers. This can be accomplished with the cooperation of companies worldwide, including exporters, shipping companies, ports, terminals, ocean liners, shipping management companies and importers. The sequential information flow in this cooperation provides an advantage in the supply chain, so it has been seen that the sequential information flow structure in blockchain technology is beneficial for solving logistics problems.

The benefits of blockchain technology for Maersk and other logistics companies include optimized and improved business processes and online tracking of shipments. In this way, both product and information flow from logistics process flows can be monitored with this technology. For this reason, it has been seen that the transparent and traceable structure in blockchain technology is beneficial for the solution of logistics problems.

Not only can this system eliminate unnecessary downtime, it can also reduce risks and uncertainties. It has been seen that the secure structure in blockchain technology is beneficial for solving supply chain problems.

5.2. DHL

DHL is a German company operating in 220 countries by providing end-to-end logistics services as well as freight transportation, insurance, customs services (DHL, 2020).

According to Interpol, about 1 million people die each year from counterfeit drugs, 50% of pharmaceutical products sold through websites are considered counterfeit, and as many as 30% of pharmaceutical products sold in emerging markets are known to be counterfeit. To answer this problem, DHL and Accenture are running a blockchain-based project that provides tracking and tracing capabilities in the pharmaceutical industry.

In the first quarter of 2018, DHL and Accenture are working on the blockchain technology they have developed for fraudulent drugs and promise to solve these problems related to the healthcare industry. Blockchain is to follow every step of the drug from the manufacturer to the customers. Each drug will be assigned a unique ID and information related to the drug will also be associated. About the drug; ingredients, unique identification number, expiration date, date of manufacture, manufacturer, etc. contains information (Aces & Kleeberger, 2018).

Drug serialization is the process of assigning a unique ID (eg, a serial number) to each product; this then provides access to critical information such as the product's origin, batch number and expiry date. Serialization enables a unit to be monitored almost at any time and its location at any stage in its lifecycle.

DHL / Accenture aimed to overcome these and other challenges by demonstrating the effectiveness of block verification technology in product verification. The aim is to demonstrate that drugs come from legitimate manufacturers, are not counterfeit, and are delivered correctly throughout their journey from the origin to the consumer. This not only reassures the end customer that their medication is original and in excellent condition at the point of purchase, but also provides potentially life-saving effects.

Created in collaboration with DHL and Accenture, the system comprehensively documents every step a drug makes its way to the store shelf and ultimately to the consumer. In their joint press release, they announced that they have created a blockchain-based serialization prototype with six stakeholders to track drugs in the supply chain. The digital ledgers where the information is stored can be shared with six stakeholders: manufacturers, warehouses, distributors, pharmacies, hospitals and doctors. Lab simulations show that the blockchain can record more than seven billion unique serial numbers and can process 1500 transactions per second (Utikad, 2018).

Using blockchain technology against drug fraud is a life-saving project. It not only affects the profit and reputation of manufacturing companies, but also affects the health of individual people. This solution gives customers the power to confirm that the product they are purchasing is legitimate. In this way, both the product and the information flow from the supply chain flows can be monitored with blockchain technology. For this reason, it has been seen that the transparent and traceable structure in blockchain technology is beneficial for the solution of supply chain problems.

5.3. CARGO X

CargoX was founded in August 2017 with the idea of becoming a blockchain pioneer in the global shipping industry. Their first product, the 'Smart Bill of Lading' (SBL), based on a decentralized application (dApp), was launched on 12 April 2018 at the logistics conference in Slovenia.

CargoX's first product to offer SBL is dedicated to a distributed application (dApp). Through the DApp, the SBL is recorded and transferred to the blockchain. For DApp, clients can access the platform from different devices such as computers, phones or tablets. In order to log in, save and upload documents, users must purchase a 'trezor' comparable to a device used for online banking authentication. Trezor exposes the user's fingerprint or private key so that login and installation of the SBL is possible. Each user has a unique fingerprint and address on trezor and without it it is impossible to access the account. The idea behind Trezor is to transfer and combine the simplicity of online banking authentication with bill of lading ownership (Petersson & Baur, 2018).

After registering on the platform, users can upload PDF versions of bills of lading. The user can then send the bill of lading to the specific recipient via the dApp. While the bill of lading is sent to the buyer, the document is automatically saved and transferred from the blockchain. Normally, the bill of lading must first be printed, signed, scanned and then sent to the buyer. With the CargoX product, documents are signed with blockchain technology, which guarantees security and fast delivery to the buyer.

The main reason for the idea of creating a dApp based on blockchain technology was that traditional bill of lading delivery was implemented in a costly, time-consuming, unsafe and environmentally unfriendly way. As more than 50 million

documents are created each year, companies can save $5 billion a year in courier costs alone. Also, courier delivery of the document takes five to ten business days, as the document usually needs to be sent at least three times.

The traditional operation process of the freight bill of lading is as follows; First of all, the bill of lading is printed and signed by the cargo consolidator (NVOCC), who accepts the responsibility of the carrier legally, although the carrier is not a ship owner or ship owner. Afterwards, the printed bill of lading is sent to the shipper after it is signed, and the shipper sends the bill of lading to the importer. After the importer signs a stamp on the back of the original bill of lading, it sends it to the address of the buyer so that the container can be released. After the ship arrives, the buyer delivers this bill of lading to the carrier office at the port of destination and receives the delivery note and import customs procedures can be started. During this time there is always a risk that the original bill of lading will be lost or stolen. Especially for importers this means additional time and cost, as losses have to be formally declared and it can take weeks for the new document to arrive. As a result, cargo and production may be delayed in the next step, resulting in high losses for different supply chain members (Twenhöven & Petersen, 2019).

The blockchain technology used in CargoX's dApp connects the actors in the transport logistics chain and offers the opportunity to make collaborations even faster with the instant transfer of bills of lading. In this way, the information flow from the supply chain flows can be monitored with this technology. For this reason, it has been seen that the sequential information flow structure in blockchain technology is beneficial for solving logistics problems. All parties that need to send the bill of lading via courier services can benefit from cost and time savings through the blockchain solution.

In addition, since the bills of lading created through blockchain technology will not be lost, stolen or some actors overwrite the wrong address; It has been seen that the traceable and transparent structure in blockchain technology is beneficial for the solution of logistics problems. In general, the parties can optimize their logistics operations and ensure the transparency and irreversibility of data. Especially thanks to the features of blockchain technology such as the use of decentralized network and cryptography, the data is quite secure and protected against forgery, and therefore, the secure structure in blockchain technology has been found to be beneficial for solving logistics problems.

5.4. ZIM INTEGRATED SHIPPING

Zim Integrated Shipping, commonly known as ZIM, is an American-Israeli-partnered international cargo shipping company founded in 1945 and operates in more than 100 countries worldwide.

ZIM partnered with Sparx Logistics to leverage blockchain technology in 2017, and the purpose of this partnership is to digitize bills of lading with blockchain technology. Sparx Logistics and Wave Ltd. During the collaborative trial, participants can publish and transfer original electronic documents using the blockchain-based Wave Application. As a result of this cooperation, a pilot application was made and it was determined that the containers sent from China to Canada by Sparx Logistics were delivered to the buyers without any problems with blockchain-based electronic documents. The pilot shows that supply chain traceability and reliability can increase and paperwork can be reduced. Blockchain is able to store important information that is immutable and transparent, so that all participants can exchange data and provide

online documentation with the help of blockchain (ZIM Brining Blockchain Technology into Shipping, 2017).

Leading new solutions after a long market analysis, ZIM states that it is convinced that blockchain technology and Wave application can be the solution to lead commerce into the digital age. Because with this technology, ZIM eliminates paperwork and performs transactions on a decentralized ledger, as well as a central authority, so that all transactions can be tracked. Application; It is free for exporters and importers and requires no information technology or operational changes.

In the US, the transportation industry consortium known as the “Block Chain in Transport Alliance” (BiTA) has been established to establish technology standards applicable to the transportation industry. As maritime transport is driven by business rules and procedures tied to a bill of lading, BiTA's +200 members support the use of blockchain technology not only for maritime transport but also for multiple modes of transport, and ZIM has also joined BITA(Gardner, 2018).

Eli Glickman, CEO of ZIM, said, “I am proud that ZIM is leading the way in introducing blockchain technology to the maritime world, and we congratulate our partners on this exciting initiative.”

Blockchain connects the logistics industry and is used to track and store documents related to a line of business. The sequential information flow in logistics has advantages for both the components in the system and the end customer. For this reason, it has been seen that the sequential information flow structure in blockchain technology is beneficial for the solution of logistics problems.

Not only carriers, but also shippers, ports, banks, etc. can join the network and create and share electronic documents via the blockchain. In this way, information flow from logistics flows can be monitored with this technology. For this reason, it

has been seen that the traceable and transparent structure in blockchain technology is beneficial for the solution of logistics problems. At the same time, it has been seen that the secure structure in blockchain technology is beneficial for the solution of logistics problems.

6. CONCLUSION AND FINDINGS

Logistics has gained more importance than ever during the pandemic period. In order for people to survive and not experience product shortages, logistics companies need to ensure that they run their operations successfully, and the blockchain technology applied in logistics contributes a lot to this process. Blockchain technology provides great benefits in reducing the time of preparation and transportation of documents, which is one of the biggest factors in delays in logistics processes, as well as preventing the loss, theft or alteration of documents. In addition, companies currently using blockchain technology, in addition to the profit they earn by completing their logistics operations in a short time, also make a profit from courier services paid for document output and transportation of documents.

Tracking the product, which is one of the most important elements in logistics, is often a problem because the logistics parties will be able to speak different languages in different time zones. With the blockchain technology, the movements of the product can be tracked online 24 hours a day, and if there is a problem, immediate intervention can be made.

In addition, the prevention of document forgery in logistics and the delays due to the element of trust between the parties are eliminated with blockchain technology, since it can be verified with the approval of more than half of the participants in the chain and cannot be changed again.

This decentralized blockchain technology, where money, products or information can be exchanged, is an advantageous technology for companies and customers as it can be monitored by all stakeholders in the chain. Each transaction is recorded on the blockchain, digitally signed for protection, and this transaction is

shared with all components. No data changes are possible without the consent of the participants in the chain.

Another advantage of blockchain is that there is no need for a third central authority. The distributed network structure of the blockchain system, which is thought to help eliminate the problem of trust, which is one of the most important problems in the logistics industry, also allows transactions to be concluded faster and costs are lower.

Logistics company DHL have benefited from blockchain technology to increase traceability in the logistic industry, based on the conclusion that drug fraud in the supply chain threatens human health. In the traditional logistic process, temperature records of temperature sensitive structures of medical products are kept by distributors and logistics providers. However, we have been faced with the consequences of the error rate in insufficient and repetitive information entry affecting human health.

In addition, the presence of counterfeit medicines and counterfeit prescriptions in the market also threatens human health. In order to find a solution to all these problems, blockchain technology was used and with the distributed structure of this technology, accurate information was shared with all logistics parties, provided that it could not be changed. Undocumented drugs in logistics processes have been eliminated with the feature of blockchain technology to connect the digital identities of medical products. Based on this, the transparent and traceable structure in blockchain technology, it has been seen that it is beneficial for solving problems in logistics processes.

Traceability and sequential information flow in the supply chain are important for companies and customers, as the paperwork procedures in the logistics industry

both waste time and cost companies in any missing or incorrect documents. Logistics companies such as MAERSK, CARGO X and ZIM have solved the common problems of limited traceability and trust in the traditional supply chain by using blockchain technology.

Blockchain technology can reduce the time to send materials to the production line by 40%, thus allowing a clear understanding of each statement with end-to-end transparency, minimizing unnecessary processes and reducing costs (Haswell & Wagner (2018)).

By drawing attention to the importance of sequential information flow between ship owners, agencies and customers, smart bills of lading were created with blockchain technology. In this way, the risk of extra cost to companies by incorrect information being written on bills of lading, which is an important document that helps to identify the owner of the cargo, is eliminated. In addition, due to bills of lading that cannot be delivered on time, companies have to pay a warehouse fee for their products waiting at the port, and this expense is avoided thanks to smart bills of lading that are delivered instantly with this technology. For this reason, it has been seen that the transparent and traceable structure in blockchain technology is beneficial for the solution of logistic problems thanks to the sequential information flow.

When the benefit distributions of the analyzed cases are examined; As a result of the case studies on 4 cases, it is seen that the transparent and traceable structure in blockchain technology is beneficial for the solution of logistics problems. It is seen by the review of the case studies of MAERSK, DHL, CARGOX and ZIM that the secure structure in blockchain technology is beneficial for the solution of logistics problems. The sequential information flow structure in blockchain technology is beneficial for

solving logistics problems, it is seen by the case studies of logistics companies MAERSK, CARGOX, DHL and ZIM.

In the cases examined, it is seen that; In all cases except CARGO X and ZIM, blockchain technology was used to monitor both product and information flow. In CARGOX and ZIM, however, this technology was used to monitor the information flow only from the supply chain flows.

Since it is known that the flow of false information in logistics will affect the entire chain, it is known that company managers provide cost advantages when they access the right information on time, both in demand forecasts and market research. It is thought that the managerial contribution of this study will help logistics organizations increase their final profitability by reducing the company costs of accurate and timely information transfer.

Although it has not been implemented in different sectors due to the fact that it is a new technology, it is foreseen that this study will shed light on future studies and will integrate blockchain technology in more sectors. The limited number of studies related to blockchain technology is among the limitations of this research. In advanced research; A more comprehensive study can be done with more studies. Applications made specifically for sectors can be examined and application suggestions can be developed. With the increase in the use of blockchain and the increase in information sharing, comparison researches can be made before and after the use of blockchain.

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