

Blockchain Technology in Supply Chain

Tedarik Zincirinde Blok Zincir (Blockchain) Teknolojisi

Abstract

The technological changes in recent years have played a major role in changing the rules in business life. After technological innovations such as autonomous tools, the Internet of Things, and industry 4.0, the new issue that has emerged with crypto money today is Blockchain technology. A blockchain technology is a peer-to-peer digital ledger of transactions that may be publicly or privately distributed to all users and therefore is said to be decentralized and distributed. The most important feature that distinguishes block-chain-based technologies from other technologies is that it has a special algorithm without being connected to any center. Therefore, this technology makes a significant difference in supplying fast, secure and accurate information flow among supply chain members. Reducing the costs and time that arise in the supply chain, it provides significant advantages to enterprises such as the transparency of the operations performed. The purpose of this study is; to explain the block chain technology and to contribute to supply chain processes and stakeholders. In this context, the study is considered as literature review. The study is important in terms of contributing to the relevant literature in basic level.

Öz

Son yıllarda yaşanan teknolojik değişiklikler, iş hayatında alışlagelmiş kuralların değişmesinde büyük rol oynamaktadır. Otonom araçlar, nesnelerin interneti ve endüstri 4.0 gibi teknolojiye bağlı yeni gelişmelerden sonra günümüzde özellikle kripto paralarla birlikte daha fazla öne çıkan bir konu da blok zinciri (Blockchain) teknolojisidir. Blok zinciri teknolojisi; bir ağ ortamında veri bloğunun ağa giriş izni olan tüm kullanıcılar tarafından, aynı anda takip edilebilirliğini sağlayan veya özel olarak tüm kullanıcılara dağıtılabilen ve bu sebeple merkezi olmayan, değişmez bir dağıtık veri tabanına kalıcı şekilde kaydedilmesini sağlayan şifrelenmiş bir dosyalama sistemidir. Blok zincir temelli teknolojileri, diğer teknolojilerden ayıran en önemli özellik ise herhangi bir merkeze bağlı kalmadan özel bir algoritmaya sahip olmasıdır. Dolayısıyla bu teknoloji, tedarik zinciri üyeleri arasında hızlı, güvenli ve hatasız bir şekilde bilgi akışı sağlaması konusunda önemli bir fark yaratmaktadır. Tedarik zincirinde ortaya çıkan maliyet ve zaman gibi unsurları azaltarak, gerçekleştirilen işlemlerin daha şeffaf olması gibi işletmelere önemli avantajlar sağlamaktadır. Bu çalışmanın amacı; blok zincir teknolojisini açıklayarak, tedarik zinciri süreçlerine ve paydaşlarına sağlayacağı katkıları ortaya koymaktır. Bu kapsamda çalışma, literatür incelemesi olarak ele alınmıştır. Çalışma, konu ile ilgili literatüre temel düzeyde katkı sağlaması bakımından önem taşımaktadır.

Introduction

The virtual currency Bitcoin, which was introduced in 2008, is becoming more popular and therefore the interest in Bitcoin technology increases gradually. Blockchain technology is an innovation which is considered to be at the center of Industry 4.0 revolution and it became part of our lives. With the innovations provided, Blockchain technology has achieved in attracting various sectors. The fact that this technology is a decentralized and scattered data network makes it traceable by all the participants. Although the fact of clear visibility of data has increased the attractiveness of it, the structure of the system that prevents any manipulation has made it very secure. In the broadest sense, Blockchain eliminates the existence of an authority or a central network, and allows the user to monitor the data on the Internet by himself/herself. Blockchain is a decentralized



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cryptography registry where valuable data is stored, as well as the information stored is always secure.

Although this technology finds its first application in the financial sector, it has become possible to use it in all sectors which can be integrated with technology today. Blockchain technology, which has many examples of use throughout the world, also became widespread in Turkey.

After the Industry 4.0 revolution occurred, there have been rapid transformations in the manufacture of products and its transportation to the end consumer. These technological transformations affect each sector and include the businesses in this rapid transformation. Although each sector is affected by this transformation, the logistics sector is one of the most affected ones. Given the fact that businesses today compete by involving in supply chains, they also wish to use the benefits of Blockchain technology. With the help of these benefits, businesses have the opportunity to become more efficient in supply chain management. Blockchain technology, which first emerged as crypto coins, has attracted attention in all sectors that can be integrated with Internet after proving its reliability and transparency in financial sector. Each sector wants to use this technology suitable for its business area and benefit from it.

1. Blockchain Technology

Blockchain distributes the digital data and prevents the duplication, and therefore it is a database basically designed for the digital currency, Bitcoin. This databased was first announced in 2008 by a person or group using the nickname of Satoshi Nakamoto with a technical study titled "Bitcoin: Peer to Peer Electronic Cash Payment System" (Satoshi, 2008). Bitcoin has emerged as a virtual currency in which action can be taken against manipulation of users or external links by taking necessary measures and operating without being connected to a centralized system. The Bitcoin currency is not only virtual but also has a strong cryptography technique called Blockchain and it has attracted attention with its distributed data structure instead of a single center (Usta and Doğantekin, 2017; 17-18). Although the first application of Blockchain technology is the Bitcoin currency, it now has a wide range of applications. Blockchain is a distributed ledger that does not have a single record database in which all Bitcoin operations are performed. Blockchain's database is the most important feature that makes it safe to be distributed, as the community agrees in all actions through this. There is no central authority to prevent or reverse payments made throughout the chain (Hampton, 2016). Blockchain technology is briefly defined as a reliable and decentralized system which is monitored collectively (Tian, 2016). Hampton (2016) summarizes the use of Bitcoin virtual money through Blockchain as follows; Each page is considered to be a physical ledger containing about ten minutes of Bitcoin processes. After approximately ten minutes of operation, the page is permanently pasted and stamped with a unique serial number. Provided serial number then represents the links in the Blockchain. Because all users are able to see the operations in the ledger, no one can change or delete the process before the page is torn. The serial number saved following the process makes it difficult to delete or modify the process. Because, this number allows mathematical locking (chaining) of all pages in the ledger. The only way to change an action in Blockchain is to separate the page containing the operation and all subsequent pages. The pages should be separated and a new hybrid should be generated. In this context, the safe operation of Bitcoin is thus possible as it is almost impossible to replace and re-paste all the pages (Nakamoto, 2016).

As shown in Figure 1, in the Blockchain filing system, each block contains a summary of the preceding block. For this reason, the blocks become more of a chain than being interconnected. While the sum values of the current block are determined, the sum values of the previous block are also processed. Malicious participants will have to change all the blocks forward if they want to change any block. However, it is not possible to use it because it requires a lot of processing power because it requires proof of work before changing any block. This is one of the strengths of Blockchain technology (Çarkacıoğlu, 2016; 43).

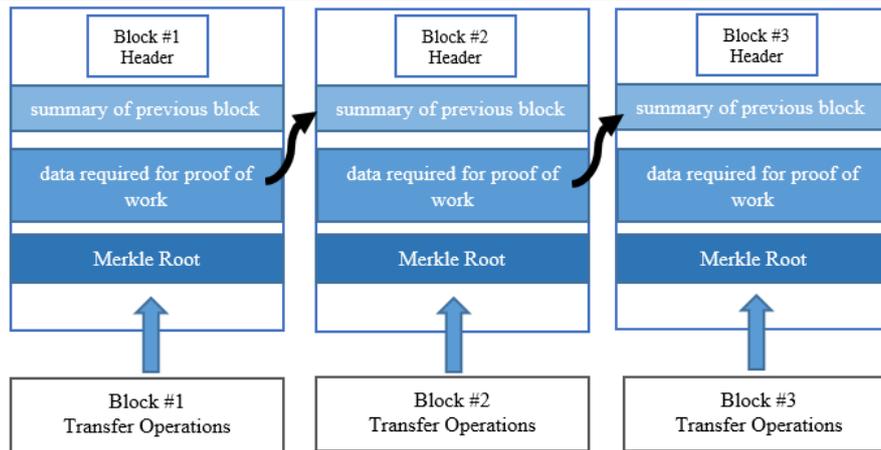


Figure 1. Simplified Blockchain Data Structure

Over the centuries, the preservation of valuable assets has made it necessary to store them in a physical space. Thanks to the development of technology, the storage of valuable assets has become easier. Today, currencies that worth millions may be lost in a sudden or they can be stored in a small driver. A secure storage space has been generated with the Blockchain technology. This technology provides each participant in the system with a tool to transparently account for each other without a supervisory institution / organization or central authority (Prosser, 2015). Such a large database allows the editing and recording of transactions. At the same time, it is the network with most transparent financial records which are easily accessible to all participants (Jose, 2014).

Nowadays, it is practically possible to transfer the data to more than one computer via cheap communication networks. At this point, the data is copied to all systems. The main reason for this is to reduce the costs to the minimum point. The approaches referred to in Moore, Metcalfe, Reed or Bezos laws, as shown in Figure 2, indicate essentially the same thing: The development in digital technologies is very rapid, and technology and costs are adversely proportional in every few years. This development, as indicated in the figure, has helped the transfer of data to the final stage. In this context, it is at the point where it is practically possible to distribute the data to many computers via cheap communication networks. This approach is called Distributed Ledger. The concept is not a new concept and has been used in the past in networks such as eDonkey and Bittorrent. However, the data on these networks are not encrypted and anyone who wishes can access this data (Usta and Doğantekin, 2017; 44).

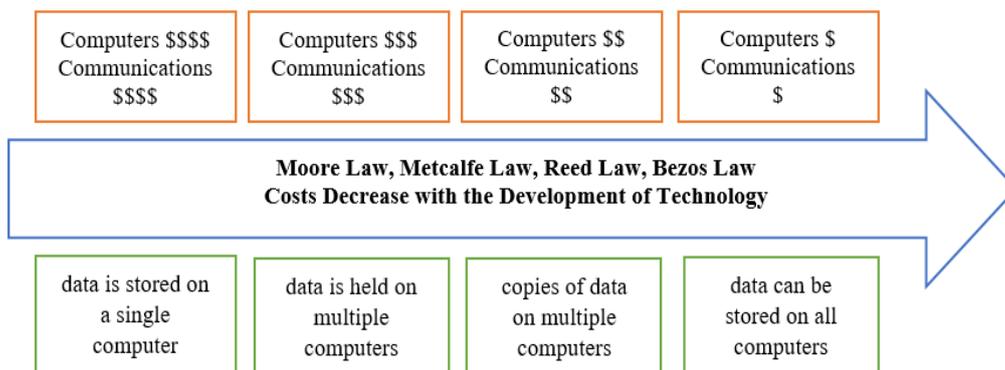


Figure 2. Evolution of Digital Data

The requirement to make sure that the distributed data remains the same on all networks in which it is distributed is in the field of the Blockchain application. In case of Blockchain, any data added to the system must be valid and must be checked by the system in general. This control process and reaching to a consensus is called "reconciliation". In order to ensure the reconciliation structure on a digital system, it should have a guarantee in terms of software. At this point,

Blockchain technology offers a different perspective to the possibility of writing, deleting and updating the data as desired. The data should be handled as different blocks, each block should be created according to certain rules and then added to the system and finally the block should be distributed to the endpoints in the whole distributed ledger structure. The incoming new block includes a summary of the previous block (cryptology approach) and its addition to chain and thereby, the blocks formed in this way generate a chain and constitute the whole of Blockchain technology (Usta and Doğantekin, 2017: 46-47).

1.1. Types of Blockchain

The main criteria for the sorting the Blockchain technology is data writing and reading activities. According to these two criteria, networks are divided as Public and Private. Both networks are separated into two according to specific permit criteria. This is indicated in detail on Figure 3.

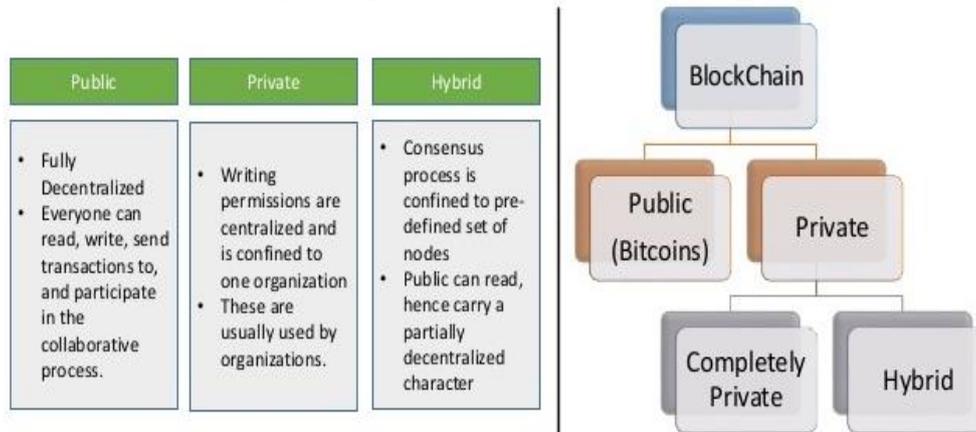


Figure 3. Types of Blockchain

Public Blockchain Networks

In these networks, all transactions performed in the network can be observed by all users. Although all operations are visible, users can use an anonymous profile and conceal their real identity if they wish. Bitcoin and Ethereum are examples of this type of network (<https://teknochain.com>). Such networks generally encourage too many participants to join the network. The fact that each participant can access the data without any further conditions is the most attractive characteristic of this network. Within open networks, participation in the reconciliation system may be open or partially permissible to all participants.

Bitcoin is the most suitable example of public blockchain networks that do not require full permission. Participants in this network become a peer of consensus of the Blockchain network. In this network, everyone involved in the system has an equal and balanced role to ensure reconciliation. However, participants who will be involved in this system should have a benefit from this activity. In this context, the Blockchain network itself must bear a value. In this sense, Bitcoin network is the most illustrative example of this case. In Bitcoin network, participants can trade by using virtual money (Usta and Doğantekin, 2017; 49).

The most prominent example of public Blockchain networks which do not require partial permission is Ethereum. Ethereum is located in the Blockchain network, which is called the smart contracts. What will be triggered by smart contracts can be an activity determined by a business, person or group. Logging into the Ethereum network is not subject to permission but it requires permission to participate in the transaction processes triggered by a specific reconciliation (Güneş, <https://www.sanalhukuk>).

Private Blockchain Networks

In private Blockchain networks, the authority to add a new transaction to the Blockchain is vested only to a special group / organization. The right to read the data may be open to everyone or be restricted in various ways (Ünal and Kocaoğlu, 2018; 57). In the Blockchain networks that require permission, only peers can create blocks with specific rights and contribute to the

reconciliation. This network is generally preferred in the financial sector where data security and confidentiality should be protected (BKM, 2018). Private Blockchain networks are divided into two groups, those require partial permission and those require total permission.

In Blockchain networks that require Partial Permission, only allowed participants may be included in the network. Permitted participants can access all available data and participate in the reconciliation system (Arslan, 2017; 2). An example of this network is the internal remittance system of the banks. Although all branches of the bank are part of this network, bank grants permission to branches in order to participate in the network. All branches should be included in the reconciliation system for a transfer process within a branch or between branches (Usta and Doğandemir, 2017; 51).

In Blockchain networks that require Total Permission, only authorized parties may be involved in the network, but this is not sufficient for the participants to be included in the reconciliation system. Participants who are permitted for reconciliation system can perform the reconciliation (Arslan, 2017; 3). Examples of this network are EFT transactions performed between banks. In this network, when an EFT transaction is carried out from bank A to bank B, all authorized banks that are included in the system can access the data of this transaction. However, only banks A and B are authorized to reconcile the transaction (Usta & Doğandemir, 2017; 51).

Although they differ mainly according to data writing and reading criteria, both Public and Private Blockchain networks have similar characteristics. These are (<https://limenya.com>);

- In both types, all participants are peer-to-peer networks where copies of shared ledgers are recorded for all digitally signed transactions.

- Both have copies of the data in sync with the so-called consensus protocol.

- Both offer certain guarantees about not permitting any type of manipulation about the inalterability of data, although some participants are mistaken or malevolent.

1.2. Application Areas of Blockchain Technology

Blockchain technology is considered to be at the center of the Industry 4.0 revolution and it is not limited to the financial sector. This technology is applied in various fields. Various fields that can integrate with technology are using Blockchain. It is considered that fields of application will develop in the coming years and the impact area of Blockchain technology will increase.

Blockchain technology, of which the initial application field was Bitcoin, has been used in various fields currently. The development of technology and the security it provides indicate that this technology will have more application fields in the future. The list of applications of Blockchain technology is as follows (Usta & Doğantekin, 2017);

- Digital Identity
- Customer Recognition System
- Global Payment Systems
- Fulfilling the Need for Capital on Entrepreneurs
- Collecting and Management of Donations
- Goods and Accidents Insurance Compensation Process
- Internet of Things
- Syndication Credit
- Automatized Compliance Mechanisms
- Proxy Voting
- Supply Chain Management
- Copyright Registry Systems
- Title Deed Registry Systems
- Tender with Public and Health Records
- Military Command Chain
- Protection from Knockoff Products
- Notary Applications

The most powerful feature of Blockchain technology is having a decentralized authentication system where data is retained. In this context, it is considered as one of the most influential areas of digital revolution. Blockchain, which can be used as a digital record storage, is a valuable technology

which can be applied in a wide range of fields, such as evidence and registration of instruments and valuables, collection of birth, marriage and death certificates, the realization of elections and the management of smart contracts, and the storage, processing and management of financial documents. Blockchain technology provides a new and unique control over digital identity to individual users. Blockchain is a global open account ledger and it is not only used for the generation of crypto coins but also in various fields for retaining, management and storage. The opportunity it provides for digital identity makes it the key for confidence economy (Dilek, 2018; 10-11).

There are various companies in the world where Blockchain technology is being applied. For example; Sony uses Blockchain on the basis of its new training platform, and Estonia uses the Blockchain technology to keep health records. Microsoft has developed a Blockchain-based financial transaction infrastructure with Merrill Lynch, and IBM has started to provide Blockchain as a direct commercial service. Spotify has purchased Blockchain-based Mediachain to solve license tracking issues. Canada has announced the introduction of blockchain technology in its new digital identity system. SecureKey Technologies Inc. with IBM support in the first half of 2018, it was announced that consumers could enroll in this new digital identity system. In this way, users will be able to instantly verify their identity against banks, telecom service providers and even official authorities (Alexander, 2018). Companies using this technology in Turkey are; Akbank, Interbank Card Center (BKM), Copyrobo, Global Miles and T2 Software. Considering that Blockchain will initiate a new era in many fields including money transfer in the financial sector, Akbank is using Blockchain technology for international money transfer transactions. Copyrobo uses Blockchain technology for copyright protection. Global Miles team, which transforms the Airline miles into a complete digital asset through Ethereum Blockchain infrastructure, performs the transfer on this infrastructure in a safe way (Demirel, 2017).

2. Supply Chain Management

Competition, which became more important with globalization, has transformed businesses more sensitive about customer satisfaction and caused them to shorten the period to place their products into the market. For the businesses which focus more on these issues, supply chains are considered as important and businesses have been investing in this field. When considering that an effective supply chain process will affect all business processes positively, we should note and acknowledge that supply chain is a very important factor for businesses.

Today, businesses can not perform all their business processes within their own structures for various reasons. For this reason, they get involved in chains with other businesses. With this chain formed, businesses try to coordinate business processes with their partners to become more competitive. The supply chain, which is one of these chains, consists of a number of processes (suppliers, customers, factories, distributors and retailers) in order to fulfill customer orders (Yıldız, 2018; 1216). The supply chain of businesses is a set of activities that are connected to each other and are directly or indirectly affected by each other's business results. According to the definition of the Supply Chain Management Professionals Board; supply chain begins with raw materials and is a network which is completed when the end customer uses the finished product. All of the links in the supply chain are connected to each other.

According to another definition supply chain contains retailers, wholesalers, manufacturers, distributors, logistics service providers and suppliers, and which carries out information, material and money flow among all these actors (Özdemir, 2004). The supply chain aims to consider the pre and post production together and to realize these processes as efficient as the production process. Accordingly, the main purpose of the supply chain is to meet consumer demand with minimum cost and to provide maximum efficiency in these processes (Küçük, 2014).

In order to reduce unit production costs and to utilize economies of scale, various businesses have preferred to focus on mass production by adopting the basic strategy of product and transaction flexibility as of 1950 and 1960. By the 1970s, managers started to develop new strategies by recognizing the importance of resource planning (Tan, 2001; 39-41). Until the 1980s, businesses and managers focused on vertical structuring, business forecasting, demand planning, needs

planning, storage and purchasing (Chandra and Kumar, 2000; 100). As a result of the increasing competition in international trade after 1980, businesses started to take measures such as reducing costs, increasing quality, increasing flexibility and reliability in production. The concept of timely production that emerged in this period has become the focus of attention in global trade and made the businesses challenge with criteria such as zero stock, efficiency in production and shortening cycle times. All these developments have led businesses to maintain their relationship with their suppliers in the context of strategic cooperation (Tan, 2001; 41). Companies have started to maintain their relations with suppliers as well as their customers, through supply chain management in the 1990s (Altuntaş & Türker, 2012; 39). The most important reason to consider suppliers as a stakeholder is that increasing impact of globalization. The competition, which has increased with globalization, led to the necessity of increasing the importance given to customer satisfaction, while pushing businesses to become more rapid and have more specific organizational structures. In order to realize all these, businesses realized the need to establish stronger relations with their suppliers and started to maintain their relations within the framework of supply chain management. Because, in order to realize the efficiency in the production process and to be able to experience a smooth production process, the necessity of the advancement of the pre-production processes was realized. In addition, it was realized that after an efficient production process, it was important to ensure customer satisfaction, and the logistics activities to be realized after the production directly affected customer satisfaction.

Supply chain management is defined as combining basic business processes, demand forecasting among supply chain members and the whole of activities that facilitate production, logistics processes, financing, information flow from producer to consumer, profit maximization and customer satisfaction (Ferrell et al., 2013; 262). Supply chain management is the network that carries out the flow of information, material and money among the links, with the aim of providing more customer satisfaction with minimum cost as a whole of the businesses operating in it (Christopher, 2011). Supply chain management is a concept formed by eight important building blocks. These building blocks are; customer relations, customer service management, demand management, order, production flow, purchasing, product development and product commercialization (Stock, 2001). Supply chain management consists of companies which cooperate to strengthen strategic positioning and increase the efficiency of the businesses (Bowersox et al., 2002). All of these businesses operate in order to achieve the most efficient construction of the eight building blocks that constitute the supply chain management.

Supply chain management has major objectives. These are (Kağnıcioğlu, 2007);

- To reduce operating costs,
- To maintain production quality,
- To minimize inventory costs / losses,
- To have reliable suppliers and to maintain the activity,
- To provide continuity in the goods / services and information among the chains,
- To standardize the raw materials, semi-finished products, parts and services supplied,
- To increase the competitiveness of the enterprise,
- To establish good relations with other groups within the enterprise,
- Production of raw materials, semi-finished goods, parts goods and services required for production at minimum cost.

In the current period, it has become very difficult for businesses to realize all their business processes. Therefore, businesses no longer prefer to perform all business processes by themselves, but they become part of a supply chain. Nowadays, businesses reflect their competitiveness not only with each other, but also with their supply chains (Özdemir, 2004). Therefore, supply chain management has become an important factor. Businesses are responsible not only for their own obligations but also for the success and failure of the supply chain stakeholders in which they operate. For this reason, effective supply chain management can bring considerable success to businesses, however any slowdown or problem will cause failure in supply chains. According to the

results of the study conducted by the National Research Council, the advantages of an effective supply chain management for businesses are as follows (2003; 33);

- Businesses measure customer expectations faster and achieve higher customer satisfaction.
- Because of their agile structure, supply chains provide fast information about changes in supply and demand to their stakeholders.
- Businesses are adapting more rapidly to changing economic conditions through globalization.
- With stakeholder targets, risks and costs are shared.
- It reduces cycle time and product development costs are minimized.
- By eliminating barriers that do not add value to the production process, it reduces resource wastes.
- It reduces the costs of operation.
- Effective information sharing and information technologies reduce transaction costs.
- Supply chains enable participants to save more.
- By keeping the number of suppliers at a sufficient level, management costs of the supply chain are kept at a minimum.
- Accuracy of demand forecasts is increased and stock level is kept in balance.
- It provides preparedness in case of sudden changes in demand or supply.
- With the partnerships, supply chain members offer the opportunity to collaborate with various businesses in global trade.
- Stakeholder sharing increases the speed and amount of information sharing, and makes decision-making easier throughout the chain.

An effective supply chain provides businesses with the numerous advantages outlined above. Throughout the chain, activities can be carried out smoothly when businesses operate by providing efficient performance in their supply chains and taking into account the profitability of their stakeholders. An efficient supply chain provides businesses with unique products / services, a high quality supplier relationship, increased customer satisfaction, more efficient resource management, shorter product / service cycle time, and qualified channel relationships. All these advantages will help the companies to stand out in a global competitive environment. They will stand out among the competitors and also they will be able to have a permanent spot in the industry. However, in addition to these, there are some cases when supply chains cannot operate effectively. The most important obstacles to the effective performance of supply chains are the following: (Eawcett, 2008; 37);

- Top management does not provide sufficient support to the supply chain,
- Uncertain strategic and operational plans,
- Reluctance to share information among members of the chain,
- Trust issues among the chain members,
- Reluctance among members to share risks and rewards,
- Organizational systems and processes which are not flexible enough,
- Reluctance towards change,
- Insufficient explanation of work definitions,
- Inadequate support for innovative ideas,
- Lack of training/ knowledge in necessary subjects.

It is possible to eliminate these factors which will adversely affect the efficiency of the supply chain. One of the most important steps is to make the members see each other as stakeholders, accept the concept of stakeholders and the responsibilities of the ideal of friendship throughout the chain. The continuity of the flow among the members and the willingness to share the risks is one of the criteria that can be effective and advantageous. At the same time, closely monitoring customer demands and supply and demand, which are constantly changing in the market, will also benefit the efficient management of supply chains. However, by accepting the changes and the use of information technologies is one of the measures that can prevent these problems. With the efficient use of information technologies, communication and information transfer among the members of

the chain will be facilitated, while time and cost savings will be achieved through the operations carried out throughout the chain. Focusing on information technologies which will provide an advantage in the cost and time saving will help businesses to have the maximum profit from supply chain.

3. Blockchain Technology in Supply Chain

An effective supply chain management is made possible by reducing costs and increasing customer satisfaction without reducing the quality of products or services. In order to achieve this, a successful transportation, storage, inventory management and payment process must be experienced within the supply chain. However, this is not always possible. The volume and complexity of the operations performed today make the process difficult. As the number of participants in the supply chain increases, the complexity of the process increases. A product emerges as a result of many processes that have been carried out in different places. While this product shifts hands between international businesses, processes such as customs procedures, shipping problems and disruptions, and payments made by the parties to each other lead to a longer delivery time and a loss of productivity. The three basic flows in the supply chain; material / product, information and money flow often do not occur simultaneously. In particular, time can be very long in the financial flow point. In addition, the flow of information is disrupted by the change of the material between the parties in most supply chains. However, when the material reaches the other company, the company begins to store data from the point where it receives the product. It is not possible to see the whole flow together with the existing systems, which means that the end-to-end traceability can not be achieved (Blockchain Türkiye Platformu, 2019).

In an increasingly digitalized world, emerging technologies such as Blockchain provide companies with greater convenience in increasing business value throughout their supply network. Adding new capabilities to the supply chain with digital technologies can contribute to the performance at a very high level. Blockchain technology has been in the agenda of the supply chain for some time, and it is now being applied in real platforms. Large companies such as Maersk, Basf and IBM have been engaged on innovative platforms to provide end-to-end transparency through the Blockchain.

Especially through globalization, the elimination of borders between countries has made the financial system complicated. This complexity creates negativities for businesses as cost and time loss. Although blockchain technology is under the shadow of Bitcoin as a result of the emergence, it is capable of solving the problems caused by the flaws of the financial system today. The solution of these problems is realized by decreasing the costs of money transfer transactions and increasing the speed of transactions (Whitehill, 2017).

One of the biggest contributions of this technology to the supply chain will be cryptography. Cryptography is defined as all of the methods used to convert readable data into a form that cannot be understood by the undesired parties. This allows individuals or institutions to create more secure digital identities. At the same time, it also simplifies the transfer and verification of all data belonging to the individual or organization to the network (Euro Banking Association (EBA), 2016).

In the supply chain, smart contracts are very important. Smart contracts started to be used with the emergence of Ethereum are a series of contracts and rules governing a business. Smart contracts are contracts that can be applied between parties without the need of a third party. They are arranged in a way that they can carry out their own self in part or in full time. For this reason, many procedures in today's contracts are eliminated. The contracts made are recorded on the network and facilitate traceability. With this feature, smart contracts bring great innovation to supply chains. Smart contracts in the supply chain reduce costs and transaction time and provide high security (Yavuz, 2019).

Logistics companies and their customers execute smart contracts based on Blockchain technology and automate the commercial transactions carried out during the shipment of goods. Blockchain technology can provide the follow-up of the supply chain starting from raw material and ending with delivery to the end customer. Due to the realization of the demand and supply

traceability, it minimizes the bullwhip effect which may occur in the supply chain. Information on the safety and accuracy of the products carried on the supply chain network, the stage and conditions of the product within the link of supply chain and their transfer are shared on the network with the support of Internet of Things technology. In addition, speculative increases in product prices can be prevented. Product waste rate that may occur in chain may be minimized via early warning or directions (uutikad.org.tr). The use of smart contracts in the supply chain is capable of responding to many problems. First of all, problems arising in the payment method of letter of credit can be reduced through a blockchain network where banks, institutions and transport companies participate. In the commercial activities between the parties, banks can make transactions quickly and automatically by sending the smart contract containing the required conditions to the parties. As the transactions between buyers, sellers and intermediary banks over these smart contracts can be monitored simultaneously, the processes such as the regulation, delivery and transmission of the bill of lading will be eliminated. At the same time, all the processes of the contracted goods from the seller to the buyer will be cryptographically signed on the blockchain network and saved in the block chain (Cocco ve diğer., 2017:5; UniCredit, 2016:15).

The reduction of risks is very important for the members of the supply chain. These risks are reduced and increased security. Minimizing the bullwhip effect and avoiding fluctuations in product prices will minimize the uncertainties that might occur in supply chains. In this way, any complexities in the supply chains will be prevented. Eliminating all these uncertainties will reduce the cost of the end customer and increase customer satisfaction from the chain.

With Blockchain technology, it is aimed to reduce the transportation costs by using Blockchain technology in container transportation, to eliminate the inefficiency caused by the processes carried out on paper and to increase the traceability during transportation. In accordance with these goals, redundant waiting times in transportation can be eliminated and cost advantage can be achieved. The main companies, such as Maersk and IBM, who want to take advantage of this advantage, work on innovative platforms to provide end-to-end visibility and transparency through the blockchain.

In addition, it can be said that Blockchain technology will accelerate the customs procedures. The need for the approval of more than one user in foreign trade transactions creates problems such as slow progress of transactions. Increase of speed and reliability is also made possible by Blockchain technology. Also, with the security features, it also provides transparency in transactions. This will be a positive step for customs transactions.

Supply chain management is performed on a central system without the need for a common blokzincir approval of transactions and making automatic payments after delivery stage it is possible. These processes can be followed by blokzincir technology it is possible at each stage. Participants can follow the process in a transparent manner. It is not possible for one of the registered participants to delete or change the records retrospectively. This provides fast communication among members of the chain. This is a very important advantage when it is considered that enterprises have to be fast in line with various reasons today. At the same time, the fact that the data cannot be changed after the necessary conditions are met makes it possible for participants to have a trust relationship.

Other benefits of utilizing blockchain technology in the supply chain are as follows (<http://cerasis.com>) :

- To ensure that suppliers and vendors are made more reliable by ensuring that the tasks included in the service level agreement are fulfilled.

- Integrated payment options.
- Ensuring that the goods are delivered undamaged and on time.
- Create block chains and protect the rights of the owner.
- To record all movements of valuables within the supply chain.
- Customer service offering the best level information about the product.

Blockchain technology can prevent the problems faced by businesses from different sectors within the supply chain. This will enable the participants to feel mutual trust. It can even eliminate the mutual trust initiative directly. At the same time, communication between participants will

accelerate and mutual harmony will be achieved. When all this happens, Supplier Relationship Management will reach maximum efficiency. Blockchain technology, which is a transparent network for the problems encountered in supply chains where more than one actor operates, can offer various solutions. An efficient supply chain management can be established through Blockchain technology, which allows all stakeholders (supplier, manufacturer, logistic service providers, recyclers, etc.) to cooperate with full trust on each other and no manipulation on the data processed into the system will be allowed. It is considered that there will be positive effects on the success of supply chains with the benefits it will provide.

4. Conclusion, Recommendations and Discussions

After the Industry 4.0 revolution, productions and end consumer transportation processes are undergoing very rapid transformations. These technological changes affect every sector and engage the businesses in a rapid transformation. Although each sector is affected by this transformation, the logistics sector is one of the most affected ones. Blockchain technology, which first emerged with crypto coins, proved its reliability and transparency in the financial sector and it attracts the interest of this technology in other sectors. Each sector wants to benefit from this technology suitable for its business.

The issues which are expected to be solved by using blockchain technology in supply chain management are as follows (Blockchain Türkiye Platformu, 2019):

- Not taking into account the transparency principle of chain processes
- Delays in supply chain processes
- Lack of end-to-end traceability in the chain
- Deficiencies in audit processes
- Difficulty in reconciliation between participants
- Lack of consistent and accurate information flow in processes
- Slowdown in problem determination, action taking and adaptation
- Producing inappropriate or low quality products / services
- Confidence problem among supply chain participants
- Presence of manual and paper operations
- Security issues in information systems

Blockchain technology plays an important role in the supply chain because of its potential impact on the documentation process. The ability to follow order orders, allocate and validate documents provides benefits such as physical connection between IoT-compatible devices and products. Since supply chain activities are very comprehensive activities, disruptions may occur among the supply chain members in the control processes. One of the most important advantages of Blockchain technology for the supply chain is that it will ensure the control and traceability of this comprehensive and complex structure. By adapting this technology to the supply chain, the traceability of information between workflow processes and members will be much more comfortable.

The most important point that makes the use of block chain technology in the financial sector and the block chain technology important is the transparency and trust it forms. This technology is very secure because it is not connected to any center or organization through its structure. It is not possible to change the information since no changes can be made to the information saved on the system. As every information recorded in the supply chain will be shared among other members, everyone will be able to see and follow up the information about the product. This will eliminate any mistrust about the product and service and will make the supply chain transparent. Each code stored in Blockchain technology is difficult to steal because it overwrites the previous code and generates its own code for each code. Therefore, Blockchain technology is a very significant in regards of its capability to maintain the supply chain information in terms of cyber security. It is impossible for people with malevolent intentions to access this information through this technology.

It will deliver faster delivery of products, and eliminate the loss of time during the customs clearance processes of the product in international trade. It will eliminate unnecessary bureaucracy and paperwork in the customs clearance process. With the use of this technology, customers will be able see which raw materials are used during the manufacturing process of their products anytime, and there will be great advantages in providing customer satisfaction and creating competitive advantage for businesses. In particular, it will increase the reliability of food products, if there is any deterioration of the product, the determination of the link in the supply chain where this deterioration occurred will be easy. Reducing cycle times in supply chain processes will minimize inventory and warehouse costs, which is one of the most important expense items for companies.

Although blockchain technology offers many convenience in the supply chain, the fact that it is a technology that has just begun to be used creates some problems. One of the most important problems is that the data stored on the blockchain network cannot be played /changed. Although Blockchain is very powerful and reliable, security related problems can be encountered. The data to be saved to the network in the blockchain chain is encrypted by using cryptographic methods. Although cryptography is an effective method, it is not enough alone. As an example, it is possible for some participants to have their private keys captured by malicious people on a permitted network. It becomes possible to reverse the transaction histories of the records belonging to these participants and to provide full access to the database. At this point, the security of the private keys belonging to the users is of great importance (Hileman ve Rauchs, 2017). Another problem with security is the potential attacks on blockchain networks. Among these security issues, the 51% attack is the most discussed problem. This attack can be accomplished when more than 50% of the network harvesting are controlled by a group. In this case, the network can delete, change or stop the operation of the network. Although theoretically possible, there has never been a 51% attack that has been successful before. The Blockchain network is increasing in security as it grows (<https://www.binance.vision>).

Blockchain registers can become very large over time. The current growth in Blockchain sizes is higher than the growth in hard drives. If the registries become large enough for participants to download and store, problems such as the loss of books may be encountered. The lack of a centralized management, which is characterized as an advantage when defining Blockchain technology, can turn into a problem in the process. Decentralized blockchain technology makes decision making difficult in supply chains.

In addition to the advantages of the blockchain technology in the supply chain, there are cases where it can create problems. In conclusion, we can say that Blockchain technology is integrated in all sectors and is applied in the supply chain. With this technology, activities in the supply chain are more reliable and more transparent. Blockchain technology is foreseen to minimize errors caused by human factor in supply chains. For this reason, it can be said that this technology needs to be carried out in terms of supply chain and logistics and an increase of the sectoral practices related to this subject is needed.

References

- Alexander, D. (2018). Canadians to use blockchain for digital IDs - Bloomberg. Retrieved June 14, 2018 from <https://www.bloomberg.com/news/articles/2017-11-14/forgetiris-scans-canadians-to-use-blockchain-for-digital-ids>
- Altuntaş, C., Türker, D. (2012). Sürdürülebilir Tedarik Zincirleri: Sürdürülebilirlik Raporlarının İçerik Analizi, D.E.Ü. Sosyal Bilimler Enstitüsü Dergisi, Cilt 14, Sayı 3, S.39.
- Arslan, C. (2017). Dünya Enerji Konseyi Türk Milli Komitesi Risk Çalışma Grubu R1, Enerji Sektöründe Kayıt Zinciri Teknolojisi Çalıştayı, s.2 <https://www.dunyaenerji.org.tr/WpContent/Uploads/2017/11/Risk1tr.Pdf>
- Bankalararası Kart Merkezi, Blockchain Raporu, Keşif: Blockchain'in Sırları, Mart,2018. https://www.bkm.com.tr/Wp-Content/Uploads/2018/03/Blockchain-Raporu_Bbn_Faz1.Pdf

- Blockchain Türkiye Platformu, (2019). Tedarikçi Tanıma Platformu, Blockchain Türkiye Platformu Üretim, Lojistik Ve Ulaşım Çalışma Grubu Raporu, Türkiye Bilişim Vakfı, Nisan. <https://bctr.org/wp-content/uploads/2019/04/U%CC%88retim-Lojistik-Raporu.pdf>
- Bowersox, D. J., Closs, D. J., & Cooper, M. B. (2002). *Supply chain logistics management*, McGraw-Hill.
- Chandra, C., & Kumar, S. (2000). Supply chain management in theory and practice: a passing fad or a fundamental change?. *Industrial Management & Data Systems*, 100(3), 100-114.
- Christopher, M. (2011), "Logistics & Supply Chain Management", Prentice Hall Financial Times, Fourth Edition.
- Cocco, L., Pinna, A. ve Marchesi, M. (2017). Banking On Blockchain: Costs Savings Thanks to the Blockchain Technology, *Future Internet*, 9 (25), 5.
- Çarkacıoğlu, A. (2016). Kripto-Para Bitcoin. Sermaye Piyasası Kurulu Araştırma Dairesi Araştırma Raporu, [Http://www.spk.gov.tr/siteapps/yayin/yayingoster](http://www.spk.gov.tr/siteapps/yayin/yayingoster)
- Demirel, F. (2017). <https://webrazzi.com/2017/08/07/turkiyede-blockchain-kullanan-sirketler/>, (Erişim Tarihi: 29.01.2019)
- Dilek, Ş. (2018). Blockchain Teknolojisi ve Bitcoin. Analiz, Şubat, (231). Seta Siyaset, Ekonomi Ve Toplum Araştırmaları Vakfı, Turkuvaz Haberleşme Ve Yayıncılık A.Ş., İstanbul
- Euro Banking Association (2016). Applying Cryptotechnologies To Trade Finance, (2016), 7-9, <https://www.abeeba.eu/1339/applying-cryptotechnologies-to-trade-finance.pdf>, E.T.:13.07.2018.
- Fawcett, S. E., Magnan, G. M., & McCarter, M. W. (2008). Benefits, barriers, and bridges to effective supply chain management. *Supply Chain Management: An International Journal*, 13(1), 35-48.
- Ferrell, O. C., Rogers, M. M., Ferrell, L., & Sawayda, J. (2013). A framework for understanding ethical supply chain decision making. *Journal of Marketing Channels*, 20(3-4), 260-287.
- Hampton, N. (2016). Understanding the blockchain hype: Why much of it is nothing more than snake oil and spin. *Computerworld*, 5. <http://www.computerworld.com.au/article/606253/understanding-blockchain-hype-why-much-it-nothing-more-than-snake-oil-spin/>. (Erişim Tarihi: 25.01.2019).
- Hileman, G. Ve Rauchs, M. (2017). *Global Blockchain Benchmarking Study*, Cambridge Judge Bussiness School, 13-15.
- Kağncıoğlu, C. H. (2007). *Tedarik Zinciri Yönetiminde Tedarikçi Seçimi*. Eskişehir: Anadolu Üniversitesi Yayınları.
- Küçük, O. (2014). *Stok Yönetimi: Amprik Bir Yaklaşım*. Ankara: Seçkin Yayıncılık.
- Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system, [Online] Available: <https://bitcoin.org/bitcoin.pdf>.
- Özdemir, A. (2004). *Tedarik Zinciri Yönetiminin Gelişimi, Süreçleri Ve Yararları*. Erciyes Üniversitesi İktisadi Ve İdari Bilimler Fakültesi Dergisi. Sayı: 23.
- Pagliery, J.(2014). *Bitcoin And The Future Of Money*, Triumph Books, Chicago.
- Prosser, D. (2017). Bitcoin Triggers A Significant Chain Of Events İn The Financial Sector, *Blok, Kurtosys.Com*, October 29.
- Stock, J. (2001). *Strategic Logistics Management*, Fourth Edition. New York: McGrawHill Irwin.
- Yıldız A. (2018), Endüstri 4.0 İle Bütünleştirilmiş Dijital Tedarik Zinciri, *Bmij*, (2018), 6(4): 1215-1230 Doi: <http://dx.doi.org/10.15295/bmij.v6i4.322>
- Tan, K. C. (2001). A framework of supply chain management literature. *European Journal of Purchasing & Supply Management*, 7(1), 39-48.
- The Financial Cost Of Fraud (2017). The Latest Data From Around The World, Crowe Clark Whitehill, 9, <https://www.accountant.nl/globalassets/crowe-the-financial-cost-of-fraud-2017.pdf>, E.T.:12.07.2018.
- Tian, F. (2016, June). An agri-food supply chain traceability system for China based on RFID & blockchain technology. In *Service Systems and Service Management (ICSSSM)*, 2016 13th International Conference on (pp. 1-6). IEEE.

-
- Usta, A., & Dođantekin, S. (2017). Blockchain 101. MediaCat Kitapları, Kapital Medya Hizmetleri A.Ş., Isbn: 978-605-4584-97-0, İstanbul.
- Ünsal, E., & Kocaođlu, Ö. (2018). Blok Zinciri Teknolojisi: Kullanım Alanları, Açık Noktaları ve Gelecek Beklentileri. *Avrupa Bilim ve Teknoloji Dergisi*, (13), 54-64.
- Yavuz, M . (2019). Ekonomide Dijital Dönüşüm: Blockchain Teknolojisi Ve Uygulama Alanları Üzerine Bir İnceleme. *Finans Ekonomi Ve Sosyal Araştırmalar Dergisi (Fesa)*, 4 (1), 15-29. Doi: 10.29106/Fesa.498053
- <https://limenya.com/acik-blockchain-ile-ozel-blockchain-arasindaki-fark/> (erişim tarihi: 25.01.2019)
- <https://teknochain.com/blockchain-ag-cesitleri/> (erişim tarihi: 23.01.2019)
- <https://www.binance.vision/tr/blockchain/positives-and-negatives-of-blockchain>
- <http://cerasis.com> : <https://oplog.com.tr/tedarik-zincirinde-blockchainin-onemi/>