BLOCKCHAIN AND ITS USE IN LOGISTICS

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Abstract

New technologies play an important role in our daily lives and the logistics sector is booming, both internationally (maritime transport) and nationally (land transport). Private capital and government subsidies make it one of the most important trends today. But in the meantime, it also suffers from the pandemic, and we can say that the pandemic exacerbates conflicts between different parts of the logistics sector. In this paper, we will try to know the blockchain and its possible implementation in the work processes of the logistics sector to bring us a more resilient and effective supply chain, hoping that it will bring us a continuous improvement.

Key words: Blockchain; logistics; SCM; new technology

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1. Introduction

Today we are surrounded by countless new technologies. With its rapid growth, the way we do things in our lives has changed radically as well. The possibility of purchasing whatever you want online never seemed real to us, but it has become one of our daily routines. (Kenneth C. Laudon, 2013) Not only have the new technologies changed our lives but also have changed the rules of game in various sectors like 3D printing for the construction sector, cryptocurrency for financial industry…etc. (Shankar, 2021) This year has been tough for many sectors with the pandemic, but even though many companies have bankrupted, there are still companies that thriving, of course there are many reasons for their success, I believe that the introduction of new technologies plays an important role in this. (Group, 2021)

The present research is about blockchain and its possible use in the logistics sector. We can say that the concept of blockchain is relatively new and fashionable now. This technology refers to a shared and unchangeable ledger that simplifies the recording of transactions and asset monitoring in a corporate network. (IBM)The main feature of this technology is the inability to be corrupted, decentralization, security, distributed ledger technology, consensus, and rapidity in making a deal. (Rodriguez, 2019)

As for the logistics sector, we know that it is a fundamental and essential sector in our daily life, it embarks many parts such as storage, transportation, and information. (Bhutta, 2015)Thanks to the technological advancement, we have reached the era of e-logistics, many companies used to use third-party logistics and now they start to form their own car flow. The problems that already exist and will arise in this new era require a lot of attention and we want to see if the introduction of blockchain can solve some of these problems, such as lack of trust, etc. (Pietro, 2018)

The research of this technology and the logistics sector was carried out due to the interest of knowing the trend of technological advancement and the boom of this sector. This allowed us to know better the world that surrounds us and then have more competitiveness in the labor market or if we want to set up our own business.

2. Literature review

Before we talk about its implementation in logistics, we ought to know the concept of blockchain and Supply Chain Management (SCM).

2.1 Blockchain

The basic goal of blockchain is to store data, similar to how your chat logs are stored. We can write and read any information that we want to store using the blockchain. (K. Salah, 2019) Anyone can join the blockchain network by setting up a server and becoming a node. For blockchain, central node doesn't exist, each node is of equal importance holding the whole database and all of them will synchronize to assure the whole chain's consistency which means you can write or read data on any node. (Alshatera, 2021)

Term	Description
Decentralized	The system that stores data across the network.
Transparent	Everyone in the node and can see the ledger that share amount decentralized network
Miner	Transaction verifier
Consensus	A v method used to verify the transaction.
Forks	The problem that arises when the node is used for different version of Blockchain
Hash	One-way hash function to check the integrity of a transaction or message.
Node	The ledger in the Blockchain system.
Timestamp	A date and time in the computer system used as an electronic time stamp for the transaction.

Table 1 Description of technical terms for blockchain

Satoshi Nakamoto was the first to present the idea of blockchain in his paper "Bitcoin: A Peer-to-Peer Electronic Cash System" (Nakamoto, 2008). But in fact, distributed databases are not an innovation, there are already such products in the market (Mohamed, 2019), however, blockchain has a pioneering feature: it has no administrator, it is entirely decentralized, and no one can remove, freeze, or ban any other's content, whereas all other databases do. If someone wanted to add auditing to the blockchain, it would be impossible to do so, because it is designed to prevent the emergence of a centralized administration. It is because it is unmanageable that the blockchain can be made uncontrollable. (T. Aste, 2017)

2.1.1 Structure of Blockchain

But, with no administration and anybody able to add data into a blockchain, how can we be sure the information is reliable? What if it is tampered with by people with malicious intention? Blockchain is composed of one block after another, and every single block is like a bank of data. Once data is entered, a new block is formed. Each block consists of a block header and a block body. The header holds the current block's characteristic value including the hash of previous block, a timestamp, Nonce and the Merkle root, while the block body contains the data. (Meva, 2018)

Hash is of significance for a block. The hash of blockchain is 256 bits so that no matt er what the original content is, a voice or a paragraph, a 256-bit binary number will be c alculated to represent it; and it is guaranteed that one hash number will only represent o ne certain content. For example, the hash of the string 789 is 68053af2923e00204c3ca7 c6a3150cf7, which is 256 bits when translated to binary, and only the string 789 can ac quire it. Of course, other strings also have the possibility to obtain this hash, but the like lihood is exceedingly low, and can be considered as impossible. (Pierro, 2017)

So, the conclusions are: 1, The hash is in some level, unique, so that it can be used to identify the block. 2, The block and the hash are one-to-one correspondences. Each block's hash is determined for the block head, which is done by connecting the values of the block head's features to make a long string and then generating the hash for that string. The block chain's hash method is SHA256 hash (block head), and this formula only involves the block head meaning that the block head is the only thing that can determine the hash. (Pierro, 2017)

The hash of both blocks (the current and the previous one) are both stored in the block header. Any change that happens on the two blocks will also cause the change of the hash of the current block, which is critical to the blockchain. If a block is modified, the hash of the block is changed, as are the hashes of all the blocks behind it; otherwise, the changed blocks will be removed from the blockchain. (Pierro, 2017)

Of course, obtaining the hash takes time, and changing many blocks in a short period of time is extremely difficult unless someone has more than 51 percent of the network's computer capacity. The data cannot be changed once it has been written. What occurred

is what happened, and it can never be changed again, just like history. (A. Gervais G. O., 2016)

2.1.2 Why data stored on Blockchain is hard to manipulate

New blocks cannot be added too quickly due to the necessity to maintain synchronization between nodes. Because each block can only be followed by one other block and a new block can only be generated after the previous one, you are obligated to synchronize as soon as the signal arrives abandoning your current calculation. Satoshi Nakamoto, the bitcoin's creator, designed the network to generate a new block every 10 minutes on average, making it impossible to add additional blocks. (Nakamoto, 2008)

We have all heard of "mining" in blockchain, it means the process of massive calculations to gain the valid hash of the current block. Calculating the valid hash is like It's like finding a drop of water in the ocean. This output speed is rather slow because they deliberately setting up a massive number of calculations. (S. Bano, 2017)

A hash-calculating machine is referred to as a mining machine, and the person who runs it is referred to as a miner. Everyone says mining is difficult, because not every hash can be used, the blockchain will only accept hashes that match the conditions, which are quite stringent, meaning that the majority of hashes will fail to meet the standards and will need to be recalculated. (A. Gervais G. O., 2014)

The Hash header contains a difficulty factor, which determines the level of difficulty of calculating the hash. If the difficulty factor of 100,000 blocks is 14000, and the blockchain protocol stipulates that target=targetmax/ difficulty, and the target value can be obtained by dividing a constant by the difficulty factor, obviously the larger the difficulty factor, the smaller the target value. Because the target value is so small, the possibility that the hash is less than the value is incredibly small, and it may be computed a billion times to strike once, which is why mining is so tough. (Christopher Klinkmü ller, 2019)

The block header determines the hash of the current block in a unique way: If it senses that the hash has been calculated repeatedly for the same block and still couldn't get it, the block header will change; If not, we will never be able to obtain a different one. Despite the fact that the block header's characteristic values are all fixed, Satoshi

Nakamoto purposely added a random character called Nonce to cause the alter of block header. (Shivam Sharma, 2020)

In order to let the block header's hash less than the target value so that the block can be posted to the blockchain, the miner has to estimate the nonce. Nonce is extremely tough to predict, and the only way to do so right now is to use exhaustive enumeration. The nonce is a 32-bit binary with a maximum value of 2.147 billion bits. The nonce of the 100,000th block is 274 million, which means the miner started from 0 and calculated 274 million times to achieve a nonce number that meets the parameters. (MacKenzie, 2019)

Assuming you're fortunate, you might find the nonce after a few calculations, but if you're unfortunate, you might not be able to find it after 2.147 billion calculations, at which time the protocol permits the miner to alter the block body and start over. Mining is random, and there is no assurance that a block will be produced in exactly ten minutes; it may be counted in a minute, or it may not be counted for hours; however, as hardware improves and the number of miners increases, the calculation speed will increase. Satoshi Nakamoto also created a dynamic adjustment mechanism for the difficulty factor, which is adjusted once every two weeks, to keep the output speed at ten minutes. If the average block generation rate over the two weeks is 9 minutes, which is 10% faster than planned, the difficulty factor is increased by 10% for the next two weeks; if the average block generation rate is 11 minutes, which is 10% slower than planned, the difficulty factor is decreased by 10% for the next two weeks. The smaller the target value becomes the higher the difficulty factor is adjusted approximately, resulting in progressively difficult mining. (S. Debnath, 2017)

Even if the blockchain is trustworthy, there is still a problem to be addressed. If two blocks are added at the same time, both connected to the previous block, it will form a fork. So which side of the fork will be the final one? The norm today is that the node always adopts the longest chain, and once a fork occurs, the method known as six confirmations, will determine which branch is chosen. (G. Srivastava, 2019) And according to the calculation of one block in ten minutes, it can be completed in one hour. Because the speed at which new blocks are generated is dictated by computing power, this rule states that the branch with the most processing power is the genuine blockchain. (Jing Li X. W., 2018)

Not only is blockchain technology at the basis of all cryptocurrencies, but it has also found widespread use in the traditional financial sector. It also enabled new applications, such as smart contracts, to arise.

2.1.3 Research of Blockchain

In recent years, there has been a rapid increase in the study and practice of blockchain, which is regarded as the fifth disruptive innovation after the mainframe, personal computer, Internet, and mobile social network, and is also regarded as the prototype of next-generation cloud computing, which will have a significant impact on the society. (https://www.oracle.com/cn/blockchain/what-is-blockchain/, 2020)

It's a decentralized transaction and data management technology that allows for a low trust (or trustless) exchange system in its optimal form. This method does not rely on a third-party and instead uses the peer network's economies of scale to peer-validate entries and disseminate transaction data in a ledger. While Blockchain began as a foundation for the financial services sector, and is now transforming that area, its use has begun to extend to other industries. The rate of Blockchain adoption is determined by the industry's ability to benefit from it as well as its sensitivity to the issues it poses. (Joe Abou Jaoude, 2019)

2.1.4 Usage scenarios of Blockchain

Financial Sector

The use of blockchain technology in the financial sector can eliminate the need for third-party middlemen and enable direct peer-to-peer transformation, allowing transaction to be completed promptly and at a lower cost. This is primarily due to the advantages brought by the decentralized nature of blockchain. In traditional financial institutions, such as banks, when i want to transfer money to someone, I will need to go through the confirmation of the central institution, the bank, before I can transfer the money, while in the blockchain network, the money can be transferred without being inspected by an administrator, which not only improves the efficiency of the transaction, but also saves the transaction cost. (Li Zhang, 2020)

Public services

Blockchain is also closely related to public administration. The centralized nature of this area brings some problems that can be improved by blockchain. For example, for ordinary people, the most difficult thing is when they go to government departments, they will need to fill and bring lots of documents and need to go to various departments, what's wore is that different departments have different requirements. The main reason for this chaos is that the data of each government department was originally isolated and not shared with each other. By using blockchain, all processes are delivered to the smart contract, they can be automatically processed and transferred, so the so-called "one network for all" is no longer a dream. (D. Cagigas, 2021)

Protection of copyright

We can use the decentralized technical features of blockchain to embed a hexadecimal password for original works, which will be stored on all blockchain computers at the same time, which is equivalent to registering an "electronic ID card" for original works, and it is permanently valid and cannot be falsified. Take a song as an example, if the original songwriter applies for the copyright of the song, but due to the defects of insecure storage, not transparent and easy to be driven by interests, the copyright may be manipulated by others, which may damage the rights and interests of the original songwriter of the song, but if the digital information and copyright information of the song are recorded in the blockchain, with the advantages of blockchain such as openness, transparency and anti-manipulation, it can well avoid manipulation. If the digital and song copyright information is registered on the blockchain, it can be prevented from being maliciously manipulated. (AlexanderSavelyev, 2018)

Insurance sector

Insurance companies are in charge of fundraising, investing, and settling claims, sometimes these process can cause huge costs. However, with the implementation of smart contracts, they are able to eliminate the need for either the insured's petition or the insurance company's consent when a problem occurs; as long as the claim criteria are met, the coverage will be settled automatically. In the future, blockchain will be incorporated with many other technologies to create more revolutionary uses in the insurance market as a significant tool. (Arpan KumarKar, 2021)

The potential to alleviate the double spending problem (the owner of cryptocurrency may spend his money many times before he come to senses that it has already been spent) while keeping the anonymity and privacy of the transacting user's information was the key reason for the adoption of Blockchain technology. (Chohan, 2021)

As Ghassan Sarsak, Chief Technology and Innovation Officer of ICS Financial Systems Limited said "*I see a permissioned blockchain like a family. What I mean by this is family members, they trust each other and protect each other's back. No guests are allowed in without the formal agreement of all family members. So true family members, they keep private information within the family. It's data privacy. What happens in a family stays in the family? They update each other with all information. Like data privacy, they protect each other's information so they can protect each other and make each other's house secure. So, this is the family chain. It is the blockchain. From my point of view, blockchain is all about security, efficiency, and data privacy*." (https://www.oracle.com/cn/blockchain/what-is-blockchain/, 2020)

In the following years, blockchain technology adoption is likely to accelerate. It's commonly recognized as a game-changing, disruptive, and inventive technology that has the potential to transform workflow through efficiency, dependability, and security. (Sarkis, 2018)

Now we've known blockchain, it's time to get to know supply chain and supply chain management.

2.2 Supply Chain and Supply Chain Management (SCM)

2.2.1 Concept of Supply Chain and Supply Chain Management

"The supply chain is a holistic chain structure that revolves around a core company, starting with the procurement of raw materials, the production of products, the delivery to distributors and finally to hands of consumers. It connects all the members as a whole." (G. Baourakis, 2002)

Along with supply chain, its management is also of significant importance. Supply chain management (SCM) is the process of optimizing the operation of the supply chain, starting from purchasing the raw material to satisfying the customer, at the lowest cost.

It involves coordinating the various individuals in the supply chain to meet the needs of the consumer. We could assume all the parts of supply chain as different departments of a “company”, managing this “company” is managing the supply chain. (Mohamed Ben-Daya, 2019)

When COVID disrupted the supply chain in early 2020, few analysts predicted that we would still be suffering from pandemic-related supply chain disruptions in 2022, but here we are, figuring out our own way to survive. (AbdulMoktadirc, 2021)

According to Simon Ellis, an effective SCM can make the supply chain more connected, the members more collaborative, rise cyberaware in the face of hackers, introduce a platform with artificial intelligence thus enhance the ability of supply chain. Supply chain management is more dynamic than traditional logistics management and can bring tangible benefits to supply chain members. (Simon Ellis, 2017)

Therefore, effective SCM can enable companies to gain and maintain a stable and lasting competitive advantage, and in this way increase the general competitiveness of the supply chain. The application of SCM can bring great benefits to companies, but it should not be ignored that SCM is complex, involving many companies with different objectives and involving all aspects of the enterprise. Therefore, it is also common to occur problems. (Sajal Kumar Ghosh, 2022)

2.2.2 Challenges of Supply Chain Management

First, the nature of supply chain leads to the emergence of "bullwhip effect", which means small fluctuations in demand can cause great fluctuations for all the members in the supply chain. It arises because the various parts of the supply chain are not a whole, and everyone makes decisions based only on what the ones next to them tell them. When customers' demand information is passed from bottom to top, it will be distorted through layers, making enterprises misjudge the real demand. (Y.YangaJ, 2021)

Second, the lack of shared information platform. Although the theories about IOT are mature in the market now, there is a lack of technical standards and industry norms. The existing SCM is outdeted and the degree of level of informalization is low, which will inevitably cause the difficulty in building a shared information platform. (Arun Aryal, 2020)And for some, SCM technology implementation costs are high, the enterprise's own

strength will be limited. Since the majority of SMEs' internal management of non-standardization is chaotic, this brings a certain degree of difficulty to the creation and implementation of management software based on standardization, therefore, supply chain management technology has not been effectively implemented. (Rebecca Stekeloruma, 2020)

Third, mistrust between businesses makes it harder to build a mutually beneficial cooperation. All of the entities in the supply chain gather together solely for short-term gain, rather than allowing others in the chain to exchange the information they require. This fragments company activities, resulting in high costs, poor controllability, and a significant trust crisis. This is also the contradiction between the management mode of pursuing the optimal profit of the supply chain as a whole and the traditional mode of pursuing individual companies to maximize their own interests. (Hyunwoo Park, 2018)

Fourth, Sometimes, although enterprises try to introduce supply chain management, but because of the difference in the nature of each one, the industry barriers appear easily with the phenomenon of "trade secrets", keeping it like a secret and not letting others use it. This increases the mutual oppression among supply chain members, everyone is trying to make each other bear the cost and risk. This kind of malicious dumping eventually not only makes it impossible for vulnerable companies to survive, but also increases the overall cost of the supply chain. (Xiong Feng, 2019)

Fifth, the SCM is getting slower and slower. The reason for this phenomenon is because the complexity of supply chain is growing. In recent years, supply chains have tended to evolve towards greater globalization, as well as shorter lead time and reduced inventory. However, many companies have come to realize that, while global supply chains have brought significant benefits, they have also increased complexity in the SCM. The use of manual processes and outdated systems has resulted in information "silos" and led to errors, delays, and high costs. (Bin Shen, 2019)

The need to transform supply chain is especially pressing in the 2020s as the new epidemic and increased trade barriers are obligating the supply chain transformation. The covid has further exposed weaknesses in companies' global supply chains and inadequacies in their manufacturing strategies. (Serpil Aday, 2020)During the outbreak, people were quarantined, and factories were shut down, leading to disruptions in the

production of some goods. Countries around the world experienced shortages of mascara, medicines and other products, and dozens of countries imposed temporary export restrictions on essential goods to safeguard domestic supplies. (Hoek, 2020)

At the same time, outdated manufacturing technologies and planning processes made it difficult for companies to adapt to rapidly changing demand. Prior to the outbreak and city closures, global supply chains were already under stress due to the U.S.-China cold war and rising trade barriers such as tariffs. (Bekkers & Schroeter, 2020)These factors combined are putting more pressure on the already complex enough global supply chains. One is that companies are more aware that the risk of supply chain disruption is extremely high. The other is the impact of the international situation and the need for companies to increase domestic production and diversify their supply chains internationally to avoid over-reliance on perceived "risky" suppliers. (Omera Khan, 2007)

However, it is not easy for companies to rethink and redesign their supply and manufacturing chains. For many industries, moving production in-country or establishing a supplier infrastructure in another country or region, as well as sourcing from multiple suppliers to reduce risk, is too expensive and requires renegotiating with new suppliers, which involves relocating factories and hiring new staff. The final direction chosen by companies, industries and countries will vary, as there isn't one solution for all contexts. What is true is that global supply chains must become more resilient, flexible, and efficient, while being able to safeguard the health and well-being of people. (Daniel J. Garcia, 2015)

Even though supply chain, logistics, and procurement professionals have conquered adversity in numerous ways throughout the years, old and new difficulties continue to interrupt manufacturing and shipping operations around the world. (Alok Raj, 2022)

2.3 Real cases of Blockchain in Supply Chain

2.3.1 Walmart, IBM, Jingdong, Tsinghua and others form blockchain consortium for food supply chain

Walmart uses blockchain to improve the transparency and traceability of his food supply chain. Thus, enhance consumer trust. Walmart is able to record every activity of

his partners and precisely manage the whole food supply chain thanks to a collaboration with IBM.

China is a significant pig consumer country, and Walmart, as one of China's leading retailers, launches his worldwide blockchain program here. The project utilizes blockchain technology of Hyperledger, which enables the rapid capture of product information on a secure blockchain network.

The project allows Walmart to digitally trace the source of the pork it sells as well as the process of each intermediate exchange, Full traceability will ensure that food gets healthier, providing actual benefits to consumers, and, ultimately, increasing his brand's competitiveness. (Chen, 2020)

2.3.2 Maersk and IBM: Tradelens

IBM and Maersk have joined forces to form a blockchain-based transportation and supply chain enterprise. enabling blockchain commercialization for all areas of international supply chain, from shipping to ports, banks to customs in marine transport. They deployed Hyperledger Fabric technology, which digitizes end-to-end supply chain processes and assists businesses in managing and tracking the trail of their containers, boosting information transparency and enabling highly secure information sharing between trading partners. (Jensen, Hedman, & Henningsson, 2019)

2.3.3 SF blockchain pharmaceutical traceability platform

SF is a Chinese logistics company with a self-built logistics system and his own land, sea and air transportation system. His big data platform, blockchain, intelligent storage and many other products and technological means closely connect the end-to-end links of the supply chain such as storage, transportation and distribution. In this epidemic, the security and anti-counterfeiting nature of RFID is used to effectively prevent the market circulation of counterfeit medical supplies and play an important role in the process traceability of back-end transportation and after-sales maintenance, which protects the lives of the people.

In the supply chain of medical supplies, food and materials, it is important to verify key information such as upstream and downstream documents, transportation and storage

in the supply chain. Blockchain-based information traceability and deposition can raise the barriers to information forgery, improve the difficulty of forgery and enhance the trustworthiness of information on the chain through joint information verification by multiple parties on the chain to reach consensus, and because the information is cascaded according to the timestamp and is not able to be tampered, the verification cost of the system is not high. (https://www.sf-tech.com.cn/solution/sf-trace-blockchain-solution)

2.3.4 Online shopping platform anti-counterfeiting

The development of China's e-commerce platforms is in full swing but has also given rise to many problems and ensuring the authenticity of goods on their own platforms has become the primary goal of each platform. Jingdong access to a number of domestic and foreign brands, to achieve 1.2 billion data on the chain. These include Wuchang rice, Maotai, Pingwu honey and other goods. Suning International puts an "ID card" on each newly purchased cross-border import, and also joins forces with a number of cross-border brand owners such as Kao, Swisse, SPA and ISDG to launch the "Authenticity Guarantee Alliance". Tmall and Belgium Antwerp Diamond Exchange reached a cooperation. Using Ant blockchain technology and traceability coding technology, it shows the information of diamond sourcing and identification, cross-border transportation, inbound customs clearance, diamond setting and finished product identification. (Kshetri & Loukoianova, 2019)

2.4 Disadvantage of Blockchain

Unfortunately, blockchain is also a double-edged sword. Depend on the circumstance, its advantage can be disadvantage as well.

1. Energy consumption

Since the production of blocks requires miners to perform innumerable pointless calculations, which is a waste of energy, the blockchain's usefulness is limited. It is currently estimated that the Bitcoin community alone consumes 142 terawatt hours of electricity per year, which is equivalent to releasing about 67.51 megatons of carbon dioxide into the environment at the same time. Many countries have banned the mining action in their territory because it causes regular power outages. (D. Puthal, 2018)

2. Cannot be tempered with and irrevocable

This has both a benefit and a downside. There are no regrets on blockchain since you have no control over the data changes. If the transfer address is incorrectly entered, it will result in permanent loss that cannot be reversed; similarly, if the key is misplaced, it will result in permanent loss that cannot be recovered. (Heires, 2016)

3. Transaction ledger must be open to public

Blockchain is a decentralized system. Because of its need of calculating the balance and verifying the legitimacy of every transaction, the transaction details are open and transparent to all the users on the public chain. If I happen to know someone's account, I can see all of his assets and transactions meaning there is no privacy. (R. Henry, 2018)

4. Performance Issues

As previously stated, everyone has a complete ledger and occasionally needs to go back to each record, resulting in performance issues as time passes when the transaction data is quite vast. For example, the first time you use it, you must download all of the transaction records, and for each transaction later, the counting of your account will be made to make sure you have enough money to pay for it. Although some technical solutions (such as indexing) can help with performance concerns, the problem still exists. (D. Mingxiao, 2017)

5. Latency of blockchain

Latency is a barrier in blockchain transactions. In the case of Bitcoin, network transmission affects the validity of a recently issued transaction since it must wait until the next accounting cycle in order to make sure most of nodes on the network recognize this transaction. The join of two or more nodes on the network at the same time will also cause a problem. In this case, there will grow two or more branches on the chain, but the chain only allows one. So, they will compete their computing power and, in the end, the longest blockchain branch will join the main chain. As a result, blockchain transaction data is delayed. (G. Srivastava, 2019)

3. Contribution of the author: How blockchain can help reduce supply chain risks

In this part, I'd like to summarize the problems of supply chain and state my personal opinion on how the blockchain can help mitigate them.

In my humble opinion, blockchain can help handling this challenges of supply chain: 1. The poor information flow that affects efficiency and costs 2. low trust between members on the chain which can easily lead to cooperation risk 3.the difficulty when trace the source.

For the problem of traceability and transparency, blockchain guarantees the access to all the data for all the members on the same chain. By accessing all necessary documents and shipping data, each user knows where, for example, at any given time, the location of a parcel. With the help of the Internet of Things (IoT), locations can be shared in real time. And since the blockchain records all the data, the "bull-whip" effect can also be mitigated.

As Far as I know, there are pharmaceutical companies worldwide using blockchain in their supply chain to trace the vaccines they produced, since all vaccines need to be shipped refrigerated, the sensors they use will monitor the temperature, in case some batches exceeded specific temperatures during shipping, they will be excluded to ensure the vaccine activity. Another diamond company De Beers is also using blockchain to prevent diamonds that cause the lives of miners since in poor countries, diamond mining is often accompanied by crime.

For the problem of trust, once information is written to the blockchain, its authenticity can be updated and verified by a third party in real time. In addition, the strong security of its inherent cryptography will prevent unnecessary audits. In addition, blockchain can help creating a paperless process, thus increasing the efficiency of distribution. The document, for example the bill of lading, does not have to be sent to each partner, but each user can access it immediately at any time via the chain. Changes and deletions can be viewed and controlled directly.

Payments can be made efficiently and cost-effectively via blockchain, for example, with the help of so-called smart contracts. These digital contracts no longer need to be activated manually, as they are executed automatically under certain conditions. The details of the contract between the buyer and seller are recorded directly in the lines of code. When the terms of the contract are met, the transaction is carried out automatically. Since smart contracts are also stored in the decentralized network of the blockchain and the specified code can only be changed with the consent of all parties in the blockchain, a centralized legal system or authority becomes redundant. All transactions are transparent, traceable to each partner, and virtually irreversible.

Here I have to mention a special type of blockchain - Consortium Blockchain, as I said before, blockchain faces the problem of invading privacy for the public since everyone can see your ledger. But with the introduction of consortium blockchain, you need permission to join, and it is jointly managed by multiple organizations, each of which manages one or more nodes whose data allows only those organizations within the consortium to read, write and send transactions. It's semi-decentralized but of more control and privacy for the members on the chain. R3, Hyperledger, China Ledger are some of the examples of consortium blockchain.

Logistics and supply chain management seem destined to use blockchain technology. The problems and conditions of logistics are similar to those of the crypto and financial industries. Just like in finance, a large number of users in production and logistics must be able to access large amounts of data. However, the transportation industry is by far one of the least digitized industries.

Documents such as bills of lading must be sent back and forth to all parties in paper form. As with the offline text document example, this takes time and money. Still: Blockchain solves a major problem at this point, as parties only have real-time access to the latest version of the document and can immediately view every change. Since the system notices every action immediately, fraud is not possible. In addition, the entire supply chain can be automated and digitized with the help of blockchain, thus increasing efficiency and productivity through simpler management.

4. Methods and Data

Considering the advantage and disadvantage of blockchain, when and only when there doesn't exist an authority that can have the trust of all members, the data written does not need to be used immediately, and the gain from meaningless calculation can make up for the cost itself, can blockchain be a useful technology.

The evolution of blockchain is as below:

1.0 Bitcoin

2.0 The combination of digital currency and smart contracts will extend the application scenario from finance to various fields, including culture and entertainment, charity, social management, medical and health, sharing economy, communication, logistics, etc.

Typical of 2.0 is the application of smart contracts

A smart contract is a multi-party recognized event-driven, stateful software that operates on top of a trusted, shared blockchain ledger and may autonomously handle assets on the ledger based on pre-defined criteria. Smart contracts have the advantage of using mathematical procedures to arbitrate and enforce contracts rather than people. (Bin Wen, 2018)

New generation technologies, such as cloud computing, big data, and the Internet of Things, are required as infrastructure support for blockchain technology and applications, and in the meantime, blockchain plays an important role in promoting the development of more advanced I.T tools.

Cloud computing services have the characteristics of elastic resource scalability, rapid adjustment, cheap cost, and high dependability, all of which can assist small and medium-sized businesses in developing and deploying blockchain swiftly and affordably. (Jing Li Z. P., 2020)

The scale of data is growing in parallel with the increase of blockchain applications, and big data's vast data storage as well as flexible and efficient analytical ability, considerably promotes the capacity of blockchain.

The integration of artificial intelligence devices via blockchain may lead to a new economic model, in which human organizations and artificial intelligence exchange information and even conduct business transactions.

Sub-deployment is a natural aspect of the IoT, and each device in the network can manage its own role, behavior, and regulations in the interaction, which is beneficial to the blockchain system's consensus process.

Supply Chain Finance

The buyer needs to give the seller an account receivable after receiving the goods, and the seller wants to receive the money as soon as possible, while the buyer wants to give the money as late as possible, so you can find a financier, such as a bank, and let him make a loan in the middle, in this case, the buyer does not need to pay, and the seller can also receive the money. Essentially, the seller is taking out a loan on the buyer's credit.

Distributed Data Storage

Benefits:

Easier to interact data between different business entities, especially ones with varied locations and accessibility.

No central failure, reducing downtime

Resistant to regulation

Lower broadband requirements

Disadvantages: redundancy, inefficiency, slow speed

Has privacy issues

Requires consensus building

Steeper learning curve, higher maintenance costs

Distributed database

Save time multi-party transactions are closed quickly, avoiding full reconciliations that would normally take several days

Reduced costs Business-to-business processing eliminates the overhead of middlemen

Only needed in cases of mistrust

Supply chain information sharing-measures

Organizational alliances

The stick or the carrot

1. like Walmart using market forces

2. bundle with benefits like data analytics and supply chain financing

3. using data-intensive machine learning more important as financing shifts to SME (smaller companies need dense transaction information to improve their credit for lending)

4. virtual marketplace of supplier capabilities

Potential applications: pass-through economics

Incentivize early participants with late-stage benefits (stock-like concept, token)

Align incentives with participants' goals and keep incentives relevant over time

Guaranteed truthfulness of the uploaded data

Privacy Transparency of information but not full transparency Optional visibility

Blockchain with token/ without token

In maritime shipping, the success of blockchain platform requires the participation of customs, ports, shipping companies, logistics companies, etc. Intermediaries such as freight forwarders, brokers and clearing houses will disappear.

5. Conclusion

The supply chain is a complex chain structure that connects suppliers, manufacturers, distributors, retailers, and users in the industry through logistics, commercial flow, information flow, and capital flow. As a gigantic transaction medium, blockchain technology is inherently suited to supply chain management.

Blockchain and its future

Greener blockchain: Tesla does not accept virtual currency payments e.g., carbon offsets, introduction of eco-friendly blockchain Focus on less energy intensive blockchain network models, e.g., to reach consensus blockchain networks may move from proof-of-work model to proof-of-stake model

Central Bank Digital Currency: Salvador 2021 Adoption of Bitcoin as legal tender Increased remittance costs for overseas remittances and global inflation will be the most important drivers for the adoption of cryptocurrencies as legal tender

National cryptocurrencies: Central banks will create their own coins instead of opting for decentralized coins Central banks can also keep the value of their national currency tokens parallel to their traditional currencies

Blockchain manufacturing and tracking of vaccines: Managing covid remains a top priority Concerns about manufacturing and selling fake vaccines create complex and huge problems for managing global pandemics Tracking the source and distribution of vaccines ensures that valid vaccines are getting to where they need to be.

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