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INNOVATIVE USE OF BLOCKCHAIN TECHNOLOGY IN THE LOGISTICS INDUSTRY

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Abstract

The problem of minimizing the number of intermediaries in the supply chain is long overdue in the logistics industry. How to carry out logistics operations without the participation of a large number of intermediaries, whose main task is to guarantee the transaction and document flow? Is this possible with Blockchain technology? While this technology is still evolving, there are still many challenges that remain to be addressed. One of the main challenges in implementing this technology in logistics is to reach agreement on its use among all stakeholders. When interaction between different stakeholders in the supply chain with different interests is achieved, then the full potential of this technology to improve the efficiency of logistics processes will be revealed. This will facilitate the emergence of new business models and processes in global trade logistics and increase transparency in the supply chain. Smart contracts with embedded business rules promise not only to reduce transaction costs but to create more agile value chains that enable closer cooperation.

Keywords: Blockchain, supply chain management, logistics, innovation, transformation

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1. Introduction

1.1. Hidden costs in logistics

A logistic system can only work flawlessly if all the processes implementing the flows of both physical goods and large flows of information, which include both information about the goods and various types of financial information, work in a clear and coherent manner (see Figure 1).

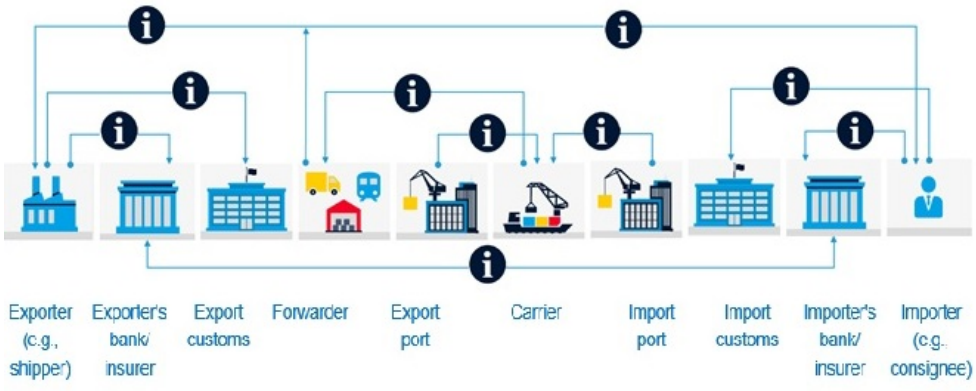

Figure 1. Hidden costs in logistics

Due to high competition in the industry, most of the added value is now concentrated in logistics. According to various estimates, there are about 600,000 different, independent companies offering transportation services in the United States alone (Crosby et al., 2016). As a result, of such a high number of intermediaries involved in logistics processes, we have the fact that much of the processes do not have a common standard, storage of supply information is also heterogeneous. Moreover, the level of automation and implementation of new technologies is different for different companies (Kim & Laskowski, 2018).

If to consider the majority of logistic processes, it is possible to notice strong influence of the human factor. For example, most Customs procedures still require documentation on paper and the use of manual data entry into various Customs information systems. As a result, the human factor reduces transparency, both in tracking the origin history of goods and in obtaining reliable information on the current status of goods in the supply chain. Such insufficient information on the state of goods causes various difficulties in world trade. Moreover, there is no absolute confidence in the reliability of the data provided. In these conditions, it is the application of the technology of the distributed register or block-chains, potentially, able to resolve many accumulated contradictions (Kitahara et al., 2000). The efficiency of logistic processes can be significantly improved. Distributed registry technology does an excellent job of ensuring data transparency, with a large number of stakeholders. The security mechanisms built into the cluster system create trust between the participants in the information flows of the logistics process.

The creation of automated systems based on blockage technology can reduce costs and errors in logistics processes. It will also increase the predictability of logistics operations, which will increase the speed of flow of physical goods. Reliable and reliable mechanisms for tracking the origin of goods will make the fight against counterfeit products more effective and ensure that reliable suppliers are established

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in the market (Kong et al., 2013). The potential of Blockchain technology will enable companies to offer new logistics services and integrate new and innovative management systems into their business.

This article will review several common business models based on the use of blockchain technology. It will be shown that in a global trade logistics environment, blockchains do not need to establish a trust relationship in advance to secure mutual transactions (Li et al., 2010). A blockchain can ideally address trust issues in logistics processes (see Figure 2).

Figure 2. Using blockages in logistics

2. Fast and economical logistics in world trade

Currently, about 90% of all transportations in the world trade are carried out by the shipping industry, and logistics is rightly considered a source of vitality in the modern world (Wang et al., 2004). At the same time, a large number of interested participants with different priorities and using different information logistics systems reduce the effectiveness of trade logistics. Costs arising from the interaction of intermediaries lead to higher prices for goods for consumers. Therefore, cost reduction and increased efficiency in logistics will have a positive impact on the global economy. According to the World Economic Forum - to increase global trade by 15% and gross domestic product by 5%, it is necessary to significantly reduce obstacles in the supply chain of goods (Nakamoto, 2008).

In which areas of global logistics can Blockchain technology help? First and foremost: transport management, customs clearance, financial trading, purchasing and much more. The main objective is to improve the efficiency of maritime transport. This is due to the fact that this industry involves various customs procedures that regulate the passage of goods and a large number of ships. The potential of the Blockchain technology is exactly ideal for solving problems of trade documentation exchange, which will minimize time and financial costs of maritime cargo transportation administration. An example of this is the transportation of frozen and chilled products. Analysis of data from open sources shows that the transportation process will require about 200 different contacts between interested parties. About 30 people will also be involved in the process.

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On 6 January 2018, Maersk and IBM announced the creation and joint development of the world's first block-platform for cargo transportation. The technology, which uses the blockchain to control the supply chain and allows you to track the movement of goods in real time around the world. A comprehensive solution has been developed that allows all stakeholders involved in international trade to track a shipment and allows government agencies to allow its further movement remotely. The new platform will save the shipping industry billions of dollars per year by replacing the existing paper-based system. Blockchain technology will provide a common virtual location for all stakeholders to store all transportation information and manage the movement of goods. In addition, security will be enhanced through the use of double encryption and consistency. Blockchain technology uses smart contracts, where the work process is carried out independently, depending on the goods being transported and the permits required for their transportation (Kitahara et al., 2000).

One of the leaders in the world container transportation industry, ZIM, implements the use of electronic bill of lading (e-B/L). The first shipment with the use of electronic documents based on the Wave platform has already taken place. ZIM, has significantly improved its service and customer support process, getting a significant reduction in time and costs.

The Wave technology that provides this process is designed to digitize original paper documents and related processes. Electronic documents meet legal standards recognized by the international trade industry. Document transfer time has been reduced from days to minutes.

On March 4, 2018, a consortium of AB InBev, Accenture, APL, Kuehne + Nagel and the European customs organization successfully tested the Blockchain solution. This solution will significantly reduce the need for printed shipping documents, which will save the logistics industry more than $100 million annually. This solution allows for information exchange using Blockchain technology (Morley, 2017).

This solution can significantly reduce the risk of penalties for non-compliance with customs requirements, significantly accelerate the information flow of transport documents, reduce the requirements for data entry, simplify the introduction of changes in data during transport, make better reports for verification.

3. Improving transparency and traceability in supply chains

In international trade, for example, in areas such as the automotive, consumer goods or retail sectors, companies require more than 20 different types of paper-based documents. This is necessary to transfer ownership of the cargo or goods from the exporter to the importer. These paper documents may contain more than 2/3 of the information needed. This means that the current approach to information exchange in international trade is much documented. This results in limited visibility of the data and reduced data quality for all stakeholders. Also, it can cause various delays in mutual financial settlements.

Moreover, company transaction data is mostly stored privately, and in many cases there is no single information field for all activities. Typically, transaction data in many companies is often dispersed between different business units. This makes reconciliation of transactions very difficult and increases the probability of errors (Yang & Lirn, 2017). For example, a typical container search operation may take several seconds, but its direct transfer may take much more time. The reason for this is that stakeholders do

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not have access to each other's information. They cannot check the ownership of the goods and formalise the transfer of these rights. Intermediaries use this opportunity and act as guarantors of assets.

There is no need to involve third-party intermediaries in the Blockchain to verify or transfer ownership. On the contrary, a blockchain-based system reliably and securely settles transactions within seconds, since the transaction register is replicated in a large number of identical databases. This is achieved thanks to the basic principles by which a blockage is created:

1. All Blockchain network members have equal access to the database and its history.

2. The exchange of information between the members of the blockage network takes place directly (P2P), each node stores and sends information to all other nodes (Lakshman & Agrawala, 1986).

3. Each transaction and its data are available to all who have access to the system,

4. Once a transaction is entered into the registry and the registry is updated, the records cannot be changed.

5. Transactions in the blockchain can be started automatically by a pre-programmed logic ("smart" contracts).

Therefore a blockchain in logistics can make processes in the supply chain more efficient. The use of this technology will result in data transparency and access to data by the stakeholders involved in the supply chain. In addition, Blockchains will provide more economical, automated and error-free processes, improve transparency and predictability in logistics operations, and accelerate the physical flow of goods (Wang et al., 2004; Wang, 2004a,b; Wang, 2010).

As a result, a blockchain has the potential to help overcome these logistics frictions and increase the transparency of processes in the supply chain (Mori, 2001). In particular, the use of this technology can significantly improve data transparency and address the issue of access to data by all stakeholders in supply and settlement chains. In this way, it is possible to create a "single window" for information flows using Blockchain technology. Thanks to its properties, Blockchain technology can help to minimize costs, increase process automation and significantly reduce errors. Blockchain technology not only increases transparency and predictability of logistics operations, but also speeds up the physical flow of goods (Eremina et al., 2020).

4. Automation of commercial processes in logistics through smart contracts

The problem of unreliability and inaccuracy of data leads to financial disputes and reduces the efficiency of processes in the logistics industry. According to industry estimates, about 11% of invoices contain errors or inaccurate data (Crosby et al., 2016). In such industries as energy and oil, it is possible to save about 5.2% on transportation costs only by increasing the accuracy of the information entered.

Smart contracts in logistics processes will not consist of a paper document or a text file on a server. It will be a special kind of computer programs that will be launched and executed in a network blockchain. The composition of the program code of a smart contract are the terms and conditions of the contract. The smart contract cannot be adjusted, and thus provides the trust that previously required complex audit and control processes. Besides the fact that a smart contract can have the same level of detail as a regular contract, it can also provide additional services (Lv et al., 2009). For example, it can negotiate prices and

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monitor inventory levels. This will replace inefficient and costly manual labor with automated real-time monitoring of supply chains and inventory levels (see Figure 3).

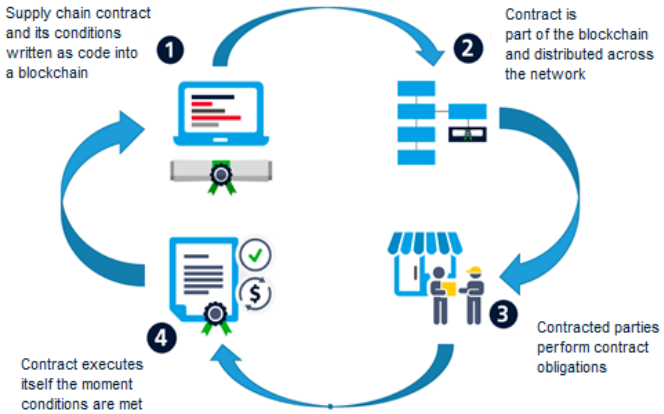

Figure 3. The work of smart contacts in logistics

One of the first satraps in this area, ShipChain, is a multi-component logistics ecosystem based on block-chain technology. ShipChain is based on smart contracts. Ethereum, a public block-keeper, was chosen as the main form, and Solidity, the main algorithmic language for creating smart contracts. Ethereum is an open, public blockchain network.

The main components of ShipChain's ecosystem are - SHIPToken - internal digital currency of the ecosystem, the main purpose of which is to be the "fuel" for transactions; supply registry - serves for fixing each delivery and description of its life cycle, as well as to identify trusted persons and store links to the external data warehouse with detailed information about the logistics process; payment acceptance system - a set of tools and applications to the supply registry to help in payment for conditional deposits; user profile directory; evaluation systems of the bids.

In the future, users of the ecosystem will be able to create their contracts in their own subspace of the ecosystem and independently start validation of nodes creating their own open logistics chain.

By integrating an ecosystem based on blockchains with the Internet of Things (IoT) in the logistics industry, the new innovative concept of Internet of Things with High Value (VIoT), proposed by Waltonchain, can be transferred. For example, a container or pallet connected to an IoT will automatically transfer its current position and condition of the item to the Blockchain ecosystem. The ecosystem independently checks the delivery of the goods, the conditions of transport of the goods (such as humidity, temperature, impact, etc.) and after confirming the delivery, it makes transactions between the parties concerned. All this reduces the impact of human factor and the efficiency and integrity of the logistics process.

Another example is the joint development by Bank of America Merrill Lynch (BofAML), HSBC and Infocomm Development Authority of Singapore (iDA) of a solution to digitize letters of credit (LC), which can also improve the efficiency of the supply chain process.

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Trade finance includes several stages: credit, issuance of letters of credit (LC), factoring, export credit and insurance. At each stage, all processes are time and labour intensive. Several stakeholders are involved in the processes. These are importers and exporters, banks and financiers, insurers and export credit agencies, and other service providers. To mitigate risk and provide guarantees, sellers, buyers and their banks need to review a large number of documents. An LC or documentary credit is a bank guarantee that the seller will receive payment from the buyer after certain conditions are met.

The Hyperledger open source platform was chosen as the basis. This platform was created by the Linux Foundation and supported by IBM, is a commercial class platform already used by many consortiums. Using the Blockchain Consortium mechanisms, it is possible to significantly optimize the manual processing of import/export documentation and improve security by reducing errors. Achieving consensus among stakeholders consists of several stages. The importer starts the process and creates the LC application. A notification is then sent to the importer's bank to have the bank approve the LC, and if approved, the data will be stored in a block list and accessed automatically by the exporter's bank for approval. If the exporter's bank confirms the LC, the exporter is invited to review the requirements of the LC. The exporter then sends the goods and adds an invoice and an export document. All documents after confirmation will be recorded in a blockcheck, and the exporter's bank may approve or reject the recording transaction. Finally, the importer's bank checks the documents against the letter of credit requirements. If everything is verified, the importer makes the payment.

The proposed solution mirrors the existing "paper" letter of credit (LC) transaction process. This allows the automatic conclusion of a trade transaction using a series of digital smart contracts (Lehmacher, 2017).

The area of trade finance attracts startups, and Libelli is one of the promising ones. The company is developing a platform that will act as an intermediary between any interested parties to create a smart contract. This will remove banks from the process of issuing a letter of credit. The automated platform will ensure transparency for all participants of the process and will reduce the time of execution of the letter of credit to several minutes, and the costs will be reduced by dozens of times compared to the fees charged by the bank.

5. How to start with blockchain in logistics

If a company is interested in the potential of Blockchain technology, and the company decides to increase the efficiency of its work using a distributed registry, the first step is to create a road map. It is necessary to understand the potential of the Blockchain technology and its value to all stakeholders. There are three success factors for the implementation of the Blockchain technology:

The first factor is to create a new culture of cooperation.

If a company is planning to implement blockchain technology, it accepts the concept of intensive interaction and cooperation. This decision is necessary because it is necessary to build a new business model of interaction between all stakeholders, and public - government agencies, regulatory bodies, and private organizations - industrial enterprises, partners and even competitors.

As an example, an analogy can be used in the financial services industry, which, although highly competitive, has nonetheless been able to make effective use of block technology. A blockchain creates a

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new reality in which cooperation with competitors benefits everyone. The more parties are interested in cooperation, the higher the value of the blockchain solution. It is for this reason that consortia are creating new projects in the logistics industry.

The second factor is to develop new opportunities for the Blockchain.

New knowledge and capabilities of Blockchain technology will allow all participants to discover the value of new business models. It is necessary to provide all stakeholders with the tools and resources to implement their part of the block solution ecosystem. All participants must interact effectively with both each other and the technology leaders in the industry.

The third factor is to capture the new values of the Blockchains.

Cooperating in new business models based on Blockchains, all participants should prove and understand the value of the new model for business, as well as explore the technical feasibility of the project. Real goals and expectations must be set. As it is necessary to recognize that the technology of blocchines is at the initial stage of the development (Yuan & Wang, 2016). The development of new business models for new business solutions depends on the entire ecosystem in which all stakeholders cooperate.

When creating new business models, participants should study and analyze each new model in order to understand how it can be implemented with the help of Blockchain technology.

In order to implement the idea and the new business model, the participants will go through the steps shown in Figure 4. During the strategic planning phase, a prototype decision must be created to adopt the business model development concept. In this phase, stakeholders learn all the features and pitfalls of using block technology in the ecosystem being created. In the pilot phase, participants test individual elements of the ecosystem (Swan, 2015). The entire ecosystem of the new product is then tested. In the pilot phase, all stakeholders test the entire ecosystem of a product.

The final stage of the logistic Blockchain ecosystem implementation is ecosystem scaling. At this stage, all the benefits of the ecosystem are realized, which are manifested in the complex interaction of all its components. This stage will require stakeholders to significantly transform most business processes both within companies and in inter-corporate interactions. In other words, the success of a decision and project depends largely on the adoption of new rules of the game by all stakeholders. Thus, stakeholder participation is the most important factor for success in implementing the new ecosystem based on Blockchain technology (Zhang et al., 2011).

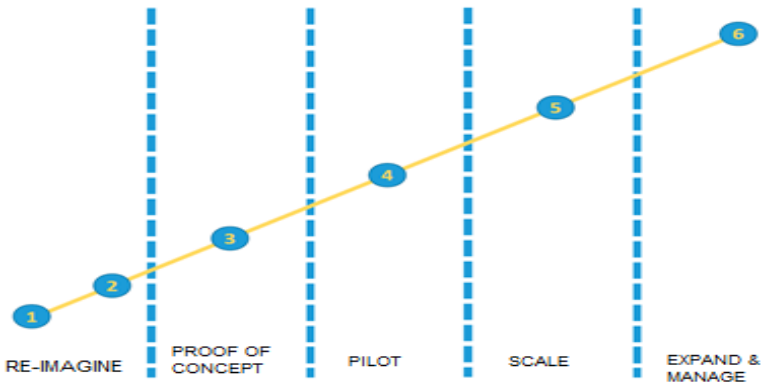

Figure 4. Blockchain technology implementation steps in logistics

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6. Conclusion and prospects

Apart from active implementations in the cryptovoltaic industry, the Blockchain technology is used in many other industries, including logistics. The impact of this technology on various industries will only increase, leading to new business models, new innovative services and new, more efficient business processes.

By increasing transparency in the supply chain, reducing the human factor and automating administrative business processes, the number of new projects for the application of block-chain technology in global transport logistics will increase dramatically. The intersection of Blockchain technology with IoT technology and the emergence of a new entity in the form of VIoT is already visible. This, in turn, will make it possible to synchronize the physical flow of goods with financial and information flows, as well as to connect artificial intelligence and other digital technologies.

However, public demand for greater transparency and openness in logistics processes can lead to the dominance of independent, public open Blockchain networks that provide greater visibility and accountability in the registration of supply chain transactions, tracking of orders and trade logistics-related documents, and the appointment and verification of product certificates and properties. The use of public Blockchain networks will continue to grow as the use of public Blockchain networks will not mean that personal data is available to the public.

The capabilities of blockchain technology can be used not only in banking and for creating cryptographic currency. When used correctly, its main advantage is the speed and ease of establishing trust between business process participants will make it possible to innovate in many areas of logistics. But the technology and standards of Blockchains are still being developed and improved. Significant resistance from governments and existing intermediaries is slowing down its progress. As with any new technology, the integration of the blockades with existing technologies and new platforms such as IoT, and adaptation skills, requires considerable investment.

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