

# BLOCKCHAIN TECHNOLOGY INTO THE LOGISTICS SUPPLY CHAIN IMPLEMENTATION EFFECTIVENESS

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Technologies currently have a tremendous impact on all spheres of economy, business and a state. They integrally change people's conception of trade, property, and market entities interaction.

Artificial intelligence, additive, information-communication, green technologies, biotechnologies, and blockchain technologies development and implementation confirm their leadership importance and inevitability in relation to the activities traditional approaches. In the modern world only the companies with flexible vision, equipment and technologies able to instantly reform, adapt to new conditions and challenges, will benefit. The point at issue is Industry 4.0 as a new technological mode emergence.

One of the latest technologies, which may soon change business models essence in many sectors of the economy including logistics should be pointed out. It is subject to blockchain technology. For the first time blockchain was used in Bitcoin payment system, due to which the technology has exposed to the world. Bitcoin was designed by an unknown software developer (or a group of software developers) Satoshi Nakamoto in 2008. Along with the platform launch Nakamoto published a protocol describing mathematical and conceptual principles of the system. He wanted people to transfer money directly to each other, without banks and other intermediaries servicing [1].

However, cryptocurrency is currently a special case of blockchain application, the product based on it. While digital currencies are gaining fa-

vor, leading corporations and business organizations are beginning to concern Blockchain-technologies.

The technology is not sufficiently extensively introduced in scientific literature. Blockchain technology in financial sector application is described in most of the articles, as well as cryptocurrency current status and development in the near future are highlighted. Blockchain technology practical application is proposed in articles of I. M. Kiselev, “Blockchain Technology in Economy Application” [2], S. Korchagin “Current Trends in Blockchain Technology Development” [3], V. V. Dorokhov “Blockchain Technology: The Future of Financial System” [4]. Scientific development of blockchain technology in logistics application issue is presently fragmented, hence causing interest to this issue study.

In general, blockchain technology essence can be limited to the following. Blockchain is a continuous sequential containing information chain of blocks (linked list), built according to the certain rules [5]. The basic idea of the technology is simple: a distributed registry or database that runs simultaneously on the set (sometimes it is about millions) of cross-points is created and distributed between different users (organizations) around the world. Every new user expands and strengthens the network. It is noteworthy that all computers are equal and there are no organizers, moderators, supervisors and managers. Everyone is responsible for himself.

Five essential characteristics of this technology are emphasized, they are:

*Transparency.* Access to the entire events history, i.e. cash transfers, agreements and other records are always available to all participants of the system.

*Decentralization.* Transaction history is stored by each participant on the hard disc drive, not on some master server.

*Anonymity.* Identity disclosing is not necessary for blockchain operation.

*Equality.* All blockchain participants have the same status and opportunities with no administrators or information custodians.

*Security.* Snapshot Blockchain data can neither be forgotten nor counterfeited. It can be trusted valid [6].

Blockchain uniqueness is in downloaded data permanence or irreversibility, which is ensured by cryptographic protection system. Any system in which information is transmitted, freedom of access is required and reliability is guaranteed can be created on this technology basis.

In 2013 blockchain technology development was seriously influenced by Vitaly Buterin, a young Russian-born Canadian software programmer. He realized that in addition to transactions data information as to absolutely any events can be recorded into the chain of blocks. The system can also be embedded with the software that allows creating applications that operate on the “smart contracts” principle, that is stand-alone programs that are run when certain conditions are met [7].

A recognized technological visionary, scholar and author of books on the future of digital economy, Don Tapscott calls blockchain “the second generation of the Internet” and the technology that will likely to have the greatest impact on the nearest future of the world economy. The blockchain value is expected to increase in the near future, and it will be spoken about more often [8].

When blockchain technologies just appeared, they were considered to be the future basis of all social and economic processes. Most of these ideas, as well as smart contracts application are still related to the futurology area. Dozens of blockchain projects emergence allows to assess the overall market situation and find prospective directions.

The first group of blockchain applications brings together projects initiated by “traditional” companies. New technologies application makes significant optimization of business processes possible. Such projects economic effect is operating time and personnel costs reduction.

It should be noted that the distributed economy scope is only a limited start-ups founders’ imagination. For example, currently funds are being actively invested to implement blockchain technologies projects:

- in banking;
- in stock trade;
- in the field of rules and regulations compliance monitoring;
- in the field of smart contracts;
- in medicine;
- in education;
- in the field of cybercrime defenses;
- in the networking technology and “Internet of things”;
- in the field of cars leasing and sale;
- in the air transport industry;
- in the field of logistics and food supply;
- in music industry, etc.

Published literature analysis has revealed [1-4, 6-9] that Blockchain technology has significant potential and prospects for application in various fields of economy but the most interesting area for this technology is logistics.

Given that supply chain is a sequence of delivery points on route from the origin to destination, information on goods through decentralized records movement is rather essential. One of the most universally applicable blockchain technology performance capabilities is that it can become a successful solution for supply chains elements recording and controlling while providing entire cycle operations secure and transparent monitoring [9].

Blockchain, which is bitcoin technology core, in fact, is a very reliable and effective way of information exchange between the parties. This creates an immutable digital Transactions Ledger that is maintained by computers distributed network. This technology sharing potential, its protected from unauthorized access architecture and complete transparency make it an ideal tool for today's supply chain management methods revolutionizing.

Logistics is defined as a planning structure for material, service and information flows management. Physical goods logistics typically involves information flow, transportation, warehousing and often security integration.

Logistics chains often involve numerous stages and hundreds of geographical locations. Due to this, transparency in the process (goods production and transport) assurance, quality and origin of goods to the ultimate buyer (counterfeit and/or low-quality goods) guaranteeing seem extremely difficult. This issue is especially acute for the food group products, where a buyer, for example, can not in any way identify harvesting, animals and poultry culturing, fishing, etc. location and environmental conditions.

In this aspect blockchain technology introduction main advantage is synchronized audit between partners' provision and the processes in real time optimization. More importantly, blockchain increases the entire promotion chain entities trust level, as well as facilitates decision making process at every stage due to the possibility of providing one-time access to information that allows processes and actions synchronizing and anticipating.

Blockchain, even in the most basic version, into the supply chain introduction allows to ensure the following:

- unnecessary middlemen elimination;
- payment security and fraud protection;

- decentralization, i.e. possibility of a logistics process entities to participate in the real-time operations monitoring; in vehicles and goods movement monitoring; in documents in the form of smart contracts completion and thus errors and fraud risks reduction; in illegal links in the supply chain eliminating; goods counterfeit, smuggling and illegal labor, etc.;

- traceability from the place of the origin to its final consumer; consumer's rights and health safety protection, which allows informed buying decision making.

It is noteworthy that in container carriage the costs of processing documents and information often exceed the physically moved cargo cost more than twofold. The main problem in transportation is a significant time gap and a gap of information transfer and actual goods movement.

In this respect, Maersk in association with IBM experiment result is of interest. The purpose of this experiment was research of feasibility of blockchain technology implementation when transporting one container with flowers from Kenya to Rotterdam. More than 200 interactions with documents and goods, the most important of which are signatures from three agencies for exports approval; completion of six documents confirming origin, chemical composition and quality of the product; customs formalities, etc. are required in the course of such transportation.

With blockchain application this chain looks like the following:

1. The farm completes a packing list; which information becomes visible immediately to all participants in the chain.

2. This action is the basis for a smart contract drafting, which is sent for approval to the three agencies. Once signatures are affixed, the information is updated for all the participants.

2. Simultaneously, all information as to the flowers verification, refrigerated container on a truck loading, and customs resolution are transferred to the port of Mombasa, enabling them to prepare for the container arrival.

As is evident, by means of blockchain technology all documents and goods processing operations are recorded and available to the public. Promptness of information as to which documents are signed, whom by and when, as well as where the flowers are located and who is responsible for them at a particular stage are especially important in this particular example, since flowers are perishable goods and errors and delivery time are critical for them.

Main advantages of blockchain technology in logistics application are:

- all network participants' consistency and transparency;
- handling operations traceability and recording;
- errors in auditing and payments minimization;
- protection against fraud (hackers);
- confidence of network participants and customers increase;
- real-time feedback, which allows the supply chain participants to react on a timely basis and improve their operations;
- companies' activity scale expansion.

Along with that, bottlenecks of blockchain in modern logistics implementation should be noted. Among these are:

- skepticism as to innovative technologies, particularly by the traditional supply model adherents;
- complexity of participants' coordination and business processes standardization;
- high requirements for personnel qualifications.

Thus, one of the main barriers to the blockchain introduction is the lack of trained personnel, i.e. professionals who have experience in cryptocurrency area and crypto-assets consciousness. Accordingly, a company, which plans to introduce innovations in its operations, should learn more about its specific nature and analyze business in order to assess potential advantages and disadvantages. Along with this, experts note technological imperfections of the system itself, namely technical failures and hacker attacks on the data sets. It should be understood that today blockchain as an innovative technology for supply chain management introduction is rather slow due to associated risks and skepticism of individual companies, but it is very likely will soon gain credibility, and its application will increase the industry efficiency [9].

The above arguments allow to summarize the following. Blockchain introduction guarantees huge potential cost saving benefits for the industry. Such a system can certainly reduce delivery delays and likelihood of frauds, saving billions of dollars for every transportation chain participant. According to the World Trade Organization, barriers in goods international supply chain elimination will increase global GDP by 5% and traffic total volume by 15% [10].

We will give some examples of blockchain technologies startups in logistics implementation.

Thus, in 2015 international Blockchain consortium Hyperledger, which currently consolidates more than 115 companies from various industries including finance, automotive, healthcare, IoT and aircraft, was launched by the Linux Foundation. The main objective of the consortium was to create a single blockchain-platform with an open source code, which will enable organizations around the world to introduce blockchain technology into their business processes.

In October 2016 logistics and legal experiment at Commonwealth Bank of Australia, Wells Fargo and Brighann Cotton was performed.

In its course, 88 bales of cotton valued at \$ 35,000 were delivered from the United States to China. Between the continents they were transported by Marie Schulte container ship. After a trip of 11,000 km the goods were unloaded in the port of Qingdao. Evidence that technologies like blockchain and smart contracts combination can produce real business benefits was achieved.

QUASA, a created decentralized logistics platform, which offers innovative solutions based on blockchain technology in supply chain management, introduction enables to make a technological breakthrough in logistics industry by a transparent interaction system between all participants creating.

QUASA Platform will support all participants in gaining tangible benefits of decentralized service and a unique transparent economic system based on its own crypto currency QuasaCoin.

QUASA is a decentralized system that gains blockchain advantage and consists of several smart-contracts within the blockchain and its own crypto currency. Such approach shifts logistics technologies development to a completely new level, as well as ensures complete safety and confidentiality throughout the supply chain.

The system functionality is designed to protect cargo owners and shippers by the aid of blockchain technology and smart contracts to eliminate trust issues, information barriers and legal expenses [11].

Retailer WalMart was one of the first to believe in blockchain promising future and is testing IBM new technology for mango in the USA and pork in China supply. As suggested by the Company its implementation will increase inventory management efficiency and ensure food supply safety that WalMart considers particularly important after the salmonellosis onset in 2006. At that time, when using paperwork, infection source identification took the Company about two weeks. According to the tech-

nology proponents blockchain will provide the details of any consignment of goods listed in the database in a matter of seconds.

End-users who can be sure of product safety, its freshness, lack of GMOs and unwanted additives will benefit from the supply chain transparency as well. Or alternatively to verify exactly that the tuna bought was not obtained by poaching; to protect itself against such accusations blockchain was put forth by the British Startup Provenance. By the aid of blockchain technology the Company tracks tuna movement, controlling its fishing and shipping.

Currently, the giant e-Commerce Company Alibaba Group in cooperation with AusPost, Blackmores and PwC are exploring a unique technology potential to response food counterfeits. The “Food Trust Framework” project was created to improve supply chains security and transparency.

Intel, which has demonstrated blockchain platform operation to establish seafood supply surveillance, stands out among the other institutions. The resource is specialized in control over marine products harvesting establishing, as well as its accounting accuracy and reliability increasing. The process regulation starts with the harvest and up to the product storage conditions according to the sanitary rules observance [12].

Yojee start-up (Singapore) has already been run for more than a year. Technology platform that provides powerful logistics capabilities in the supply chain management deploys artificial intelligence and blockchain technology. It substitutes the dispatcher, monitors orders status in real time, issues invoices and manages tasks. The Company claims they have already been working with 30,000 vehicles and customers from Singapore, Australia, Cambodia and Indonesia.

Maersk, the leader of maritime transport, together with IBM, having conducted an experiment on blockchain in cross-border global supply chain application, demonstrated that even companies of such level are ready for innovation if it is profitable for them.

According to experts, a large container ship can generate several pounds of paper documents that must be signed manually – a huge expenditure that have long been ripe for automation.

Maersk, which has started testing the technology on several container line routes, is already preparing to receive multi-billion-dollar savings with blockchain successful implementation. Imagine: 90% of foreign trade volume in the world is delivered in containers. Upon each delivery on aver-



age 30 links of the logistics chain (including shippers, consignees, carriers, customs, fiscal, controlling bodies) are involved that are more than 200 information interactions. It is assumed that each of the links in the chain will be able to record each entry into the blockchain using a smartphone, and this will eliminate the need to register tons of shipping documentation at each stage of the delivery. Digital technology for data in real time exchange and storage introduction could make a real quantum leap in supply chains.

The technology will help to measure not only the location, but temperature, humidity and power supply status in real time as well [13].

The Port of Rotterdam, Europe's largest commercial port, has been testing Blockchain logistics technology since 2016; and this could be a starting point in transparency in the industry development. The project is supported by more than fifteen public and private sectors companies based in the Netherlands with the Ministry of Economic Affairs assistance. According to the creators, this blockchain project is unique by the fact that it covers the entire logistics supply chain. Over the next two years the consortium members will test applications for exchange of logistical and contractual information between the parties.

Less than a month ago in Australia a comprehensive testing of the blockchain-based architecture of TBSx3 security system, which is capable of providing a qualitatively new level of global supply chains protection, was carried out.

DP World, DB Schenker, Hamburg Süd and the Australian wine company IUS successfully completed blockchain technology testing in the intermodal supply chain from Kunavarra area (South Australia) to the Chinese port of Qingdao by road and sea transport (chain length is 8,100 km).

The development is based on the 44-bit alphanumeric cryptographic encoding adopted in military-industrial complex (as opposed to publicly used 6-bit digital cryptography). The TBSx3 developers plan to continue multilateral system testing and hope to establish a new world standard for the global supply chains security.

Study groups in Sydney and Beijing monitored the process and the mode changes to develop protocols that would verify goods substitution lack throughout the entire supply chain. KPMG audit and consulting company confirmed the goods authenticity throughout the supply chain and followed -up whether the system could potentially detect falsifications. The

partners involved in the project followed up each link of the chain, as well as the protocols conformity at the end of the chain as to wholesale and retail supplies to retailers and consumers.

The second largest port in terms of container turnover in Europe, the port of Antwerp (Belgium), in late June 2017, announced a pilot blockchain project launch aimed at logistics processes optimization. Pilot testing will be conducted in cooperation with T-Mining blockchain startup.

The port representatives noted that simple handling of containers from point A to point B can cover more than 30 different participants, including freight forwarders, carriers, shippers, etc., as well as approximately 200 different operations. In their view, blockchain technology can improve data exchange transparency and accelerate logistic process and interaction of participants and port customers. This, in turn, will minimize any data manipulation likelihood.

On August 22, 2017 IBM announced a project aimed to explore blockchain technology application to control food supply and improve food safety. This initiative was joined by leading retailers and food companies.

As explained by Brigid McDermott, the Vice-President for IBM blockchain-business development, it is not about creating a technology, but an entire ecosystem. It is assumed that blockchain, capable of hundreds of mass production participants' operation and food supplies chain tracking, will quickly determine the spoiled food source, preventing it from getting to the shelves of the stores.

Annually 400 thousand people die due to contaminated food. Issues affecting food safety, such as pollution, disease spread and waste, are exacerbated by the lack of access to information and ability to track it. It may take weeks to determine the exact contamination location. For example, it took over two months to figure out which farms were used to deliver salmonella-infected papaya supplies, IBM noted.

In addition to the American IT-Corporation, Nestle, Unilever, Tyson Foods, Kroger, Dole Food Company, McCormick & Company, Golden State Foods, Driscoll's, Berkshire Hathaway and McLane Company were included into the new blockchain-consortium [14].

Summing up, it can be said that due to Bitcoin the world has learned about blockchain technology wide possibilities, which can now play a key role in decentralized economy construction.

The world is changing: domestic added value level decrease and market and technological changes speed increase require that procurement becomes a flexible, connected innovation leader and in real time mode; an integrated supply chain manager. In the digital world, procurement will enhance its corporate value as an innovative catalyst by linking significant external knowledge and expertise with internal business partners to ensure technology and market leadership of its own products despite reduction of private incremental costs associated with ambitious Procurement 4.0 [15] term which is believed to be very correct in its essence.

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