

Digitalization of the Transport Industry: Technology of Blockchain

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ABSTRACT

Transport development trends and the digitalization of the economy pose new requirements for the level of service and the quality of freight transport, which are difficult to maintain without optimizing transport and logistics costs. To optimize the management of freight transport in modern conditions, it is necessary to use modern intelligent information technologies, methods of information and conceptual computer modeling of supply chains that will virtualize transport resources to further build an optimal development for managing this activity. The article analyzes the use of intelligent information technology Blockchain technology in the management of transport processes, which can improve the quality of transport and forwarding services. The authors describe examples of the use of Blockchain technology in the transport industry in such well-known companies as Ryder, BiTA, the Plato system, MTI (Marine Transport International (UK) Limited), Toyota. Based on the experience of using Blockchain technology, the authors identify the advantages and disadvantages of Blockchain technology in the transport industry. As a result, it was concluded that Blockchain technology will become one of the key tools of the digital society, which will not only optimize various processes, but will bring simplicity, transparency and efficiency to the transport and logistics industry.

Keywords: *digitalization of the economy, transport industry, Blockchain technology*

1. INTRODUCTION

Modern information technologies have a huge impact on the economy and society, changing the prevailing economic structure and lifestyle of people [1]. The present and future modernization of the Economy, new types and methods of relations between transport organizations and cargo owners of Russia consists in the development and widespread use of innovative systems. Transport development trends and the digitalization of the economy pose new requirements for the level of service and the quality of freight transportation, which are difficult to maintain without optimizing transport and logistics costs. To optimize the management of freight forwarding activities in modern conditions and to solve new problems in the market of freight forwarding services, it is necessary to use modern intelligent information technologies, methods of information and conceptual computer modeling of supply chains and virtualization technologies that will virtualize transport resources to further build an optimal management development for this activity.

And in addition in order to provide customers with a high quality transport service, it is necessary to use information systems and software systems that allow for analysis, planning and support in making management decisions. The use of digital and intelligent information technologies in transport and forwarding management brings a number of useful functions. For example, due to the active use of information technologies, the process of receiving new orders, as well as the process of delivery and

transportation of goods, warehouse management and vehicle fleet is significantly accelerated. As a result of increasing the speed of these processes, the duration of order execution is reduced from the point of view of the client and the customer, reducing the paper document flow reduces the role of the human factor, therefore, leads to a reduction in material costs. Thanks to the fast response to customers, the forwarding company reduces the share of fluctuations in consumer demand, and also guarantees the stability of the execution of orders. In addition, information technologies have a positive effect on transport planning and the development of alternative management solutions.

One of these technologies is the Blockchain business model, which has a unique competitive advantage for a freight forwarding company. The purpose of the study is to analyze the use of intelligent information technology Blockchain in the management of transport processes, which can improve the quality of transport and forwarding services.

The relevance of the topic lies in the widespread digitalization of the transport industry in accordance with the program for the development of the digital Economy of the Russian Federation until 2035 and on the basis of this, there is the need to improve the processes of organization and management of transport and forwarding activities.

The works of many scientists were devoted to the research of the problem of implementation of intellectual

information technology in the management of transport processes [2-5]. However, developing information management technologies and new methods of intellectual organization of transport and forwarding activities pose new problems in the field of improving and optimizing methods of management and organization of transport and logistics processes and the functioning of intelligent transport systems. With a significant study of the organization and management of freight forwarding activities, it is necessary to describe and evaluate the implementation of new technological principles such as Blockchain virtualization into the organizational and managerial process in transport industry.

2. METHODOLOGY

As a theoretical and methodological basis for the work, we used scientific research and articles of domestic and foreign scientists on the development of the transport industry and the application of blockchain technology to improve the quality of services in the field of freight forwarding service.

A significant number of scientific studies are devoted to information and intelligent technologies in logistics, digital logistics, application and organization of intelligent transport systems and traffic flows. Among them are the works of L.N. Pospelova, M.O. Suraeva, M.Ya. Blinkin, L.A. Borisova, Yu. O Pazoysky, and A.N. Rakhmangulov. The works of V.I. Sergeev, V.V. Dybskaya, S.V. Domnina, G.V. Zahodyakin, G.V. Bubnova, A.Ya. Kalinichenko, Yu. A. Morozova, S.M. are devoted to logistics and Economics of transport and forwarding activities, including issues of inter-transport interaction.

As the methodological base of the study, we used systemic, processual and integrated approaches to the study of the stated problem. The article used methods of generalization, analysis and synthesis, schematization, structuring and modeling, comparison and groupings, scientific abstraction, ranking, evaluation.

3. RESULTS

In this section, we want to dwell on examples of using Blockchain in the transport industry and to highlight the advantages of its using.

Blockchain technology is an electronic environment that enables digital logistics Blockchain technology was first introduced in 2008 and was implemented from 2009. Its emergence was caused by the digitalization of transport through the integration of information technologies implemented in the management and maintains of transport. Blockchain is a continuous sequential chain of blocks (linked list) built up according to certain rules containing information [6]. In fact, it is a distributed electronic object (generalized account) shared by all network servers that record transaction reports in the form of encrypted blocks in a constant and verified manner.

This is often referred to as Digital Ledger Technology (DLT). Each such block is a unique digital object that is stored on a variety of servers (nodes) of a file sharing network. The latter constantly checks and ensures that each copy matches its equivalent. Once a record in a block is changed, it is very difficult to make a change to it. That's why this technology implies the possibility of using or transferring such objects with maximum security [7].

Next, we want to provide an overview of the applications of Blockchain technology in transport. It is worth noting that most of these are either projects or implementations that are in their early stages.

The Ryder company, which is an American transport and logistics corporation [8], uses the Blockchain to store reports that truck drivers fill out before and after the trip. The report describes the condition of the vehicle, reflects its maintenance. The distributed registry allows you to keep a complete history of both trips and car maintenance operations throughout the life cycle. This ultimately simplifies the task of asset management and use. Let's note the key point in the model, which makes it possible to implement a distributed registry. There is no single authority that would be responsible for all registrations. There are users (customers) who, when ordering transportation, need to make sure that the car is serviceable, serviced and, for example, has performed similar trips in the past. The exact same base of vehicle history can be used in sales transactions. Tom Kroswek the Group Director of Supply Chain Excellence at Ryder highlights the following benefits: "Blockchain can give better visibility and control across the operation such as keeping track of remittances and cross-border transfers or letting companies know exactly where certain products are in the event of a recall. Ultimately, this saves supply chains time, cost, and liability [8].

The American association of carriers (heavy vehicles) BiTA is talking about creating standards for the use of Blockchain in its industry. Applications that are reviewed include, for example, transaction history. This is a register that describes who, when, what, and how it transported. In the proposed standards, this is called a performance analysis and allows potential customers to digitally evaluate (receive confirmation), for example, an approval of the type "experienced carrier with extensive experience". In the same way, the history of all payments can be stored, which will allow all interested parties to evaluate the real (actual) cost of transportation. Another registry is proposed to describe the current loading of trucks ("I will take a passing cargo", etc.). A separate registry can store repair information. Very interesting is the idea that the so-called truck movements are ideal candidates for storing data in a distributed Blockchain register [9].

Drawing parallels with current Russian practice, the Platon system [10] (the Russian system of levying trucks with a maximum permissible weight of more than 12 tons) should record information not in the database of the system operator, but in a publicly accessible distributed register (register). Even more interesting models are obtained, naturally, if information on the functioning of the engine

during operation, fuel consumption, etc. is recorded in the same register. Based on this information, it will be possible to build predictive models for repair and maintenance. Now, for example, aviation companies “Boeing” and others collect data during operation [11]. The proposed standard is to create a similar Blockchain-based system for trucking companies. Also, this information can be used by insurance companies (insurance telematics, when the tariff depends on operating conditions) so-called “black boxes” (in the English version: ELD - electronic logging devices), which allow you to record functioning parameters. We should note that IBM Transport Portal pays special attention to projects associated with the Blockchain [12].

MTR (Marine Transport International (UK) Limited) [13] was the first company in the world to launch a public Blockchain system for container transport.

Insurance (for cargo transportation, automobile insurance) is noted as an extremely promising industry for Blockchain. Cuomo said: “There's an opportunity for smart contracts to really re-imagine business processes. IBM and Microsoft are two of the major tech players in the so-called Blockchain-as-a-Service (BaaS) space, using their public cloud platforms and developer tools to help enterprise organizations build out Blockchain infrastructure”. Marley Gray, Director of Business Development, Blockchain at Microsoft, described smart contracts as a mechanism for creating a more collaborative economy. Smart contracts can execute complicated multi-party agreements beyond the capability of any singular organization [14].

Here, it is possible to speak about the so-called smart contract mechanism. The key technology of Blockchain include: distributed ledger, asymmetric cryptography, consensus algorithm and smart contract [15]. Smart contracts is a mechanism for programmatically executing transactions in Blockchain registers.

Transactions in the registry can contain predefined steps (stages) which will be executed only after the previous ones are completed. You can draw parallels with triggers in the database. As an example of a predefined sequence, we can give a rule that a record of the transfer of a document to the user's address is formed only after the payment from the user to the document owner has been processed. More precisely, each predefined transaction chain creates and releases the next chain. If one chain of a transaction is not performed properly, the following sequence could not be completed. Thanks to this mechanism (also cryptographically secure), Blockchain registries can model the execution of actions without intermediaries. For insurance companies, these are, of course, compensations that must be fulfilled (paid) only after the preliminary conditions are met.

Note in this regard, such a direction as Blockchain-as-a-Service (BaaS). This is something that will make it easier for non-it companies to use the technology by offering them ready-made solutions.

Startups also offer Blockchain-based solutions for transport. One example is Djvu. The company implements a marketplace (platform) for transport data. On this

platform, you can find a carrier, arrange insurance, etc. [16]. Technically, this is implemented on the Ethereum platform. However, according to [17], the transport direction is not the most attractive for Blockchain startups. Toyota (Toyota Research Institute) initiated the creation of a mobile Blockchain consortium [18]. The consortium is focused on finding solutions for the following areas: data exchange between transport companies, P2P transactions (direct payments) for transport companies, insurance that depends on the mode of use of vehicles (insurance telematics).

There are theoretical papers describing the global architecture of an intelligent transport system designed on the basis of Blockchain and smart contracts.

The European view on the development of the transport sector [19] considers the use of Blockchain for logistics and smart tickets (the right/purchase of a ticket is registered using the Blockchain).

We consider the use of Blockchain for the so-called sharing economy in Smart cities. This includes, of course, shared mobility that is the sharing of vehicles.

The studied experience of using Blockchain technology allowed us to highlight the advantages of using Blockchain in the transport industry:

- reduction of paper document flow in global trade. Paper documents must be replaced with signed electronic counterparts;
- support for loyalty programs. The distributed registry stores the history of actions performed within the framework of loyalty programs (customer rewards for any actions). This creates a transparent environment for monitoring such actions and facilitates analysis;
- a distributed registry which can be used for storing information about completed repairs and purchased (replaced) spare parts.

Thus, it can be argued that thanks to the use of Blockchain, the speed, quality and validity of logistic decisions increase.

4. DISCUSSIONS

A distinctive feature and novelty of Blockchain technology is that it does not require a Central regulatory body (for example, a Bank) to approve and register any transactions. This allows, in principle, to get rid of intermediaries in the transaction system without losing its integrity.

Blockchain technology theoretically provides the following features:

- replacing slow manual procedures with fast automatic;
- tracking the origin and properties of cargo (raw materials, semi-finished products, finished products) and passengers;
- information about cargo and passengers that ensures timely payment, insurance and payment of customs duties;
- information on the state of goods and passengers, allowing them to be tracked during transportation or during transfer between modes of transport;
- information for regulatory authorities about the goods and passengers involved participants (exporters, importers, carriers, etc.).

The main principle of this technology is to use information blocks that are stored and encoded in a distributed network. "Smart contracts" further increase the advantages of system flexibility due to the possibility of automatic verification and fulfillment of the previously mentioned contract provisions.

Blockchain, being a relatively new area in the transport management system, is becoming a global technology that is projected to contribute to economic growth over the next several decades. This technology, as it was mentioned above, has many advantages, including the following:

1. **Process Integrity.** Due to the security reasons, this program was made in such a way that any block or even a transaction that adds to the chain cannot be edited which ultimately provides a very high range of security.
2. **Traceability.** The format of Blockchain designs in such a way that it can easily locate any problem and correct if there is any. It also creates an irreversible audit trail.
3. **Security.** Blockchain technology is highly secure because of the reason each and every individual who enters into the Blockchain network is provided with a unique identity which is linked to his account. This ensures that the owner of the account himself is operating the transactions. The block encryption in the chain makes it tougher for any hacker to disturb the traditional setup of the chain.
4. **Transparency.** Any data in the Blockchain can be viewable for any person, also if any changes were made in the Blockchain, those changes are publicly viewable. That's why Blockchain used in cryptocurrencies because, in cryptocurrency, every transaction is recorded and showed to the public.
5. **Faster and Cost Effective.** If you used any cross-border transactions and/or between banks can take days and be quite expensive. But in the case of Blockchain-based cryptocurrency transactions, you can send money to anywhere and to anyone in the world because Blockchain is decentralized and no paper works needed. To be clear, Blockchain transactions are not fast (at all); they're just faster than international inter-banking. They are also cheaper, though by no means free. In fact, if you want a speedier transaction, you'll have to pay for it. Still, compared to traditional system Blockchain is faster and more effective.

Thus, it is obvious that the success of Blockchain has moved the technology to a very wide range which ultimately provided a huge amount of convenience to the organization's but on the other hand, if the technology has pros, it has its cons too. So, Blockchain, like any technology, is not perfect, it has some obvious shortcomings, especially in terms of mass implementation of the technology. Among the shortcomings, the following should be noted:

1. High volatility of the most common Blockchain with the Proof-of-Work consensus algorithm due to the complexity of the transaction, which makes it an expensive technology.

2. The high cost of implementing this technology and the small number of specialists who understand it. Using the Blockchain, you can significantly save on paying for intermediary services, logistics, maintaining various registers, and so on, but the very creation of the system and its implementation is very expensive. For example, to support the system, you need your own Blockchain specialists, who are difficult to find and expensive to hire. To solve this problem in Russia in September 2017 the "MEPHIUS Blockchain technology development Center" was opened on the basis of the Moscow Engineering Physics Institute, which will not only create its own MEPHIUS Blockchain platform, but will also prepare a new generation of information technologies that are so necessary in the digital economy.
3. Uncertain regulatory status.

5. CONCLUSIONS

In this paper, we analyzed the use of Blockchain technology in the transport industry. Applications of Blockchain technology in various global transport and logistics companies were considered. It was revealed that Blockchain is used as a distributed registry model in the transport industry. In this case, all nodes of the system are kept signed and protected by cryptographic mechanisms from modifying the record of completed or completed operations. Such systems can store a wide range of information related to the transport industry. For example, this may be information about the operating conditions (modes of use) of the vehicle. The data collected in this way can be used later, for example, in insurance telematics applications. Another area is the use of distributed Ledger in logistics, especially in global (international) operations. Also, the characteristic of the Blockchain technology was given and the advantages and disadvantages of this technology were identified.

In conclusion, we would like to say that today the Blockchain technology does not stand still, and its capabilities have long gone beyond the cryptocurrency network. It is quite obvious that in the near future, the Blockchain will become one of the key tools of the digital society, which will not only optimize various processes, but will bring simplicity, transparency and efficiency not only to the transport and logistics industry, but also to the world economy.

REFERENCES

- [1] Vaslavskaya, I., Bilyalova, A.A., & Tarasova, A. (2018). Economic Education: the Role of the State in National Economy. DOI: 10.22478/ufpb.2179-7137.2019v8n4.48381
- [2] Oleg A. Kopylov ; Valery P. Mayboroda ; Vladimir N. Azarov (2019) New Scientific and Educational Technologies in Transport Industry International Conference "Quality Management, Transport and

Information Security, Information Technologies" (IT&QM&IS). DOI: 10.1109/ITQMIS.2019.8928393

[3] Ingemansson A.R. (2020) Characteristics, Composition, Mechanisms of Function and Modern Aspects of Implementation of Digital Production Systems in Mechanical Engineering Industry. In: Radionov A., Kravchenko O., Guzev V., Rozhdestvenskiy Y. (eds) Proceedings of the 5th International Conference on Industrial Engineering (ICIE 2019). ICIE 2019. Lecture Notes in Mechanical Engineering. Springer, Cham. DOI: 10.1007/978-3-030-22063-1_124

[4] N V Fedorova, V V Kukartsev, V S Tynchenko, Sh M Atluhanov, D K Gek1 and E A Zagudaylova (2019) Problems of the digital economy development in the transport industry . IOP Conf. Series: Earth and Environmental Science 315 (2019) 032047 IOP Publishing. DOI:10.1088/1755-1315/315/3/032047

[5] Hsiao, W. and Chang, T. (2019), "Exploring the opportunity of digital voice assistants in the logistics and transportation industry", Journal of Enterprise Information Management, Vol. 32 No. 6, pp. 1034-1050. <https://doi.org/10.1108/JEIM-12-2018-0271>

[6] G.J. Larios-Hernández (2017) Blockchain entrepreneurship opportunity in the practices of the unbanked Bus. Horiz., 60 (6) (2017), pp. 865-874. DOI: 10.1016/j.bushor.2017.07.012

[7] Y. Chen (2018) Blockchain tokens and the potential democratization of entrepreneurship and innovation Bus. Horiz., 61 (4) (2018), pp. 567-575. DOI: 10.1016/j.bushor.2018.03.006

[8] Blockchain: The Future of Supply Chain Operations. <https://en.paperblog.com/blockchain-the-future-of-supply-chain-operations-1638444>

[9] Blockchain in Trucking Alliance Seeks to Revolutionize the Transport Industry <https://bitcoinmagazine.com/articles/blockchain-trucking-alliance-seeks-revolutionize-transport-industry>

[10] Grigoryev M.N., Uvarov S.A. (2016) The Platon system as a first step in organizing logistics management of traffic in Russia // Innovation Science. No. 3-1.

[11] Comitz P., Kersch A. (2016) Aviation analytics and the Internet of Things //Integrated Communications Navigation and Surveillance (ICNS) IEEE, 2016. – C. 2A1-1-2A1-6. DOI: [10.1109/ICNSURV.2016.7486327](https://doi.org/10.1109/ICNSURV.2016.7486327)

[12] IBM Travel & Transportation Industry Blog <https://www.ibm.com/blogs/insights-on-business/travel-and-transportation/tag/blockchain/>

[13] Blockchain in Transport Industry (Shipping containers)

<https://steemit.com/technology/@jacor/blockchain-in-transport-industry-shipping-containers>

[14] Blockchain in 2017: The Year of Smart Contracts

<https://www.pcmag.com/article/350088/blockchain-in-2017-the-year-of-smart-contracts>

[15] Christidis K., Devetsikiotis M. Blockchains and smart contracts for the internet of things //IEEE Access. – 2016. – T. 4. – C. 2292-2303. DOI: 10.1109/ACCESS.2016.2566339

[16] Jaguar Land Rover is backing DOVU to bring the Blockchain to the mobile future

<https://techcrunch.com/2017/08/29/jaguar-land-rover-is-backing-dovu-to-bring-the-blockchain-to-the-mobile-future/>

[17] Friedlmaier, Maximilian & Tumasjan, Andranik & Welp, Isabell. (2018). Disrupting Industries with Blockchain: The Industry, Venture Capital Funding, and Regional Distribution of Blockchain Ventures. 10.24251/HICSS.2018.445. DOI: 10.24251/HICSS.2018.445

[18] Blockchain Mobility Consortium <https://blockchain-mobility>

[19] Chen T. M., Bodea G., Huijboom N. M. Anticipating EU transport sector governance //EARPA Form Forum 2016, 1-24. – EARPA, 2016.