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Building logistic information systems using the blockchain digital economy method

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***Abstract* — The article discusses the use of progressive methods of the digital economy in building an information and logistics system and issues related to the organization of production logistics when using the digital economy. Using the example of a logistics operator, the possibility of introducing blockchain technology has been evaluated. Attention is paid to the evolution of the development of automated production management systems at the enterprise. The issues of the development of the digital economy in Russia and abroad are considered. The essence of the blockchain technology and the possibilities of its use in practical conditions are determined. The methodological approach developed by the authors was applied to the application of the blockchain method when building an information and logistics system in the context of a specifically selected SVX Logistics enterprise.**

Keywords — logistics, logistics services, 4PL, 5PL – operator, digital economy, blockchain.

I. INTRODUCTION

The rapid development of information and communication technologies in the late twentieth — early twenty-first century, contributed to a change in the nature of industrial relations. As a result of this technical stage, a national project "Digital Economy of the Russian Federation" was developed in Russia, aimed at ensuring increased internal costs for the development of the digital economy from all sources; creation of a stable and secure information and telecommunications infrastructure for high-speed transmission, processing and storage of large amounts of data, accessible to all organizations and households. [1].

The concept of digital economy is the last decade relevant to the organization of production. Especially actual is the use of modern information technologies in the economic sector of production. The development of society is based on the natural sequence of technological revolutions, i.e. a radical change in the technological mode that dominates in society, which, in turn, is determined by the means and methods of organizing social production and the life support of society. Professor A.I. Rakitov, the creator and scientific director of the Center for Informatization, Social and Technological Research and Science of Science, established the influence of the information revolution on the technological, where the information revolution is the transformation of public relations due to fundamental changes in the field of information processing.

The latest innovations in the field of information technology include progressive technologies (the blockchain) that has been successfully used abroad, which dynamically presents replicated database information on the technical, economic and social status of an object of interest to an outsourcing services customer distributed across a variety of independent computers.

In the study, the authors made an attempt to use these blockchain technologies in the construction of information and logistics systems in a number of companies. Thus, the aim is to study the blockchain and the possibilities of using this technology in the conditions of SVX Logistics.

In accordance with the aim of the work, the following tasks are defined: to study the degree of development of the problem of the development of the digital economy in Russia and abroad; to study the processes of automation of information flows in the field of organization of logistics systems of enterprises; to explore the blockchain system as the possibility of switching logistics outsourcing to 4 PL.

II. REVIEW OF LITERATURE

Today we can finally talk about the beginning of the development of the digital economy in Russia and the appearance of scientists involved in the study of this phenomenon. So in questions of studying digital production are engaged V.V. Aleksandrov, A.V. Babkin, A.I. Borovkov, Yu.Ya. Boldirev, A.V. Gurianov, D.N. Kozlov, K.V. Kukushkin, V.Yu. Kulemin, G.M. Martinov, V.M. Maruseva, Yu.A. Ryabov, V.A. Sarichev, Yu.A. Sidorenko, S.A. Tolkachev, V.G. Frolov, A.V. Shmid, A. Venkatesh, V.S. Mkrtchyan, etc.

Internet of things, blockchain: Yu.V. Kupriyanovskaya, V.P. Kupriyanovskiy, A.A. Klimov, D.E. Namiot, A.V. Dolbnev, S.A. Sinyagov, Yu.P. Lipuntsov, A.G. Arsenyan, S.N. Evtushenko, O.N. Larin[2]. World experience in the transition to a digital economy is described in the writings of

Russian scientists V. V.V. Ivanova, O.V. Krivosheeva, G.G. Malinetskiy, D.S. Medovnikova, etc.

Non-Russian authors who have formed a theoretical understanding of the digital economy are J. Beckert, E. Brynjolfsson, J. Cohen, E. Coleman, D. Coyle, B. Kaheen, D. Leidner, E. McLean, D. Tapscott, T. Terranova, P. Samuelson, T. Scholz, M. Smith, E. Turban, G. Wetebeedr.

However, issues related to the organization of production logistics using the digital economy and blockchain technology have not been adequately reflected in the works of the above authors. What served as the basis for the study of this problem.

III. HISTORY OF THE USE OF AUTOMATED PRODUCTION MANAGEMENT SYSTEMS

There are a number of notable dates for 2019: 125th anniversary of the birth of the founder of cybernetics, Norbert Wiener, 95th birthday of the creator of Fortran J. Backus, 85 years old, outstanding scientists - programmers Nicklaus Virt and Sir Anthony Hoar, 115th birthday of Academician S.A. Lebedev and corresponding member of the USSR Academy of Sciences I.S. Brook, 95th anniversary of academician M.M. Glushkov and the creator of computers M-2, M-10, M-13 M.A. Kartsev.

The fundamental stage in the beginning of the development of automated control systems can be considered the report of scientists A.I. Berg, A.I. Kitov, A.A. Lyapunov. "On the possibilities of automating the management of the national economy," made in November 1959 [3] in which the issues of creating an automated economic management system were voiced, which can be the beginning of the emergence of a digital economy.

One of the decisive areas of production preparation was the creation and effective use of automated control systems. Automated systems for technological preparation of production (ASTPP), which are subsystems of an automated enterprise management system, were widely distributed. Improvement of automated systems has contributed to the reduction of design, technological, organizational, economic and industrial information. All this was debugged, implemented and solved on tube computers with a speed of only 4–5 thousand operations per second and with very low reliability, when the equipment failed 10–15 times a day. The daily amount of processed information in the 60s was not more than 1.13 million decimal. characters/day.

Before the start of the automation process, the organization of the enterprise’s work was based on a human factor, it was impossible to transfer the enterprise’s logistics to a third party, since the warehouse records were kept on paper and depended on the personal qualities of the employees. Therefore, with the development of information technologies, in particular, the appearance of Russia's first so-called WMS (Warehouse Management System) warehouse accounting program or warehouse management system - 1C:Warehouse and gaining foreign experience, where WMS appeared much earlier

This allowed enterprises to focus on the main type of production, giving auxiliary and servicing services to outsourcers, thereby increasing their competitive advantages. Digital technologists began to widely introduce the first multinational corporations that came to Russia. Russian logistics operators received their first experience with such corporations as Colgate&Palmolive, Orbit, Kraftfoods and others [4].

At the beginning of the 2000s, competing WMS systems with 1C Russian production began to appear, such as Sevko, Solvo, as well as Western and American developers introduced their products to the Russian market (Manhattan, Axapta). Today, the Russian market for automated warehouse management solutions is about 50 WMS solutions (of which professional ones are about 15 Russian and about 15 western solutions) different in their functionality, price and quality [5]. Transportation management also requires automation of processes; for this, transportation management systems - TMS (Transportation Management System) were created, which appeared almost simultaneously with WMS systems, but did not receive such wide distribution. TMS developers offer many solutions with a wide variety of features: from route planning, vehicle location monitoring and body loading optimization to a strategic planning system and geo-marketing analysis. About 20 Russian and foreign products are presented on the Russian market, such as 1C:Logistics, 1C:Rarus, Antor Logisticsmaster, Infor SCM transportation management, Interlogistics mercury TSM, SAP for logistics service and others [6].

IV. METHODOLOGY

Given the specifics of the business of each logistics operator, the necessary set of information becomes almost impossible to obtain within a single system from a single supplier and on a single platform. In addition, solutions in the field of information systems management were developed by different manufacturers, they do not always provide for the possibility of data exchange, therefore systems have appeared that combine the flow of information between all information systems involved in the supply chain. As a rule, these are self-written systems adapted to the needs of a particular logistics operator, which complicates the operational management of production when using the services of logistics outsourcers.

Today, the modern logistics operator in Russia is a company with high-tech resources (WMS, TMS, CRM systems) and highly qualified personnel located in modern logistics centers that provide services for the delivery and warehousing of goods, they take charge of planning and optimizing customer traffic flows. It is the high technological effectiveness of the processes of the warehouse operator that allows its consumer to receive cheaper service, with a higher quality of services. Everything related to the goods distribution of the Company is up to one logistics management company. The introduction of a 4PL operator in the Company's logistics system requires, as a rule, a consistent restructuring of the entire logistics chain and production business processes. The logistics operator becomes not just an executor, but also a strategic partner of the company, it fully adapts to the requests and needs of the client, deeply integrating into the business processes, information and communication systems of the enterprise. It becomes very difficult to replace such an operator. That is why, at the stage

of concluding a logistics outsourcing agreement, it is very important to achieve a complete balance of interests of both parties, since the withdrawal of one of the parties from such a project can have irreversible consequences for the business as a whole.

The 4PL approach aims to optimize the supply chain as a whole by influencing four key components: increased service, reduced operating costs, reduced lead time and increased fixed asset turnover [7].

The fifth level — 5PL — at which the 4PL operator begins to provide services for the organization of sales (network business). As such, the definition of 5 PL level does not exist. With regard to the prospects for the development of this level of logistics, expert opinions vary greatly. Some generally argue that introducing the definition of 5PL is more of a marketing ploy, a purely theoretical construct. It does not bring anything fundamentally new to the practice of logistics activities, but only improves the 4PL level: automates and optimizes the work of searching for logistics solutions. The 5PL level has real chances for its development, the only question is in what form this will happen. Nevertheless, at the moment in Russia there is no market for 4PL operators. An enterprise as a developer and integrator of information programs becomes a 4PL operator [8].

It should be noted that at the 1PL level transport services are provided to customers; 2PL — warehouse, 3PL — warehouse and transport; 4PL — customs, warehouse, transport, supply chain management; 5PL — customs, warehouse, transport, supply chain management, sales, fundraising. It turns out that when organizing the operational management of production, we need an operator of at least 4 PL, for which the principles of the Digital Economy — Logistics 4.0 will be widely used. The term "Logistics 4.0" was created in relation to the term "Industry 4.0" in Hanover at the IAA Commercial Vehicles in 2011 [9], which means that we are currently using the knowledge of the peak of the fourth industrial revolution.

The implementation of the Logistics 4.0 method is based on the full list of opportunities for the development of the information society, such as digital networks, cloud computing, data processing centers. The creation of a unified information environment contributes to a change in the functional and organizational approaches in the organization of the supply chain. We can say that the modern development of infocommunication technologies contributes to a new organizational approach in the interaction of participants in the logistics process. Logistics is looking for new technologies to reduce costs and optimize supply chains, increasing their transparency. For the successful completion of this task, blockchain technology is suitable, which allows solving most of the urgent problems. The blockchain technology is based on the P2P application, which allows you to combine information on local computers of various manufacturers, customers, suppliers, auditors. Thanks to blockchain technology, equal rights are granted to all participants in the process.

The blockchain replaces obsolete and restrictive methods of doing business, thanks to a reliable distributed registry, protected by the latest encryption and data verification technologies. An authorized network of participants protects the integrity of the registry, and each side can only see the information that it has access to as part of the transaction.

True trust arises when numerous independent participants keep their own copies of important information. Distributed blockchain systems do just that. There is no need for a single process management body, be it a centralized authority or a large bank.

Only parties involved in a transaction can see information and make changes. All transaction data is always stored in the registry, which means that no one can rewrite or deny the history.

In other words, the blockchain eliminates the possibility of fraud, because all data is open to participants and persons with access. Risk is minimized in a system in which control is essentially distributed among participants. This is the ideal definition of trust [10].

When using the blockchain methods of the digital economy to build a logistics system of production, the authors identify interconnected and interdependent stages

1. A study of the degree of development of the digital economy in Russia and abroad.
2. The essence of the blockchain technology and the features arising from its use are determined.
3. The study of the existing information support system in a particular enterprise.

When testing the methodology in practice, the basis was the existence of a single information space and the possibility of rapid data exchange between the subjects of the logistics system. The tasks were monitored to control the arrival of goods for their intended purpose, stock status, control of returnable packaging in accordance with the Editfact standard, all studies were conducted on materials provided by SVX Logistics.

V. RESULTS

The testing of blockchain technology within the system Svx Logistics, specializing in outsourcing in the field of warehouse functionality, allowed the following conclusions:

Blockchain technology allows to create distributed applications on its basis, the code of which is implemented on the computers of network participants. With the help of blockchain, the company got the opportunity to organize a secure supply chain. Each product received a certain label, which allowed the company to protect its supply chain with software products.

A single register allowed storing information about the authenticity of the raw materials, origin, safety certificates, storage location and records.

A single level of access allows companies to synchronize system updates in real time and modify data using one interface without affecting other systems. Thus, all the necessary information is stored in one place, which is easy to access, which makes the supply chain completely transparent. This allows to draw up contracts in the form of an executable

code that is protected from the human factor and violations of the rules. This approach will ensure the reliability and accessibility of information for all participants at any time.

VI. CONCLUSION

As a result of the study, the authors obtained the following results:

The problem of blockchain, in terms of its application as a progressive method of digital logistics, is currently not widespread in the construction of information logistics systems.

In the work, the authors presented the technology of blockchain in terms of its application in the outsourcing of logistics services.

A methodological approach to the use of digital economy technology "blockchain" in the development of an information production system is proposed.

The blockchain technology was tested in the context of a particular enterprise specializing in logistics outsourcing of warehouse functionality.

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