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Устойчивое развитие экономики: международные и национальные аспекты [Электронный ресурс] : электронный сборник статей III Международной научно-практической online-конференции, Новополоцк, 18–19 апреля 2019 г. / Полоцкий государственный университет. – Новополоцк, 2019. – 1 электрон. опт. диск (CD-ROM).

Впервые материалы конференции «Устойчивое развитие экономики: международные и национальные аспекты» были изданы в 2012 году (печатное издание).

Рассмотрены демографические и миграционные процессы в контексте устойчивого развития экономики; обозначены теоретические основы, практические аспекты управления человеческими ресурсами; выявлены и систематизированы драйверы инклюзивного экономического роста в Беларуси и за рубежом; раскрыты актуальные финансовые и экономические аспекты развития отраслей; приведены актуальные проблемы и тенденции развития логистики на современном этапе; отражены современные тенденции совершенствования финансово-кредитного механизма; освещены актуальные проблемы учета, анализа, аудита в контексте устойчивого развития национальных и зарубежных экономических систем; представлены новейшие научные исследования различных аспектов функционирования современных коммуникативных технологий.

Для научных работников, докторантов, аспирантов, действующих практиков и студентов учреждений высшего образования, изучающих экономические дисциплины.

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IMPLEMENTATION OF BLOCKCHAIN TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT

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The article analyses modern international logistics market, the principles of operation and application of Blockchain technology. The authors explore existing projects in the logistics industry using Blockchain technology and cases of possible using Blockchain technology for the logistics industry.

Key words: *Logistics, supply chain management, globalization, transportation, smart contracts, IoT.*

The relevance of the study is that globalization and the integration of the international economy provide excellent opportunities for economic development through international trade and investment. States are making efforts to reduce tariff and non-tariff barriers, but to enter to the key markets, it is necessary to make the product and services more competitive. One of the factors determining the competitiveness of trade is how quickly and how economically the goods can be delivered to key markets.

The main problem is that many countries have inefficient transport and logistics due to imperfect communication infrastructure, administrative barriers or lengthy custom clearance processes. Without improving transportation and logistics systems, countries with logistics problems will not be able to take advantage of the opportunities provided by the world community.

The transportation and logistics traditionally were among the most significant costs in international commerce. The cost of logistics services can vary from 30% to 50% of the total price of the product. Therefore, the logistics play an important part in international business and influence on the competitiveness of a company.

Global systems are complex and chaotic, the dynamics of their interactions between their parts is not very clear, nonlinear. This system is difficult to predict. [1] The primary interest of researchers is how to make the system manageable. [2-5] They see this through the creation of structures, systems analysis, strategic management, but most of all through operations management. [6]

In these conditions effective IT solutions are vital tools for logistics and the ability to manage the logistics processes in the business environment in the context of globalization is a factor of competitiveness [7].

According to the PWC report, digital changes will be carried out in the industry for several years [8]. More and more companies began to stand in the priority of technology because it can save time [7]. So, it can be concluded that there is a need to introduce innova-

tive alternative solutions that will improve the system of cargo control and tracking, making clear the payment system. A modern method of solving this problem can be the technology of Blockchain.

There are two approaches to the creation of software systems: centralized and distributed. In a centralized approach, the blocks are linked to and located around one central unit. In a decentralized system, on the contrary, the system has many nodes without a central control node [9]. The Blockchain is an example of a decentralized system.

Despite firstly it was realized in financial sphere, Blockchain architecture provides opportunities for the application of the technology in almost any area where high-level protection, integrity, and security of data are needed. Satoshi Nakamoto defined the Blockchain as “a chain of digital signatures.” Analyzing the definition of professionals about the technology, Blockchain is incorruptible digital ledger decentralized among all the computers participating in this network, and it cannot be altered. The new technology is fundamental and changes the way of doing operations [10].

Using smart contracts on the Blockchain will help to mitigate the complexity (randomness) that will arise from the elimination of intermediaries between the producer and the consumer. Smart contracts force to consider the same phenomenon from different sides and make the contract more detailed, which increases transparency and reduces uncertainty.

The main principles of Blockchain that were identified:

1) **Transparency.** All data can be read, and new data can be written, but the data that already existed earlier in the Blockchain cannot be changed because each block is linked to its previous block in the chain, and any attempt to change the data will be visible because the new digital fingerprint (hash) will also be changed. Transactions in the Blockchain also have timestamps, which facilitates monitoring of information.

2) **Encryption.** The Blockchain is based on the mechanism of cryptography which means that all information is secured and it needs digital signatures to prove identity to make a transaction. The pair of cryptographic private and public keys allow understanding which participants made a transaction, registered data or signed a smart contract.

3) **Decentralization.** The Blockchain is distributed among all network participants in real time. A copy of the records is open to all users. This feature eliminates the need for organizations such as banks or other intermediaries. As a result, no single point of failure exists.

4) **Smart contracts:** the instructions are written in the block and allow to make transactions when the conditions are met. In a smart contract, a person can create instructions that will be executed automatically, according to the previously written code stored in the Blockchain.

Blockchain creates new opportunities in the field of logistics. [11] The use of this technology will ensure transparency of operations and data exchange among participants in the supply chain, improving the accuracy of tracking supplies, reducing the risk of documentary errors and fraud. Modern logistics, due to its cross-functionality, is one of the key elements of the companies' activities. The use of advanced digital technologies for logistics management can significantly improve the efficiency of operations in supply chains, especially for organizations operating in global markets [12].

At present, there are many companies which are developing projects in the direction of implementing cargo control and documentation through Blockchain. A small number of companies can already demonstrate a working prototype of the synthesis of the Blockchain, IoT, and logistics.

IBM is one of the first companies which started implementing projects in the logistics. The main and most famous partnerships IBM has with Walmart and Maersk. Walmart is an American company that manages the world's largest wholesale and retail trade network.

Walmart is the leader in implementing technologies related to the use of RFID tags in trading, which can be used by IoT and transferred to Blockchain. Walmart & IBM are working on two pilot projects on food traceability and transparency in mango in the U.S and pork in China [13]. Recent testing by Walmart demonstrated that applying Blockchain reduced the time it needed to trace a package of mangoes from the farm to the store from days or weeks to two seconds [14]. The main reason why the company paid attention to tracking pork in China happened because the company found out that the trust in meat from China is not high. Half of the respondents expressed worries about China's food safety. According to the report, in China, more than 49,500 incidents of food safety were detected in the food production [13].

Blockchain technology can locate places where the supply chain can work better when it comes to errors. Walmart intensively works in the field of implementation of the IoT and the Blockchain. The company wants to obtain patents aimed at improving logistics by connecting drones to the Blockchain [15]. The goods will be delivered not to the customer's threshold, but into protected containers with which the drone is connected remotely. Drones will deliver the products, and as soon as they are close to the container, it will automatically open. The technology of Blockchain will provide an additional level of security and accuracy of tracking. It can be especially crucial for fragile loads, such as food, flowers, and medical tests. Such IoT devices connected to Blockchain can also be supplied with the digital currency. It will allow to interact autonomously with other parties and – through smart contracts - to pay fees and duties themselves, for example, for priority access to restricted air corridors [16].

The second example of IBM's partnership with large shipping companies. An example of such collaboration is the Blockchain project with the company Maersk. Maersk is a Danish company operating in various sectors of the economy, for the most part, known as the port and cargo shipping business. Partnership with Maersk provides the idea of digitizing the supply chain and track the paper trail and millions of containers. They want to digitize the workflow of the trade to use the technology of the Blockchain and track the shipment from point A to point B. The results of the implementation will allow to monitor millions of containers in the Blockchain and integrate with the customs authorities. For example, if Blockchain technology evolves, then the farms will be able to enter information into the Blockchain using a PC or mobile device. As data is recorded, it automatically becomes available to other parties, and this cannot be deleted or hidden. It launches an effective contract and the process of harmonizing exports between the parties [17].

The digitalization provides many benefits for the logistics that today cannot be realized such as participants' flexible integration, networked processes, data automation, easy and quick access to the crucial information, business processes coordination. To solve this problem, it needs to find the technology that can help to make the process of fully digitalization realizable. Blockchain may become the most suitable technology for the supply chain digitalization and the whole industry transformation. From the start Blockchain technology implies the use of digital workflow, it has high resistance to hack attack, it is very stable due to decentralization and highly secured due to cryptographic encryption. All these factors make Blockchain suitable technologies for using it in logistics digitalization.

In the future it would be difficult to imagine logistics business without using IoT. Companies like DHL are implementing IoT in its daily operations [18]. According to PWC report, the use of IoT in logistics makes it possible to reduce costs and develop new sources of income and thereby gain a competitive advantage. IoT is already changing the infrastructure of warehouse complexes. According to the forecasts of specialists in the field of warehouse logistics, automation can be replaced by the robotization. According to experts PWC, the use of large data will improve the quality of customer service. 3PL and 4PL will be able to use forecasting technologies, using machine learning to plan delivery routes more accurately and more efficiently, and technologies such as Blockchain acting as a platform will be able to integrate all processes and ensure security. Logistics can become one of the most promising applications for IoT and Blockchain [19-20].

Blockchain can be one of the most promising technology for logistics. It can solve many problems: the complexity of communication, significant amount of paper workflow, tracking the cargo is tracking based on documents on paper rather than sensors in real time, no transparency.

The companies see their shortcomings in technology and data. In these conditions effective IT solutions are vital tools for logistics and the ability to manage the logistics processes in the business environment in the context of globalization is a factor of competitiveness.

To sum up, it should be emphasized that in the era of digitalization, it is necessary to implement a reliable and modern platform that could provide the transparency of operations, increase the reliability of operations, ensure the interaction of all participants in the logistics process around the world. It should be decentralized to be independent, safe, and affordable for every participant in the logistical process.

The trend of digitalization and transparency is growing which means that most of the companies will have to become more open to survive. Logistics by the Blockchain is an innovative idea, which is still at the stage of its development.

It must be noted that the main threats are connected with regulations because the absence of regulation makes the implementation of technology risky and challenging. The problem of digitalization and Blockchain implementation can be solved by enhancing the level of education among stakeholders and developing new platforms for increasing efficiency. Low trust in the technology can be resolved after many tests and demonstrate the viability of innovative companies.

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