


N.B. Suyeuova , **A.U. Tabylov, A.A. Yusupov, K.S. Rzaeva, Q.S. Bilashova**
Yessenov University, Aktau, Kazakhstan
E-mail: nsuyeuova@mail.ru

EVALUATION OF THE EFFECTIVENESS OF INNOVATIVE BLOCKCHAIN TECHNOLOGIES IN THE GLOBAL CONTAINER TRANSPORTATION MARKET

Abstract. The article examines innovative blockchain technologies used in the global container transportation market. The review article examines innovative blockchain technologies used in The rapidly developing blockchain technologies in logistics are designed to systematize the transportation management process based on the consolidation of all partners-entities involved in the supply chain. The use of blockchain technology in the container transportation system as a tool for improving the transport logistics system will significantly simplify and accelerate a wide range of logistics processes, solve the problem in communications between supply chain participants, reduce the cost of transportation in this area. Promising digital technological solutions of a number of the largest container transport operators for the implementation of blockchain platforms in the global containerization developed on the basis of blockchain technology have been identified and their effectiveness has been evaluated. Solutions based on blockchain technology for the container transportation industry using digital currency and optimizing the redistribution of capital to increase the efficiency of companies in the shipping industry are considered. An open system built on the basis of creating cryptographic protection of data and implemented in security mode allows you to optimize the search for carriers, minimize the cost of time and money, eliminate hacker attacks on a simple interface.

Keywords. Containerization, container turnover, container transportation system, supply chain, digital transformation, business process, blockchain technology, sea container terminals, blockchain platforms, crypto projects digital currency.

Introduction.

In modern conditions of economic development, the innovative and rapidly developing blockchain technology has found wide application in various industries and at present, the range of transport services representing the highest possibilities of automation of business processes is determined by the need to use digital logistics in the transport business. In the global container transportation market, this is dictated by the pressing issues of competitiveness of transport companies in this area.

According to a Fortune Business Insights report, the main reason for the growth of the global blockchain technology market is that more and more enterprises around the world are increasing their investments in blockchain research and development from within. The current market for blockchain-based solutions is growing at a rapid pace. The dynamics of the market in question can be approximately represented in Figure 1. Transport processes with container cargo flows are aggravated due to the minimum speed of logistics cycles in supply chains; long duration and the presence of errors in document flow and issues of cargo safety.

Currently, in the container cargo transportation system, problems are being found with the use of a fragmented system for processing and presenting information between partners of the logistics chains of the transport process, causing an increase in transformational and transaction costs and an increase in the logistics cycle as a whole.

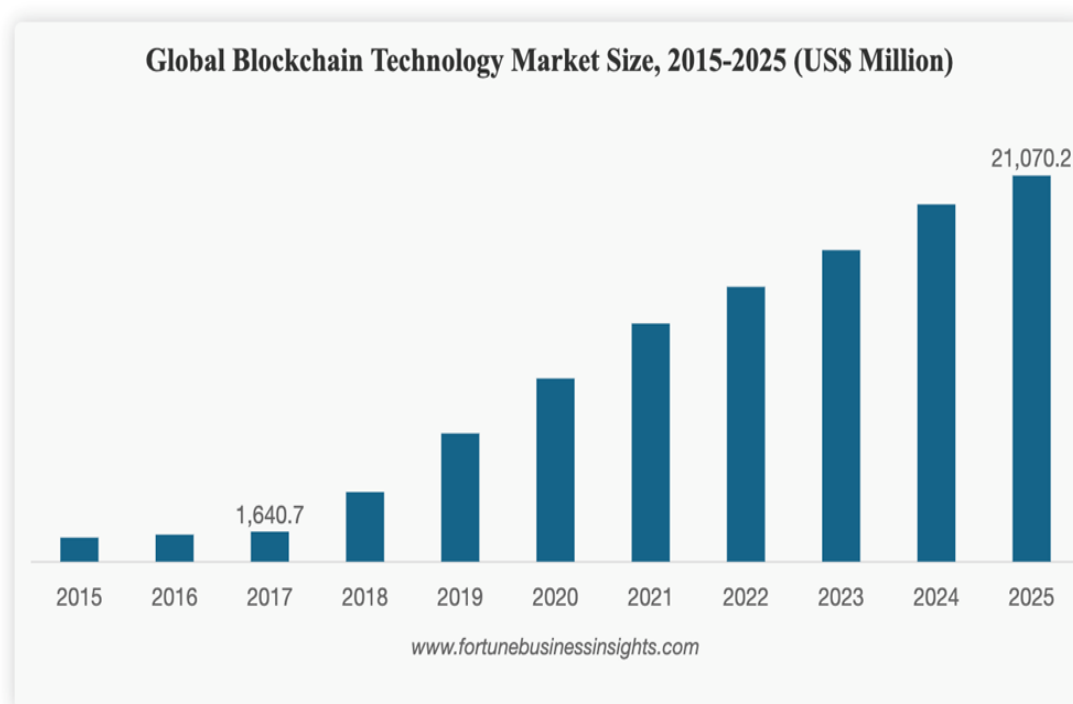


Figure 1 - Growth dynamics of the global blockchain technology market

The length of logistics chains and the final price of complex services in the container cargo transportation system is determined by the number of logistics intermediaries and the rhythm of interaction between participants in the transport process. In addition, the lack of probability of the implementation of control of delivery processes by cargo owners is one of their common

grounds for the formation of controversial and problematic issues. All this predetermines the development of a rational and transparent system of mutually beneficial cooperation of logistics intermediaries in the supply chain, which in general will ensure the development and rise of the transport business to a high-quality level [1,2].

The relevance of the topic of the scientific article is due to the fact that the sphere of container transportation is a complex and voluminous transport system, where, in addition to ensuring the safety of goods, it is necessary to minimize delivery times and document flow and automate all transportation costs. This is the most important condition for raising the transport business in the container transportation system to a qualitatively new level based on the use of blockchain technologies. The purpose of the study is to analyze modern innovative blockchain technologies in the global container transportation market, to determine the role and promising opportunities of these technologies to improve the efficiency of global business processes in this area.

To achieve the set goals, the following tasks are solved:

- review and analysis of promising digital technological solutions of a number of the largest container transport operators for the implementation of blockchain platforms in the global containerization;
- evaluation of the effectiveness of blockchain technology in the global container transportation market.

The scientific novelty of the research consists in the fact that a new pragmatic aspect of known information is applied, which reveals the object of research in depth in the new conditions of digitalization of the current economy.

Table 1 - The main characteristics of blockchain technology in transport logistics

Evaluation criteria	The advantage of blockchain technology	The lack of blockchain technology for this parameter
Costs	The use of blockchain technology reduces transaction costs associated, for example, with the collection of fees by the data holder and verifier for their services.	The introduction and use of technology entails significant financial costs.
Efficiency	Processing of an operation/transaction is faster than using a bank or a person.	The processing speed of the operation/transaction is limited (for example, the VISA system is more productive).
Anonymity	Confidentiality of operations determines the safe protection of individual user materials.	The confidentiality of transactions and the publicity of data create acceptable conditions for illegal transactions for the blockchain
Safety	All computers connected to the network have the same array of information, which significantly complicates any unscrupulous manipulation of it. It is extremely difficult to make changes to the information block after adding it to the chain	There are no unconditional assurances of the stability of data transmission, regardless of the advantages of the system of computing computer networks built on blockchain technology, hacker attacks take place.

Materials and methods.

The theoretical basis of the study was the methods of comparison, review analysis, synthesis. As part of the digital transformation strategy, the world's largest operators in the container shipping market, in a local form, carry out digital business on the basis of the implementation of blockchain technology, which is a multi-purpose, multi-level information technology in the form of an extensive digital database and secured against unauthorized access in order to sustainably evaluate and register a variety of transactions, assets, systematizing transportation management processes based on the consolidation of all partner entities that simplify and optimize a wide range of logistics processes.

Blockchain technology is the largest innovation considered today and comparable to the widespread digitalization of the current economy.

Innovation in the container cargo transportation system is determined by the fact that the implementation of blockchain provides promising opportunities to accelerate the implementation of business processes in the logistics supply chain, with the implementation of high authenticity and transparency of information for the selection and implementation of motivated decisions.

This will provide ample opportunities to reduce costs created to avoid possible risks and eliminate processes that are of little value to customers and clientele.

blockchain network. In technological terms, the blockchain, representing a distributed chain of blocks, acts in the form of a centralized register of all transactions in the information network. From the point of view of the principles of management systems in logistics supply chains, this technology provides unique opportunities to overcome difficult problems in implementing the principles of inter-organizational regulation on the development of transparency of information movement and ensuring mutual trust of counter-agents of logistics supply chains in the system of container cargo transportation on the world market. The

paramount importance and role of the implementation of blockchain technology in the global container transportation market is determined by the implementation of promising opportunities to improve the efficiency of global business processes in this area [3].

Results.

Let's analyze the implementation of blockchain platforms in the global containerization, developed on the basis of blockchain technology. In 2019, the largest container transportation operator in the world, A.P.Moller–Maersk, together with IBM, a well-known developer and manufacturer of hardware and software on the world market, launched the "TradeLens" blockchain platform, an applied software product for improving the container transportation system developed on the basic platform of blockchain technologies. Hyperledger Fabric and IBM Cloud.



Figure 2 - Integrated, seamless logistics ecosystem, blockchain technologies

The «TradeLens» blockchain platforms are represented by a complex of neutral industry platforms of a general type, which includes modules of blocks of operations closed in a chain that perform functions in the container transportation system (UPC):

- accumulation of information on all completed operations;
- storage and exchange of information;
- control and management of cargo transportation and supply chains in maritime transport;
- implementation of step-by-step tracking of the movement of cargo flows in online modes;
- ensuring electronic cooperation of all participating partners involved in the supply chain in matters of cooperation and acquiring access to information on pressing issues;
- reducing costs and reducing the delivery time of goods;
- stimulating innovation

The TradeLens blockchain platforms are designed to consolidate all partners-entities involved in the supply chain, including cargo owners and representatives of state regulatory authorities. The innovative solution of this project is to connect over 100 participants from 22 countries of the world to the TradeLens blockchain platform (the largest Asian and European world ports and customs authorities, border control services, a network of global container terminal operators Global Container Terminals, Singapore Pacific International Lines, Procter Multinational Corporation & Gamble, and others). In comparison with the traditional form of

document management, the predominant advantage of the company's EDI is the provision of opportunities for information sharing by partners in modes of interest in the field of freight transportation, with the advantage of the security of the transmission of this information [4].

The development of the Russian company «Vostok» in 2019 of a universal blockchain solution for scalable digital infrastructure - the international intermodal logistics blockchain platform «Vostok Trade», implemented on the basic foundation of a distributed registry system for transport operations.

Table 2 - The use of blockchain in transport logistics

Project	Brief description
IMMLA - International multimodal logistics application	The founders are SBSolutions (an IT company with a focus on logistics), as well as the leaders of the logistics industry «Global Transport Investments» и «Hellmann Worldwide Logistics».
«Trade Lens» is an application product developed on the basic platform of blockchain technologies (Hyperledger Fabric и IBM Cloud).	A logistical result combining the immediate analysis of applications and the conclusion of contracts in the multimodal transportation system based on the optimal pricing. Guarantees cooperation between the cargo owner and the carrier at all stages of the transport process based on the Ethereum blockchain. A logistics solution for digitizing all trade operations and cargo control, provides access to tracking the movement of goods along the chain, having full clarity of finding each container online 24/7. Market participants are presented with transparency of the status of all customs documents.
«Filament» - an international hardware startup based on blockchain	Logistics solution to improve the container transportation system, connects shipping containers and industrial machines with blockchain technology through the Internet of Things (IoT) chip. Things must follow instructions on their own, via the Blocklet software.
Ship Chain (TGE, SHIP tokens) – international platform	Registration of deliveries on the Ethereum blockchain, using a sidechain to track individual encrypted geographical points through each smart contract. The value of each cryptographic waypoint is accessible only by the parties involved in the sending itself. This facilitates the interaction of the participants in the process. Upon delivery and confirmation of shipment, the contract is filled out and stored on the main blockchain.

The following innovations stimulated the creation of the Vostok Trade blockchain platform with connected UPC elements, including a network of seaports and services of terminal operators, shippers, carriers, customs brokers and end users, etc.):

- a complex of workflow automation processes;
- ensuring data verification and immutability;
- increasing the level of traceability of goods and others.

The basic functional elements of the blockchain platform are:

- implementation of document management digitalization;
- formation of automation of UPC business processes;

- implementation of an API for consolidation with systems for obtaining information about transport process events;

- accessible and rational interface;

- performing tracking of transport operations;

Tracking containers on the way and at terminals will allow you to optimize the shipping process, see which destinations are most popular, as well as promptly fix downtime.

An innovative solution for the implementation of the Vostok Trade blockchain platform, which ensures the efficiency of the UPC, is:

- the possibility of automating the document flow of the transport process;

- implementation of data verification based on the information of the transport process;

- the possibility of implementing integration with existing platforms;

- the possibility of implementing measures for the economic security of transport processes;

- implementation of transparency of the management model;

- representation of intellectual rights among participants in the transport process;

- the presence of an affordable pricing policy.

The implementation of innovative solutions in transport production on the basis of a single platform "Vostok Trade", which provides for the use of the technological method of the distributed registry, is a highly effective course in the development of the infrastructure of the transport and logistics industry of the post-Soviet countries. In 2019, an innovative ship maintenance system "Digital Port" was put into production in Russia, representing the combined development of the ICONIC blockchain integrator and «Infotech Baltika» JSC, the largest Russian freight forwarder with a wide agency network in seaports.

The system is based on the technological processes of management of dedicated registers of accounting and certification of rights, ensuring the transfer of document flow of marine vehicles with port infrastructure to the electronic version. This blockchain technology provides a significant reduction in the amount of production loads on the port staff, contributes to the growth of port capacity by 5-10% and improves the quality of services provided to the fleet. The innovative vessel maintenance mechanism "Digital Port" provides participants with ample opportunities to locate and carry out production activities in a single information field, where a clear fixation of the complex services provided by facts, time periods and volumes is carried out. In 2021, the Global Shipping Business Network (GSBN) company, registered in Hong Kong, launched a new blockchain-based platform with the potential to track shipping containers around the world. GSBN, a company focused on cargo sea transportation for the creation of a blockchain platform, pursues the goal of digitalizing a third of container transportation for document management in logistics operations [5].

In order to ensure the control of information, the company provides encryption of the database before sending it to the blockchain platform. This deprives partners of access to the database without authorization and provides potential opportunities for GSBN to cooperate with disconnected competing participants in the global container market. In June 2021, GSBN implemented an innovative blockchain-based software product "Cargo Release" in China, designed to minimize data processing deadlines due to the rejection of paper documentation and data storage on the blockchain. In May 2021, the company launched the first application based on the Cargo Release blockchain, which aims to speed up the processing time of the database by moving away from traditional paper documentation while maintaining the database on the blockchain [6,7].

The global company CargoX Ltd (Denmark), which develops solutions for the delivery of documentation based on blockchain transactions and ownership verification platforms, focused on problematic issues in communications among supply chain partners in the intermodal container transportation system and accordingly adopted an innovative solution for the rational

use of the bill of lading. The essence of the solution lies in the development of an open system based on the Ethereum blockchain technology and the creation of cryptographic protection of data located in a distributed database, providing the creation and exchange of bills of lading using a server tool for secure remote access to the database of information resources and responsible storage of the database.

The interaction operations of partners participating in supply chains in the intermodal container transportation system are carried out in the following sequence:

1) At the port of departure, it is applied and issued by the carrier company to the exporter in the form of a token, including a set of DApp applications, to create a "smart" bill of lading with the presence of blockchain addresses of exporters.

2) At the end of financial settlements for the goods, through the DApp application, the exporter transfers to the importer all rights certifying the ownership of the token of the "smart" bill of lading.

3) Upon presentation of tokens using the DApp application, the parties of importers are given the prerogative of the authority to own goods at destination ports.

4) Upon verification of the ownership of the token, the importer is issued goods from the carrier at the port of arrival.

In the process of interactions between partners participating in supply chains in the intermodal container transportation system, a block of confidential information under a trade agreement is subject to secrecy from public viewing and is presented only to the owners of the token - importers, exporters and carriers [8]. In addition to this, the issues of secure protection of complete information on trade agreements between partners are subject to increased attention.

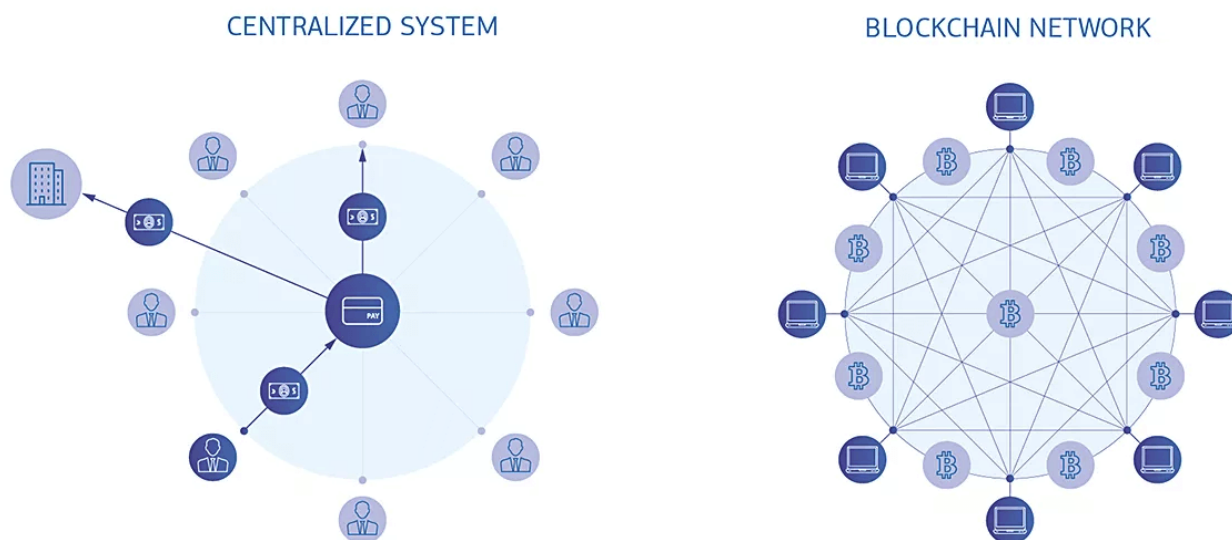


Figure 3 - The scheme of a blockchain transaction on the example of an operation in the Bitcoin network

The company 300Cubits (China, Hong Kong), specializing in sea container cargo transportation, has implemented a project based on blockchain technology in the container transportation industry using the digital currency TEU2 Tokens. The implementation of these tokens is provided by the support of the TEU ecosystem. The implementation of the project determines the possibilities of conducting a transport business in conditions of security and independence from intermediaries. TEU tokens, which perform the functions of a digital currency, provide unique opportunities for obtaining industry solutions and services for business users free of charge in the global container transportation market [9].

The implementation of the project does not require corrections in the corporate systems of partners participating in supply chains in the intermodal container transportation system and this provides opportunities for independent and early entry into the global container transportation market. It is planned to implement an innovative solution of 300Cubits for the use of the digital currency TEU2 Tokens in the transport system of feeder, cargo container and other transportation, which are subject to the requirements of booking operations

The module implementation algorithm includes:

1) Performing operations for sending TEU tokens by users for the number of reserved units required by them.

2) Performing operations to notify the transport vessel of the sent tokens via e-mail.

3) Performing operations to control the compliance of TEU tokens for booking confirmation.

4) Performing operations on clientele notifications about the corresponding deposit booking via e-mail.

The implementation of this project provided significant opportunities to reduce significant losses for UPC, supported the strategic management of the global supply chain and optimized the redistribution of capital in order to increase the efficiency of companies in the shipping industry. Crypto projects within the framework of this project make it possible to optimize the search for carriers, minimize the cost of time and money, taking into account the fact that the entire system is implemented in security mode and eliminates hacker attacks on a simple interface [10].

The implementation by the world's largest container transportation operators - digital solutions in UPC based on blockchain technologies, representing a distributed database of digital data protected from unauthorized access - provides a number of innovative measures that determine a number of advantageous factors: adaptation of internal business processes; increasing the efficiency of container transportation; monitoring the location and condition of cargo; reducing the time of work with cargo; optimization of personnel activities; reduction of business risks through the implementation of online payments; taking effective measures in cases of force majeure and others.

Conclusions

Currently, innovative blockchain technologies, which contain a significant potential for changing the structure and reducing costs in UPC transport business processes, have real opportunities to change the sphere of container transportation. The logistics blockchain in the UPC minimizes the number of participants in the chain of the transport process, removing unnecessary links in the final reduces transport costs and risks during deliveries.

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Набат Суйеуова, магистр, аға оқытушы, Yessenov University, Ақтау, Қазақстан, nsuyeuova@mail.ru

Абзал Табылов, т.ғ.к., доцент, Yessenov University, Ақтау, Қазақстан, tabylov62@mail.ru,

Асгербек Юсупов, аға оқытушы, Yessenov University, Ақтау, Қазақстан, askerbek_usa@mail.ru

Камар Рзаева, аға оқытушы, Yessenov University, Ақтау, Қазақстан, sisenkyzy@mail.ru

Гульмира Билашова, магистр, аға оқытушы, Yessenov University, Ақтау, Қазақстан, ms.bilashova@mail.ru

КОНТЕЙНЕРЛІК ТАСЫМАЛДАУДЫҢ ӘЛЕМДІК НАРЫҒЫНДАҒЫ ИННОВАЦИЯЛЫҚ БЛОКЧЕЙН ТЕХНОЛОГИЯЛАРЫНЫҢ ТИІМДІЛІГІН БАҒАЛАУ

Андатпа. Мақалада контейнерлік тасымалдаудың әлемдік нарығында қолданылатын инновациялық блокчейн технологиялары зерттелген. Логистикадағы жылдам дамып келе жатқан блокчейн технологиялары жеткізу тізбегіне қатысатын барлық серіктестер-субъектілерді шоғырландыру негізінде тасымалдауды басқару процесін жүйелеуге арналған. Көліктік логистика жүйесін жетілдіру құралы ретінде контейнерлік тасымалдау жүйесінде блокчейн технологиясын пайдалану логистикалық процестердің кең ауқымын едәуір жеңілдетуге және жеделдетуге, жеткізу тізбегіне қатысушылар арасындағы коммуникациялардағы проблеманы шешуге, осы саладағы көліктік тасымалдау шығындарын азайтуға мүмкіндік береді. Блокчейн технологиясы негізінде әзірленген әлемдік контейнерлеуде блокчейн-платформаларды іске асыру бойынша бірқатар ірі контейнерлік тасымалдау операторларының перспективалық цифрлық технологиялық шешімдері айқындалды және олардың тиімділігін бағалау орындалды. Цифрлық валютаны пайдаланатын және кеме қатынасы саласындағы компаниялар қызметінің тиімділігін арттыру үшін капиталды қайта бөлуді оңтайландыратын контейнерлік тасымалдау индустриясы үшін блокчейн технологиясына негізделген шешімдер қаралды. Деректерді криптоқорғауды құру негізінде құрылған және

қауіпсіздік режимінде жүзеге асырылатын ашық жүйе тасымалдаушыларды іздеуді оңтайландыруға, уақыт пен қаражаттың шығындарын азайтуға, қарапайым интерфейсте хакерлік шабуылдарды болдырмауға мүмкіндік береді.

Түйінді сөздер. Контейнерлеу, контейнер айналымы, контейнерлік тасымалдау жүйесі, жеткізу тізбегі, цифрлық трансформация, бизнес-процесс, блокчейн технологиясы, теңіз контейнерлік терминалдары, блокчейн платформалары, крипто жобалары сандық валюта.

Набат Суйеуова, магистр, старший преподаватель, Yessenov University, Ақтау, Қазақстан, nsuеuova@mail.ru

Абзал Табылов, к.т.н., доцент, Yessenov University, Ақтау, Қазақстан, tabylov62@mail.ru

Асгербек Юсупов, старший преподаватель, Yessenov University, Ақтау, Қазақстан, askerbek_usa@mail.ru

Камар Рзаева, старший преподаватель, Yessenov University, Ақтау, Қазақстан, sisenkyzu@mail.ru

Гульмира Биляшова, магистр, старший преподаватель, Yessenov University, Ақтау, Қазақстан, bilashova@mail.ru

ОЦЕНКА ЭФФЕКТИВНОСТИ ИННОВАЦИОННЫХ ТЕХНОЛОГИЙ БЛОКЧЕЙН НА МИРОВОМ РЫНКЕ КОНТЕЙНЕРНЫХ ПЕРЕВОЗОК

Аннотация. В статье исследованы инновационные технологии блокчейн, используемые на мировом рынке контейнерных перевозок. Быстроразвивающиеся технологии блокчейн в логистике призваны систематизировать процесс управления перевозками на основе консолидации всех партнеров-субъектов, участвующих в цепи поставок. Использование технологии блокчейн в системе контейнерных перевозок как инструмента совершенствования системы транспортной логистики, позволит существенно упростить и ускорить широкий спектр логистических процессов, решить проблему в коммуникациях между участниками цепей поставок, сократить затраты на транспортные перевозки в этой сфере. Определены перспективные цифровые технологические решения ряда крупнейших операторов контейнерных перевозок по реализации блокчейн-платформ в мировой контейнеризации, разработанных на базе технологии блокчейн и выполнена оценка их эффективности. Рассмотрены решения, основанные на технологии блокчейн для индустрии контейнерных перевозок, использующей цифровую валюту и оптимизирующие перераспределение капитала для повышения эффективности деятельности компаний судоходной отрасли. Открытая система, построенная на базе создании криптозащиты данных и реализуемая в режиме безопасности, позволяет оптимизировать поиск перевозчиков, минимизировать затраты времени и средств, исключить хакерские нападения на простом интерфейсе.

Ключевые слова. Контейнеризация, контейнерооборот, система контейнерных перевозок, цепь поставок, цифровая трансформация, бизнес-процесс, технология блокчейн, морские контейнерные терминалы, блокчейн-платформы, крипто-проекты цифровая валюта.
