The Impact of Blockchain Technology on the Scenario Development of a Logistics Enterprise

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Summary
The article reveals the essence and tools of Blockchain IT technology from the point of view of digitalization of a typical logistics enterprise. Examples of the use of Blockchain by leading companies are given. The advantages of using Blockchain in the process of managing supply chains are analyzed. An assessment of the economic effect of the practical implementation of project proposals for the introduction of Blockchain at a logistics enterprise was carried out under a pessimistic, realistic and optimistic scenario, taking into account the time saving factor.

Keywords:
Blockchain, Logistic, Supply Chains, Economic Effect, Scenario Development.

1. Introduction

For decades, logistics remained a conservative industry, accepting only the most necessary achievements of progress. The supply chain mechanism has effectively remained unchanged until recently. But the transition to digital production and Internet trade forces us to rethink the essence of logistics as a tool for managing value chains and justify the direction of changes that should take place in enterprise logistics under the influence of the transition to cyber production [1].

Digitization allows you to accelerate the execution of business processes in supply chains, providing greater reliability and transparency of information for making informed decisions, which leads to cost reduction by preventing possible risks and eliminating operations that do not create additional values for customers. The basis of digital technologies, which constitute the main functionality of digital logistics, includes Big Data (Processing of big data and analytics), IoT (Internet of Things), Blockchain (register of distributed transactions), Cloud services, e-SCM, 3D-Printing and others [2]. As world practice shows, one of the most promising directions in the information provision of logistics services is the use of Blockchain technology.

The introduction of Blockchain into the practice of a typical logistics enterprise makes it possible to store the required amount of data, protect documents from illegal appropriation, and prevent the possibility of changing digital information about the transportation process. This system can clearly reduce suppliers' delivery costs and prevent the possibility of fraudsters' actions, while saving the financial resources of all participants in logistics processes, taking into account time management and return on investment from implementation.

The implementation of the outlined aspects, according to the authors of this publication, will provide a more complete and comprehensive definition of the potential benefits of using Blockchain in logistics with the justification of possible scenarios of their application in the information provision of logistics services, taking into account the saving of the time factor.

2. Literature Review

The history of the creation of Blockchain begins on October 31, 2008 with the publication of the article «Bitcoin Peer-to-Peer Electronic Cash System» by the author with the pseudonym Satoshi Nakamoto [3]. This work describes a fully decentralized electronic cash system. At the beginning of 2009, the first version of the bitcoin wallet and the bitcoin network was released. Representatives of McKinsey & Company Alicke K., Rexhausen D., Seyfert A. [4] repeatedly in their analytical reports call the Blockchain the «Internet of Values», because each person can post information on the Internet that other people can access from any points of the world

Recently, many foreign scientists have been studying the role of Blockchain in the field of transport and logistics. In their publications, Abeyratne S. A. and R. P. Monfared [5], Badzar A. [6], Dickson B. [7] highlight the content of Blockchain technology, the mechanisms of application of Blockchain in transport and logistics services, and the logistics management process. Friedlmaier M., Tumasjan A., Welpe I. M. [8], claim that the application of Blockchainin the transport and logistics industry will have both positive and negative consequences, and some logistics experts, such as K. O'Marah [9], Hackius N., Petersen M., Casey, M. J. and Wong, P. [10] believe that the Blockchain has great potential for transforming the

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supply chain and consider exclusively positive developments from its implementation in logistics and transportation systems.

3. Problem Formulation

A systematic review of the above studies by scientists, practitioners and analysts of leading consulting corporations identifies the problem of the lack of thorough research on the practice of applying Blockchain in the process of digitalization of a typical logistics enterprise and possible scenarios of its development taking into account the saving of the time factor, which determines the problem of the article.

4. The Research Methods

In order to achieve the goals of the research, the following research methods were used: scientific abstraction, analysis, induction and deduction during the disclosure of the essence of the Blockchain IT technology and the international experience of its implementation; the method of comparative analysis when summarizing the main directions of modern research on selected issues and determining the role of Blockchain in logistics; the method of statistical comparisons and income discounting during the analysis of the NPV calculation from the project decision to implement the Blockchain at the enterprise; systemic, structural-functional, observation, grouping and graphical display of results during the study of individual processes and phenomena that arise in the process of comparing various indicators in scenario calculations.

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5. Theoretical Consideration

Blockchain is based on a complex encryption system in which each block has its own unique key. The use of a cipher ensures that users can change only those blocks of the chain to which they have access, that is, which they own, knowing the corresponding key, without which writing to the file is impossible. This feature of Blockchain databases makes it almost impossible for hackers to break into it, because for this they need to simultaneously access copies of the database on all computers in the network. If even the original document or transaction is subsequently changed, the resulting data will receive a different digital signature, indicating a discrepancy in the system. This system is organized in such a way that each of its participants constantly checks the information that comes to them. As a result, during any operation, the integrity and authenticity of the materials stored in the network are confirmed. This guarantees the preservation and accuracy of information. In addition, encryption ensures that all users' copies of the distributed Blockchain are synchronized. In this way, one of the most important functions of technology is implemented - the establishment of trusting relationships between users due to the fact that information cannot be forged, and at the same time it is available to everyone and everyone is responsible for himself.

There are three «generations» of Blockchain - 1.0, 2.0 and 3.0 - Blockchain bitcoin, Blockchain of «smart» contracts and the so-called «Blockchain of everything» - a system in which information about any object is publicly and securely stored. The main idea of all generations of Blockchain is a chain of blocks with information about each transaction, which is stored in each unit of the computer network [11].

Transport and logistics activity faces multiple problems that require innovative solutions and transformation of the e-logistic segment[12]. The strategy of using Blockchain IT technology of all generations, depending on the specifics of the enterprise, is one of the ways to solve them. The introduction of Blockchain will ensure real-time tracking of cargo, shortening the workflow and increasing transparency, as Blockchain is a cheaper and safer infrastructure with the highest scalability and ease of integration compared to other technologies.

The main advantages of Blockchain in logistics are the cost reduction of the logistics process itself; impossibility of falsifying any data; the entered documents - invoice, waybill, certificate of product origin and other documentation - remain in the system in their original form forever; unnecessary intermediaries are eliminated; labeling of illegal goods disappears; document processing time is reduced; quick search for stages of the logistics chain where an error was made [13; 14].

Research by scientists Vladyko A., Spirkina A., Elagin, V [15] and scientists A. S. Arefieva, G. G. Gogokhiya [16], regarding the dynamics of the development of Blockchain IT technology, rely on the analysis conducted by the analytical companies Transparency Market Research and Grand View Research and their forecast for 2025.

The report of the American analytical company Transparency Market Research states that the global Blockchain market will reach $20 billion by 2024. In their calculations, analysts are based on the Blockchain market in 2015, the volume of which amounted to $316 million. Thus, in their opinion, growth industry in a year will be approximately 59%. A similar study was conducted by Grand View Research, which estimated the Blockchain market at $509 million in 2015, and projected the industry volume to $7.74 billion by 2024 [17] (Fig. 1).

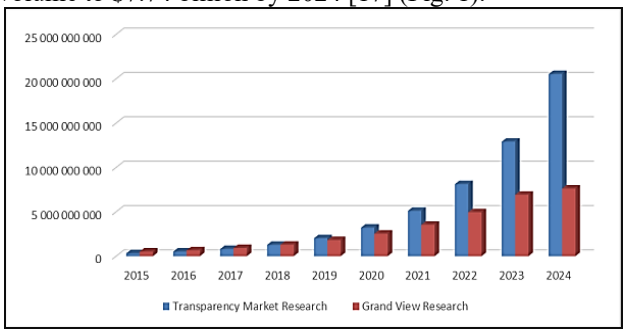

Fig. 1 Blockchain market growth dynamics, US dollars (version 1)
Source: [15-17]

Other analysts predict that in 2025, the global Blockchainmarket will reach $21.07 billion (Fig. 1). This is stated in the study of Fortune Business Insight [18]. The authors of the report recalled that in 2017, the volume of the Blockchain services market amounted to about $1.64 billion. Since 2018, a steady increase in the number of products launched on the basis of decentralized technologies has been observed. Thus, according to these authors, by the end of 2025, the industry market will be above $21 billion. The rationale for this is the recorded surge in the activity of investors interested in Blockchain and the growth of funding for startups engaged in software development using Blockchain technology.

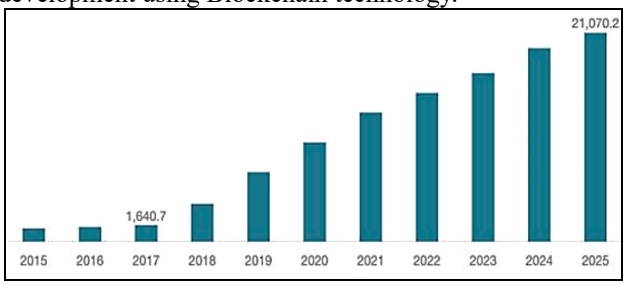

Fig. 1 Blockchain market growth dynamics, US dollars (version 2)
Source: [18]

The vision of the authors of the publication regarding the dynamics of the development of Blockchain IT technology can be seen in the inclination towards version 1 in view of the global trends of pandemic processes and military conflicts, which act as catalysts for the development of the digital segment.

The conducted research also showed that in the period from 2012 to 2020, more than 3,000 operations with venture capital in the field of Blockchain technologies were concluded around the world. A total of more than 900 different venture investors, angels, incubators have invested more than $16 billion in Blockchain startups. This is evidenced by a report compiled by Cointelegraph Consulting researchers and published in April 2021 [20].

Venture capital investments in the Blockchain industry have come under severe economic pressure during the COVID-19 pandemic. Between 2019 and 2020, Blockchain venture capital investment decreased by 13%, while traditional venture capital investment increased by 18%. In general, the volume of venture investments in Blockchain decreased from $ 3.17 billion in 2019 to $ 2.77 billion in 2020. Blockchain startups specializing in decentralized finance (DeFi) attracted the most venture capital in 2020. More than 200 venture capital and hedge funds have invested about $20 billion in DeFi. In 2020, Blockchain projects that are the developers of such digital coins as Avalanche (AVAX), Curv (CRV), DerivaDEX (DDX), Nervos Network (CKB) and Zilliqa (ZIL). One of the main reasons why venture capitalists will continue to show interest in Blockchain projects in the next 10 years is liquidity. While traditional funds generate profits only after 5-10 years, digital coins provide liquidity from day one, attracting more and more attention to the Blockchain industry [21].

The World Economic Forum believes that after the introduction of the Blockchain, bureaucratic obstacles in building supply and logistics schemes will decrease, which will increase the size of global GDP by five percent and global trade by up to 15% [22].

According to many scientists [5-10], Blockchain due to the distributed registry, which provides for the absence of a single place for storing information and replacing data with hashed data (temporary mark), will allow to perform work more quickly and reliably.

Joint programs for the development of a platform based on this system are a confirmation of the successful use of Blockchain for the logistics and transport industries. The Blockchain platform, which is being developed by IBM, makes it possible to track the location and status of trucks, and all authorized participants in the chain can see the necessary information throughout the transport cycle. Traditionally, supply chain transactions have been completed manually, creating delays and increasing the likelihood of duplicate data or erroneous information being entered. The use of RFID tags, which contain data about the vehicle, driver and cargo, allows IoT (Internet of

Things) sensors to monitor the truck's movement and information about the availability of free space, and then enter this information into the Blockchain. The use of IoT in such deliveries can be expanded, for example, by installing humidity and temperature sensors on the product. If they show sharp jumps in these indicators, the insurance company will be notified in the smart contract that the goods may have been damaged [23]. Thus, a single database is created, to which all authorized participants have access, data in which can be changed only with the consent of all parties. As soon as the truck leaves the loading point, the user is automatically notified of the load, weight and estimated time of arrival. In addition, through the sensors located on the trucks, a database is created that tracks all the exchanges, stops and transactions made by each car and its corresponding cargo, from the point of loading to the final customer [24].

At the same time, investments in this market by technological and financial giants are growing. Among such companies, IBM stands out, which is a dominant player in the corporate Blockchain sector. Among other giants, analysts singled out Linux, Oracle Corporation, Microsoft and Chain Inc.

Scientists Kernychniy B. [25] conducted a study highlighting the most famous projects regarding the implementation of Blockchain in logistics and supply chain management (Table 1). It was established that the speed of processing orders and obtaining the necessary information directly affects the efficiency and success of the business. At the same time, the growing volume of information flows that can be processed makes the implementation of IT in various spheres of life in modern society necessary and inevitable.

Table 1: Blockchain projects in logistics and supply chain management

Project name	Description of the project	Country	Used software
IBM	Maintaining a distributed register of records on the origin of food products, information on the status of transportation, current status	USA	IBM Blockchain, Hyperledger Fabric
Smart Containers	Transportation in containers of products sensitive to temperature and other storage conditions, tracking and maintenance of storage and transportation conditions	Sweden	Ethereum, Corda
Provenance	Tracking the movement of food products along the supply chain from production to purchase	Great Britain	Ethereum
Yojee	Tracking the status of freight orders by carriers in real time, generating invoices, dispatching and automatic distribution of orders between drivers	Singapore	Yojee
Hyperledger Sawtooth	Tracking the movement and registration of the conditions of storage and transportation of seafood from the catch to the final consumer	USA	Hyperledger Sawtooth
A2b Direct	Tracking the status of freight orders by carriers in real time, creating invoices, dispatching	Ukraine	A2b Direct
Open Port	An electronic platform for providing transportation services, concluding smart contracts, tracking the process of order fulfillment	Hong Kong	Ethereum
Bloqly	Tracking the status of orders by cargo carriers in real time, creating invoices, dispatching.	Ukraine	Bloqly
TrucksNearMe	Cargo tracking and tracking - from the parcel to the sea container, from the car to the wagons using Blockchain and the Internet of Things	Ukraine	Lardi trans

Source: [25]

Our research on the features of Blockchain and the review of the work of scientists [5-10; 25] regarding the analysis of the experience of using this tool in the logistics field made it possible to identify the main advantages that can be obtained from its implementation:

1). Compliance and transparency provided by a well-defined network of participants in which membership and access rights are allowed for all contacts in the chosen business network. Under such conditions, the possibility of access to confidential information by third parties and the practice of fraud are excluded.

2). Privacy of transactions, which is manifested in the fact that companies are given the flexibility and security of conducting transactions that are visible only to its participants if the correct encryption key is used.

3). Access to information: it is easy and quick to find, all information between participants is synchronized, and instant access to data in the digital system is allowed, accordingly, the interaction time between participants is reduced, which reduces delays in operations.

4). Increasing customer trust, because Blockchain enables companies to provide reliable information about a product at all stages of its life cycle, and customers to find all the information they need about products, transportation and packaging. Businesses can have real-time feedback from consumers as customers can respond to products they have bought or received in real-time. This can help different members of the supply chain analyze their work and avoid mistakes.

5). Possibility of concurrent use of cloud technologies and transfer of information from physical media. A significant number of current delivery processes traditionally use

paper, which has its limitations in application. In the block system, all information about delivery processes will be digital, which will enable participants to receive relevant data at any time. Consequently, it reduces risks and improves the quality of logistics processes, while at the same time enabling the organization to reduce waste, spoilage and defects.

6). Programming opportunities: on the one hand, the use of Blockchain leads to a reduction in the programs used in work, and on the other hand, smart contracts provide the opportunity to automate business processes in the selected network

Therefore, the integration of Blockchain in logistics makes it possible to improve logistics processes, which has a positive effect on management. The usefulness of the technology stems from the fluid nature of logistics, because points such as tracking the movement of goods at all points of the supply chain and the dynamics of transport, extensive document flow - all this can be easily solved.

The economic effect of supply chain management increases profits, creates favorable conditions for enterprise development and ensures competitiveness in the market. However, not all methods of supply optimization end successfully and bring the expected results, which determines the relevance of calculations of the economic effect of the implementation of Blockchain based on the example of a typical logistics enterprise.

6. Practical Results

Speaking about the economic effect of the implementation of Blockchain in the activities of a typical logistics enterprise, it is appropriate to state the benefit from its use. We have presented information above that Blockchain technologies increase the controllability and transparency of supply chains, help identify the causes of cargo losses and delays. As a result, the direct economic effect in the field of logistics can be calculated as a reduction in the execution time of certain business processes carried out by employees of a typical logistics enterprise during the day.

The resulting effect can be calculated using the formula:

$$E^e = \sum E_i^e - \sum C_i \,, \qquad (1)$$

where E_i^e - possible economic effects according to the i-th component, which the logistics company can receive from the implementation of the project;

C_i - components of costs for the implementation of this project.

As already mentioned above, it is possible to calculate the direct effect of the implementation of the Blockchain project by calculating the reduction in the execution time of certain business processes and, accordingly, saving the time of employees.

Time saving of each employee of a typical logistics enterprise can be translated into money saving according to the following formula:

$$E_t = \sum T_h \times P_h, \qquad (2)$$

where T_h is the total time savings of 1 employee in terms of hours per year;

P_h - the cost of 1 hour of payment for the company's employee, which is saved.

As a possible saving of time spent per day, we will accept the following values: 10, 15, 20, etc. up to 45 minutes per day.

To convert these minutes into annual time savings, you need to divide the daily savings in minutes by 60 (this is the number of minutes in an hour), and then multiply the resulting value by 22 (this is the number of working days in a month) and by 12 (this is the number of months in a year) .

We will accept the following initial conditions:

1) the average salary of 1 employee of a typical logistics enterprise without deduction of taxes is 3000 US dollars per month,

2) 22 working days in one month,

3) the working time of employees is 8 hours.

Thus, the cost of 1 hour of working time of 1 company employee is: 3000/22/8 = 68.18 US dollars/hour. Based on the determined data, we calculate possible cost savings from the implementation of Blockchain technology.

The results of calculating the total possible cost savings of a typical logistics enterprise are presented in Table 2.

Table 2: Calculations of possible cost savings from the introduction of Blockchain IT technology

№	Indicators	Possible values of time savings of company employees during the day, minute							
		10	15	20	25	30	35	40	45
1	Time savings of company employees per year, hours	46	69	92	115	138	161	184	207

2	Cost of 1 hour of working time of 1 employee of the company, US dollars	68,18	68,18	68,18	68,18	68,18	68,18	68,18	68,18
3	The number of company employees, persons	25	25	25	25	25	25	25	25
4	Total possible cost savings for the company per year, US dollars	78407,0	117610,5	156814,0	196017,5	235221,0	274424,5	313628,0	352831,5

Let's consider the components of costs of a typical logistics enterprise for the implementation of Blockchain (Table 3).

We will calculate the NPV of the project of implementing Blockchain into the activities of a typical logistics enterprise for different discount rates (15% and 20%), as well as for three possible scenarios: for the pessimistic scenario, we will take the possible cost savings when saving 15 minutes per day; for an optimistic scenario, let's take the possible cost savings when saving 40 minutes a day; for a realistic scenario, let's take the possible cost savings of saving 25 minutes per day.

Table 3: Costs of implementing Blockchain technology

№	Cost components	Year		
		2022	2023	2024
1	Analysis and preparation for the implementation of the most optimal solution, US dollars	5000	-	-
2	Development and implementation of a corporate logistics solution based on a private Blockchain platform, US dollars	10000	-	-
3	Training of end users, US dollars	3000	-	-
4	Professional support for developed solutions, US dollars	1500	1500	1500
5	Total expenses for the year, US dollars	19500	1500	1500

The calculation of the NPV of the project of introducing Blockchain into the activities of a typical logistics enterprise for the pessimistic scenario is presented in Table 4.

Table 4: NPV of the project for the pessimistic scenario

№	Year	№ year	Discount factor at a discount rate of 15%	Discount factor at a discount rate of 20%	Total project implementation costs, US dollars	Total costs at a discount rate of 20%, US dollars	Total costs at a discount rate of 15%, US dollars	Projected revenues from the project (savings), US dollars	Projected income at a discount rate of 15%, US dollars	Projected income at a discount rate of 20%, US dollars	Projected profit from the project, US dollars	Projected profit at a discount rate of 15%, US dollars	Projected profit at a discount rate of 20%, US dollars
1	2023	0	1	1	19500	19500	19500	10140	10140	10140	-9360	-9360	-9360
2	2024	1	0,87	0,83	1500	1305	1245	10140	8821,8	8416,2	8640	7516,8	7171,2
3	2025	2	0,76	0,69	1500	1140	1035	10140	7706,4	6996,6	8640	6566,4	5961,6
4	Total				22500	21945	21780	30420	26668,2	25552,8	7920	4723,2	3772,8
5	Net present value, NPV											4723,2	3772,8

The calculation of the NPV of the project of introducing Blockchain into the activities of a typical logistics enterprise for an optimistic scenario is presented in Table 5.

Table 5: NPV of the project for the optimistic scenario

№	Year	№ year	Discount factor at a discount rate of 15%	Discount factor at a discount rate of 20%	Total project implementation costs, US dollars	Total costs at a discount rate of 20%, US dollars	Total costs at a discount rate of 15%, US dollars	Projected revenues from the project (savings), US dollars	Projected income at a discount rate of 15%, US dollars	Projected income at a discount rate of 20%, US dollars	Projected profit from the project, US dollars	Projected profit at a discount rate of 15%, US dollars	Projected profit at a discount rate of 20%, US dollars
1	2023	0	1	1	19500	19500	19500	27300	10140	10140	7800	7800	7800
2	2024	1	0,87	0,83	1500	1305	1245	27300	23751	22659	25800	22446	21414
3	2025	2	0,76	0,69	1500	1140	1035	27300	20748	18837	25800	19608	17802
4	Total				22500	21945	21780	81900	54639	51636	59400	49854	47016
5	Net present value, NPV											49854	47016

The calculation of the NPV of the project of introducing Blockchain into the activities of a typical logistics enterprise for a realistic scenario is presented in Table 6. According to our calculations, the NPV of the project of introducing Blockchain into the activities of a typical logistics enterprise is positive at two discount rates and at three forecasts.

Table 6: NPV of the project for a realistic scenario

№	Year	№ year	Discount factor at a discount rate of 15%	Discount factor at a discount rate of 20%	Total project implementation costs, US dollars	Total costs at a discount rate of 20%, US dollars	Total costs at a discount rate of 15%, US dollars	Projected revenues from the project (savings), US dollars	Projected income at a discount rate of 15%, US dollars	Projected income at a discount rate of 20%, US dollars	Projected profit from the project, US dollars	Projected profit at a discount rate of 15%, US dollars	Projected profit at a discount rate of 20%, US dollars
1	2023	0	1	1	19500	19500	19500	20300	10140	10140	800	800	800
2	2024	1	0,87	0,83	1500	1305	1245	20300	17661	16849	18800	16356	15604
3	2025	2	0,76	0,69	1500	1140	1035	20300	15428	14007	18800	14288	12972
4	Total				22500	21945	21780	60900	43229	40996	38400	31444	29376
5	Net present value, NPV											31444	29376

According to our calculations, the NPV of the project of introducing Blockchain into the activities of a typical logistics enterprise is positive at two discount rates and at three forecasts. Thus, this project is economically profitable and can be recommended for implementation.

Now let's calculate the payback period of the project of implementing Blockchain in the activities of a typical logistics company. For this, it is necessary to sum up the net benefits of the project for the entire considered period at different discount rates.

Graphical determination of project payback points for a discount rate of 15% is presented in Fig. 3 and for a discount rate of 20% in Fig. 4.

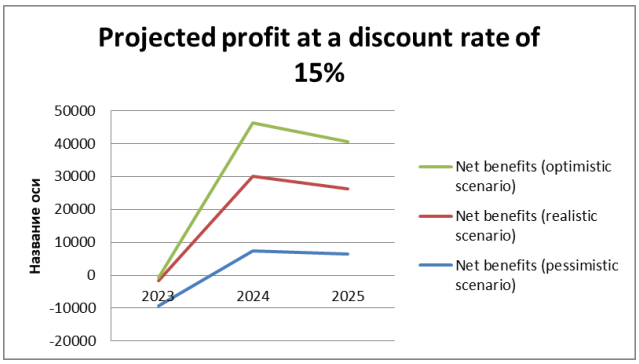

Fig. 3 Finding the payback of the project for a discount rate of 15%

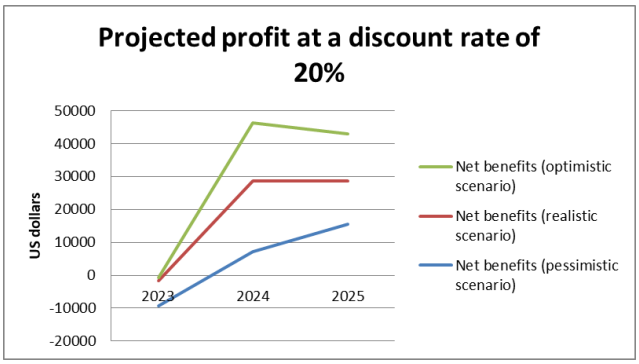

Fig. 4 Finding the payback of the project for a discount rate of 20%

As can be seen from both figures, according to the pessimistic forecast of the implementation of Blockchain IT technology, it will pay off in about 2.3 years. Realistically - a little more than in a year, and optimistically - less than a year. Taking into account the fact that Blockchain can not be implemented only in one separate company, we consider it expedient that the partners of the logistics enterprise also take part in its implementation. And therefore, it will already be a network solution. On the one hand, it will increase the number of participants, which will lead to an increase in total costs. However, on the other hand, project investments can also be distributed among all interested parties and, accordingly, will pay off much faster.

7. Conclusion

Blockchain for logistics is still in its infancy, although the prospects it opens up for logistics companies, freight forwarders and other entities are truly remarkable. The entry of logistics into the Blockchain sphere requires a period of adaptation, implementation, testing and is a prospective segment. The market of logistics and freight transportation under the influence of the new Blockchain will begin to change in the near future, when more and more small firms will learn about it and see the benefits of its use based on the experience of leading companies.
According to the calculations, the NPV of Blockchain implementation projects, taking into account the time saving factor in the activities of a typical logistics enterprise, is positive at two discount rates and at three development scenarios, which indicates the economic feasibility and recommendation for the implementation of Blockchain in the practice of business structures engaged in logistics .

References

[1]. Logistics 2.0: Blockchain will make supply transparent and fundamentally change the entire industry. Available at: https://bakertilly.ua/news/id44236.

[2]. Dumanska, I., Vasylkivskyi, D., Zhurba, I., Matviiets, O., Goncharuk, A.: Dronology and 3d printing as a catalyst for international trade in industry 4.0., *WSEAS Transactions on Environment and Development*, Vol. 17. - pp. 740–757 (2021) DOI: 10.37394/232015.2021.17.71

[3]. Nakamoto, S. Bitcoin: A Peer-to-Peer Electronic Cash System. Available at: https://cutt.ly/pMw7Q3X

[4]. Alicke K., D. Rexhausen, A. Seyfert. Supply Chain 4.0 in consumer goods. Operations as a competitive advantage in a disruptive environment. McKinsey & Company. Available at: https://cutt.ly/BMw7ZV5.

[5]. Abeyratne, S. A. and R. P. Monfared: Blockchain Ready Manufacturing Supply Chain Using Distributed Ledger, In: *International Journal of Research in Engineering and Technology*, Vol. 5.9, pp. 1–10 (2016)

[6]. Badzar, A. Blockchain for Securing Sustainable Transport Contracts and Supply Chain Transparency. Master's Thesis. Lund University. Helsingborg, Sweden Available at:: https://cutt.ly/ZMw5xi3

[7]. Dickson, B. Blockchain Has the Potential to Revolutionize the Supply Chain. Available at: https://techcrunch.com/2016/11/24/Blockchain-has-the-potential-to revolutionize-the-supply-chain

[8]. Friedlmaier, M., Tumasjan, A., Welpe, I. M.: Disrupting industries with Blockchain: The industry, venture capital funding, and regional distribution of Blockchain ventures, In : Proceedings of the 51st Hawaii International Conference on System Sciences. Waikoloa Village, HI, USA. 3–6 January 2018. Available at: https://core.ac.uk/download/pdf/143481280.pdf

[9]. O'Marah, K. Blockchain for supply chain: Enormous potential down the road. Forbes. Available at: https://cutt.ly/xMw5WFa

[10]. Hackius, N., Petersen, M.Casey, M. J.; Wong, P.: Global Supply Chains Are About to Get Better, Thanks to Blockchain. Available at: https://cutt.ly/BMw5I8D

[11]. Lavrynenko, S.O. Innovative approaches to the management of logistics activities – «blockchain technology». Available at: https://cutt.ly/nMw5D78.

[12]. Dumanska, I. and O. Matviiets: E‑logistics: definitions, development and conceptual, *Foreign trade: economics, finance, law,* Vol. 2, pp. 44-55 (2021)
[13]. Ream, J., Chu, Y., Schatsky, D.: Upgrading Blockchains: Smart contract use cases in industry, Deloltte Univercity Press, Vol. 02(04), pp. 1–11 (2016)
[14]. Saveen A. Abeyratne, Radmehr P. Monfared: Blockchain read manufacturing supply chain using distributed ledger, *International Journal Of Research in Engineering and Technology*, Vol. 05(09), pp. 1–10 (2016)
[15]. Vladyko, A., Spirkina, A and Elagin, V.: Towards Practical Applications in Modeling Blockchain System, *Future Internet***,** Vol. 13*,* 125 (2021) https://doi.org/10.3390/fi13050125
[16]. Arefieva, A. S., Gogokhia G. G.: Prospects for the implementation of blockchain technology, *Young Scientist*, Vol. 15 (149), pp. 326-330 (2017)
[17]. BlockchainMarket (Type — Public Blockchain, Private Blockchain, and Consortium Blockchain; Application — Financial Services and Non-financial Sector) — Global Industry Analysis, Size, Share, Growth, Trends, and Forecast 2016–2024,Market Research Reports, Idustry Research Firm, Consulting Services. Available at:: http://www.transparencymarketresearch.com/Blockchain-technology-market.html
[18]. Study: The blockchain technology market will exceed $21 billion by 2025. Available at: https://cutt.ly/AMeqPCu
[19]. Blockchain - how the technology of the future will be used in logistics. Available at: https://cutt.ly/xMewi49
[20]. Investments in blockchain. Available at: https://www.tadviser.ru/index.php/
[21]. DIGITAL ECONOMY: trends, risks and social determinants, Razumkov Center, 2020. Available at https://razumkov.org.ua/uploads/article/2020_digitalization.pdf
[22]. Vasilenkov, S. Is there a need for blockchain in the field of freight transportation. Available at: https://cutt.ly/CMeqUS9
[23]. IBM is developing a blockchain platform for logistics. Available at: https://cutt.ly/1MeqEjr
[24]. Saveliev I.E. Blockchain technology and its application, *Journal of applied informatics,* T. 11, no. 6(66) (2016).
[25]. Kernychniy, B., Foreign and domestic experience of application of Blockchainin transport and logistics, *Socio-Economic Problems and the State*, Vol. 23, no. 2, pp. 46-56 (2020)

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