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USE OF BLOCKCHAIN TECHNOLOGY IN PUBLIC ADMINISTRATION

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ABSTRACT

One of the new technologies that will determine our future is blockchain. The article describes the technology of the blockchain, analyzes the world experience of using the technology, and gives examples of the use of the blockchain in public administration. Special attention is paid to mathematical methods of evaluation the effectiveness of technology implementation in the public sector.

Key words: blockchain, blockchain technology, public administration, effectiveness, implementation.

1. INTRODUCTION

One of the new technologies that will determine our future is blockchain [1]. The introduction of the blockchain in everyday life will happen exactly. Blockchain is a kind of

evolutionary innovation that will help humanity. 105 global technology companies, including SWIFT, IBM, Ripple and Consensys AG, became part of the International Association of Trusted Application Blockchain (INATBA) to promote DLT technologies in the European Union. "It clearly signifies that blockchain technology will be a driving force for our economy in the coming years, and through INATBA we will be able to foster an environment that encourages the application of the technology across the EU member states" [2]. The fundamental part of Blockchain are cryptographic algorithms [3].

Blockchain infrastructure is able to implement new business models in the market. The blockchain technology has long crossed the stage when it is associated primarily with cryptocurrencies. Even those companies and countries that are against Bitcoin and other cryptocurrencies, note the great potential in using blockchain technology [4-6]. So, electronics giant Bosch and Austrian power supplier Wien Energie have come up with a blockchain refrigerator aimed to allow consumers to monitor and control electricity consumption [7]. Residents of Shenzhen pay for transport via blockchain application [8]. Blockchain is increasingly being introduced into everyday life, spreading to all sectors of the economy.

1.2. Overview of blockchain technology

Blockchain represents a secure and decentralized framework for transaction processing. The main feature of the blockchain system - the ability to record facts and data with built-in protection against malicious interference - creates undeniable advantages over other distributed data processing and storage systems, thereby promising to save us from intermediaries in many areas of life, forcing to reconsider traditional methods of transactions, storage information, asset transfers and rights registration.

Blockchain is a special technology on which platforms for conducting operations between peers, acting without intermediaries, are based, and in which decentralized information storage is used to reflect all transaction data.

Thanks to the blockchain technology, the order of operations is changing: the corresponding transactional model gradually moves from using a centralized structure (banks, exchanges, trading platforms, energy companies) to using a decentralized system (end users, electricity consumers).

In such systems, independent intermediaries, the services of which most industries today need, are no longer required (at least in accordance with the blockchain theory), since operations can be initiated and carried out directly "between peers".

This reduces costs and speeds up processes. As a result, the whole system becomes more flexible, as many work tasks that were previously performed manually, are now solved automatically using "smart contracts".

One of the key inherent characteristic of Blockchain is its distributed and shared nature (Fig. 1) [9]. Therefore, blockchain-based systems can reduce or eliminate frictions and costs of current intermediaries and, thus, improve data integrity, decentralize trust, and reduce costs.
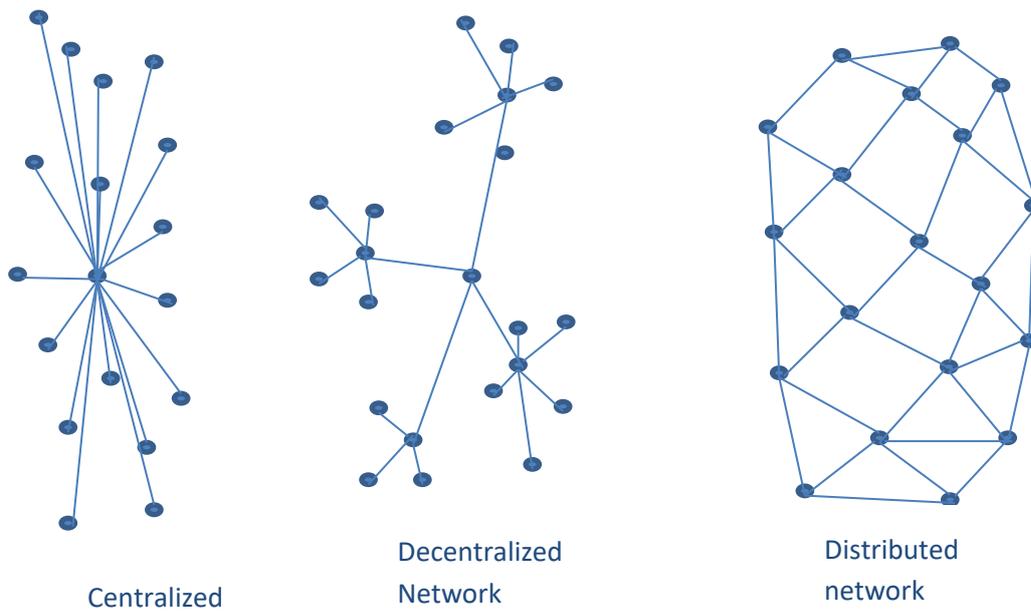
Centralized

Decentralized Network

Distributed network

Figure 1 Distributed network in comparison with centralized and decentralized networks

For the first time, the blockchain technology was used in the financial sector, where it served as the basis for creating the bitcoin credential. Recently, more and more applications have emerged that extend the key function of this technology - decentralized storage of transaction data - through the integration of mechanisms that allow decentralized real transactions. These mechanisms, called smart contracts, operate on the basis of rules that are set individually (for example, specific requirements for quantity, quality, price) and allowing to automatically select potential customers for suppliers and vice versa based on distributed registries.

The potential scope of the blockchain is broad. Such a technology can be used to create a huge variety of databases, registries, accounting books, business services, and new payment systems (Fig. 1).
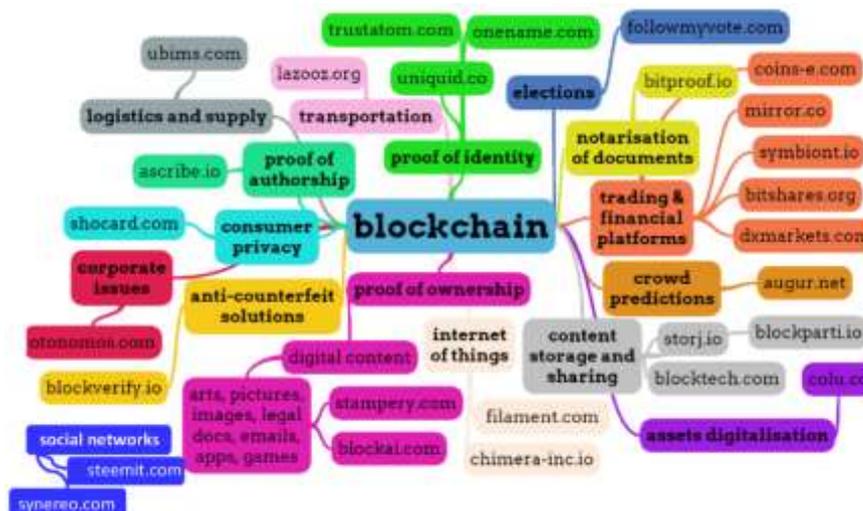

Figure 2 Areas of application blockchain [10]

The blockchain technology is also used in insurance, taxation, real estate services, logistics, property transactions, and land and so on.

2. ANALYSIS OF THE GLOBAL EXPERIENCE OF USING BLOCKCHAIN

As shown in the overview below, blockchain-based applications are developed for a wide variety of industries and application scenarios (Fig. 3-4).
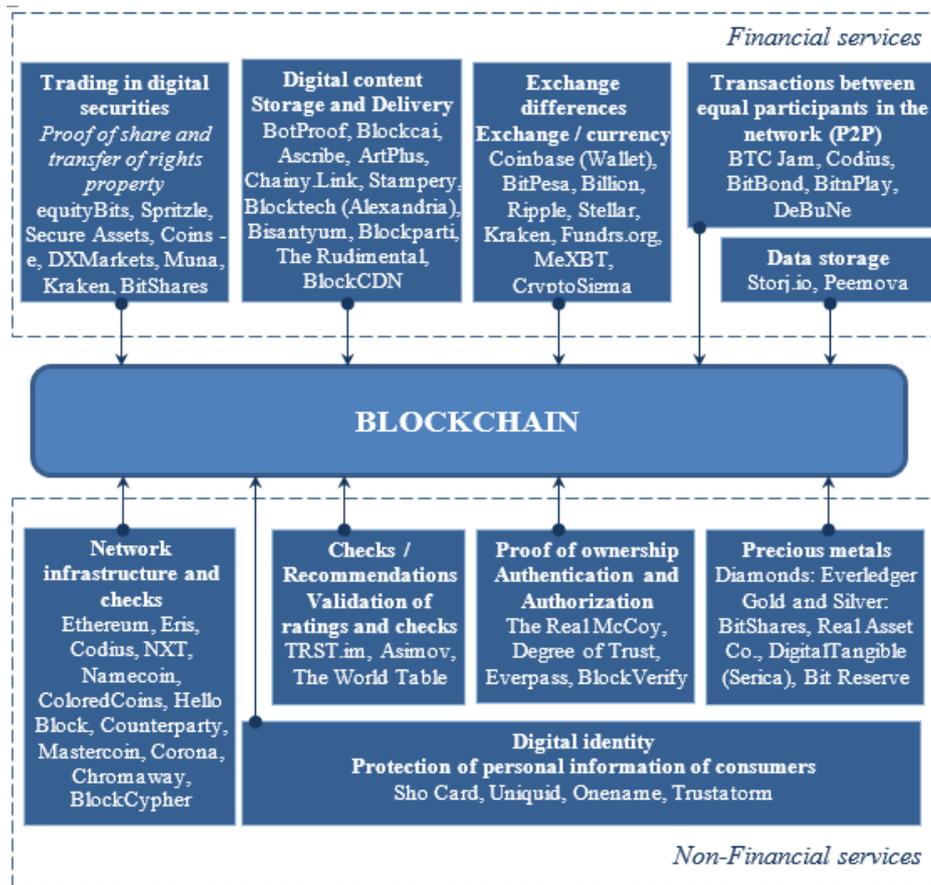

Figure 3 New blockchain applications

All of these new products are still at an early stage of development: most projects focus on refining concepts or conducting first trials. However, solutions like one name give us some insight into the potential impact of block chain technology on areas other than financial ones. One name creates virtual identification numbers that uniquely identify users and allow them to sign in to social networks using their own identification information.
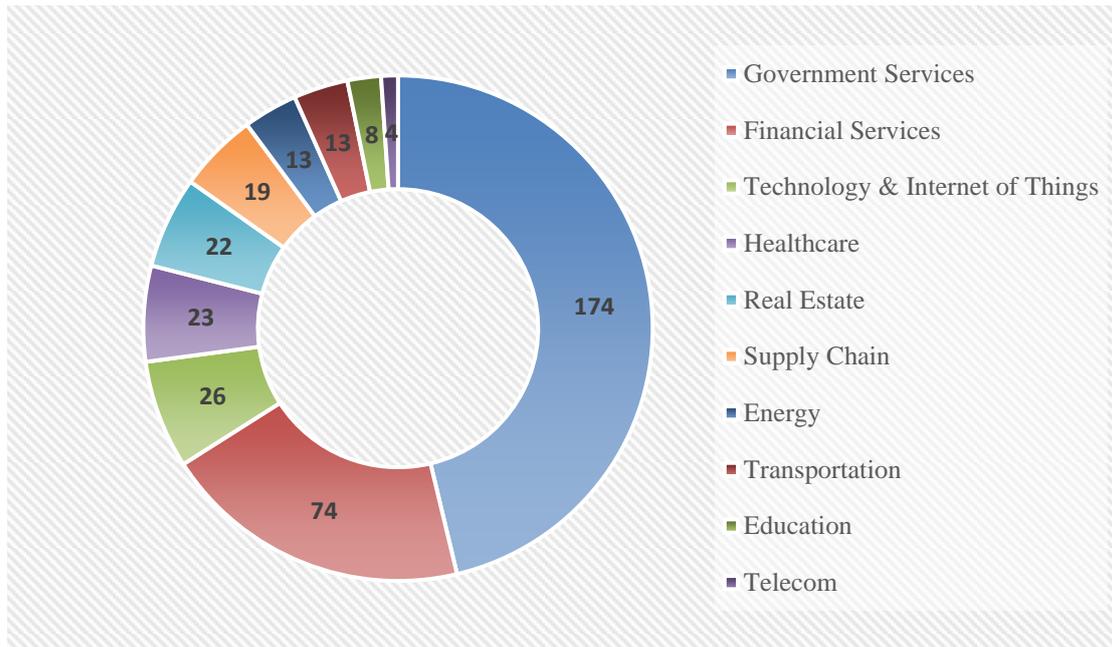
Figure 4 Top 10 types of industries [11]

3. THE PRESENTS AND FUTURE OF THE BLOCKCHAIN IN PUBLIC ADMINISTRATION. MATHEMATICAL METHODS OF EVALUATION THE EFFECTIVENESS OF TECHNOLOGY IMPLEMENTATION IN THE PUBLIC SECTOR.

Not only business, but also government processes are moving into the virtual dimension. Digitizing databases eliminates bureaucracy. More precisely, it "transfers" it to online, and citizens, instead of kilometer-long queues from one department to another, can collect all references and extracts without leaving the house.

Increasingly, blockchain technology has been introduced at the state level, somewhere as part of a specialized solution, somewhere on a larger scale.

A good example is the Swedish company Bitnation. The application developed by this company ensures that state administrative acts (for example, contracts, insurance policies or official certificates) are stored in a block chain. This decision has already been applied in practice in individual cases, for example in Estonia, where, since 2015, marriage has been recognized using the Bitnation application. However, Bitnation is not yet as successful in creating other comparable practical solutions based on its block chain. Honduras, for example, abandoned the planned transfer of its land registry to the blockchain.

When it comes to electronic registries, the question immediately arises about the reliability and security of data, as well as guarantees against hacking information. These tasks are successfully solved by the blockchain, since the properties of decentralized databases ensure the confidentiality, integrity and availability of information.

Consider how distributed registries deal with pressing issues in public administration. A large direction of the future development of the blockchain is the replacement (decentralization and differentiation) of the state functions of providing services to the population. Blockchain could serve as a repository of all public documents, playing the role of a global registry.

Key benefits of technology are:

- cost reduction;
- transparence;
- efficiency in combating fraud and error.

Blockchain is a technology that allows you to store and use information in a distributed database, with a full guarantee of preserving information in its original form. This information cannot be changed, replaced or pulled out of it a piece.

The blockchain is able to help government agencies deal with fraud and errors, as well as reduce the costs of paperwork and ensure transparency of interactions. However, the technical complexity and security risks hinder its implementation.

Among the limiting factors of the blockchain application is to highlight the confidentiality and immutability - cons of technology for state services, high power consumption and high cost of experiments with it.

The blockchain technology in the sequence system for obtaining places in kindergartens is actively used in Ukraine - the capital city (Kyiv) has already introduced this technology, now it is being implemented in Lviv and Drohobych. The use of blockchain technology will make it possible for all parents to submit applications for places in educational institutions of the city into a single and transparent database. Applications submitted before March have already been entered in the register; now parents can register and track their applications themselves.

The use of blockchain technology completely eliminates the possibility of corruption and the influence of heads of educational institutions on the enrollment of children in conditions of a shortage of places in schools and kindergartens.

In various cities of Ukraine, self-government bodies will not restrict the use of technology only to the education system. Already, the departments of information technology are working on road maps for the implementation of distributed registry technology in the urban infrastructure. The city plans to transfer land registration, the register of communal property, the register of property contracts for blockchains.

Best of all, Estonia handled the task of synchronizing state databases in real time. The authorities have built a single decentralized ecosystem that allows you to seamlessly create and synchronize new services and bases. The results of the implementation of blockchain infrastructure have proven their effectiveness:

- 94% of citizens have an e-ID for receiving e-services;
- 2% of GDP saved due to the transfer of documents from paper to electronic form;
- > 4 thousand services are available via the Internet.

Also, the authorities of the United Arab Emirates are also planning to fully transfer state documents to the blockchain. By 2020, it is planned to create a scalable state blockchain ecosystem and a unified database standard for smart city management.

The use of blockchain technology can bring benefits, but it is necessary to evaluate the effectiveness of technology implementation in the public sector.

Based on the identified model, the generalized system efficiency of blockchain implementation in the public sector as a whole is determined. The overall elasticity of input resources expended $\lambda = \alpha \beta$ shows the integral efficiency of using both resources.

Weighing the contributions of the relative changes in resources $K = K/K_0, L = L/L_0$ with normalized elasticities $\rho = \alpha/(\alpha + \beta), 1 - \rho = \beta/(\alpha + \beta)$, we find the value of the

integral scale effect M from the joint use of the involved additional monetary and labor resources in the process:

$$M = K^{*\rho} \cdot L^{*(1-\rho)}$$

Similarly, weighting the relative efficiency of each of the resources, we obtain a generalized indicator of technological efficiency.

$$R = \left(\frac{Y^*}{K^*}\right)^{\rho} \cdot \left(\frac{Y^*}{L^*}\right)^{1-\rho}$$

where $Y^* = Y / Y_0$; K_0, L_0, Y_0 – initial values of factors

Figure 5 shows the values of the integral scale effect – M, the generalized indicator of technological efficiency – R and the relative efficiency parameter R/M
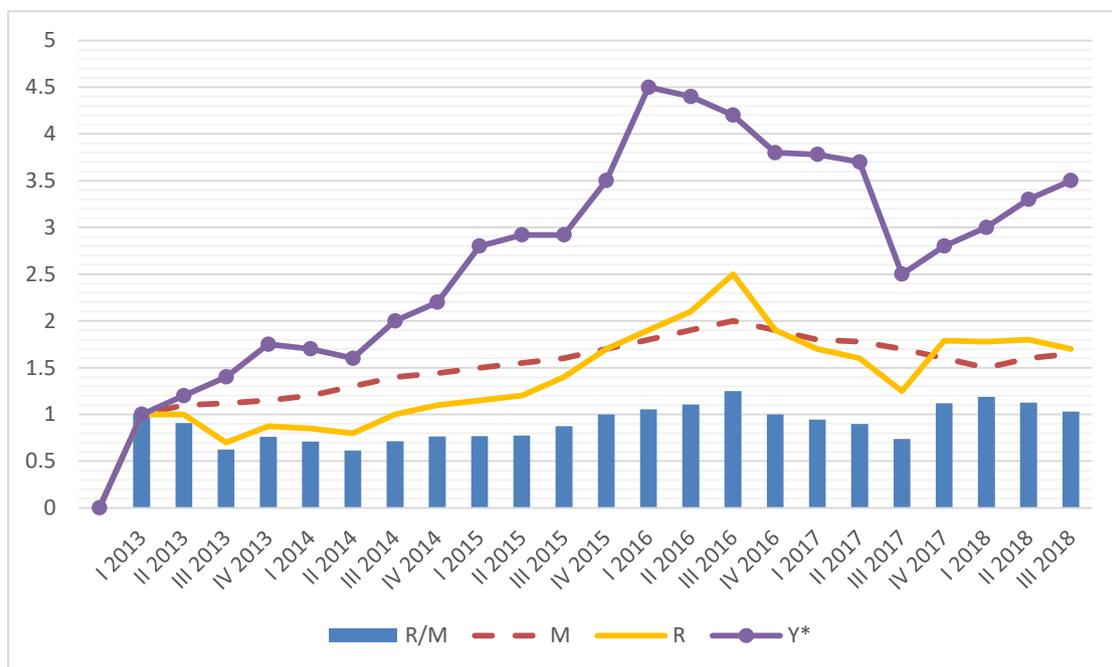

Figure 5 Estimation of parameters of the composition of the efficiency factor

Second approach – a multi-criteria comparative efficiency approach — the Data Envelopment Analysis (DEA) methodology. Its essential advantage is the minimal presence of the subjective factor in the formation of integral performance evaluations.

The approach allows reasonably, taking into account a significant number of input and output parameters, which can be economic, technological, and other criteria, to find generalized assessments of the effectiveness of processes and production in the complex of a single organizational system.

The DEA methods are a generalization of calculations of the use of input resource impacts on the multidimensional case. For a multidimensional production and economic object with m input and k output parameters: $X = \{X_1, X_2 \dots X_m\}$ and $Y = \{Y_1, Y_2 \dots Y_m\}$

The complex generalized efficiency indicator for each n-th object in the basic version of the DEA method is formed as follows:

$$f_n = \max_{u_{in}, v_{jn} \in G} \frac{u_{1n} \cdot Y_{1n} + u_{2n} \cdot Y_{2n} + u_{3n} \cdot Y_{3n} + \cdots + u_{kn} \cdot Y_{kn}}{v_{1n} \cdot X_{1n} + v_{2n} \cdot X_{2n} + v_{3n} \cdot X_{3n} + \cdots + v_{kn} \cdot X_{kn}}$$

Where u_{in} and v_{jn} are weights that satisfy the system of constraints determining the range of G values:

$$\frac{u_{1n} \cdot Y_{11} + u_{2n} \cdot Y_{21} + u_{3n} \cdot Y_{31} + \cdots + u_{kn} \cdot Y_{k1}}{v_{1n} \cdot X_{11} + v_{2n} \cdot X_{21} + v_{3n} \cdot X_{31} + \cdots + v_{mn} \cdot X_{m1}}$$

$$\frac{u_{1n} \cdot Y_{12} + u_{2n} \cdot Y_{22} + u_{3n} \cdot Y_{32} + \cdots + u_{kn} \cdot Y_{k2}}{v_{1n} \cdot X_{12} + v_{2n} \cdot X_{22} + v_{3n} \cdot X_{32} + \cdots + v_{mn} \cdot X_{m2}}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots , i = \{1,2 \ldots k\}; j = \{1,2 \ldots m\}$$

$$\frac{u_{1n} \cdot Y_{1N} + u_{2n} \cdot Y_{2N} + u_{3n} \cdot Y_{3N} + \cdots + u_{kn} \cdot Y_{kN}}{v_{1n} \cdot X_{1N} + v_{2n} \cdot X_{2N} + v_{3n} \cdot X_{3N} + \cdots + v_{mn} \cdot X_{mN}}$$

The system of relations (1), (2) for $n = \{1, 2, \ldots N\}$ defines N problems of mathematical programming. The solution of each n-th task $(n = 1, 2, \ldots N)$ for the n-th object gives the value the corresponding generalized efficiency indicator f_n, ranked on the unit interval [0, 1], and the corresponding set of weight coefficients $u_n = \{u_{1n}, u_{2n} \ldots u_{kn}\}$ and $v_n = \{v_{1n}, v_{2n} \ldots v_{mn}\}$ the maximizing functional (1). Generally speaking, these u_{in} and v_{jn} weights will be different for different nth systems.

Note that, in the general case, the solution to the multicriterial optimization problem (1), (2) has not a single, but a whole set of solutions that satisfy the given constraints (2). At the same time, some set of solutions can correspond to the same relative efficiency both in the space of input and output parameters, and in the space of weights of the functional. Therefore, different objects with different characteristics in the DEA method may have the same generalized performance indicators.

4. CONCLUSION

The blockchain technology is the future of humanity, but still modern computers are not capable of providing the blockchain with computing power, so its widespread implementation will last for some time. The use of this technology in the administrative sector will significantly accelerate the process of its implementation, will increase the loyalty of residents to both the technology and the country. Meanwhile, the question remains open: it may be necessary to implement the principles of the blockchain through another, less expensive technology. That would take advantage of blockchain and neutralize disadvantages.

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