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THE BLOCKCHAIN AS A DIGITAL TECHNOLOGICAL PLATFORM FOR ELECTRONIC GOVERNMENT DEVELOPMENT

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Abstract

As part of this study, Blockchain is considered as an integrated-distributed technology and a digital platform for transformation and development of e-government structures. There is conducted critical assessment of Blockchain technological characteristics and also, there are considered the consequences of its implementation into government organizations and their processes. At the same time, from the interdisciplinary point of view, it is regarded to transfer from a technology-oriented approach to a needs-oriented approach, which is adapted to Blockchain applications, ensuring and keeping the requirements for administrative and managerial processes. Based on the assessment, the authors' substance the approach to investing the potential benefits of using Blockchain for e-government structures, as well as managing the architecture and applications of Blockchain in accordance with social needs and social values within the changing institutional paradigm conditioned upon the transition to a digital economy. On the one hand, the prospect of Blockchain technology management, in which government agencies use Blockchain technology for their own processes, such as the provision of public and municipal services, where Blockchain technology is used to manage transactions. Another perspective is called Blockchain technology management, which defines how the Blockchain should look like, how to adapt to changes and ensure the ability to implement the goals and objectives of public authorities, as well as the social needs of the population.

Keywords: Digital economy, electronic government, computerization, Blockchain, institutions.

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1. Introduction

The result of the socio-economic revolution taking place in the modern world, according to some authors (Ioda, Bulavko, Khmeleva, & Ioda, 2013), is the construction of a post-industrial society, when information technologies, computerized systems, high production and innovative technologies play an important role. According to Semenov Y. A. "spreading digital technology increased the number of arguments about the formation of a new socio-economic relations and digital economy" (Semenov, 2017, p.128). In the context of the transition to the digital economy, the basic Blockchain technology is the innovative one, the universal technology for citizens, companies and governments to exchange information, carry out a variety of transactions, provide network services, and also contribute to the organization efficiency exchanging data in government agencies. Blockchain technology stores identical information on different nodes and new data is added only when the nodes reach consensus. However, although new transactions can be added, the previous information cannot be deleted, allowing all nodes to track history. Storing transaction information in different nodes is called a distributed registry. This reduces the dependency on the central node and the risk of data manipulation or system failure because all nodes have complete information. Blockchain technology can be used to record owner data and store important information and documents such as certificates, licenses, government decisions and legislation. Typically, the information stored in the Blockchain is transactional data, which can include not only information about monetary transactions, but also such data as ownership of land, birth and marriage certificates, vehicle registers, licenses, educational certificates, loans, social benefits and voting results.

Blockchain technology has the potential to be used for the benefit of government and society and can represent the next step in the development of e-government, as this technology can reduce costs and complexity, ensure reliable collaboration, increase the openness of audits and ensure the confidential processing of documents.

2. Problem Statement

Most articles currently focus on technological development, solving technological problems using Blockchain technology for processes with peer-to-peer communication (P2P) or capacity proposed for reorganizing the transactions processes and information exchange for private purposes. However, there are currently no studies examining Blockchain technology in terms of its ability to address social needs. None of the potential applications based on Blockchain technology is considered in terms of possible usage within e-government. This study is devoted to solving this problem.

3. Research Questions

As a rule, most of the studies devoted to the Blockchain technology, on the one hand speak about the enormous potential and technological issues on the other, but usually ignores the peculiarities that arise between these two extremes, such as sales, trade-offs, limitations, materiality and aspects of management that can limit opportunities. As part of this study, we will review the potential benefits and identify new opportunities for government bodies related to the management of Blockchain technology, which could guarantee possible implementing of these technological advantages, as well as focus on the points that are currently underestimated in terms of the possibility apply in e-government and thus need

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more research. On October 31, 2008, the article "Bitcoin – peer- to-peer electronic cash system" by Satoshi Nakamoto (Nakamoto, 2018) was distributed in the electronic cryptography mailing list. The system was launched on 3 January 2009.

Since 2009, this digital currency system has gained over $ 150 billion in capitalization by May 2018 and now it is still the most famous Blockchain app, but more importantly, it has led to an innovative ecosystem technologies and services that go far beyond the financial sector.

4. Purpose of the Study

The main purpose of this study is to develop a mechanism for the Blockchain technology, based on the example of so-called “smart contract”, which can save an agreement on the terms of the participants, and after the conditions are fulfilled, the changes specified in the contract will be made. The smart contract defines the rules and penalties under the agreement and automatically fulfils the obligation in the contract. Such a contract can be defined as "a mechanism using digital assets of two or more parties, where some or all parties contribute assets and assets are automatically redistributed between those parties according to a formula based on certain data that hasn’t been unknown by the time when the contract starts (Buterin, 2014). Thus, it is a program that runs on the Blockchain and ensures the correct execution of the contract through the use of the consensus protocol. The smart contract contains information about the transaction and will be executed only if the conditions are checked by all network nodes.

The original app, based on Blockchain, is Bitcoin - focused primarily on crypt currency transactions. However, since its origins date back to 2009, since then the use of Blockchain has expanded to a wide range of economic sectors outside the financial one. Blockchain applications can be used for a wide range of tasks, from simple to complex transactions and information exchange, and smart contracts can be used to manage these transactions. In addition, the public sector has several areas of activity where the use of Blockchain technology could be useful or at least would allow exploring its potential as required. Therefore, understanding the potential benefits is a key aspect to determine areas that Blockchain technology can be effectively used within the digital economy. In order to understand these processes, it is necessary to consider this problem in relation to the public sector and, in particular, to e-government.

5. Research Methods

There are applied methods of system, factor analysis, empirical, diagnostic, retrospective, predictive, stochastic and others.

6. Findings

Blockchain technology can be used for any transaction or information exchange that the government is involved. Key features of this technology allow implementing automation of a processes wide range for the property register, inventory and information exchange on physical assets, property, intangible assets, such as votes, patents, ideas, reputation, health data, knowledge, etc. The essence of the Blockchain is that organizations can keep track of the registry data that organizations work together to

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create, develop and follow one unchanged transaction history and determine the sequence of events. Governments around the world are conducting pilot projects using Blockchain technology. The Blockchain projects diverse in nature and include a digital identification, storage of judgments, the construction funding and money tracing, data on marital status, electronic voting, licenses, business, passports, information about criminal records and even the tax records (Analytical statement, 2014). In this light, further research is advisable to compare the diversity of initiatives and analyze the positive aspects of this technological implementation. Blockchain technology is well suited for situations in which several unrelated parties are involved in a transaction. An example of such interaction is giving permissions to mass event's organizers that require coordination with the structures that ensure the legitimacy, public order and security together with the police, firefighters, health care organizations, etc. Another example is the transfer of car ownership. To find the car owner, it must be analyzed the transaction history of the car, if it contains a unique identifier. The car owner can be identified by performing a search, as all data is uniformly considered in the structures of the Blockchain. The rule is prescribed in the chain that only the owner can sell the car. When a car is sold, you must create a transaction that the previous owner confirms the car sale, the new owner confirms the car purchase, and the Bank (or other party) confirms the payment of the title transfer. Another example is the retention permission sets granted to a public organization, and the ability to change permissions only if there is an agreement between nodes that are classified as higher in the hierarchy. Thus, Blockchain is a technology that replaces individual databases with a distributed general information register, which should lead to increase in security and availability. Each node in the network contains a full copy of the Blockchain data, transactions are written to the register, and each node has access to the entire transaction history. Access to the register may be restricted, therewith the number of nodes must be determined, as well as the type of consensus mechanism. This determines the leadership role of public authorities in deciding on the appropriate tolerances and types of mechanisms, which will be discussed in more detail below. Blockchain applications can significantly improve the efficiency of data exchange in government agencies. For example, in the case of Blockchain applications, cadastral organizations involved in land registration processes can interact directly with each other. This reduces the intermediary role of these organizations, which need to focus only on the development, maintenance and regulation of Blockchain technology. However, the need and procedure for converting such organizations into owners and operators of Blockchain applications currently remains an open question in terms of their powers and administrative regulations. Looking at this issue in terms of the context of governance technologies, it can be concluded that the Blockchain is in some form an institutional management technology that competes with other economic institutions of capitalism, namely firms, markets, networks, and even governments. Moreover, in a certain context, Blockchain can be seen as a technology that competes with the role of government in society. Despite the seeming abstractness of the issue, these trends should not be ignored, and further research is needed to formulate the issue more realistically, considering both technological and institutional elements. At a minimum, the Blockchain technology can offer distributed transactions on the platforms of the P2P, which are supported and provided by the authorities: the authors came to this conclusion (Melnikova, Lobanov, & Basha, 2014). This raises the question of who will create, develop and maintain this infrastructure, which is likely to belong to the public authorities, while the actual

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transactions can be carried out without their participation. On the one hand, Blockchain technology management means that the introduction of Blockchain technology at the government level ensures the information exchange and transactions between users according to the rules defined by the technology itself and implemented in the design of a system. Transactions can be fully automated and executed using Blockchain technology. This is similar to how the implementation of Bitcoin sets the conditions for digital money exchange. Blockchain technology management assumes that the government is developing a Blockchain system that implements the most appropriate type of Blockchain architecture. Surely, it is necessary to manage the development, implementation, maintenance and adaptation of the architectures and applications of the Blockchain. By this we will understand the management of Blockchain technology, which determines how this technology works and how users can interact with it. It is often the case that several experts dictate the rules in which an application manages users, whereas it is the developers who have an important role to play to ensure that the goals and objectives of public authorities and the social needs of the population are considered when designing and managing Blockchain architecture and applications. By the way, it is necessary to establish close cooperation between experts and policy makers, in order to develop the management of the Blockchain from one side, and to ensure compliance with social values and the achievement of social needs of the Blockchain for applications developed by other parties from another. Understanding these aspects and their implications to realize the benefits of this technology is an important task for improving the efficiency of the Blockchain architecture and applications. To do this, you need to assess the potential benefits of using Blockchain technology critically that will be discussed later. The main features of Blockchain technology, such as its distributed nature of P2P and a full copy of transactions on each node in the network, were discussed above. How can these features be used by public authorities for the benefit of society? Now, a large number of studies have revealed a significant number of such opportunities for the use of Blockchain technology to improve the efficiency of public authorities in the digital economy, which is summarized in Table 1 in the form of the author's ranking of technology features by management levels. This list of benefits, using Blockchain, is quite extensive and may not be fully implemented at the same time. In the absence of practical implementation, many of these possibilities are supported only by theoretical reasoning without empirical evidence. These features in some cases overlap and depend on each other, so the probability of their implementation depends on the design solutions in the Blockchain architecture and the application development process. The main advantages of using Blockchain are associated with improving data integrity and irrefutable transactions, which in turn leads to the tracking of changes (transparency), which, in turn, supports the anti-corruption component and prevention of other offenses. On the other hand, it is necessary to note that distributed solutions such as the Blockchain, is much more inefficient than traditional centralized solutions for databases from the perspective of scaling up to higher capacity, as well as from the standpoint of easy change, which leads to less flexibility (Nakamoto, 2018). This is especially true about open public Blockchain, such as Bitcoin or Ethereum, where their development should be supported by most users.

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Table 01. The potential benefits and prospects of using Blockchain in the digital economy

Level of use	Advantages and prospects	Essence
Strategic	Transparency	Open access to data. Transaction history remains visible and all nodes have a full set of transactions.
	Reduction of offences	Hacks or unauthorized changes are difficult to implement unnoticed because the information is stored in several registers, which are stored in different places.
	Reduction of corruption	Storing data in distributed registries prevents corruption by having clear rules for changing data that cannot be manipulated.
Organizational	Increase of trust	The credibility of the process increases due to the enhanced control because it's impossible to change the recording and to check data by multiple nodes.
	Transparency and verifiability	Ability to track transaction history and to audit transactions. Also, the presence of several registers allows you to access to check the consistency and reliability of the data.
	The greater capacity of prediction	As historical information is fully available, its availability increases the ability to predict.
	Enhanced control	Strengthening control by the need for consensus to add a transaction.
	Clearly defined rules	The management system clearly defines how information can be changed.
Economic	Reduction Cost	Conducting the costs and verifying the transaction can be reduced because no human involvement is required.
	Increased resistance to spam and DDOS attacks	A higher level of fault tolerance and security reduce the cost of measures to prevent attacks.
Informational	The integrity of the data and higher quality data	The information, stored in the system, corresponds to the objective reality due to the need for a consensus vote in the implementation of transactional operations and distributed nature of storage records. This results in improved data quality.
	Reduction of the " human factor»	Automatic transaction management and automated transaction execution reduces possible operators' errors.
	Access to information	The information is stored in several places, which can facilitate access and increase its speed.
	Privacy	The user can be anonymous by providing encryption keys or providing access rights so that other users cannot view the information.
	Reliability	Data is stored in multiple locations. Consensus mechanisms ensure that information is changed when and only when all parties concerned agree.
Technological	Resistance	Resistance to malicious behavior.
	Security	Because data is stored in multiple databases, the use of encryption becomes more complex. At the same time, the probability of simultaneous hacking of several databases is significantly lower.
	The constancy and the permanence (immutability)	After the data was recorded in the Blockchain, they cannot silently change or remove. In addition, the same data is stored in multiple registers.
	Reduced of energy consumption	Network power consumption is reduced by improving efficiency and transaction mechanisms.

Note: Source: authors.

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It is expected that the reliability of information will be improved through the use of consensus mechanisms that ensure that information is changed only when all parties concerned agree. Security is created through distributed registries, which are more difficult to manipulate. In the design process of the system, it is determined; the user is anonymous or uses a personalized access. For many applications in government, identity management will be a key aspect. Therefore, the Blockchain must be associated with identity management systems that can be used at the expense of other technological features, such as privacy. In this case, if there are a significant number of users, identity management will be very difficult, because in such circumstances it is difficult to ensure that the user who has the key is the one who should have the key. Table 01 shows the many benefits that Blockchain technology can provide, some of which may not meet the requirements of Blockchain in its original form and require significant organizational and regulatory improvements to allow the Blockchain system to function in a way that the effects from its use outweigh potential risks. From the results of the analysis presented in Table 1, it is clear that some advantages are realized with the use of other technologies (for example, encryption, identity management) and are not specific to Blockchain. Some other benefits are indirect consequences of using Blockchain, such as reducing fraud and corruption. Blockchain technology cannot prevent fraud in the provision of public services on its own: first of all, it is necessary to change the regulatory framework for the provision of public services to reduce fraud or corruption. In some cases, the advantages of using this technology look mythical. In particular, some studies (Olnes, Ubacht, & Janssen, 2017) consider the Blockchain as a way to counter repressive political regimes. The reduction of energy consumption is debatable, since the use of more computing nodes can lead to the opposite. It should also be noted that trust is not created only by technology. Blockchain technology can improve efficient control and audit, which ultimately can lead to greater confidence in the system. However, the key role is played by the necessary institutional mechanisms, which must be trusted. The implementation and operation phase determine what opportunities and how they can be implemented. Therefore, the ability to realize the specific benefits of using this technology depends on the applications of the Blockchain, the management activities of public authorities and the social and institutional context, using specific applications. Understanding the possibilities of Blockchain technology requires rethinking the processes in public authorities, their conditions and requirements to the government. It may be necessary to change existing structures to ensure efficient management of distributed transactions, considering the peculiarities of this technology. Furthermore, such an adapted structure must consider social needs in order to ensure the proper functioning of a public administration system that meets the requirements of society, such as equality of rights, transparency, accountability and confidentiality. Most of the possibilities can also be achieved using other technological means. This raises the question about benefits from using Blockchain that are specific and when Blockchain is the most appropriate solution, considering that Blockchain technology is still evolving and therefore it can change. To sum up, it should be noted that realizing the power of Blockchain can be more time-consuming than it seems at first glance. In addition, the realization of these opportunities may require the replacement of existing technologies, and implementation must be accompanied by effective governance at the state level. Researching features of this technology and its potential for government, it requires interdisciplinary research into possible Blockchain architectures and applications that combine the evolutionary nature of the technology with its institutional and social

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spread. In this context we need to make further review of options to build the relevant systems from the point of view of the context to implement the Blockchain possibilities. Public authorities need to consider which type of Blockchain technology is most appropriate, as there are advantages and trade-offs for each type. Understanding the most important architectural solutions is a key element. Control, data ownership, privacy and access are some of the key issues in building data applications. But it should be borne in mind that the more control is exercised at the level of management, the less the Blockchain system will resemble the original idea underlying the Blockchain. The potential of the Blockchain makes the technology attractive for governments and state agencies use. However, its distributed nature and the need to choose a particular technology require management decisions on the part of the government to take full advantage of these opportunities. While traditional systems have relatively simple control, the distributed nature of Blockchain technology requires changing roles of participants and applying new approaches to management. Implementation of Blockchain without detailed consideration of these issues may not lead to obtaining all the benefits. To do this, consider the following issues related to the implementation of Blockchain for e-government in the digital economy, which must be solved.

1. The Blockchain as a driver of transformation. Ensuring information integrity and implementing smart contracts, it can have a significant impact on organizing the ICT architecture, as well as on the way, how transactions are managed. Distributed registration of documents and assets has changed the traditional role of public authorities and new leadership roles are emerging. Changes, initiated by Blockchain technology, involve three stages:

1) traditional infrastructure;
2) Blockchain information infrastructure;
3) transformation.

2. Needs-based approach: no single solution. Ways to implement Blockchain can take different forms, resulting in different features. The introduction of the Blockchain largely depends on technology; often require different technological combinations to the Blockchain architecture to meet the requirements of e-government application. For example, transactions can be stored in the Blockchain, but the underlying document data can be stored in another system to which transactions belong. In other areas experiments with networks Blockchain without permits are already held on a large scale, and increasingly wide range of suppliers already offers the introduction of specialized technologies based on the Blockchain.

For e-government applications, institutional aspects play an important role and should be taken into account when Blockchain technology is used. As in cloud computing, the geographic location of servers and nodes will play a key role. In particular, in modern Russian realities servers should be geographically located in the territory controlled by the relevant authorities.

3. Conducting experiments and the need for standardization and flexibility. Blockchain adoption is not a linear, rational or deterministic process. There is a high level of uncertainty, and experiments are therefore needed to understand the technology and to assess its capabilities as well as its limitations. In addition, new technological innovations often lead to changes in the paradigm of human behavior, which in turn affects the technological usage. Experiments also require applications to be able to change and adapt to changing circumstances.

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However, it is not clear at this stage how the Blockchain implementation will meet this requirement of adaptability and update management in the implementation and management process. Further experiments are needed to explore this interaction between the technological characteristics of Blockchain systems and the specific requirements of processes in government.

4. The sharing infrastructure provider. Currently, a large number of experiments are being carried out in terms of Blockchain technological usage in public authorities. These experiments use different technologies and software, which can lead to fragmentation during the transition to continuous operation. As a distributed strategy is necessary to realize the key features of the technology and to further development, it can lead to fragmentation and large duplication of efforts in the long term. Therefore, the research (Olnes, Ubacht, & Janssen, 2017) (in order to provide a common standard for applications in the field of e-government) has revealed such a feature that the experiments should be based on the standardization in the field of e-government. This common infrastructure allows you to prevent the emergence of a new infrastructure for each project and reuses, having implemented opportunities. In addition, it may not be clear who controls the technology and whether the legal requirements are fully complied with. According to the authors (Dyatlov & Lobanov, 2017a) in the digital environment, increasingly dependent on technology and managed networks, everyone who owns and controls the platform, always hold considerable power over civil society. For public authorities this underlines the need to have the ability to control the technology and control it with the aim of providing state and municipal services that meet the population needs. At a general level, a Blockchain network without permissions has properties that point to the information infrastructure and therefore can be very important as future infrastructures for open innovation (Analytical statement, 2014). In many regions, governments have created their own cloud infrastructure to stimulate innovation. Likewise, the government can be a Blockchain provider, using the infrastructure that allows public authorities, municipalities and government agencies to create Blockchain apps and guarantee safe and reliable execution of legal requirements. To be compatible, technology needs to be harmonized as well as data standardization. Thus, the experience of implementing Blockchain technology can also be generalized, and new common standards can be created on its basis.

5. Data management and its transparency. It is expected that the Blockchain technology will facilitate direct interaction between the population and the public authorities, provided public and municipal services. It is often claimed that Blockchain technology replaces the intermediary. When using Blockchain technology, the system may not have a central authority or a third-party requiring authorization that verifies and approves the transaction. For example, Bitcoin does not need Central Bank to manage its currency. At the same time, in many situations, public authorities are the information owners, providing and updating it themselves. Blockchain technology can allow adjusting the role of the government in this process, maintaining the data legitimacy. Nevertheless, any organization in any case should design the system, manage and support it, which is the most important thing, according to some authors (Dyatlov, Lobanov, & Gilmanov, 2017). Hardware that uses Blockchain technology is always owned and operated by one or another owner, although they do not own or control the software running on it. Blockchain can change the power balance between parties, and in particular can change the role of information management. The focus will be on infrastructure development and management, as well as its

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adaptation to ensure adequate data quality. The government can play the role of a trusted administrator who initiates and manages the registry, determines transaction and audit rules to ensure the proper functioning of the system. In the role of an operator, public authorities are likely to be responsible for handling applications, and they may be responsible in the event of failures or data quality problems. Thus, Blockchain technology will require a change in the role of government. It is likely that the role of government will change, and more research will be needed to examine these structural shifts.

6. Audit of Blockchain applications. Audit is a systematic work analysis, made by an independent party. While traditional auditing focuses on transaction auditing, the immutable (or at least unaffected) nature of data storage displaces the focus from the audit to the system level. The Blockchain as the software and the algorithms, which it is based, must be validated to ensure its proper functioning, including for compliance with the legal requirements. This change in the nature of the audit procedure, according to some authors (Olnes, Ubacht, & Janssen, 2017), needs to be studied in order to assess its impact on the audit process and related entities.

Another important aspect should be noted. Russian President Vladimir Putin after a meeting with Ethereum project co-founder Buterin (2014) set the government a task to develop a framework for regulating the market of digital currencies and Blockchain. In Russia, a draft law "on digital financial assets" has been developed, as well as changes in the civil code, which provides for restrictions for unqualified investors, purchase and sale only on registered national platforms, mining is qualified as entrepreneurial activity with mandatory implementation of the extracted on national exchanges, cryptocurrency is considered as a digital asset, but not a legal payment means.

7. Conclusion

The results of the study confirmed that the modern global economy is an information network, intellectual and psychological economy with its inherent Hyper-competitive technologies and methods of information and psychological, programmable and controlled impact on the consciousness, psyche and people's will (producers and consumers) (Dyatlov, Bulavko, Balaovskaya, Nikitina, & Chudaeva, 2016). Within this research work, it is proved that the Blockchain technology is a fundamental innovative technology that offers new ways of recording transactions, events, certificates and access rights. Blockchain is a form of distributed computing in which transactions are democratized by introducing consensus mechanisms that allow a transaction to be made. As the application ways of this technology for personal reasons is extremely frequent, the Blockchain, according to study's results (Dyatlov & Lobanov, 2017b) offers significant advantages when it is used as a basic e-government technology at the Federal and regional levels. However, from a practical point of view, this approach is difficult to implement, and the possible results of its application for e-government should be explored through interdisciplinary research that goes beyond the generally accepted technology-based approach. The study identified potential benefits in terms of strategic, organizational, economic, information and technological aspects. However, the practical implementation of the proposed concepts can be a much more complex process than theoretical development. In this study, we identified two perspectives for public authorities regarding Blockchain architecture and applications. On the one hand, the prospect of Blockchain technology management, in which government agencies use Blockchain technology for their own processes, such as

the provision of public and municipal services, where Blockchain technology is used to manage transactions. Another perspective is called Blockchain technology management, which defines how the Blockchain should look like, how to adapt to changes and ensure the ability to implement the goals and objectives of public authorities, as well as the social needs of the population. Both perspectives imply a deep understanding of Blockchain technology in the context to develop digital economy institutions, which was emphasized in this study. The process of test implementation in public authorities Blockchain applications is paramount in order to gain a deeper understanding of the Blockchain as a complex socio-technical system and to find, may be redefined, its own role and functions within the changing institutional environment and economic paradigm. Based on the analysis of the emerging patterns of digital transformation in the world and national economies, it can be concluded that the results of the study made by some authors (Dyatlov, Lobanov, & Selischeva, 2017) the recent large-scale processes of digital transformation, convergence and information spaces integration, as well as the widespread introduction of Blockchain technology, launch the process of "creative destruction" in the out-of -date world financial and economic system and its institutions, as well as forming a neuro-network of the global hypercompetitive economy.

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