



Opportunities and Barriers of Using Blockchain in Public Administration: The Case of Real Estate Registration in Kazakhstan

Yerlan Akhmetbek¹, David Špaček²

Abstract

Blockchain technology has a great potential for improving public administration – its transparency and efficiency. It is also discussed as an instrument for reducing corruption and transaction costs. This paper discusses the potential use of blockchain technology in public administration. It is based on a case-study approach focusing on real estate registration in Kazakhstan. Particular attention is paid to identifying factors hindering the development of the blockchain technology. The paper indicates that the main barriers to further use of blockchain technology in Kazakhstan are insufficient legislation and also the complexity of the technical implementation of blockchain projects and integration with existing systems.

Keywords:

blockchain, public administration, real estate registration, Kazakhstan

1. Introduction

In the last decade, there has been a massive interest in blockchain technology, which is rapidly gaining popularity and, along with the Internet, is becoming an apparent phenomenon in recent digital technologies. Blockchain is the most well-known and used distributed ledger technology, its core innovation is essentially a distributed append-only ledger on which messages can be irrevocably recorded (Allessie et al. 2019). So the main advantage of it is that it is rather hard to make illegal changes to databases (Klechikov et al. 2017). In addition, the blockchain eliminates any intermediaries, and all operations are performed directly between the participants of

1 Academy of Public Administration under the President of the Republic of Kazakhstan, Ministry of Justice of the Republic of Kazakhstan, Kazakhstan.

2 Masaryk University, Faculty of Economics and Administration, Brno, Czech Republic.

the system, which makes it more cost-effective (Saveliev 2016). Blockchain actively penetrates into many areas of the economy and human life, especially in the financial and economic spheres, in particular in the cryptocurrency market. However, the scope of application of this technology is not limited to one financial area. There are also examples of its application in both the private and the public sectors.

As a field, the use of blockchain technology for e-government applications is still in its infancy (Alexopoulos et al. 2018). It is estimated that the introduction of blockchain technology in public administration will increase the efficiency of public services while ensuring reliability and immutability of data and reducing the level of corruption (Momo et al. 2019; Cavalcante 2018). Maza (2019) and Thakur et al. (2019) argue that blockchain can be a tool that can work for the benefit of society, ensuring information security and compliance with legislation through an encrypted model of storing government data and distributed registries. Feng et al. (2017) assume that blockchain can transform the application of digital technologies to smart cities from two aspects: automation and security. Rot et al. (2020) conclude that the governments of many countries approach blockchain technology not only as an innovative solution but also as a tool for creating new management work methods and models in various areas of public administration. Allesie et al. (2019) emphasize the impotence of reducing economic costs, time and complexity in inter-governmental and public-private information exchanges, to reduce bureaucracy, discretionary power and corruption, to increase automation, transparency, auditability and accountability of information in government registries and to increase trust in governmental processes and record keeping.

On the other hand, also challenges have been discussed in literature – e.g. potential delays of transactions, privacy leakages, selfishness of miners, trust of the technology, or incompatibility of some GDPR requirements (Alexopoulos et al. 2018).

The potential of blockchain technology is rather relevant also in the area of the real estate registration, including land plots. Sweden is conceivably recognized as a pioneer country where blockchain technology is used in the cadastral system for the accounting of real estate, in particular land plots (Golovanova and Zubarev 2018). The Swedish Cadastral Service stores all the documentation in the blockchain, but at the same time, it is available to other participants of the system. The authenticity of the signature confirming the ownership rights, the contract and the mortgage documents are protected by blockchain (Pankratov et al. 2020). Available information indicates the following benefits of blockchain deployment in Georgia (Allesie et al. 2019): a significant reduction of the land title registration and verification time; increased transparency in the registration process of land titles; increased reliability for citizens driven by the accuracy of the data stored; efficiency gains realized in the ecosystem.

Despite the measures taken by the central government in Kazakhstan, the area of real estate registration is rather vulnerable in terms of corruption offences and

abuse of power by officials. Law enforcement agencies are still detecting the facts of forgery of official documents (Kazinform 2019). This paper outlines and discusses the potential use of blockchain technology in public administration. It is based on a case-study approach focusing on real estate registration in Kazakhstan. Particular attention is paid to the identification of factors hindering the development of blockchain technology.

The paper is structured as follows: first, theoretical background and methodology are summarized. This is followed by the introduction of the national context in Kazakhstan and findings focusing on the organizational and the micro-level. The paper is finished with a discussion and points for further improvement.

Preparation of this paper was supported from the project of Czech Science Foundation (GA19-06020S).

2. Theoretical background and methodology

Blockchain is a new data-storage technology, however, based on older concepts – e.g. the concept of smart contracts introduced by Szabo (1996). According to Gartner (2019), it not only remains a relevant strategic trend, but also a technology that is among the top five IT trends that will significantly affect business, society and every person in the next 5–10 years. He believes that blockchain is a type of distributed registry that expands chronologically through cryptographically signed, irrevocable transactions that are simultaneously distributed among all participants of the platform. Blockchain is an incorruptible digital ledger of economic transactions which can not only record financial transactions, but also almost any value (Tapscott and Tapscott 2020). The technology became widely known in 2008 when Nakamoto proposed a new technical solution for the digital payment system used in the bitcoin cryptocurrency allowing for users to carry out financial transactions directly without the involvement of intermediaries (Nakamoto 2008). According to Swan (2017), blockchain is a technology for securely distributed storage of records of all bitcoin transactions ever committed.

The technology consists of the following key components: a decentralized distributed platform, nodes, encryption (hashing), consensus, smart contracts, and tokenization. The decentralized distributed platform (hereinafter referred to as DDP) is understood as a database that is simultaneously available to all users of the system and has the functions of data immutability (Varnavskiy et al. 2020). Unlike centralized database systems, where all relationships and operations are looped into a central control server, in a decentralized system there is no central control body, and interaction is carried out directly with the participants in the system. The fundamental principle of the DDP is that blocks are created in it with various kinds of data or transaction records, which are linked together by means of codes, the so-called “hashes”. All this continues in a given sequence in one chain. The data re-

corded in the block may contain information about any transactions made, including with real estate, about fulfilled or deferred obligations, or about other events. In contrast to the centralized systems, there is no complete trust between the participants in a decentralized system. On the contrary, the system is programmed so that the previously agreed terms and obligations cannot be changed, and there is practically no human factor. To provide access to the platform, keys are generated in the DDP, with the help of which the system participants are given access to data.

Regarding its use in public administration, Lelou (2018), for instance, summarized that blockchain can be considered a software product that allows storing and transforming value or data using the Internet in a secure and transparent way, without having a central governing body. Similarly, the OECD (2018) concludes that blockchain is a public registry of transactions between parties on the network that is not controlled by a central authority. In this registry of transactions, transactions are stored permanently unchanged using cryptographic encryption methods (WTO 2018). In principle, parties that do not know each other can safely interact in a digital environment and exchange new forms of value and assets, without the need for central management, and transactions in the network are carried out directly between its participants. At the same time, all users of the blockchain network simultaneously own the data. All assets and liabilities are recorded in blocks and are simultaneously distributed among all platform participants. As soon as the nodes confirm the complete fulfillment of obligations by the parties, the system automatically fulfills the terms of the smart contract, while all transactions are carried out directly between the parties, without intermediaries (Christidis and Devetsikiotis 2016). Unlike the central management of the system, there is no single control centre in the blockchain, the system is decentralized, and the network participants, who can be distributed around the world, directly handle the maintenance of its functioning. For this reason, a blockchain-based technology system is very difficult to hack. In addition, the data are also hard to manipulate because they are located on numerous stand-alone servers and computers. If any part of the input data changes (for example, an attacker changes the transferred amount), the hash will change to a completely different character set and make it incompatible with the rest of the chain, and the system will reject this transaction accordingly. Hence, even without seeing the details of a transaction, nodes can quickly determine that the data in a block has been tampered and rejected the transaction. This cryptographic security makes decentralized blockchain platforms more reliable and immutable. In order to change something in the blocks, it is necessary to obtain the consent of more than 51 % of the participants in the system, which is practically not possible to implement (Scholz et al. 2017; Pryanikov and Chugunov 2017). Therefore, blockchain technology allows parties to track transactions starting from their origin, which is not conceivable all the time in traditional financial systems or information systems in general. Consensus is one of the key characteristics of blockchain technology, with the help of which all participants in the system can make decisions according

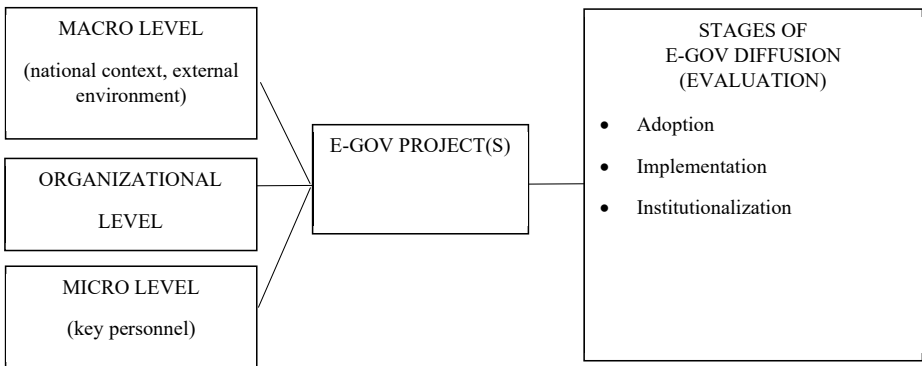
to a pre-agreed algorithm, and all processes must have the same value for all (Lelou 2018; Shilov and Zubarev 2018; Yaga et al. 2019).

Literature is also concerned about some issues of blockchain implementation in public administration. Talapina (2020), for instance, argues that the very principle of the classic blockchain is based on a decentralized data-exchange system and the transfer of all public services to a decentralized blockchain platform can lead to a loss of control by the state and can jeopardize not only the normal functioning of state bodies. According to her, it may also threaten the national security of the country.

The paper discusses the potential benefits of the use of blockchain technology in public administration. We examine Kazakhstan's experience of digitalization in the area of real-estate registration, analyze the current use and discuss the potential of future use of blockchain technology in real-estate registration. The paper is based on a single case-study design (Zongozzi and Wessels 2016). Data were obtained through desk-research and observations of practices used in real-estate registration. The case-study approach was used because it allows researchers to go a mile deep rather than a mile wide (Johnson 2014), and similar approaches are considered to be more practical, because they may provide useful information that can inform decision-making (Yin 2013). The official data of the Committee for legal statistics and special accounts of the General Prosecutor's Office of the Republic of Kazakhstan, the Anti-corruption Agency of the Republic of Kazakhstan were used. We also surveyed the content of the current legislation, and state programmes in the field of real-estate registration have been analyzed.

During the analysis the framework outlined in the following figure is used:

Figure 1
Analytical model



Source: Steinbach et al. (2019), adapted to e-government by authors.

The analytical model is based on the assumption that the government can be considered a central actor of e-government development. The importance of the side of government and public administration has been confirmed in e-government literature. E-government development/use is often determined by the government and public administration. As Welch and Feeney (2014) suggested, outcomes of e-government are conditioned by technology use and capacity in government and the organizational culture in which those technologies are being implemented. Therefore, also additional levels should be added to the analytical framework that is suggested for e-government exploration and evaluation. The approach of Steinbach et al. (2019) that was originally suggested for the evaluation of the diffusion of e-government was adapted for this paper. The adaptation is in line with e-government literature, and it is believed that it can be sufficient for analysing our case. Various meta-analyses concluded that for e-government development various variables might be relevant that can be grouped similarly to the model used in the paper. For instance, Rana et al. (2011) enumerate the following groups of variables that can be used in researching e-government: environmental characteristics, organizational characteristics, individual characteristics and innovation characteristics. Chen (2010) differentiates environmental setting, institutional characteristics, government capacity and government style. Müller and Skau (2015) work with the following categories of e-government implementation success factors: external environment, organization, management, employee, citizens (users) and technology. The levels of adoption that are used by Steinbach et al. (2019) are similar to a model suggested by Frambach and Schillewaert (2002) that recognizes 6 stages/phases of technology adoption: awareness, consideration, intention, adoption decision, continuous use and user acceptance.

The analytical framework works with three levels of analysis of e-government diffusion – the micro-level (actors like employees and managers), the meso-level (organizations and their characteristics like organizational size, organizational culture, practices); and the macro-level (an external environment that includes factors such as national culture, regulations, and societal norms). It differentiates three stages of e-government diffusion – adoption (organizations become aware of and learn about ICTs, gather information to evaluate the potential benefits and make the decision whether to acquire ICTs); implementation (integration of innovations into organizational processes and structures); institutionalization (ICTs become integrated into organizational routines and structures).

3. National approach to use blockchain in PA in Kazakhstan

Kazakhstan does not stand aside from innovations, but generally, the situation with the use of blockchain technology can be described as an initial stage of development. Currently, blockchain technology is at the stage of development and implementation of pilot projects.

The Republic of Kazakhstan is currently implementing the state programme “Digital Kazakhstan” for 2018–2022 in five key areas, one of which is the “Transition to a digital state”. However, within the framework of this programme, blockchain and distributed registry technologies are not designated as tools and methods implemented in the public administration system. In this programme, blockchain technology is perceived as an economic technology that has all the prerequisites to make a global transformation of the monetary system (Government of Kazakhstan 2017). Therefore, blockchain technology as a strategic direction for improving the public administration of Kazakhstan has not yet been identified. At the same time, the country’s leadership pays serious attention to the issues of digitalization of public administration, in connection with which the Government is tasked with transferring all public services into an electronic format, while using the potential of new digital technologies, including blockchain. In 2020, Kazakhstan adopted a law regulating digital technologies (Law of the Republic of Kazakhstan 2020) that also contains concepts and terms related to blockchain technology and distributed data registries. Nevertheless, in the law, there are no clear special provisions and standards for their implementation in public administration.

Two independent associations carry out public regulation in Kazakhstan:

- 1) The National Association of Blockchain and Data Centres Industry in Kazakhstan (hereinafter referred to as the Association), acting as the country’s ambassador in the implementation of international programmes and the integration of Kazakhstan’s blockchain projects into the international community, as well as participating in the process of amending the legal regulation of the IT sector (NABDC 2018).

The Association was established in 2018 with the support of the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan and is a union of legal entities created to develop and popularize blockchain technology in the territory Republic of Kazakhstan. The main areas of participation of the Association are the following areas:

- Development of start-ups and support for projects in the field of blockchain and crypto technologies;
- Development of blockchain infrastructure;
- Implementation of blockchain technology in the public administration system.

The Association has a significant role in the development of the draft Law of the Republic of Kazakhstan on the regulation of digital technologies, including the regulation of blockchain technologies, which was adopted in 2020. Unlike the Association “BlockchainKZ”, this Association cooperates more closely with

government agencies and conducts joint actions to further develop blockchain technology and improve its regulatory framework.

- 2) The Association of Developers and Users of blockchain Technology “BlockchainKZ”, (hereinafter referred to as the Association BlockchainKZ), popularizing the technology itself, conducting open courses and participating in university training programmes in the field of blockchain. The Association BlockchainKZ mainly consists of entrepreneurs directly involved in real blockchain projects. Thus, the employees of the Association BlockchainKZ have developed a blockchain platform called “Tamyр”, with the help of which you can develop various decentralized applications for business and the state. Any software can interact with the “Tamyр” platform via API. In addition, it solves traditional blockchain tasks – issuing coins, creating exchanges and smart contracts (Blockchainkz 2020). In order to increase literacy among the population, the Association BlockchainKZ has developed its own author training course entitled “About Blockchain, Mining, and Cryptocurrencies”. Since the introduction of this course, more than 600 people have been trained, and 40 masterclasses have been held, which were attended by over 5,000 people (BlockchainKZ 2020).

In the public administration system of Kazakhstan, as of the beginning of 2021, several pilot projects based on blockchain technology are already being implemented, including (Egov.kz 2020):

- 1) An administration system for the collection and refund of value-added tax (VAT) based on blockchain called “VAT Blockchain”. This project will allow you to track the financial flows of VAT and ensure the transparency of the execution of tax obligations of taxpayers in real-time for the subsequent accelerated VAT refund to end consumers of goods. This mechanism reduced the VAT refund period for exporters from 55 to 15 working days. Previously, most of this time was spent checking and applying the risk management system, but now the VAT refund is made automatically without any checks and risk assessments, and no one can add or delete a VAT transaction retroactively (Baigenews.kz 2019).
- 2) The National Bank of Kazakhstan has launched a platform called “Invest Online”, based on the “blockchain” technology, for registering transactions with securities and confirming ownership rights. With the help of this service, citizens of Kazakhstan can invest in securities online, receiving a guaranteed income, while the system uses the “blockchain” technology to register transactions with securities and confirm their ownership rights (Nationalbank.kz 2018).
- 3) In a pilot format, on the platform of the Non-profit Joint-stock Company State Corporation “Government for Citizens”, “blockchain” technology is implemented in the process of providing services for registering a pledge agreement for individuals (Gov4c.kz 2020).

Nowadays, the projects are mainly implemented in a pilot format and have not been fully implemented yet. There are also certain vulnerabilities regarding information security and data security, as well as the high cost of developing and implementing projects.

4. Organizational level and micro-level – blockchain in the field of real estate registration

The real estate market has always been attractive for easy money and fraud. Fraud and other types of crimes in the field of real-estate turnover, including with the participation of representatives of state bodies and organizations, still occur in Kazakhstan. Despite the measures taken by the national government, law-enforcement agencies annually continue to identify facts of forgery of title documents for real estate, abuse by officials and notaries when registering fictitious transactions, as well as official forgeries. According to the Committee for Legal Statistics and Special Accounts of the General Prosecutor's Office of the Republic of Kazakhstan, about 200 criminal cases are initiated annually as official forgeries of official documents and data of state bodies, with colossal damage to the state (Informburo.kz 2018a). Blockchain technology can reduce issues related to violations in the field of registration and real estate transactions and unreliable data.

A joint project focusing on the use of blockchain technology is being implemented in cooperation with the Ministry of Justice of Kazakhstan, the State Corporation "Government for Citizens" (hereinafter – State Corporation) and one of the private banks called "Forte Bank" (hereinafter – bank).

The basis for the implementation of this project was the instruction of the Head of State of the Republic of Kazakhstan regarding the maximum transfer of public services to electronic format, as well as reducing financial and time costs and ensuring transparency of procedures for the provision of public services (Akorda.kz 2018). In pursuance of this instruction, the Government approved a roadmap for optimizing the business process in the provision of the state service "State registration of a mortgage on the real estate using blockchain technology". This roadmap described the entire progress of the project and the roles of the project participants. The Ministry of Justice acted here in the role of the developer of normative documents concerning the registration of mortgages on real estate and their introduction into the current legislation. The State Corporation represents a non-profit joint-stock company, and its main goal is to provide public services to the population on the one-stop-shop principle, where all citizens can receive services in one place (Gov4c.kz 2021). In this project, the State Corporation acts as a registering body, since the state information system "real estate register" is under its control. In this scheme, the bank initiates information exchange; its role is to send an initial application for registration of a pledge and receive the result of information processing

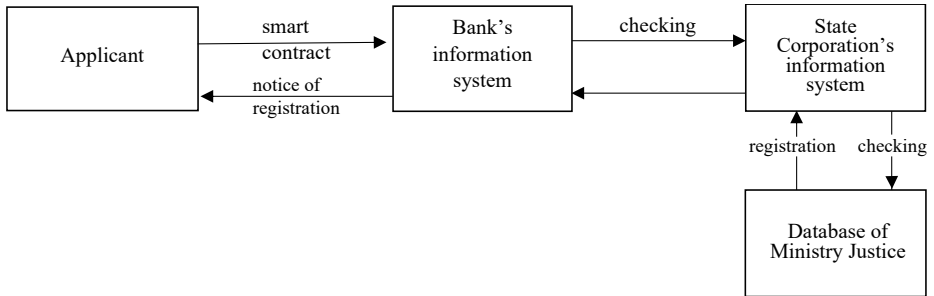
in electronic format from the information systems of the Ministry of Justice and the State Corporation. In principle, all technical implementation and its support lies with the State Corporation and the bank.

The main goal of the joint project is to transfer the state registration of bank collateral of real estate to an electronic format with the use of blockchain technology in order to ensure the immutability and safety of documents. The essence of this project is as follows: If earlier, citizens had to apply physically for the registration of a pledge of real estate at the State Corporation to obtain certificates of the presence or absence of real estate encumbrances and then carry it to the bank, with the introduction of the new services this whole procedure is fully done online. At the same time, earlier the procedure was highly bureaucratic and created conditions for committing corrupt actions – citizens had to wait for a long time, and some gave a bribe for speeding up the procedure (Inforburo.kz 2018b). Thanks to the project this procedure can be carried out now without any contact with government officials and leaving the house by means of a computer and an electronic digital signature. This registration is carried out within one working day.

The procedure can be outlined below, Figure 2.

1. An applicant applying to a bank for a loan pledges his real estate as collateral.
2. The bank accepts documents for real estate from the applicant and, through integration, sends a request to the information system of the State Corporation at the location of the real-estate object to check for any encumbrances on it. In the absence of encumbrances on real estate, the bank forms a smart pledge contract, which is signed by the bank and the applicant via an electronic digital signature. The bank then uses its information system to send the signed smart contract with the scanned documents (title documents and payment receipt) for registration to the information system of the branch of the State Corporation at the location of the real estate object.
3. The State Corporation accepts these documents in electronic form and conducts a legal analysis of the received documents. The State Corporation then registers the smart contract and sends an electronic notification of registration to the bank's information system and to the information system of legal cadastre of the Ministry of Justice. From this system, the notification of the provision of the service is sent to the bank's information system and to the applicant's personal account and he/she is notified about this by SMS. In the end, the applicant receives an electronic document on the registration of the pledge agreement for real estate, which can be downloaded and printed.

Figure 2
Business process of collateral registration



Source: Authors.

It should be noted that blockchain is used here as a tool to ensure the immutability and security of data, and the technology of smart contracts serves as a guarantee of secure bilateral transactions without the participation of intermediaries. In addition, this project was fully implemented at the expense of the project participants' own available budgets, and no additional funds were allocated from the state budget for this project.

The project implementation period from the beginning of the initiation to its implementation was 1.5 years. At the initial stage, at the level of technical readiness, the project was tested in two cities of the country, and only after successful piloting was it implemented throughout the country. The introduction of this method of registration of collateral has allowed speeding up the process of registration of collateral, reducing costs and generally simplifying the procedure for issuing loans. Given that the functions of state registration of real-estate collateral currently belong to the state, this project used the model of a private blockchain, which is mainly used in closed organizations with limited access for certain individuals and with their own nodes. The information systems of the Ministry of Justice, the State Corporation and the private bank act as the authentication nodes here. All the specified nodes store all the data on operations performed and contracts concluded.

At the same time, this blockchain network is organized using hardware certified means of cryptographic protection of at least level-three security, where the hash code length must be at least 250 bits, according to the State standard of the Republic of Kazakhstan ST RK 1073-2007 (ST RK 1073-2007).

Apparently, the requirement for cryptographic protection and information security is the main reason for slowing down the widespread distribution of this service among banks, since banks need to additionally work out these conditions. At the same time it must be noted that in order to unify and form a unified approach, the Ministry of Justice, the State Corporation and the bank have developed and

approved a technical specification for the implementation of the state service “State registration of collateral for real estate, using blockchain technology”. With the help of this document, any bank can immediately begin the implementation and testing of this public service without prior analysis and elaboration of documentation.

Our own observations on this project that were conducted during the internship at the State Corporation and the Ministry of Justice showed the following results:

1. The average request processing time was 10 seconds, with a maximum allowed request processing time of 30 seconds.
2. The peak load of integration is 2,000 requests per hour, with a normal average load of 360 requests per hour.
3. System failures were not observed, the requirement for a failure-free operation time is 365/7/24, with a recovery time of 3 hours.

Thus, the implementation of this project allowed us to achieve the following results:

- The deadline for registering a pledge on real estate has been reduced from three working days to one;
- Exclusion of paper document flow;
- Reduced financial costs for citizens;
- Personal contact with civil servants is minimized;
- The reliability and safety of the data is ensured.

5. Discussions and suggestions for further improvement

The previously mentioned text clearly indicates that blockchain technology has its potential in the area of real-estate registration. The paper indicates that with regard to the use of blockchain technology, the approach in Kazakhstan can be considered adoption. There is some awareness about its potential, and organizations have learned about it, try to gather information to evaluate the potential benefits and already made some decisions to acquire it. Thanks to the initial project, a certain material was obtained with a detailed description of the algorithm and technical conditions for the implementation of this project. The analysis of the experience with the implemented project allows us to expand the scope of the application of blockchain technology and consider the possibility of using it in the procedure for conducting transactions and registering real estate.

Based on the experiences gathered, further improvement can be suggested in procedures for conducting transactions and registering real estate in Kazakhstan. Currently, the procedure for state registration of real estate is carried out based on the law on state registration of rights to the immovable property from 2007. In ac-

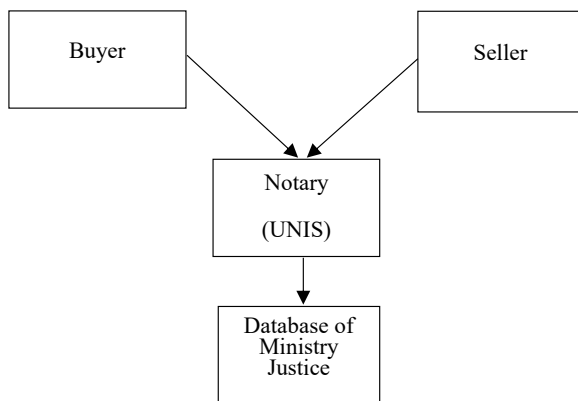
cordance with the law, the registration of real-estate transactions is carried out in two ways.

Method 1. Directly in the branches of the State Corporation, where citizens, having provided all the originals of the transaction agreement and title documents, can register their rights to real estate. Registration is held within one working day from the moment of receipt of the documents to the registration authority.

Method 2. Electronic registration is carried out through the Unified Notary Information System (hereinafter-UNIS) introduced in 2013. This procedure is carried out by sending electronic copies of contracts on real-estate transactions from the UNIS to the information system of the registering authority – the state database of the Ministry of Justice of the Republic of Kazakhstan. The terms of registration are also set within one working day from the day after the payment for registration is received.

Registration of the transaction in the electronic registration of real estate is carried out at the notary, where the parties enter into a written contract, an electronic copy of which is automatically sent via UNIS to the database of the Ministry of Justice, as shown in Figure 3.

Figure 3
The current model of the real-estate registration procedure in the Republic of Kazakhstan



Source: Authors.

The payment for notarizing the transaction according to the approved tariffs for individuals is 12 monthly-calculated indicators (which is about \$ 83 as of April 2021). If the payment is made in a non-cash form, the bank commission for the transfer is additionally paid. The average commission of second-tier banks in Kazakhstan is between 1 and 3 % of the transfer amount.

The current model involves four stakeholders, such as the parties to the transaction (the seller and the buyer), the notary and the registration authority.

Undoubtedly, this method of registering real-estate transactions has allowed citizens to make transactions quickly and efficiently within one working day, as well as without red tape in one workplace, at a notary. At the same time, as judicial practice and legal statistics show (Anticorr.kz 2020, Kazinform 2019), there are also some shortcomings in the current procedure for registering real estate, which may cause significant damage to citizens and organizations and negatively affect the image of state bodies. They can be summarized as follows:

1. In central management models of information systems, it is possible for an unscrupulous employee of the information system support to replace data about the owners and areas of real estate.
2. Unscrupulous notaries may conclude a fictitious transaction.
3. False documents may be submitted by an unscrupulous owner.
4. Technical failure of the system can occur due to an increase in the volume of data and the load on the server equipment.
5. An unscrupulous employee of the registration authority may unlawfully remove the arrests and encumbrances on real estate.
6. Manual correction of incorrect data in the real estate registration database (human factor) can also affect the reliability of the data.

The procedures can benefit from the use of blockchain technology. The proposed scheme of the business process of real estate registration is as follows.

First, it is necessary to develop a blockchain platform on which all transactions on deals and the automatic registration of real estate will be carried out using smart contracts. All participants adopt rules that allow all documents within this network to be recognized as having the same legal force as a document with a seal and signature. Thus, all users of the system are united in one network, the functioning of which is carried out on the principles of the “blockchain” technology.

As mentioned above in the blockchain system, to confirm transactions, you need to have authentication nodes that can be located around the world. Therefore, it is necessary to decide on the type of blockchain and choose between private and public blockchains. A private blockchain is used in closed organizations with limited access for certain individuals and with their own nodes, and a public one without access restrictions with multiple nodes located around the world. Due to the fact that the functions of real-estate registration currently belong to the state, it is inevitable to create a kind of symbiosis between private and public blockchains that may be called the “hybrid blockchain”. From the private blockchain strict user authentication can be used which will eliminate the anonymity of participants and

apply a scheme of authentication nodes, where several specific state and quasi-state organizations, but independent of each other, can act as such. In this case, it is proposed to use the data centres of the national telecom operator, Kazakhtelecom JSC, the national operator of the information and communication infrastructure of the electronic government, JSC National Information Technologies, as well as the information system of the Ministry of Justice of the Republic of Kazakhstan, “Real Estate Register”, as the authentication nodes. For each real-estate object in the system, a blockchain passport would be compiled with its own access code, which will contain all information in digital format about the property, indicating data about the owners, area, cadastral registration, location, and other characteristics. The blockchain platform will provide an automatic service for checking real estate about the presence or absence of encumbrances on it.

Since the blockchain platform is supposed to conduct all real-estate transactions using smart contract technology, i.e. directly between the participants, it is necessary to provide a payment system through which the purchase and sale of real estate will be carried out. Moreover, here the question arises what to use as a means of payment, since in the classic blockchain, cryptocurrency is used as a means of payment. However, because currently the Kazakhstan legislation does not officially recognize the cryptocurrency as a means of payment, two options for replacing the cryptocurrency are proposed.

The first option is to use the current national currency *tenge* in electronic format. To implement this scheme, the blockchain platform will need to integrate with the information systems of second-tier banks. In this case, the bank will inform the system about the payment. However, this scheme has the disadvantage that the bank has an additional intermediary, who will charge a certain commission for confirming the transactions carried out, and the procedure for confirming the payment in the bank may take some time.

The second option is the use of tokens for making payments in real estate transactions, i.e. instead of an electronic national currency, a token will act as a single means of payment in this blockchain network. For this purpose, a specialized token with low volatility may be issued, pegged, for example, to the US dollar or to gold. In the future, the token can be converted into the national currency through exchanges or banks. In this case, when conducting a transaction, we avoid an unnecessary intermediary, namely the bank, since all transactions in the blockchain network are made between the participants instantly. At the same time, the commissions that are paid to the owners of the system are small. According to the information portal “Blockchain.com” on average, the commission per transaction varies between 30 cents to 6 US dollars (Blockchain.com 2020).

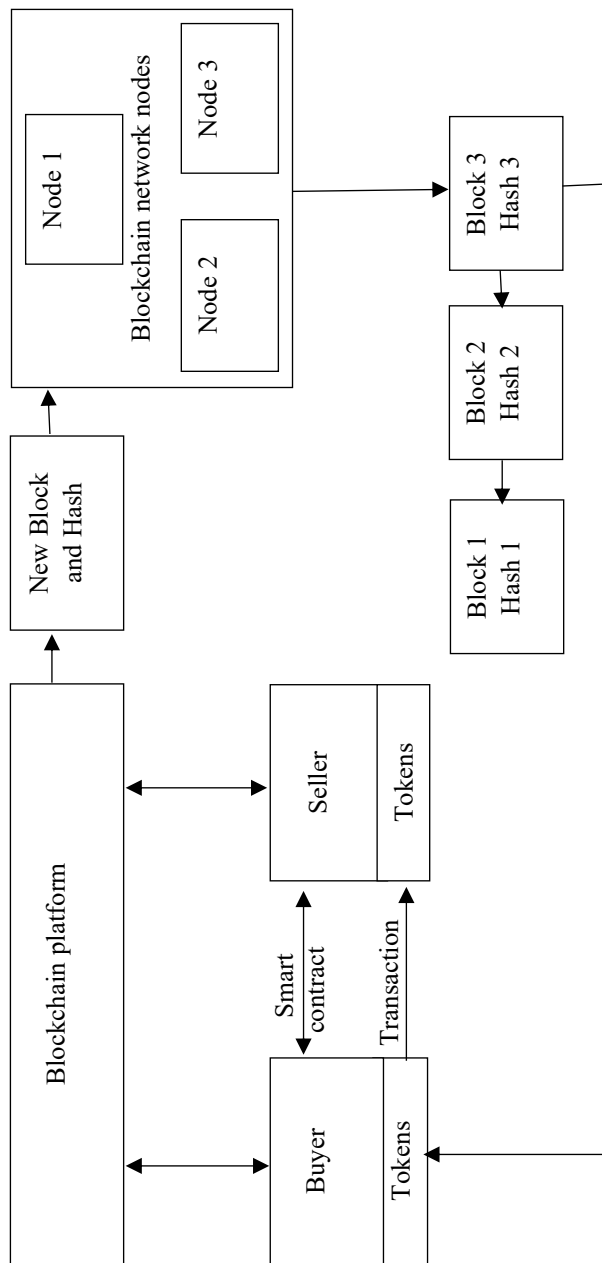
Of the two options, the second one with the use of tokens is preferable. Here we will get a high transaction speed and economic benefit. Each owner of a real-estate object registered on the blockchain platform will have electronic keys to access

the system and an electronic signature to perform transactions with his real estate. In addition, an electronic wallet for tokens will be opened for each user to make a payment and receive payment. In case of sale of a real-estate object, the owner places the terms of the smart contract on the blockchain platform with full information about the object and its value in tokens. Any user, having logged on to the blockchain platform, can purchase the selected real estate placed in the sales sector of the platform. By clicking on the “buy” button, the smart contract itself is sent to the potential buyer in his personal account, where all the terms of the transaction and instructions for concluding the transaction are described, as well as information about the presence or absence of encumbrances on this property.

In the case of consent to the transaction for the sale of real estate, the seller and the buyer sign a smart contract by means of an electronic signature, while the system blocks a certain number of tokens from the buyer, agreed upon under the terms of the contract. Further, this contract in electronic form is immediately sent to all authentication nodes that verify this operation by comparing the record of the new transaction with the records of the previous block. Upon successful verification, the tokens are transferred to the seller’s account on his e-wallet. Simultaneously with the payment, a new block is formed on the blockchain platform with a new hash and an encrypted record of the new owner of this property, which is automatically attached to the previous blocks and distributed to all nodes, including the state database “Real Estate Register”, where it will be permanently stored. This eliminates the possibility of unauthorized changes to the data recorded in the blocks, since the system is decentralized and the nodes are independent of each other. Thus, the entire cycle of the transaction procedure and registration of real estate takes place.

The suggested solution makes it possible for the transaction to be made in a single system without intermediaries, including notaries and banks, with the exception of the transaction fee, which significantly reduces the financial costs for citizens and organizations. In addition, all real estate transactions on the blockchain platform are conducted around the clock, which allows users to carry out transactions at any time of the day and without personal presence from anywhere in the world, with only access to the Internet, a new model illustrated in Figure 4.

Figure 4
Conceptual scheme of blockchain registration of real estate



Source: Authors.

Compared to the older approach and considering the potential of blockchain technology discussed in the literature, the new solution suggested may have especially the following advantages:

- The possibility of unauthorized data changes is excluded.
- The safety of documents is ensured and increased.
- Transactions can be executed instantly, and the service is available 24/7.
- There are no intermediaries (notary, real-estate agent, banks).
- There may be economic benefits for citizens and organizations (e.g. lower cost of transaction processing services).
- The transparency of transactions is increased (all transactions are stored in the network).
- Implementation of payments exclusively in electronic format may increase the tax base.

However, the model also has some risks, which in the future may become an obstacle to its widespread dissemination:

1. The situation where a transaction made through a smart contract is declared invalid by a court.

In this case, due to the presence of the property of data immutability, it is impossible to roll back a previously conducted transaction on the blockchain platform. At the same time, the “blockchain” technology provides an opportunity to cancel a transaction by making a new transaction and creating a new block, but in the archive of the database, the information about the property will remain the same until the transaction is declared invalid.

2. The situation when the purchase and sale of real estate involves three or more participants in the transaction.

Almost all implemented blockchain projects are based on two-way smart contracts, and therefore it is necessary to work out the possibility of participation in a smart contract of three or more participants in the transaction.

3. The situation when a member of a blockchain platform has lost the private keys to access it.

Private keys are the generation of numbers and symbols chosen at random in blockchain network. In fact, the keys are a hash function, and they act as proof of ownership of funds placed on the blockchain platform. If the keys are lost, access to the property will also be permanently lost.

Another important problem that may become a barrier to the introduction of blockchain in the field of real-estate registration may be the inability to verify the

validity of the will of the parties in the transaction. since in accordance with national legislation, the notary must make sure whether the parties voluntarily express a willingness to make a transaction. In the case of a blockchain model, it will be problematic to perform such a check.

6. Concluding remarks

The paper indicates that blockchain technology has good prospects for its use in the public-administration system, especially in those areas where it is necessary to ensure the reliability and immutability of data with a high degree of information security, which is achieved through cryptographic encryption and allows you to save data in an unchanged state, which is very important for any state. Indeed, the use of the potential of blockchain in the registration of bank collateral has allowed us to speed up the process of registration of collateral, reduce costs and generally simplify the procedure for issuing loans.

The current model of electronic registration and real-estate transactions, which was legally adopted in Kazakhstan in 2013, has significantly simplified this procedure, reducing the red tape and time spent on registration of real-estate transactions and bringing the terms of its implementation to one day. However, as practice and legal statistics show, there are still some gaps in this model in terms of ensuring the reliability of data, and there are loopholes for manipulation and offenses, including those of a corrupt nature. In addition, a centralized form of database management and increasing loads on server equipment can cause technical failures of the system, which increases the risk of data loss.

As part of the research, we proposed a new model of registration and real estate transactions based on blockchain technology, which eliminates the above-mentioned risks inherent in the current model. This model has a number of advantages, such as immutability and data security, which is very important for government databases. All records in the blockchain have a high degree of protection through cryptographic encryption. The high speed and low transaction costs compared to the current model make it more attractive, especially for citizens and organizations. The possibility of conducting a real-estate transaction at any time of the day and from any place can also be attributed to the positive characteristics of this model. The decentralized distributed management system used on the blockchain platform eliminates the possibility of data loss.

However, along with the listed advantages, the blockchain model still has a number of disadvantages, which in the future may become a barrier to its practical implementation. Due to the impossibility of making changes to the database, the issue of real-estate transactions cancelled by courts has not been worked out. The issues of returning the ownership of the property to its original position and returning the paid funds remain open. In this model, it is also necessary to provide

for the possibility of participation of three or more parties to the smart contract. It also requires solving the issues of generating and restoring access keys to your data. In addition, there are various shortcomings of this model, which cannot be ignored and put aside:

- High demand for electricity due to the significant amount of computing operations in blockchain system;
- High costs for creating a blockchain system and transferring all data about real-estate objects to a new platform;
- Lack of qualified specialists in the field of “blockchain” technology.

We should also not forget that one of the main factors determining the speed of promotion and application of the blockchain technology is the legislation that defines the basic rules and requirements necessary for its legal monitoring and regulation, in connection with which the study developed separate legislative amendments related to the regulation of blockchain. At the same time, we would believe that it is necessary to continue studying the potential of blockchain technology and experiment with its application in pilot projects to gain the experience necessary for large-scale implementation.

References

- Akorda.kz. 2018. State of the Nation Address of President of the Republic of Kazakhstan, 5 October. Available at https://www.akorda.kz/en/addresses/addresses_of_president/state-of-the-nation-address-of-president-of-the-republic-of-kazakhstan-nursultan-nazarbayev-october-5-2018 (last accessed 21 May 2021).
- Alexopoulos, Ch., A. Androutsopoulou, Z. Lachana, M. A. Loutsaris and Y. Charalabidis. 2018. “Blockchain Technologies in Government 3.0: A Review.” In Virkar, S., P. Parycek, N. Edelmann, O. Glassey, M. Janssen, H. J. Scholl and E. Tambouris (eds.). *EGOV-eDEM-ePart 2018 Proceedings*. Krems: Danube University of Krems, 11–20 pp. Available at https://www.researchgate.net/publication/330384749_EGOV-CeDEM-ePart_2018_Proceedings_3-5_September_2018_Danube_University_Krems (last accessed 21 May 2021).
- Allessie, D., Sobolewski, M., Vaccari, L., & Pignatelli, F. (2019). Blockchain for digital government. *Luxembourg: Publications Office of the European Union*, 8–10 pp.
- Anticorr.kz. 2020. *National Anti-Corruption Report for 2020*. Available at <https://www.gov.kz/memleket/entities/anticorruption/documents/details/152774?lang=ru> (last accessed 21 May 2021).

- Baigenews.kz. 2019. Ministry of Finance of Kazakhstan launched blockchain technology in tax administration Available at https://baigenews.kz/news/min-fin_kazakhstan_a_zapustil_tekhnologiyu_blokcheyna_v_nalogovom_administrirovanii/ (last accessed 21 May 2021).
- Blockchain.com. 2020. "Average Transaction Fee in US Dollars." Available at <https://www.blockchain.com/charts/fees-usd-per-transaction> (last accessed 14 August 2020).
- BlockchainKZ. 2020. "Tamyr Blockchain Framework." Available at <https://blockchainkz.ltd/> (last accessed 21 May 2021).
- Cavalcante, P. 2018. "Innovations in the Federal Government during the Post-New Public Management Era." *Revista de Administração Contemporânea* 22(6), 885–902 pp. <https://doi.org/10.1590/1982-7849rac2018170391>
- Chen, Y. Ch. 2010. "Citizen-Centric E-Government Services: Understanding Integrated Citizen Service Information Systems." *Social Science Computer Review* 28(4), 427–442 pp.
- Christidis, K. and M. Devetsikiotis. 2016. "Blockchains and Smart Contracts for the Internet of Things." *Ieee Access* 4, 2292–2303 pp.
- Egov.kz. 2020. Data from the portal of the Electronic Government of the Republic of Kazakhstan. Blockchain Projects. Available at <https://egov.kz/cms/ru/robotization> (last accessed 15 October 2020).
- Feng, C., Liu, Z., & Mrad, N. (2017). Blockchain-powered internet of things, e-governance and e-democracy. In *E-Democracy for Smart Cities*. Springer, Singapore, 509–520 pp.
- Frambach, R. T. and N. Schillewaert. 2002. "Organizational Innovation Adoption: A Multi-Level Framework of Determinants and Opportunities for Future Research." *Journal of Business Research* 55, 163–176 pp.
- Gartner. 2019. "Top 10 Strategic Technology Trends for 2020." Available at <https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2020/> (last accessed 3 August 2020).
- Golovanova, E. A. and A. B. Zubarev. 2018. "Prospects for the Use of Blockchain Technology in Cadastral Systems" [in Russian]. *Nauchnyi vestnik IEP im. Gaydara* 8, 36–42.
- Gov4c.kz. 2020. "The Government for Citizens Began to Provide Public Services using Blockchain Technology." Available at <https://gov4c.kz/ru/press-center/news/5667/> (last accessed 6 April 2021).
- Gov4c.kz. 2021. "NJSC 'State Corporation' Government for Citizens 2020" [in Russian]. Available at <https://gov4c.kz/ru/about/obshchaya-informatsiya/> (last accessed 5 April 2021).

- Government of the Republic of Kazakhstan. 2017. "On the Approval of the State Programme 'Digital Kazakhstan' for 2018–2022." Decree of the Government of the Republic of Kazakhstan, No. 827. Available at <http://adilet.zan.kz/rus/docs/P1700000827> (last accessed 18 August 2020).
- Informburo.kz. 2018a. "The Amount of Damage for Corruption Crimes Amounted to 3.4 Billion Tenge in 2018" [in Russian]. Information and analytical portal *informburo.kz*. Available at <https://informburo.kz/novosti/summa-ushcherba-po-korrupcionnym-prestupleniyam-sostavila-34-mlrd-tenge-v-2018-godu.html> (last accessed 10 August 2020).
- Informburo.kz 2018b. "An Employee of the Almaty Special Centre Caught in Corruption Took Money through 'Help'" [in Russian]. Available at <https://informburo.kz/novosti/ulichyonnyy-v-korrupcii-sotrudnik-specona-almaty-bral-dengi-cherez-pomogaek.html> (last accessed 21 May 2021).
- Johnson, G. 2014. *Research Methods for Public Administrators*. London: M. E. Sharpe, 3–29 pp.
- Kazinform. 2019. "V antikorrupcionnom vedomstve RK otmechayut rost prestupleniy v sfere zemotnosheniy" [in Russian]. Available at https://www.inform.kz/ru/v-antikorrupcionnom-vedomstve-rk-otmechayut-rost-prestupleniy-v-sfere-zemotnosheniy_a3547133 (last accessed 10 August 2020).
- Klechikov, A. V., M. M. Pryanikov and A. V. Chugunov. 2017. "Blockchain Technologies and their Application in Government Administration." *International Journal of Open Information Technologies* 5(12), 123–129 pp.
- Law of the Republic of Kazakhstan. 2020. No. 347-VI of 25 June 2020 "On Amending Some Legislative Acts of the Republic of Kazakhstan on Regulation of Digital Technologies." *Adilet*. Available at <http://adilet.zan.kz/rus/docs/Z2000000347> (last accessed 16 August 2020).
- Lelou, L. 2018. *Blockchain from A to Z: All about the Technology of the Decade*. Eksmo Publishing House, 2017 – (World of Technologies), 9–11 pp.
- Maza, M. V. 2019. "El auge de blockchain y sus posibilidades reales de aplicaci'ón en los registros de las administraciones públicas." *Derecho y Ciencia Política* (28), 109–126 pp. <https://doi.org/10.7238/idp.v0i28.3154>
- Momo, F. C., G. S. Schiavi, A. Behr and P. Lucena. 2019. "Business Models and Blockchain: What Can Change?" *Revista de Administração Contemporânea* 23(2), 228–248 pp. <https://doi.org/10.1590/1982-7849rac2019180086>
- Müller, S. D., & Skau, S. A. (2015). Success factors influencing implementation of e-government at different stages of maturity: a literature review. *International Journal of Electronic Governance*, 7(2), 136–170 pp.

- Nakamoto, S. (2008). Bitcoin: A peer-to-peer electronic cash system. *Decentralized Business Review*, 21260, 1–8 pp.
- NABDC. 2018. Blockchain in Kazakhstan will be legally regulated. Available at <https://nabdc.kz/> (last accessed 20 August 2020).
- Nationalbank.kz. 2018. “What is Invest Online?” Available at <https://nationalbank.kz/ru/news/tehnicheskie-resursy/7472> (last accessed 21 May 2021).
- OECD. 2018. “Blockchain-Primer” Available at <http://www.oecd.org/finance/OECD-Blockchain-Primer.pdf> (last accessed 4 August 2020).
- Pankratov, E., V. Grigoryev and O. Pankratov. 2020. “The Blockchain Technology in Real Estate Sector: Experience and Prospects.” *IOP Conference Series: Materials Science and Engineering* 869(6), 1–7 pp.
- Pryanikov, M. M. and A. V. Chugunov. 2017. “Blockchain as the Communication Basis for the Formation of the Digital Economy: The Advantages and Problems” *International Journal of Open Information Technologies* 5(6), 49–55 pp.
- Rana, N. P., M. D. Williams, Y. K. Dwivedi and J. Williams. 2011. “Diversity and Diffusion of Theories, Models, and Theoretical Constructs in eGovernment Research.” In M. Janssen, H. J. Scholl, M. A. Wimmer and Y. H. Tan (eds). *Electronic Government*. Berlin: Springer, 1–12 pp.
- Rot, A., Sobińska, M., Hernes, M., & Franczyk, B. (2020). Digital transformation of public administration through blockchain technology. In *Towards Industry 4.0—Current Challenges in Information Systems* Springer, Cham, 111–126 pp.
- Saveliev, I. E. 2016. “Blockchain Technology and its Application.” *Applied Informatics* 11(6), 19–24.
- Shilov, K. D. and A. V. Zubarev. 2018. “Blokcheyn i raspredelennye reestry kak vidy baz dannykh.” *Innovatsii* 12(242), 77–87 pp.
- Scholz J., Schiller T., Sokolov Y., Kotsoeva V., Elkina A. 2017. “Blockchain technology. Principles of operation and prospects of application”. *ETAP: ekonomicheskaya teoriya, analiz, praktika* 6, 67–76 pp.
- Steinbach, M., J. Sieweke and S. Süß. 2019. “The Diffusion of e-Participation in Public Administrations: A Systematic Literature Review.” *Journal of Organizational Computing and Electronic Commerce* 2, 61–95 pp.
- State Standard of the Republic of Kazakhstan № 1073-2007 // Available at <https://lpp.kz/wp-content/uploads/2020/10/1073-2007.pdf> (last accessed 21 May 2021).
- Swan, M. (2017). Blockchain: Scheme of the new economy. *M.: Olympus-business*, 2–3 pp.

- Szabo, N. (1996). Smart Contracts: Building Blocks for Digital Markets. *Extropy. Transhumanist Thought*, 1–11pp.
- Talapina, E. V. 2020. “Application of Blockchain in Public Administration: Perspectives of Legal Regulation.” *State and Municipal Management Issues* 3, 96–113 pp.
- Tapscott, D., & Tapscott, D. (2017). Blockchain technology, what drives the financial revolution today. *Moscow: Eksmo*. 29–33 p.
- Thakur, V., Doja, M. N., Dwivedi, Y. K., Ahmad, T., & Khadanga, G. (2020). Land records on blockchain for implementation of land titling in India. *International Journal of Information Management*, 52, 101940, 1–21 pp.
- Varnavskiy, A. V., Buryakova, A. O., & Sebechenko, E. V. (2019). Blockchain in the service of the state. *Moscow: Knorus*, 35–46 pp.
- Welch, E. W. and M. K. Feeney. 2014. “Technology in government: How organizational culture mediates information and communication technology outcomes.” *Government Information Quarterly* 31(4), 506–512.
- WTO. 2018. “Can Blockchain Revolutionize International Trade?” Available at https://www.wto.org/english/res_e/booksp_e/blockchainrev18_e.pdf (last accessed 4 August 2020).
- Yaga, D., P. Mell, N. Roby and K. Scarfone. 2019. “Blockchain Technology Overview.” *ArXiv Preprint: arXiv: 1906.11078*. 1–55 pp.
- Yin, RK (2013). Case study research: Design and methods. Thousand Oaks, CA: Sage. *The Canadian Journal of Action Research*, 14(1), 69–71 pp.
- Zongozzi, J. N. and J. S. Wessels. 2016. “Variables Influencing Case Study Research Design in Public Administration: A Conceptual Framework.” *Administration Publica* 24(2), 212–233 pp.