

Improving Public Administration by Block Chain Technologies

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ABSTRACT

The article deals with the concept of improving public administration in Ukraine on the basis of blockchain technologies. In order to assess the importance of this technology, its evolution in the world market as well as practice cases of its implementation in public administration of the developed countries were studied. The paper defines the concept of blockchain technology, describes its features and analyses the models that can be used in public administration. Aimed at studying the possibilities of adapting foreign experience in the use of blockchain technologies in the public administration of Ukraine, the use of blockchain in the commercial sector of Ukraine was analysed and successful experience that can be used in developing government programs using blockchain technology was shown.

The peculiarities of launching the Land Cadastre database in Ukraine were considered as an example and the main problems faced by the developers were outlined. Identifying the strengths and weaknesses of blockchain technologies in public administration allows to create a basis for the implementation of blockchain technology in Ukraine and its use in public administration.

1. Introduction

In an attempt to build an information society, Ukraine seeks the possible ways to significantly modernize and improve the work of public institutions through digitalization. The introduction and development of new technological solutions in the public sector, including a blockchain technology, is not only a tool to achieve these goals, but also an important factor of the integration into the club of the world's leading nations, which now determine the vectors of human development.

Nowadays, IBM is involved in developing more than 400 blockchain projects in a vast variety of industries, including financial services and healthcare. The company is constantly convincing governments that using the blockchain will reduce both the risks and cost of time and money in many areas of human activity. The use of blockchain has many advantages for the governments but perhaps the most important one is that this technology facilitates the process of digitizing documents and access to public services. For example, IBM cooperates with the US Food and Drug Administration (FDA) and the Centre for Disease Prevention on discovering possible ways of introducing blockchain in these areas. Launched in 2016, Congressional Blockchain Caucus collects information on blockchain projects. This

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data is needed to allow people to verify securely their identity in the Internet in the future, make online payments (for example, tax payments) and track supply chains.

Estonia already uses blockchain in the e-Estonia program, which allows to vote, keep medical records and pay taxes online. Blockchain technology saves Estonia up to 2% of GDP per year. The government of Dubai is working with IBM and ConsenSys on a nationwide pilot project. According to the companies' plans, this project will simplify the verification of identification data and make it possible to digitize and track medical records, testaments and various contracts.

Blockchain technology's technical complexity, a number of reservations about its implementation in public administration area not only in Ukraine but in the world in general, lead to intensive public debates on the potential consequences of its use to solve a set of socially significant problems. With this in mind, it is necessary to draw attention not only to the technological, economic, legal, political and security aspects of the blockchain's introduction in public administration, but also to its socio-cultural components. In this context, the introduction of blockchain technology can be considered as one of the factors of the new information culture of public administration, which is currently being formed in terms of dynamic information and technological progress.

The purpose of this study is to investigate foreign practices of applying blockchain technology in public administration worldwide and, considering successful experience, suggest directions for the development of public administration in Ukraine based on the use of blockchain technology.

2. Literature review

Issues of blockchain technology are widely studied not only by information technology professionals, but by the economists as well. The technology of blockchain operations is described in detail in the book *Bitcoin: A Peer-to-Peer Electronic Cash System*, written by Satoshi Nakamoto (2008). Nowadays, several models of using this technology exist but the most detailed research was conducted by Allaby D. (2016), who described private and public models as well as models with full and limited access. The practical significance of this technology is studied by Allessie D., Sobolewski M., Vaccari L. (2019), Atzori M. (2017), Davidson S., De Filippi P. and Potts J. (2016). In particular, these scientists showed the importance of blockchain in the formation of government information systems. One of the most prominent researchers of blockchain technology is Swan (2015). In his book *Blockchain. Blueprint For a New Economy* he puts forward a number of proposals aimed at practical application of this technology in various areas, including public administration (Swan, 2015). Such author as Farmer (2003) believes the blockchain opens a door to a new era of decentralization in which people virtually don't exist and the public confidence in the state administration strengthens since it moves from a person to a program code. The researcher introduces the concept of a distributed architecture "code is law", which is based on the use of open protocols that can be viewed by anyone. This network is not regulated by any organization and data is stored simultaneously by all nodes.

Some researchers define this information structure as an effective method of creating the state information environment (Kounelis, 2017; Grech & Camilleri, 2017). Similarly, such authors as Paquet & Wilson (2015) believe the desire for decentralization is a widespread anti-government phenomenon that is beginning to develop in Western democracies changing the relationships between citizens and government. Practical application of blockchain technologies in public administration is widely studied by various authors. In particular, Gartner (2018) describes the future of this technology in the development of smart contracts, which are a part of the software and perform various operations of national importance. Sharing credentials eliminates bureaucracy. Norta A. (2015), Novak M. (2018),

Myung S. J. (2018), Kounelis I., Di Gioia R. (2017) and others studied the formation of information environments for public administration using blockchain.

When it comes to Ukrainian researchers, the issue of blockchain technology is also being actively studied. This happens due to the growing interest in digitalization of information systems and the attempt to use blockchain technology to organize office work and document management in various fields, including land management, auctions and data storage.

Scientific novelty of the paper is represented by the study of foreign experience in the use of blockchain technologies for the construction of domestic information systems of public administration, as well as defining the most promising areas for implementation.

3. Results

Popularization of blockchain technology started in 2008, when the bitcoin cryptocurrency was created (Nakamoto, 2008). Given the current popularity of this technology, it can be argued the blockchain is evolving faster than the Internet itself, since it is the Internet which significantly accelerates popularization of blockchain. Blockchain technologies are evolving at a very rapid pace all over the world (Statista, 2019). In 2018, the investments in blockchain amounted to USD 1.2 billion. In 2021, it is expected the investments will amount to USD 6 billion and USD 39.70 billion in 2025 (fig.1).

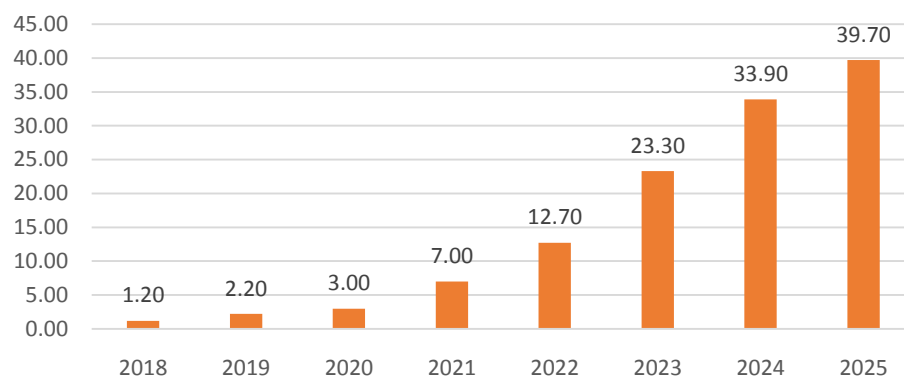


Fig.1. Dynamics of blockchain market growth in the world, USD billion

Given the origin of this technology, it's not surprising it has penetrated into the financial sector most of all. At the same time, every year the technology used to store data on cryptocurrency spreads to other industries that are not directly related to cryptocurrencies. In particular, 12% of blockchain technologies are used in energy industry and 11% in healthcare.

As for the global penetration of technology into the public administration, it is carried out through the creation and use of government programs aimed at solving a number of economic and social problems. According to statistics (Business Insider, 2019), public administration concentrated 8% of the world's blockchain technologies in 2019 (fig.2).

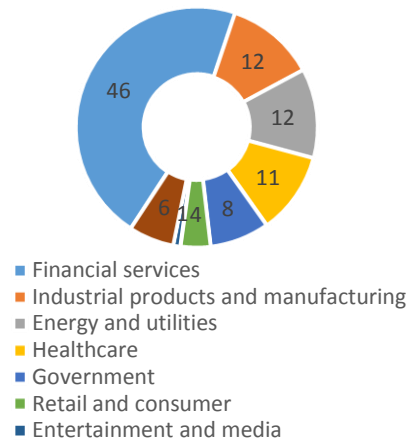


Fig.2.Structure of using blockchain technologies worldwide by areas of activity, %

At the same time, the numerous advantages of this technology encourage its use in public administration, which increasingly contributes to its spreading.

Blockchain is a type of distributed ledger technology, i.e. a digital system for recording transactions, in which transactions and their details are recorded in several places simultaneously. It is a computer protocol that leads to the formation of a specific decentralized culture of information exchange, based on trust between the stakeholders. It can be compared to a book open to all, available in a public place, where everyone can publicly register the action (transaction, contract, etc.), but without the consent of the majority no one will be able to correct an already written page.

The emergence and development of blockchain technology made to reflect on fundamentally new opportunities for e-government. The future of the blockchain, i.e. its most interesting and promising areas is literally everything that lies outside the domain of cryptocurrencies: healthcare and medicine, logistics, land cadastre, public administration at various levels, government and corporate document management. There is no sector where the blockchain technology could not be used. However, the blockchain should not be regarded as a potential product for mass consumption. Rather, it is a new flexible infrastructure that can be modeled according to the needs of public administration.

Nowadays, there are two models of blockchains, which differ by the subjects of administration and mode of access to data (fig. 3). In particular, the subjects of administration can be public or private. As for access to data, there are models with or without access permission.

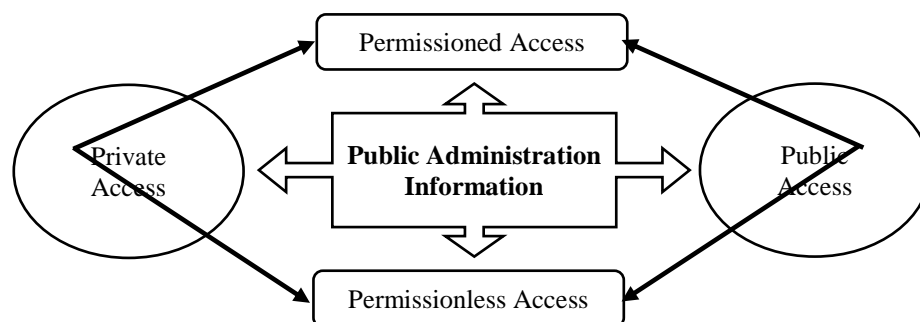


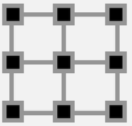


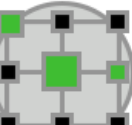
Fig.3.Modelling of blockchain technologies using public administration data based on administration requests and data openness

As a result of combining the model of administration and data availability, four main models of blockchains are formed, which can be used in public administration to pursue different goals (Allaby, 2016; Allesie, Sobolewski, Vaccari 2019). Let's consider them in Table 1.

According to Table 1, there is a direct interaction between government agencies, economic agents and citizens in the context of public administration. Such interaction improves public services in the process of creating and exchanging information. The technology itself is not a new solution, but a combination of existing and remote technologies. This allows to create a decentralized regulation of information. Decentralization is the key to a reliable interaction between the government, public authorities and citizens (Atzori, 2015).

Table 1

Models of blockchain technologies for the use of public administration data

Blockchain type	Explanation	Example in public administration	Vizualization
Public Permissionless Blockchains	Processing and creation of transactions is carried out by any user. No restrictions on data entry	uPort decentralised identity	
Public Permissioned Blockchains	Processing and creation of transactions is carried out by certain persons who have access. Everyone has access to data	Stadjerspas smart vouchers, Infrachain governance framework	
Private Permissionless Blockchains	Processing and creation of transactions is carried out by anyone in a closed environment	E-residency	
Private Permissioned Blockchains	Processing and creation of transactions is carried out in a closed environment only by the people who have access to it	Ubitquity, Exonum land title registry	

Blockchain technology is able to solve effectively some of the administrative tasks performed by the humans. This, in turn, reduces budget expenses, as well as makes relationships that cannot be influenced by interested people more reliable. This allows to create the technologies for data storage and exchange that will reduce corruption in any country interested in overcoming it. Blockchain provides a transparent interaction of the participants in a particular process, but the government must support such interaction by creating legal regulation of processes occurring within such infrastructure.

Blockchain can be used as an infrastructural system for exchanging information between all state administrations. This allows to get real-time data on the distribution of taxes, crediting funds for transactions, crime statistics, distribution of grants, etc. (Davidson, De Filippi, & Potts, 2016). Instead of registering documents centrally in a single administration, distributed registration will provide not only technical but also economic benefits. These include transparency of operations, reliability of data storage,

improved performance of operations, prompt collection of information from various sources, reduced level of bureaucracy, etc. Unlike this technology, a centralized information center creates uncertainties in the stability of the network, since only one control point is responsible for its operation. This is especially true for the banking and financial system, especially in cases of lending and money circulation, because information and data storage is distributed among all participants. However, along with the clear advantages, decentralization of information creates a number of problems. In particular, it is the problem of compatibility of aggregated data with institutional structures of governments, markets and companies operating in the current environment. Planning the transition to blockchain technologies in public administration, it is necessary to change not only the technology, but also the management apparatus, regulatory frameworks and administrative processes. This technology does not require adaptation to the work of the government, on the contrary, it requires a change of the entire infrastructure of public administration. In turn, these actions will lead to the improved cooperation with citizens. They will be able to use public services more efficiently, since the latter will be provided automatically, without notarization, issuance of licenses or permits. People do not have to stand in line to receive certificates, because information can be collected simultaneously from all government agencies (Atzori, 2015; Norta, 2015; Swan, 2015; Van Zuidam, 2017). In addition, such services as identification of a person or voting based on blockchain technologies, completely change the balance of resources in the country, increasing the importance of citizens in the formation of the state by strengthening control over democratic processes.

Given these advantages, it can be concluded that blockchain technology can significantly change the apparatus of government. It can increase government efficiency and build more efficient models of delivering administrative services.

The use of different blockchain models can reduce operational risks and increase public confidence in government agencies. However, the fact that many countries do not dispose even of the simplest forms of blockchain technology, such as smart contracts or data storage systems in certain industries, indicates that the governments of these countries are not ready at all to reorient themselves to the use of blockchain technology. Inflexibility of the system, a large scale of operations and, of course, corruption are the biggest problems in building the effective system of public administration.

It should be noted that so far none country in the world managed to create a single centre of government in all areas of public administration using a single technological solution. This is explained by the aforementioned factors, in particular, the inflexibility of the established rules of public administration and the desire of each of the spheres of public administration to increase its importance in building social and economic relations. Such forms of work allow to create a basis for increasing funding for the industry and civil servants. Everyone understands that blockchain technologies inevitably lead to a reduction in the quantity of civil servants. However, some industries in different countries decided to improve their business processes using the advantages offered by blockchain. Note that blockchain solves the problems of archiving and movement of documents first of all. Let's consider the main blockchain projects in public administration worldwide (Table 2). It's worth remembering that some projects are used not at the state but at the regional level and all of them have been successfully implemented and operated for several years (Allessie, Sobolewski, Vaccari, 2019).

Table 2

11 blockchainproject in the world aimed at public administration

№	Project	Country	Area od activity
1	Exonum land titleregistry	Georgia	Land and real estate transactions
2	Blockcerts academic credentials	Malta	Verification of educational certificates, exchange of personal information
3	Chromaway property transactions	Sweden	Land and real estate transactions
4	uPort decentralised identity	Switzerland	Electronic voting, payment for bicycle and parking spaces, digital documents confirming citizenship
5	Infrachain governance framework	Luxembourg	E-government
6	Pension infrastructure	The Netherlands	Pension system
7	Stadjerspas smart vouchers	The Netherlands	Social benefits for people
8	Land cadastre	Ukraine	Land and real estate transactions
9	Umka	Russia	Transport transactions of people
10	E-residency	Estania	State register of notary services
11	Ubitquity	Brasil	Register of land and real estate transactions

Therefore, blockchain technologies in public administration can be used in the following areas:

1. Public administration. Due to the decentralized public administration, it is possible to register state operations, in particular, track record of land ownership and real estate rights. This is the experience of Georgia, Brazil and Sweden.
2. File storage for administrative purposes. The system is used as a file storage of large arrays of information from all cities of the country. The use of blockchain makes it possible to effectively manage any assets or information due to the high transparency of transactions. This system is actively used by the Government of Malta to administer data on learning environments.
3. Public and private electronic document management. Used for notarization and data storage. Examples: Estonia and Tatarstan.
4. Conducting a public poll, including voting. This is a successful experience of Switzerland, which can also be adapted to domestic conditions.
5. Protection of intellectual property rights on the basis of smart contracts. The use of smart contracts refers to the private use of blockchain technology. Nowadays, there are plenty of projects around the world that use smart contract technology for commercial purposes.
6. Agriculture, transport, forestry. It is possible to use blockchain technologies in the agricultural sector to maintain an animal identification register. The service will help to track the path of livestock products from the moment of animals' birth to the moment of products' delivery to the retail network. Similar technologies can be used in forestry to control forest resources, as well as in transport industry, where the user can track the transportation of the goods from the seller to the point of receipt. The transport industry uses logistics systems based on blockchain technology. For instance, in Russia, Umka project has been

implemented, which is designed to control the work of public transport and organize the payment for transportation.

7. Redistribution and exchange of excess energy between network users. It is used in Japan to develop renewable energy sources and construct smart micro networks. The electricity accumulated by solar power plants is distributed between network members.

8. Banking sector (to maintain registers of bank guarantees or financial transactions). Nowadays, there are many blockchain services used to conduct financial transactions for commercial purposes. The use of blockchain in this sector of public administration is planned to be implemented in Belarus to launch bank guarantees and solve banking and non-banking tasks.

9. Medicine (to maintain appropriate registers). The project is especially relevant in terms of primary medicine, but successful government programs have not yet been implemented.

Ukraine is interested in using blockchain technology in the system of public administration in all areas. The advantages of this system in public administration are obvious. However, a set of shortcomings should be taken into account too. Let's consider the blockchain's main advantages and disadvantages in Table 3.

Table 3

Advantages and disadvantages of blockchain in public administration

Advantages	Disadvantages
Simultaneous interaction of all participants at all levels of public administration allows to improve social standards.	Each operation is irreversible, transactions are recorded in a database and are visible to each participant.
Lack of central management. Equality between all spheres of public administration. Each individual participant is an independent server.	If more than 51% of the information belongs to the central authority, the integrity of the work will fall apart.
Openness of data on concluded agreements and contracts. Data on system participants can be closed if necessary. Each participant of the blockchain has a unique key serving as a guarantee of system reliability.	Lack of legislative regulation of blockchain performance and compliance standards. As long as the technology has no legal framework, it cannot be implemented.
Unlimited blockchain allowing to create a single database that can be used to perform all tasks at all levels.	The use of powerful computing technologies that increase equipment maintenance costs.
Efficiency and reliability. Chains record transactions and guarantee protection against data spoofing or theft.	System does not reduce data falsification at the level of data transfer from paper or other traditional media.

The possibility of using blockchain technology in public administration in Ukraine was first discussed in September 2015. Bitcoin Foundation Ukraine and the management of the e-government program signed a memorandum on September 29, 2015 in Kyiv. Other countries are also showing interest in using distributed registers in public sector. In 2017, the State Agency for E-Government of Ukraine and BitFury signed a memorandum of cooperation in the area of blockchain technology. This project involved the introduction of government data stored electronically on a blockchain platform. Due to this program, it is planned to introduce state registers of transactions with state assets, especially in the process of property

privatization. Electronic auctions for the lease and sale of state property using blockchain technology were organized in Odesa region in 2017.

The main purpose of the system is to ensure transparency and equal opportunities for market participants in the lease and sale of state property, elimination of the corruption component in the process of state assets' disposal. The system will also use the technology of smart contracts. The developed system is a private blockchain with a comprehensive algorithm of participants authentication. The main task of developers at the moment is to make the access of fictitious or unfair bidders as difficult as possible or impossible at all.

As the interest of public institutions to the use of blockchains grows, so does the interest in using private blockchains. Let's consider ten largest projects using this technology, which have been successfully launched in Ukraine (table 4).

Table 4

The largest 10 projects using blockchain technologies for commercial purposes in Ukraine(Chernysh, 2018).

№	Project	Release date	Area of activity
1	Rentberry	2015	Transparent platform for accommodation rent. Homeowners can find tenants
2	D-Market	2017	Global platform allowing to sell game content
3	Neuromation	2017	The platform is a marketplace for free use
4	Remme	2017	Security service used for cryptospace
5	Brighter Lab	2017	IntellectSoftblockchain laboratory
6	Hacken	2017	Security service protecting website developers against attacks
7	Karbo	2016	Electronic currency of Ukraine
8	Land cadastre	2018	Project of electronic land trading
9	Ambisafe	2015	The company provides assistance in creating own cryptocurrency
10	Distributed Lab	2014	Currency exchange service, including cryptocurrencies

As Table 4 shows, State Land Cadastre is the pilot project of using blockchain data protection in public administration in Ukraine. Blockchain technology is also used for the state register of real property rights, the system of electronic trading of the arrested property SETAM (State Land Cadastre, 2017; Verkhovna Rada of Ukraine, 2017). On May 27, 2017, the Cabinet of Ministers of Ukraine approved the proposal of the Ministry of Justice and the State Agency for e-Government to implement measures aimed at introducing a blockchain data storage system in the State Register of Real Property Rights and SETAM. In the same year, a memorandum of cooperation was signed between the Ministry of Justice of Ukraine, the Ministry of Agrarian Policy and Food of Ukraine, the State Agency for e-Government of Ukraine, Transparency International Ukraine and Bitfury Holding to create and maintain land cadastre and other state registers based on blockchain. The updated State Land Cadastre contains information on each transaction that took place in the cadastre. This information enters the chain of blocks according to the prescribed algorithm. This means that each document certifying the land ownership is accompanied by a QR code, therefore, all data on the location, size of the plot and its owner are encrypted. Using QR, it is possible to identify the authenticity of the document or just check the information in the register. Only authorized specialists can make changes in the cadastre. It's necessary to use an electronic signature or bank-ID to identify persons who may change the information about the plot.

Studying the experience of creating the State Land Cadastre in terms of blockchain technologies in public administration, we face one important problem, which is currently impossible to solve technologically. The fact is that at the initial stage of using the technology in the area of land contracts registration, some problems with the initial identification of landowners emerged, since the data entered in the blockchain register could be inaccurate. In turn, the blockchain guaranteed the immutability of data, but not their authenticity. This system can use its own resources to verify data or obtain extracts, but not to verify the data accuracy. That's why it is very important to develop a legal and controlled procedure of transferring paper data to state registers with a guarantee of honesty and transparency. The effective operation of blockchain technologies in Ukraine depends on the accuracy of filling in the registers of citizens, real estate, companies, etc. Neither maintaining data integrity in the event of accidental failures nor preventing manipulation of the already entered data are major challenges for public administration. The real danger is the practice of entering obviously inaccurate data into the registers and in this case the blockchain technology is powerless.

Thus, the main purpose of introducing blockchain technologies in public administration is to create such infrastructure that will help prevent corruption and bureaucracy in the blockchain system. But this requires to develop laws on the blockchain status, achieve transparency of data and source codes, implement an autonomous executive administration, form a management system based on a direct democracy and create a distributed government register (Myung, 2018). For example, in Italy (GovernoItalianoMinisterodellosviluppoeconomico, 2018) a group of domestic experts was created, which was responsible for developing a national strategy of integration and implementation of blockchain technologies in the public sphere. In general, it's all about the existence of the appropriate public policy (Novak, 2018) and, of course, the political will to implement such a policy and build relationships with other stakeholders on the basis of a fundamentally different information culture. That's why, in terms of modelling the future of the public administration system in terms of the introduction of blockchain technology, it is necessary to pay attention to the change of the information culture in this system first of all.

In its general meaning, information culture is a set of principles and mechanisms for the development, storage, transmission and use of information established in a particular social community. For the system of public administration in this context, the most fundamental issues are the possession of information, the use of information to ensure the process of management and the protection of information. Blockchain forms the appropriate technologies for managing the activities of the entities that use it, thus changing the traditional notions about power and governance. New technology allows individuals to interact unprecedentedly, however limiting their interaction within the specific frameworks allowed by the technology. This means it can be considered a coercive force that restricts human activity. In this regard, a new algorithmic society may emerge, i.e. a society in which the coercive force of the algorithms will be generalized in a society as a whole. The software that implements the algorithm can be considered as a set of special conditions that limit the behaviour and interaction of individuals within these technologies. Blockchain is also an algorithm implemented by software. The security issues of a widespread blockchain implementation in the public sector need a very close consideration, in particular because quantum computers may pose a serious threat to the blockchain in the near future. At the moment, their performance is much lower than that of standard computers, but quantum computers will soon be more efficient doing certain tasks.

4. Conclusions

Nowadays, public administration in Ukraine faces numerous problems in developing the information environment. The main challenge is that most of the operations related to document management are not always carried out in electronic way. Even if digital document and database administration systems are implemented, they frequently provide limited functions. This creates problems on the way to access and

share information at all levels of public administration. In its turn, an imperfect information environment affects a society that faces bureaucracy and, as a result, corruption.

The studied foreign experience of public administration using blockchain technologies shows how useful such solutions are for society. They allow to receive operational administrative services without the involvement of people. The investigation of the implemented programs on pensions, notarial activity, joint scientific and educational databases and energy distribution shows that most of the processes performed by the state administration can be automated. This will also have a positive effect on the distribution of public funds, since they can be used more efficiently. In Ukraine, it is advisable to develop joint informational support in all areas of public administration. Presently, only documentation in the field of land relations experiences the first attempts to use blockchain technology to build an information system. We can conclude this system is far from perfect. In particular, it does not use all the benefits of blockchain, allowing to perform tasks of archivization only. It is necessary to develop this system and extend it to all other areas of administration. Such a system can be a private blockchain with a comprehensive system of participants authentication. The main task of developers at the moment is to make the access to the information as difficult as possible or impossible at all. Unfair participants who may enter false data in the process of digitizing documents should not have even the smallest chance to change data in the system. In addition, certain regulatory issues regarding the establishment and operation of such information platforms need to be solved, as well as supervisory boards should be established to oversee the process of data digitalization.

References

1. Allaby D. (2016) The Trust Trade-Off: Permissioned vs Permissionless Blockchains. *FJoednet*, available at: <https://www.fjordnet.com/conversations/the-trust-trade-off-permissioned-vs-permissionless-blockchains>
2. Allesie D., Sobolewski, M., Vaccari, L. (2019) Blockchain for digital government. Publications Office of the European Union.
3. Atzori, M. (2017) Blockchain technology and decentralized governance: is the state still necessary?..*Journal of Governance and Regulation*. Vol.6, Issue 1, available at: http://dx.doi.org/10.22495/jgr_v6_i1_p5
4. Blockchain – MembridelGruppo di esperti. *GovernoItalianoMinisterodellosviluppoeconomico*, available at: <https://www.mise.gov.it/index.php/it/10Istituzionale/ministero/2039024-blockchain-membri-del-gruppo-di-esperti>
5. Blockchain Technology Applications use cases (2019) *BusinessInsider*, available at: <https://www.businessinsider.com/blockchain-technology-applications-use-cases>
6. Chernysh, V.(2018) 10 Ukrainian Block-chain Projects, that create future here and now. *MC.TODAY*, available at: <https://mc.today/10-ukrainskih-proektov-kotorye-razvivayut-blokchejn-industriyu/>
7. Davidson, S., De Filippi, P., & Potts, J. (2016). Disrupting Governance: The New Institutional Economics of Distributed Ledger Technology. *SSRN Electronic Journal*, available at: <https://doi.org/10.2139/ssrn.2811995>
8. Farmer, J. (2003). The Spector of Crypto-anarchy: Regulating Anonymity-Protecting Peer-To-Peer Networks. *Fordham Law Review*, 72(3), available at: <http://ir.lawnet.fordham.edu/flr/vol72/iss3/5>.
9. Gartner. (2018). Preparing for Smart Contract Adoption. Available at: <https://www.gartner.com/doc/3894102/preparing-smart-contract-adoption>
10. Grech, A. ,& Camilleri , A.F. (2017). *Architecture of a Verified Blockchain-Secured Self-Sovereign Identity*. <https://doi.org/10.6084/m9.figshare.5371516.v1>
11. Kounelis, I., Di Gioia, R., Geneiatakis, D., Steri, G., Neisse, R., Karopoulos, G., Giuliani, R. (2017). *Blockchain in Energy Communities* (Technical report). Luxembourg: European Commission, Joint Research Centre (JRC),available at:<https://ec.europa.eu/jrc/en/publication/blockchain-energy-co>
12. Myung S. J. (2018) Blockchain government – a next form of infrastructure for the twenty-first century. *Journal of Open Innovation: Technology, Market, and Complexity*. 2018. Vol. 4, Issue 4, available at: <https://link.springer.com/article/10.1186/s40852-018-0086-3>
13. Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. *Bitcoin*, available at: <https://bitcoin.org/bitcoin.pdf>.
14. Norta, A. (2015). Creation of Smart-Contracting Collaborations for Decentralized Autonomous Organizations. In R. Matulevičius& M. Dumas (Eds.), *Perspectives in Business Informatics Research* (pp. 3–17). Springer International Publishing.
15. Novak M. (2018) Crypto-friendliness: Understanding blockchain public policy, available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3215629.

16. Swan, M. (2015). *Blockchain. Blueprint For a New Economy*. Sebastopol, CA: O'Reilly.
17. Paquet, G. & Wilson, C. (2015). Governance Failure and Antigovernment Phenomena. *CoG Working Paper*, available at: <http://www.pattheory.net/conference2015/papers/antigovernment-as-governance-failure-ver-12.pdf>.
18. Some issues of reference to the security of storage and protection of information of the State Register of Real Rights to Immovable Property and the system of electronic bidding for the sale of seized property: Order of the Cabinet of Ministers of Ukraine of May 24, 2017 №353-р. Database "Legislation of Ukraine". *Verkhovna Rada of Ukraine*, available at: <https://zakon.rada.gov.ua/laws/show/353-2017-%D1%80#Text>
19. Swan, M. (2015). *Blockchain: Blueprint for a New Economy*. O'Reilly Media, Inc.
20. The state land cadastre has switched to Blockchain technology. *State Land Cadastre: official website*, available at: <https://land.gov.ua/derzhavnyi-zemelnyi-kadastr-pereishov-na-tekhnohiiu-blockchain/>
21. Van Zuidam, R. (2017). Blockchain for dummies - 5 questions to Blockchain expert Rutger van Zuidam. *City Of Talent*, available at: <https://www.cityoftalent.nl/en/news/blockchain-for-dummies---5-questions-to-blockchain-expert-rutger-van-zuidam>
22. Worldwide Blockchain Technology Marker Size (2019) *Statista*, available at: <https://www.statista.com/statistics/647231/worldwide-blockchain-technology-market-size/>