THE COMPARATIVE ANALYSIS OF TECHNOLOGIES RELATIONAL DATABASES AND BLOCKCHAIN

Muftakh Khakimov, *professor at National university of Uzbekistan name of Mirzo Ulugbek, Republic of Uzbekistan.* muftah@mail.ru

Abstract. In article the author results the analytical analysis of analogies and differences between two dynamical technologies - relational databases and blockchaina. If the technology of relational databases was applied at construction of information systems of the electronic government, technology blockchaina rather new to digital economy being the new engine of the electronic government. The comparative analysis of these technologies on several parametres is carried out, are specified their strong and weaknesses. Primary factors on which the technology choice should be carried out, depending on the purposes of solved problems in digital economy are specified.

Keywords: technology, dynamic, a relational database, transaction, blockchain, digital economy, the electronic government, monitoring, decision-making, the person the making decision.

Introduction

In circulation President Republic Uzbekistan [1] economy transition to «digital rails» is underlined:

"With a view of a sustainable development we should master deeply digital knowledge and information technologies, that it will give the chance to us to go on the shortest way to achievement of all-round progress. … formation of digital economy will demand a corresponding infrastructure, huge means and a manpower.

… the accelerated transition to digital economy becomes our priority problem next five years.

… it is necessary to reconsider critically system «Electronic government», programs realized in its frameworks and projects, in a complex to solve all organizational and институциональные questions".

In the light of the given Reference, there is a necessity of carrying out of the state-of-the-art review over two very important modern information technologies of databases and blockchainом, and to give the chance to experts of subject branches of economy of representation about possibilities, complexities and advantages of these technologies, specifying their place and roles in digital economy.

The technology of databases in all developed countries (the USA, the Great Britain, Japan, etc.) is widely applied in practically in all branches of a science, technics and the industry in a current of last 30th years. By means of technology of relational databases local and global information systems, including the various systems of the electronic government intended for platforms "state-state", "state-grazhdany" and "state-business" function.

Technologies of databases give the chance for decision-making. The analysis of dynamical data allows to estimate a condition and branch developments, to do the proved forecasts and to

make the proved decisions. The software products necessary for maintenance of administrative decisions, should be provided by the developed means of the analysis of data of representation of results of data processing in convenient for experts and a management to the form (tables, schedules, schemes, structures etc.).

Technology blockchaina, rather new information technology which has received the name after a while, after publication Satoshi Nakamoto of [2] descriptions of technology of the digital coin named reception, under a name bitcoin. This technology for last 10 years wins the increasing space in the environment of technologies applied in economy. It accustoms and takes root into various branches of economy worldwide. In article H. Hou [3] the short analysis on a project example on province Чаньчэн of the first electronic governmental management in China with technology application blockchaina is stated. Conclusions are stated, that «technology application blockchaina can give advantages in - improvement of quality and quantity of public services, the big transparency and availability of the information on the government, development of joint using by the information through the various organizations and the help in creation of separate system of the credit in China». As weak a link of the project the author of article considers «information safety, cost and reliability». Article H. Hou can serve for the further theoretical researches for republic public services.

In a review «Possibilities and problems blockchaina» [4], marking a technology more potential blockchaina for working out of information systems of the Internet, authors specify in many technical problems arising at realization. For example, scalability causes huge anxiety in treading operations, with increase the quantity of blocks is required the big space of memory, it interferes with fast distribution to networks. According to authors, it can gradually lead to centralization since it is favorable to users to have big blockchain. And it also is a problem between the size of the block and safety. Other problem, it not possibility of creation of the branched off blocks in technology blockchaina, such situation also should be considered. One more problem is connected with confidentiality. Authors referring, on Birukov assert, that «on blockchaine there can be a confidentiality leak when users carry out transactions with the open key and the closed key. And thus the real IP-address of the user can even be tracked».

After the decision of these problems, the technology blockchaina can be used in various financial services, such as digital actives, a remittance and online payment, for following generation of Internet systems, such as clever contracts, services of the general using, in trading operations on the Internet, systems of reputation and security services.

The useful review on distribution and technology introduction blockchaina it is made in work [5]. In this collective work doubtless interest causes tab. 1 from this work in which the list of branches on practical realization on branches of economy and under the technology concept blockchaina is resulted.

Technology application blockchaina in problems electronic the government it is considered in article «Blockchain in the government: Advantages and consequences of the distributed technology of the account book for joint using the information» [6]. These are such as power sector, systems of deliveries and logistics, the musical industry, public health services and accounts department sectors. Technology application blockchaina in accounts department can be interpreted as «the distributed technology of the account book». Essence blockchaina is that the organizations can trace "account book" and that the organizations in common create, develop and trace one invariable history of transactions and define consecutive events.

Technology of relational databases

It is known, that the given bases are processed by dynamic image. It is possible to present it as dynamic information and logical model. The big relational databases can change the some values constantly, can be written down new, old data are changed or removed. Since we намерены to carry out the analysis of technology of databases, and it is familiar only to experts in computer knowledge hardly we will in detail stop about the basic ideas of technology put in pawn in relational databases.

Relational databases use accurate and simple structure which one or several two-dimensional tables are. Each table has the unique name. Columns (domains, attributes) tables, also have the unique names (fig. 1). Each attribute has the type (whole, symbolical, monetary etc.).

ID	**A1**	**A2**	**A3**	**A4**	**…**	**Am**
1	D_{11}	D_{12}	D_{13}	D_{14}	**…**	D_{1m}
…	…	…	…	**…**	**…**	**…**
n	D_{n1}	D_{n1}	D_{n3}	D_{n4}	**…**	D_{nm}

Figure 1. The General view of tables of relational databases

All columns of the table of relational databases are filled in strict conformity with the specified type. All tables of a relational database should be connected among themselves through the unique keys (ID) according to several requirements, the main thing from which is conformity to six normal forms. Firm performance of these requirements provides right answers on inquiries. For example, the elementary relational scheme of an educational database "Students" provides the specified requirements (fig. 2).

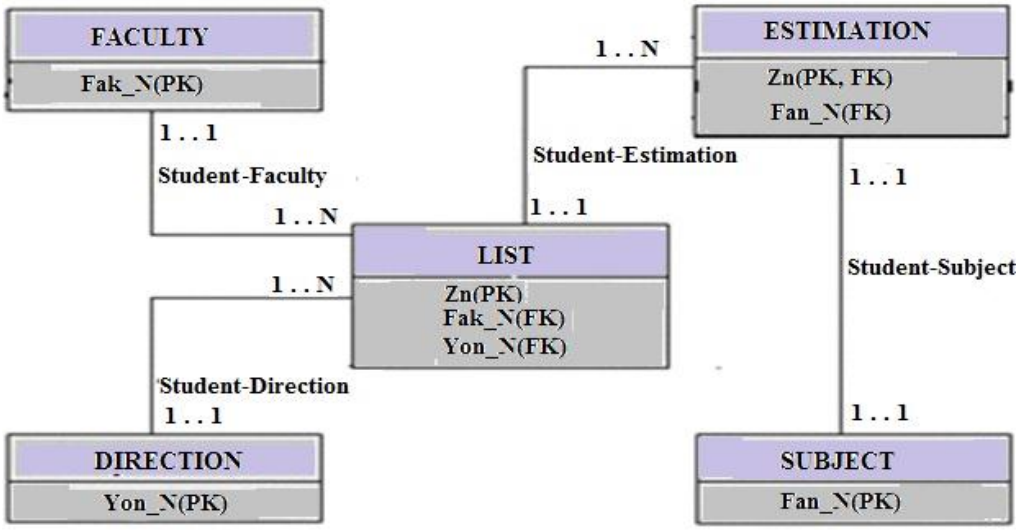

Figure 2. The relational scheme of an educational database "Students"

In the big relational databases there can be some honeycombs of tables.

All data stored in a database, can be processed with use of special language of the inquiries known as language of structured inquiries (SQL). Databases can practically work with

all types of data and can help with support of all modern structures. Besides, it can be scaled for support of millions records.

The relational database functions completely on the basis of the centralized approach (server on fig. 3). Any relational database is not based on decentralization possibility.

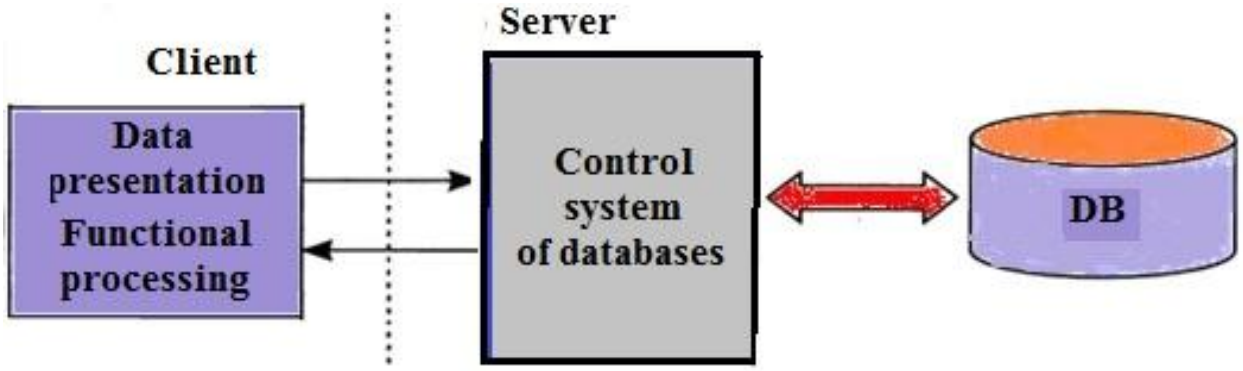

Figure 3. Architecture "client-server"

Advantages and weaknesses of relational databases and their control systems are shined enough, including [7].

The basic advantages of relational databases and their control systems it is automatic check on redundancy; the control приворечия data; sharing of data; preservation of integrity of data; maintenance of multilevel safety and confidentiality; possibility of application of standards; growth of scale of system - provides productivity growth; at occurrence of conflict situations maintenance possibility консессуса; growth of possibilities of access to data and their availability for service; increase of indicators of efficiency of work; simplicity in support of system concerning independence of data; improvement at management of parallel work; reserve copying and the developed service of restoration.

As confidentiality of data causes very important anxiety both the state bodies, and citizens, we will more low result one of variants of its performance.

For maintenance of confidentiality of information, it is possible to use methods cryptographic cache i.e. in this case First name, middle initial, last name subjects cache one of the accepted known standard functions as it is resulted on fig. 4.

ID	**A1 (Surname)**	**A2 (Name)**	**A3 (Patronymic)**	**A4** (cache a code S.N.P.)	**A5**	**…**	**Am**
1	S_1	N_1	P_1				
…	…	…	…				
n	S_n	N_n	P_n				

Figure 4.

Further in the course of monitoring, statistical and other target processing's it will be possible to use not First name, middle initial, last name, and their cache a code (if necessary) and any other data from various tables (fig. 5) databases of object of appointment. For example, values of attribute B11 (year a birth) is withdrawn from the table In, values of attribute D8

(education) is withdrawn from table D, value of attribute L7 (the payment sum) is withdrawn from table L.

ID	**A4** (cache a code S.N.P.)	**B11** (year a birth)	**D8** (education)	**L7** (the payments sum)	…
1	b013473a0451d56890f256a5…	1975	average	18975.16	…
…	…	…	…	…	…
n	…	…	…	…	…

Figure 5.

For today almost all functioning systems of the electronic state of republic do not give the chance *monitoring* carrying out on objects of appointment. All possibilities of technology of relational databases are not mastered. And after all technologies of relational databases and modern technologies of programming completely give the chance creations of such appendices (program product), including. And for mobile devices. For economy development at various levels by means of technologies of relational databases there is an excellent possibility of decision-making by the person responsible for certain branch, sector etc. economy, sciences and technicians. The scientific term sounds as decision-maker (DM). Monitoring can be provided practically on all domains and records of a relational database simultaneously, or is selective on the specified domains. For this purpose, it is necessary to create the corresponding application covering all necessary domains, and to give the chance DM to create difficult inquiries for choice domains from the corresponding form and to give a command on transaction performance. Performance of such difficult inquiries will involve necessary quantity of transactions. For creation of difficult inquiry DM it is necessary hardly to type skills, and thus special knowledge it is not required. Thus, it is possible to arm DM with powerful tools for acceptance of the optimum and constructive decision. In the described process, monitoring can be spent constantly since owing to dynamism of databases each time DM can will receive new dynamics of object and to make the proved decisions.

Lacks of relational databases and their control systems, consist from – complexities of research of object and revealing of set of data; the high price of permit systems of management; additional expenses on the centralised hardware maintenance for reserve copying; occurrence the serious results at control system refusal.

Technology blockchain

Blockchain or the technology of the distributed register is a technological report which data exchange directly between various contracting parties in a network needlessly in intermediaries allows. Participants of a network co-operate with the ciphered identifiers (anonymously); each transaction then is added to an unchangeable chain of transactions and distributed on all network knots. Thus, in structure blockchain cybersecurity it is provided with all participants of a network.

Technology blockchain contain records about each operation (transaction) made ever by participants of the given network. Records unite in blocks with labels of date and time which are protected by the cryptographic keys calculated by means of special algorithm - cache-functions (fig. 6). The cache (or a key) each block is its unique identifier and joins as a key of the following block, providing acknowledgement of reliability of data. Reliability of data in blockchain networks is in addition provided with that each new participant connected to her sees

completely all chain of blocks, and any changes are brought only with the consent of the majority of participants. For addition of the new block about records, for the majority of participants (more than 50 %) should be received identical cache values on last transaction.

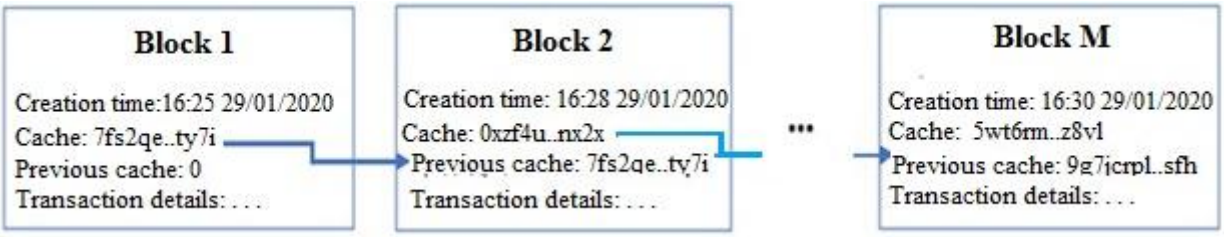

Figure 6. A chain of blocks

Variants blockchaina: *closed - private blockchain* (fig. 7), access to the register and record can carry out the authorized users, can carry out all users, *opened - public blockchain* (fig. 8) - access to the register all users have reading.

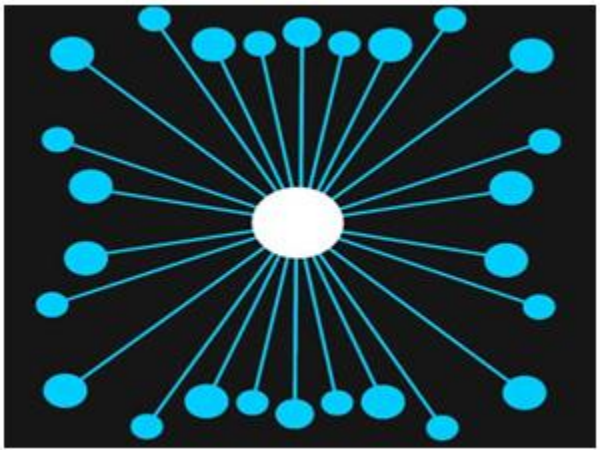

Figure 8. Opened blockchain
(the decentralized network)

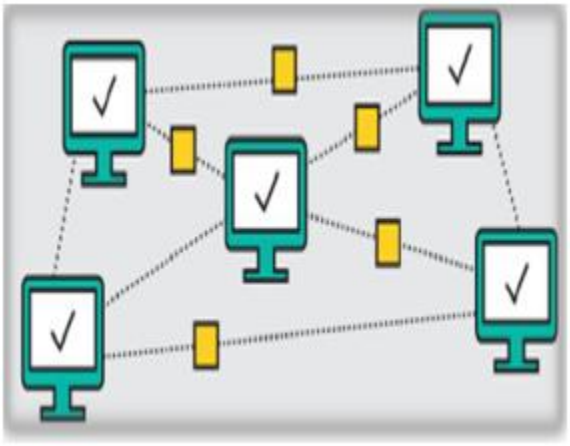

Figure 7. Closed blockchain
(the centralized network)

Use of the distributed registers can eliminate some problems connected with trust each other of the parties during financial relations. Use of smart contracts in the similar decentralized environment allows to cut expenses on services of intermediaries in transactions (services legal, bank, etc.). It also allows to reduce the time delays connected with involving of the third party.

Relational databases represent the centralized network which stores data in the structured kind, copes the manager and gives the big possibilities to users. Users can be placed on levels. To each user depending on level access to data can be expanded or narrowed.

Blockchain it is decentralized and has no centralized approach. However, exist private blockchainы which can use some model of centralization.

Data blockchaina as well as bases support integrity. Malefactors cannot change data in both technologies at application a cache of functions.

Opened blockchain offers a transparency, viewing of the executed operations (the transactions given).

Traditional databases are not transparent, thus only the protective layer functioning over it can solve, whom to admit to access reception to data. The given approach provides multilevel protection and a database effective utilization.

Blockchainы rather it is more difficult to realize and support.

The relational databases, being reliable technology, it is simple in realization and service. Data processing containing in one record of base is carried out very quickly without the coordination by other users, then blockchain technologies. Only at monitoring carrying out over a database, i.e. for processing of a considerable quantity of data, the supercomputer or some powerful servers (is required at distributed databases).

In a relational database the client can carry out four functions by data: to create, read, update and delete (all together are called as commands CRUD). Usually one organization is responsible for certain databases, she owns, operates and serves systems for integrity of data. One organization is responsible also systems belong to this organization (fig. 9).

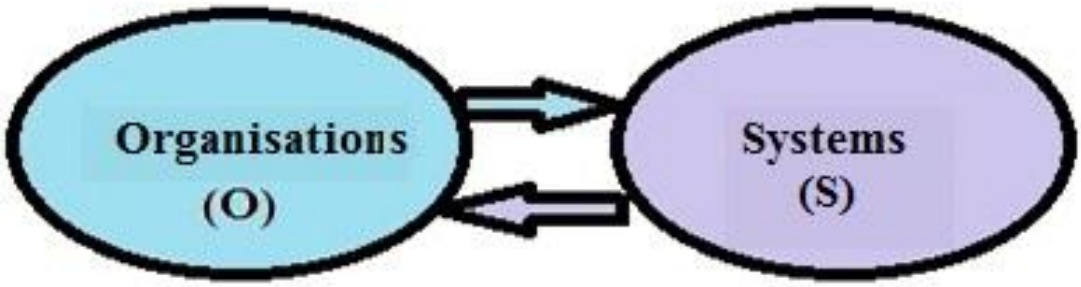

Figure 9. One organisation is responsible for certain systems

The block chain is intended for addition only structures. The user can add only additional data in the form of additional blocks. All previous data constantly remain and cannot be changed. Thus, the unique operations connected with block chains, operations only readings and records are.

The technology blockchain well approaches for record of certain types of information. In technology blockchaina many knots operated the various organizations for maintenance of distribution of systems function. Information structure similar on network structure (fig. 10). The responsible organization, establishes the rules for management blockchainом to whom allow to carry out transaction at carrying out of a voting procedure and to whom allow to execute operations on knot. The organization will develop the software for distributed "account book". At governmental bodies, management over unique object (for example, over S.N.P.) changes on network management in which some parties are responsible behind object management. Technology application blockchaina, can simplify direct interaction between citizens, providing administration without the governmental manager. It demands working out of new ways of management by a society. And what governmental organization is responsible for software and decision-making support, and powers are defined for this purpose how to exercise administration.

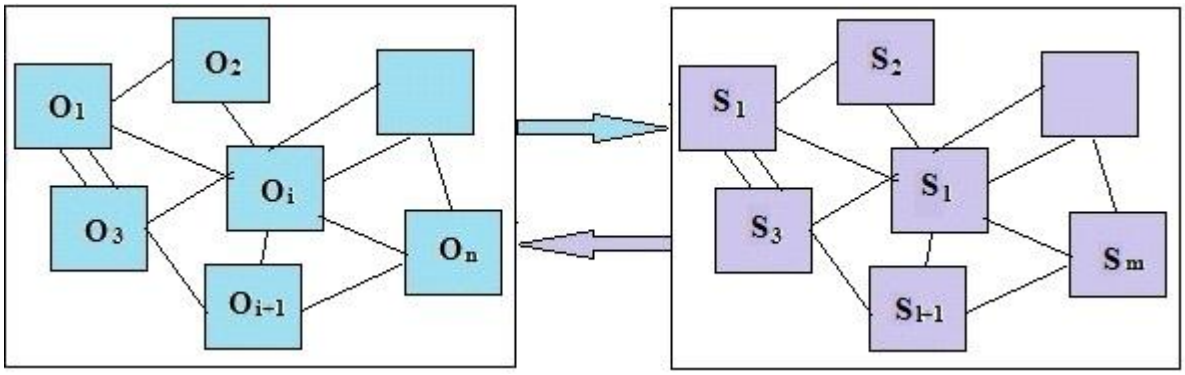

Figure 10. The scheme of the interface of "organisation-system" with technology blockchain

If confidentiality - the unique purpose technology blockchaina have no advantages before technology on application of databases. Information concealment in a block chain demands great volume of cryptographic enciphering that is fraught with high computing loading on network knots. It is impossible to make it more effectively, than easier completely to hide the necessary information in the centralized database.

The comparative analysis of technologies

Not applying for completeness, we have carried out the comparative analytical analysis between technologies a database and blockchaina on several characteristic properties which probably will help depending on a complex of solved problems of various structures and state bodies. Before to choose one of above specified technologies, each organization should find out answers approximately on such questions - that is necessary, that it would be desirable, for what time, what expenses etc. And only after that to see the strong and vulnerable parties of both technologies (tab. 1).

Table 1.

№	Properties	Technology of DB	Technology blockchain	
			The opened	The closed
1	Confidentiality of subjects	+	+	+
2	Centralized	+	-	+
3	Cache	+	+	+
4	Distribution of data	-	+	-
5	Updating	+	+	+
6	Users of a network	+	+	+
7	Operational costs	min	min ÷ max	min
8	Throughput	+	-	+
9	Maintenance cybersecurity	Cache each user of a network	Only with all users networks	Only with all users networks
10	Access to the register	-	+ reading and record for all users	+ record only avtori-zed, reading for all users
11	Access to data	+	+	+
12	Invariance of data	min	max	minimax
13	Reliability	+	+	+

14	Stability	+	+	+
15	Expenses on services of intermediaries	-	+	+
16	Time delays with third party connection	-	+	+
17	Structure	+	-	-
18	Integrity of data	+	+	+
19	Transparency of data	-	+	-
20	Multilevel protection	+	-	-
21	Multilevel access	+	-	-
22	Complexity of realization	-	+	+
23	Complexity of support	-	+	+
24	Monitoring on records	+	-	-
25	Monitoring on domains	+	-	-
26	Blocking	-	+	+
27	Record	+	+	+
28	Simplicity of work with editing	+	-	-
29	Computing loading on cache	-	+	+
30	Volume on cache	-	+	+
31	Simplicity of working out of technologies	+	-	-
32	Energy consumption	+ -	+	+

Here «+» specifies in presence of the given property, and «-» on absence.

The conclusion

The technology blockchaina innovative, it offers new ways of the organization in many domains for record of transactions, events, certificates and possession. In technology blockchaina the idea of the distributed organization of processing in which transactions are democratized by representation of mechanisms of the consent of the majority is put in pawn, allowing to make transaction. Consequences of application of technology blockchaina for the government, should be investigated by means of interdisciplinary researches.

We have carried out the small comparative analysis of two technologies: relational databases and blockchaina. Have shown positive and negative sides of both technologies. Prospects for the government, concerning advancement of architecture of relational databases and blockchaina. On the basis of given article, it is possible to draw following conclusions:

1. If the technology of relational databases can give advantages at monitoring with the subsequent possibility of acceptance of administrative decisions in the electronic government prospects for carrying out of the same monitoring at technology application blockchaina while up to the end it is not clear.

2. At large-scale realizations of projects of the electronic state the technology of databases provides the big flexibility of data processing. Technology blockchaina, in force заложенности presence of the report of the consent and an invariance of records, cannot provide flexibility of data processing.

3. Degree of maintenance of safety and confidentiality in technologies of relational databases is very reliable and there are proved possibilities of its perfection.

4. Technologies blockchaina in an unripe condition, therefore are possible small-scale experiments in the electronic government to investigate the potentials put in pawn in technology.

5. Technology application blockchaina for the electronic government can lead to potential benefits from the point of view of strategic, organizational, information and technological aspects.

6. It is necessary to spend a critical estimation of potential benefits from technology application blockchaina for the electronic government. It is required additional researches at a data control in a cut of governmental bodies.

7. In the electronic government application and hybrid technology, depending on object of appointment considering thus clear advantages of this or that technology is possible.

Reference

[1] The message of President Republic Uzbekistan Oliy Najlis// January, 24th, 2020, www.president.uz

[2] Satoshi Nakamoto. Bitcoin: A Peer-to-Peer Electronic Cash System//www.bitcoin. org/bitcoin.pdf, 9 p.

[3] H. Hou. The Application of Blockchain Technology in E-Government in China//2017 26th International Conference on Computer Communication and Networks (ICCCN), Vancouver, BC, 2017, pp. 1-4.

[4] Zheng, Z., Xie, S., Dai, H-N., Chen X. and Wang, H. Blockchain challenges and opportunities: a survey//Int. J. Web and Grid Services, Vol. 14, No. 4, 2018, pp. 352-375

[5] Purva Grover, Arpan Kumar Kar, Marijn Janssen. Diffusion of blockchain technology. Insights from academic literature and social media analytics//Journal of Enterprise Information Management, July 2019, Emerald Publishing Limited 1741-0398, www.researchgate.net/publication/334309552

[6] Svein Ølnes, Jolien Ubacht, Marijn Janssen. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing//Journal Government Information Quarterly, 34, 2017, pp. 355-364, www.elsevier.com

[7] Khakimov M.X., Gaynazarov S.M. Databased management system. Second edition//Science and technology, Tashkent, 2015, 648 p.

[8] M. Iqbal, S.A. Khan, D.S. Ivanov, R.A. Ganeev, V.V. Kim, G.S. Boltaev, I. Sapaev, N.A. Abbasi, S. Shaju, M.E. Garcia, B. Rethfeld, A.S. Alnaser. The mechanism of laser-assisted generation of aluminum nanoparticles, their wettability and nonlinearity properties// Applied Surface Science. 2020. Volume 527. Pp. 146702 Article 146702. https://doi.org/10.1016/j.apsusc.2020.146702

[9] I.B. Sapaev, K Akhmetov, A Serikbayev and B Sapaev. Dynamics of bioclimatic potential of agricultural formations of Almaty region//IOP Conf. Series: Materials Science and Engineering 883 (2020) 012075. doi:10.1088/1757-899X/883/1/012075.