Corporate Database Management on the Basis of Cloud Technologies, Blockchain Technologies and Technologies of Big Data Processing: Effectiveness and Security

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Abstract

Purpose: The work is aimed at developing a scientific concept of corporate database management on the basis of cloud, quantum, blockchain technologies and big data processing technologies on the principles of efficiency and security in the context of the digital economy of the region on the example of the North Caucasus Federal District of the Russian Federation. ***Design/method/approach***: The authors consider passports of the federal projects "Information security" and "Digital technologies" of the national program "Digital economy of the Russian Federation" from 07.11.2019. The authors analyze the statistics of financial support of digitalization of the Russian economy from 2018 to 2024. They determine the current level of development and future prospects of digital technologies in the world economy on the basis of materials of the National Research University "Higher School of Economics". ***Findings***: The conceptual model of corporate database management on the basis of cloud, quantum, blockchain technologies and big data processing technologies on the principles of efficiency and security was developed. Scenario analysis of corporate database management on the principles of efficiency and security in the regions of the North Caucasus Federal District of the Russian Federation with the application of game theory methodology was conducted. ***Originality/value***: It has been substantiated that the management of corporate databases based on cloud, quantum, blockchain and big data technologies to meet the criteria of efficiency and security should be organized in a systematic manner and be based on the capabilities of the region. This forms a fundamentally new scientific concept of the organization of the process under study, which reflects the view on it not from the standpoint of an isolated enterprise, but from the standpoint of the region's enterprises. Owing to this, security is provided with the support of the state, the risks are distributed among the enterprises of the region and full-scale financing allows maximizing the advantages. Circulation of regional enterprises allows establishing electronic document circulation and formation of an integral network of corporate databases in the region, thus further increasing management efficiency.

Keywords

Management • Corporate database • Cloud technology • Quantum technology • Blockchain • Big data • Efficiency • Security • Region

JEL-codes

G34 • O18 • O31 • O32 • O33 • O38 • R11 • R58

1 Introduction

Management of corporate databases determines the information support of enterprises and therefore is the key to the reliability of its assessment of the current internal and external (market) situation, as well as making informed and rational tactical and strategic decisions. Evaluation of corporate database management is associated with the application of two criteria. The first criterion is efficiency. As well as in any economic process, the studied management

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practice should provide advantages for the enterprise, the value of which exceeds the cost of their achievement.

This means that corporate database management is not an end in itself, but a tool for creating business benefits. The costs of collecting corporate information and its processing should be commensurate with and not exceed its importance. This criterion orients the management to set priorities in the field of information, that is, its sorting and ranking, and the preference for the most demanded information in the enterprise. As the volume of information in the information society grows, compliance with this criterion becomes more and more complicated and requires close interaction of the manager with the employees of the enterprise.

The second criterion is security. Most of the information is attractive to business only if it is unique, which requires maintaining its confidentiality and commercial confidentiality. It should be noted that this applies not only to advanced technologies but also to other intangible assets of the enterprise, including its know-how and information on market conditions. Compliance with this criterion varies with different types of information. For example, when information is stored orally and is inseparable from the medium (informal data), it is necessary to prevent staff turnover. Information on paper media requires physical security of the company building and legal support for non-disclosure of corporate information.

In the digital economy, new additional and expanded opportunities for improving the practice of corporate database management emerge based on the breakthrough digital technology Industry 4.0, the most promising of which are cloud, quantum, blockchain and big data processing technology. Although the criteria for achieving and assessing the degree of optimality of corporate database management remain the same, their application requires a new scientific and methodological approach. The digital form of data allows for automatic data classification and is subject to cyber-security risks.

This work is aimed at developing a scientific concept of corporate database management based on cloud, quantum, blockchain and big data processing technologies on the principles of efficiency and security in the context of the digital economy of the region, using the example of the North Caucasus Federal District of the Russian Federation.

2 Materials and Method

A literature review of the topic has shown that the opportunities and benefits of the application of selected breakthrough technologies in the Industry 4.0, in particular, cloud, quantum, blockchain and big data technologies in corporate database management are presented in publications by Abdulkadyrov et al. (2017), Buchaev et al. (2014), Gadzhiev and Buchaev (2014), Khachaturyan et al. (2017, 2018), Petrenko et al. (2018), Gadzhiev and Buchaev (2014), Khachaturyan et al. (2018), Popkova (2019), Popkova et al. (2019, 2018), Petrenko et al. (2018), Popkova and Parakhina (2019), Popkova and Sergi (2018, 2019), Ragulina (2019), Sergi et al. (2019), Sergi (2019).

However, the existing literature sources contain only individual recommendations and disparate fundamental conclusions and applied solutions, while the holistic concept of corporate database management based on breakthrough technologies of Industry 4.0 is absent, the criteria for evaluating this management in the context of the digital economy are not specified, and the regional context is not taken into account. This work is intended to fill in the gaps identified.

As a result of studying the passport of the federal projects "Information security" and "Digital technologies" of the national program "Digital economy of the Russian Federation" from 07.11.2019, we found that the issues of ensuring the efficiency and security of advanced digital technologies in Russia are given significant attention, as evidenced by the data on their financing (Fig. 1).

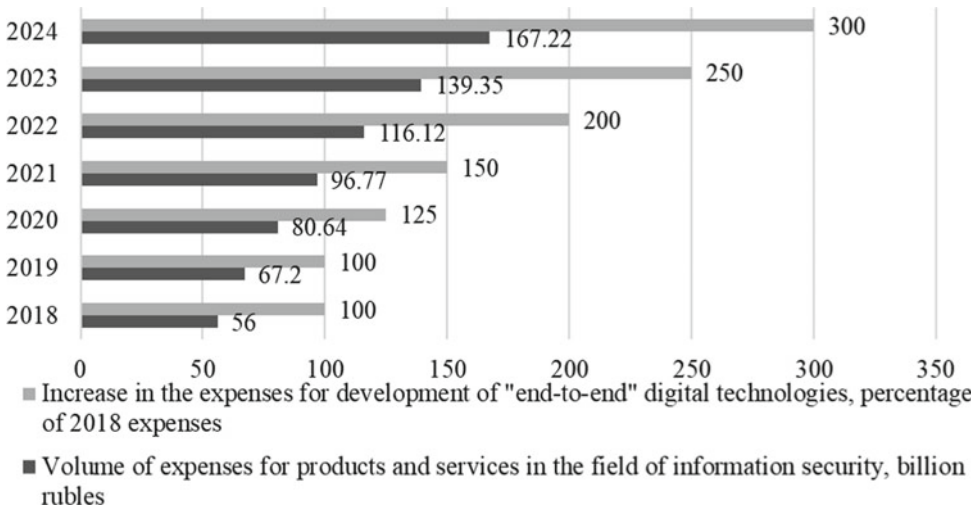

Fig. 1 Statistics on financial support to the digitalization of the Russian economy from 2018 to 2024. ANO "Digital economy" (2019a, b)

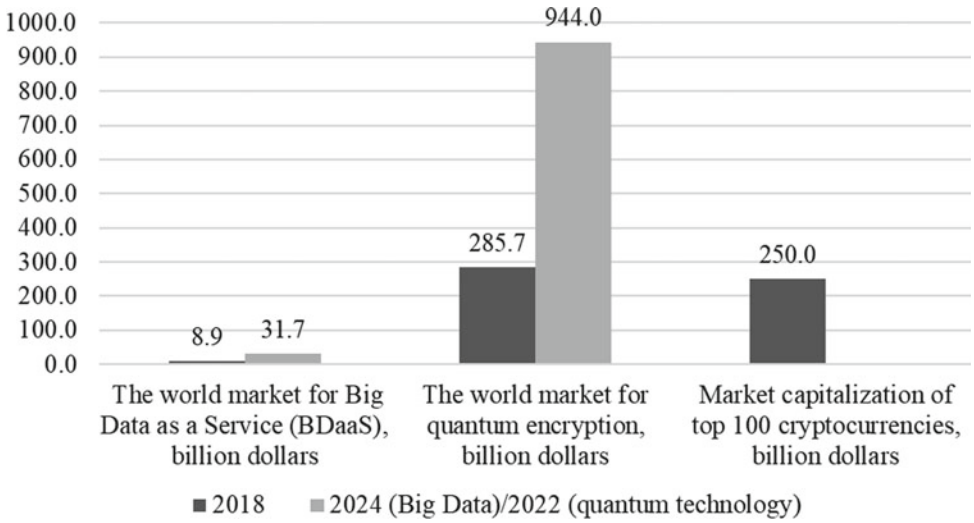

Fig. 2 Current level of development and future prospects of digital technologies in the world economy. *Source* Built by the authors on the basis of the National Research University Higher School of Economics (2019)

As shown in Fig. 1, government spending on "end-to-end" digital technologies in Russia in 2024 will increase three times as compared to 2018, and the volume of spending on information security products and services will increase from 56 billion rubles in 2018 to 167.22 billion rubles in 2024, that is three times. The materials of the National Research University "Higher School of Economics" also present the current level of development and future prospects of digital technologies in the world economy, which are illustrated in Fig. 2.

As can be seen from Fig. 2, the volume of the world market of big data as services (BDaaS) in 2018 is $8.9 billion, and by 2024 it will increase to $31.7 billion, which is almost four times. The volume of the world market of quantum encryption in 2008 is 285.7 billion dollars, and by 2022 it will increase to 944 billion dollars, that is more than three times. Market capitalization of the top 100 cryptocurrencies representing distributed registry systems (blockchains) as of 2018 is estimated at $250 billion. Consequently, there are significant prospects for the development of breakthrough technologies in the Industry 4.0 at the global level.

3 Results

We have discovered that in the regions of the North Caucasus Federal District only individual private and public initiatives are being implemented to introduce digital technologies into the practice of corporate database management, which leads to restrained results. In order to accelerate the modernization of the practice, we have developed a conceptual model of corporate database management based on cloud, quantum, blockchain and big data processing technologies on the principles of efficiency and security (Fig. 3).

As can be seen from Fig. 3, the corporate database of the enterprise is formed from its internal information, and information comes from external sources—state regulators, consumers, contractors and competitors. The top manager performs analytics of this information with the help of big data processing technologies. All internal and external stakeholders have access to the corporate database through a blockchain—a chain linked to the source database, but separate segments of information.

In this way each user generates their own database and stores it in their own cloud, and the corporate database is also subject to cloud backup. Quantum security technology prevents unauthorized access by unauthorized users. The developed scheme allows maximizing the benefits and guaranteeing the security of enterprise database management based on cloud, quantum, blockchain and big data processing technologies. At the same time, the issue of costs is not addressed and needs further research. For its study in this paper, a scenario analysis is conducted using the methodology of game theory in the regions of the North Caucasus Federal District of the Russian Federation (Table 1).

Table 1 demonstrates that at present (2019) the advantages (cost estimate of innovative goods) in the regions of the North Caucasus Federal District of the Russian Federation is 34722.4 million rubles. Capital expenditures on technical innovations amount to 8956.8 million rubles. We have estimated the security factor (cybernetic risks) at 0.5 (in fractions from 1). The efficiency of the scenario implementation is calculated as follows: 34722.4*0.5/8956.8 = 1.94. So, taking into account the advantages of the security, risks exceed the costs by 1.94 times. In this case, not breakthrough but ordinary digital technologies (computer, Internet) are used.

Scenario 1, which assumes isolated digitalization—independent implementation of breakthrough technologies by the

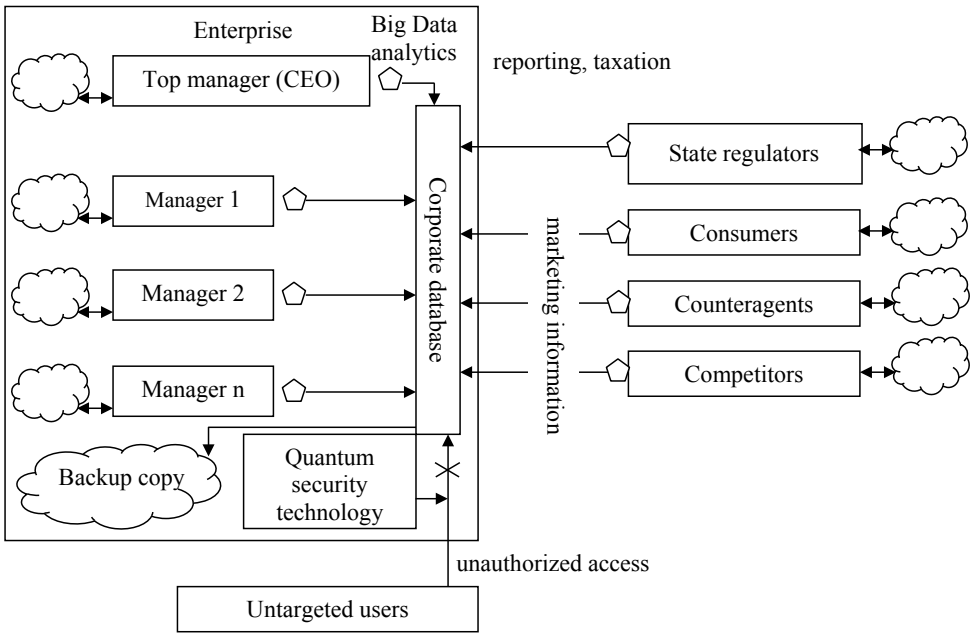

Fig. 3 Conceptual model of corporate database management based on cloud, quantum, blockchain and big data processing technologies on efficiency and security principles. *Source* Designed and compiled by the authors

Table 1 Scenario analysis of corporate database management based on efficiency and security principles in the regions of the North Caucasus Federal District of the Russian Federation

Scenario for modernization of corporate database management based on cloud, quantum, blockchain and Big Data processing technologies	Capital expenditures (expenditures on technical innovations), million rubles	Security costs, million rubles	Advantages (cost estimation of innovative goods), million rubles	Security factor, shares from 1	Probability of scenario implementation, shares from 1	Scenario efficiency
Basic conditions	8956.8		34722.4	0.5	–	1.94
Scenario 1: isolated digitalization	17913.6	17913.6	138890	0.6	1	2.33
Scenario 2: integrated digitalization	16122.2	13435.2	145834	0.75	0.9	3.33
Scenario 3: regional digitalization	13435.2	10748.2	156251	0.9	0.75	4.36

Source Compiled and calculated by the authors based on the materials of Rosstat (2019).

enterprise—promotes a slight increase in efficiency up to 2.33 and security up to 0.6. Scenario 2, referred to as integrated digitalization—breakthrough technologies implementation within the cluster of enterprises—further increases efficiency (up to 3.33) and security (up to 0.75).

The most preferable scenario is the third one, involving regional digitalization. In this case, the modernization of entrepreneurship is carried out within the framework of the relevant program of the region with state financial support. This makes it possible to increase the level of security not at individual enterprises, but in the region as a whole (up to 0.9) and to distribute costs evenly among market participants, so that efficiency (despite the increased complexity and probability of 0.75) increases to 4.36.

4 Conclusion

Thus, to meet the criteria of efficiency and security, management of corporate databases based on cloud, quantum, block and big data technologies should be organized in a systematic way and be based on the capabilities of the region. This forms a fundamentally new scientific concept of the organization of the process under study, which reflects the view on it not from the standpoint of an isolated enterprise, but from the standpoint of the region's enterprises. Owing to this, security is provided with the support of the state, the risks are distributed among the enterprises of the region and full-scale financing allows maximizing the

advantages. Digitalization of regional enterprises allows establishing electronic workflows and forms an integral network of corporate databases in the region, further increasing management efficiency.

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