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Analysis of the Factors Affecting the Choice of Information Systems by Economic Subjects of Russian Federation

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Abstract

The paper shows the relevance of studying the factors taken into account when choosing automation tools and information systems by enterprises of different activities in different regions of Russia. The growing pace of technological change requires a balanced development of information technology in different regions in order to maintain the flexibility of the entire system and ensure the economic security of the country. The choice of information systems in the public and private sectors of the economy is different. The presence of significant geographical disproportions in the distribution of costs for information technology in the regions of Russia is revealed. Classification of the factors influencing the decision-making on the choice of information systems is carried out. The necessary conditions for the creation and successful development of information technology centers have been identified; those conditions include the availability of free resources for electricity generation, a developed research and educational center and the human resources potential of the territory in the field of ICT (Information and Communication Technologies). Partially identified imbalances are associated with the multistructural nature of the Russian economy and with territorial expanse; they are objective in nature and are subject to adjustment. The expediency of creation of interregional system involving cooperation ties with the purpose to develop information technology centers in different regions of Russia is shown.

Keywords: Information systems; Economic choice; Regions; Regional development; Sustainable development; Digital technologies.

1. Introduction

Scientific and technological progress is the development of information and communication technologies in the sectors of the economy (Mustafin, 2016). Technological leadership can give significant advantages in the competitive world today. Economic globalization and the internationalization of operations are the most important factors for the integration of suppliers, partners and customers within and across national borders (Yusuf *et al.*, 2004). Network structures and formations are emerging, a cluster form of production activity organization is developing; all of this stimulates competition and leads to an increase in the interest of enterprises in modern management systems.

Structural shifts in the Russian economy, which occur under the influence of negative macroeconomic trends, make the subjects of the business sector to focus on reducing costs, to increase labor productivity and to improve their administrative mechanisms of business management. Consequently, they create a favorable basis for the automation of a number of standard operations and processes.The problem lies in the uneven introduction of information and digital technologies in the Russian economy, what hampers the accelerated establishing of digital technologies in economic processes. Sanctionary policy towards the Russian economy by some foreign partners creates additional opportunities for the development of the domestic software and hardware equipment market. However, the dissemination of information about new technologies and software products is extremely uneven. In this regard, the identification of preferences in the choice of information systems by subjects in various sectors of the economy and regions of Russia can be considered relevant. They are necessary to take into account in the subsequent development of measures aimed at accelerating the development of digital segments in the Russian economy. Taking into account the considerable territorial expanse and wide range of economic activities, preferences in the choice of digital technologies can have significant differences that should be considered when developing and implementing macroeconomic policy measures.

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2. Research Method

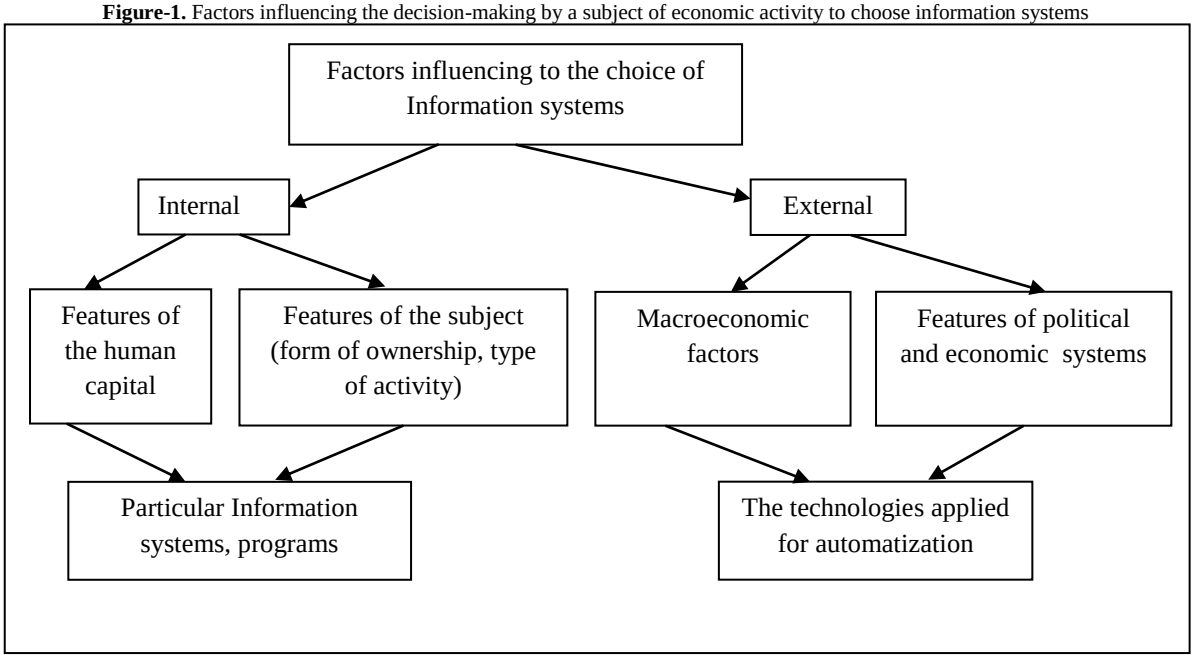
The chain of reasoning is constructed within the framework of the main provisions of the evolutionary school in economic theory; the features of each contract, a deal, and a problem situation will be taken into account, if possible. In addition, the scientific abstraction, analysis and synthesis methods, as well as approaches to system analysis were used. (We view economic entities as self-organizing systems within the framework of the system paradigm formulated by Kornai (1998). and developed by Corresponding Member of the Russian Academy of Sciences (Kleiner, 2011).

The sources of information were monographs, scientific papers and other publications in periodicals and scientific collections, Internet resources, etc. The information base of the study was made up of official statistics of the Russian Federal State Statistics Service (Krasyuk *et al.*, 2017) and its regional offices in the regions, reference documents of ministries and departments of the Russian Federation and the Republic of Tatarstan, regulatory and legal materials, author's calculations and personal observations.

3. Results

According to the results of the analysis, the factors that are being taken into account by economic entities when choosing automation systems can be divided into internal and external ones concerning the subject which makes a decision about the choice of information systems. We mean by external factors the circumstances that are related to the specifics of the structure of the economic and political system in a particular country / region (for example, the average level of education, competitive pressure, environmental requirements) or circumstances external to the state, namely, actions committed by other states in respect of the former (for example, the adoption of sanctions). Internal factors are characteristics of the business entity itself (for example, organizational and legal form, geographic location, industry and type of activity, features of the available human capital).

Figure-1. Factors influencing the decision-making by a subject of economic activity to choose information systems



The selection of information systems takes different forms in the public and private sectors of the economy. It is no coincidence that state information systems are enshrined in the Russian legislation as a separate category. So, according to the Russian legislation, information systems include:

- State information systems;
- Municipal information systems; and
- Other information systems.

In particular, it was established that the

Government of the Russian Federation approves the requirements to the procedure for the creation, development, commissioning, operation and decommissioning of state information systems, and for further storage of information contained in their databases. In total, there are about 100 state information systems in Russia, which are divided into federal and regional ones. An organization working with any of these systems must comply with the data protection requirements that are processed in it. The register of federal state information systems should be also maintained.

External factors exert a greater influence on the state bodies when choosing information systems, since the internal selection and procurement procedures are rigidly standardized and prescribed in regulatory legal acts. Procedural choice of information systems involves holding a tender / auction according to the procedure of public procurement with the collection of proposals and the subsequent choice. The requirements for bidders are serious, and the software must be produced domestically.

The costs of information and communication technologies as the total costs of ICT include capital and current costs for the development, acquisition, implementation and use of ICT.

Regression analysis of statistical data on the Russian economy for the period from 2011 to 2017 results in the following regression model:

$$Ln (Z) = 11.0557 + 0.0001 * Y + 0.6184 * D + e i \quad (1)$$

Where Z - Expenses for information and communication technologies, thousand rubles;

Y - Gross domestic product of Russia in constant prices in 2011, billion rubles (GDP);

D - Share of sales through the Internet in the total volume of retail trade turnover, in percent.

The GDP was taken at constant prices in 2011 to avoid the impact of inflation on the value of the indicator. Inflation is a significant factor in the development of the Russian economy and, due to its high values compared with developed countries it can lead to a shift in regression estimates. The calculation indices are given in Table 1.

Table-1. Regression model indicators

	D	Y	Constant
Coefficient	.6184	.0001	11.0557
SE	.1523	.00003	1.8639
R 2	.94		
F	.28		

Since the value of the correlation coefficient between explanatory variables is .28 and does not exceed .30, we can assume that the multicollinearity between the variables Y and D is absent. The value of the correlation coefficient with the random deviations values in the model (e i) is close to zero, hence all the dependent variables are internal (all variables are endogenous).

The model is statistically significant by the Fisher criterion, since Ftab. <Fmodel with significance level a = 0.05. The standard errors (SE) of coefficients are within the allowed values, what also indicates a sufficient quality of the model.

Regression analysis also showed that the cost of information and communication technology in Russia is not statistically significantly influenced by the following indicators such as:

- The share of patents granted annually in the field of information and telecommunication technologies, of the total number of patents granted annually, in relative terms;
- The proportion of the population using the information and telecommunication Internet network.

As part of the work to improve the model, these indicators were replaced by the proportion of Internet sales in total retail trade turnover, as it has high correlation coefficients with these excluded factors, and indirectly reflects the level of digitalization of the economy as a whole.

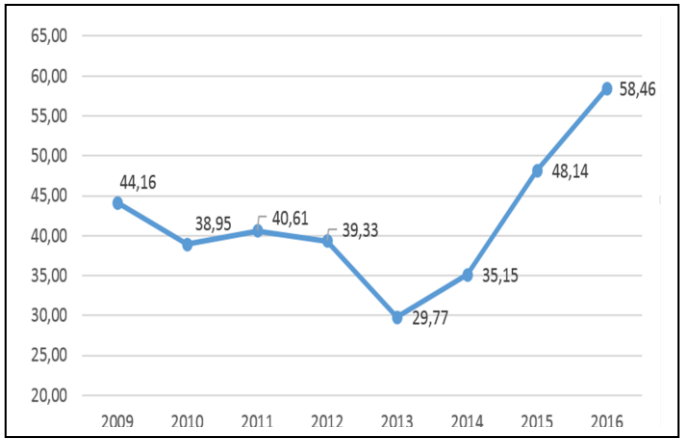
The specific weight indicator for the organizations in Russia which use information and communication technologies (as a percentage of the total number of

organizations surveyed) was excluded from the model when assessing its parameters in order to exclude multicollinearity in the final model.

In addition to analyzing the ICT costs and the factors that affect them, for Russia as a whole, it is important to note that the distribution of these costs has regional features.

In particular, the analysis of data for 2009-2016 showed that the share of the Central Federal District in the total cost of information and communication technology in Russia for the period averaged more than 40%, reaching 58.46% in 2016 (Fig. 2).

Figure-2. The share of the Central Federal District in the total cost of information and communication technologies in Russia in 2009-2016.

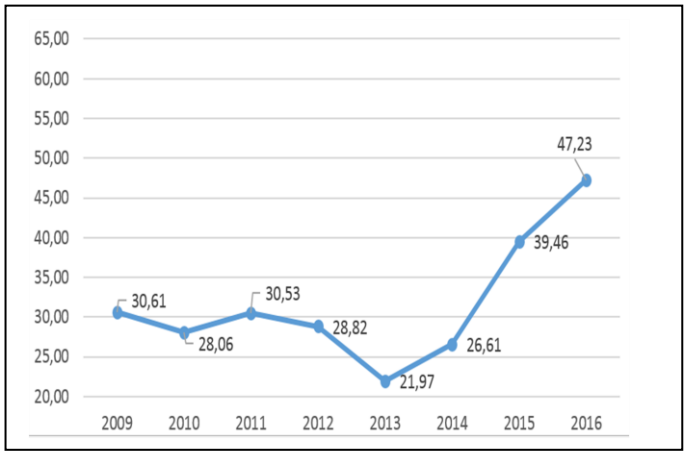


Source: authors' calculations on materials www.gks.ru

A significant contribution to the value of this indicator is made by the city of Moscow, what follows from the data in Figure 3. If from 2014 in a number of Russian regions, the costs of information and communication

technologies began to decline, possibly due to a reduction in costs against the background of crisis phenomena in the economy, but this is not the case for Moscow.

Figure-3. Share of the city of Moscow in the total expenses for information and communication technologies in Russia in 2009-2016.



Source: authors' calculations based on materials from www.gks.ru

Based on these data, it is obvious that there are significant geographical disproportions in the distribution of expenses for information technology in the regions of Russia. Centralization of these expenses in the Russian capital is an unstable situation. The second and third place in the total value of expenses for information and communication technologies in Russia is occupied by the Moscow region and St. Petersburg which a federal city, respectively. Next come the Tyumen Region (56,041,377.2 thousand rubles in 2016) and the Republic of Tatarstan (24,666,895 thousand rubles in 2016).

At the same time, such a situation has objective reasons. Firstly, the development of information technology requires a number of significant free capacities for generating electricity. In Russia there is a wholesale electrical energy and power market as a sphere of circulation of special goods: electrical energy and power within the Unified Energy System of Russia within the boundaries of the single economic space of the Russian Federation with the participation of large producers and large buyers of electrical energy and power. At the same time, despite the undoubted interconnection, electrical energy and power are treated as separate goods. This market is divided into two price zones:

1) European part of Russia and the territory of the Urals;

2) Western Siberia.

Those territories of the Russian Federation, for which, for various reasons, the functioning of a competitive electrical energy and power are impossible, are attributed to non-price zones (Arkhangelsk Oblast, Kaliningrad Oblast, Komi Republic were referred to the first non-price zone, and East energy system in the Far Eastern Federal District was referred to the second non-price zone) . Trade in the non-price zones is carried out on the basis of regulated prices (Davidson *et al.*, 2009).

Although at the present time there is a tendency to strengthen the competitive component of these markets, nevertheless, the Unified Energy System of Russia is a natural monopoly and historically it was mostly developed in the metropolitan region. Perhaps this is one of the reasons that Data Processing Centers (DPCs) of many large corporations (for example, PJSC "Sberbank" and others) are located exactly in Moscow, thus increasing statistical indicators of ICT expenses in this constituent entity of the Russian Federation.

As of 01.12.2017, 108 organizations were included in the register "Electrical energy and power providers - owners of generating equipment", 29 of them are registered in Moscow (26.85% of the total number). At the same time, there are only 9 territorial grid organizations functioning in order to perform the functions of the guaranteeing supplier and 116 energy sales companies.

In addition, the computational power must be in demand, so that it would be expedient to implement them and bear the costs of their maintenance. It was revealed that supercomputers are located in close proximity to major scientific and educational centers, since such centers have:

a) Tasks for which a wide pool of information technologies is required;

b) The opportunity to pay for the content of the computational power which consumes a significant amount of energy.

So, among the supercomputers of Russia and CIS countries the most powerful is the system located in the M.I. Lomonosov Moscow State University with the same name "Lomonosov". The second place is occupied by a supercomputer from the Interdepartmental Supercomputer Center of the Russian Academy of Sciences (Moscow again). The third place is occupied by an unnamed computer from the South Ural State University. Moscow remains the largest scientific and educational center of Russia, which contributes its own warehouse to its leadership in ICT costs.

An important component is also the personnel potential of a territory, as information technologies need skilled personnel for their development, support, implementation, and use.

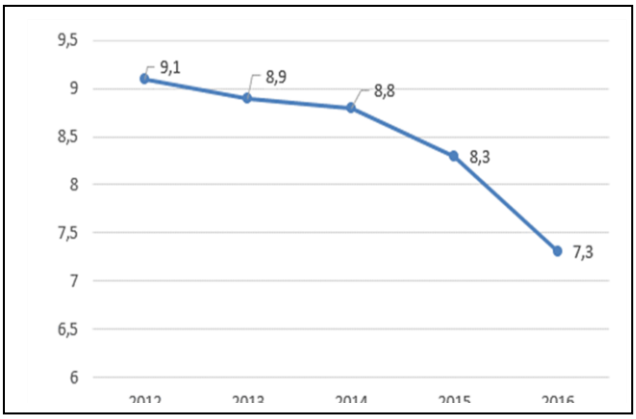
Thus, the necessary conditions for the establishment of an information technology center in a particular region are:

- Availability (or readiness for operational creation) of significant free energy capacities;
- Availability of a large scientific and educational center;
- Availability of free human resources in the field of information technology.

All this means the need to develop digital technology centers by creating economic clusters. The Strategy for the development of the information technology industry in the Russian Federation for the years 2014-2020 and for the future up to 2025 indicates that due to the widespread use of new mobile, intellectual and other systems and related hardware, the demand for design centers and engineering centers will increase. The same document notes that according to the data of the Ministry of Economic Development of Russia, digital and information technologies are among the first three main branches of regional economic systems only in Moscow and St. Petersburg. In addition, the Ministry of Economic Development of the Russian Federation concludes that the companies of the industry which activities are mainly connected with software and digital technologies are practically not represented in small Russian cities. This is an extremely unstable situation, when the regions are, in fact, unable to support the vector of economic development, proposed at the federal level as a strategic one. Therefore, we believe that the Russian economy as a whole and it`s regions in particular need to search for new management, organizational solutions, which are based on a systematic approach to innovative modernization and new management mechanisms, naturally built into all types of innovative processes of economic life in the center and in places (Brynjolfsson and Hitt, 2000).

So, if we consider the data on the indicator "The share of organizations that implemented technological innovation in the Russian Federation, in percent" for 2012-2016, then we also note its negative dynamics, which is shown in Figure 4. While in Moscow and St. Petersburg, as well as in the Moscow region, this dynamic is generally positive. The share of organizations that implemented technological innovation in the total number of organizations surveyed in Russia was significantly influenced by the events of the end of 2014, which increased after 2014 the tendency to reduce the share of enterprises using technological innovations.

Figure-4. The share of organizations that carried out technological innovation in the Russian Federation, in percentage, 2012-2016.



Source : authors' calculations based on materials www.gks.ru

Thus, economic shocks have different effects on the economic activities of the regions. As a negative factor, we can note the increase in Moscow's share in total ICT expenses from the total volume of corresponding expenses for the Russian Federation as a whole. This reinforces existing imbalances.

4. Conclusions

The economy is becoming increasingly dependent on information technology (Mustafin, 2016). At the same time, the centers of development of information technologies are extremely unevenly distributed over the territory of Russia. In recent years, attempts have been made to create an alternative to Moscow center for the development of information technology in the Republic of Tatarstan (the city of Innopolis), however, according to data for 2016, Tatarstan occupies only the fifth place among the subjects of Russia in this sector. The most stable in the innovative activities of the Republic of Tatarstan are industrial production, where the main part of the innovation - active enterprises, accounting for about 70% of total numbers remains from year to year (Kundakchyan and Grigoryeva, 2016). Partially identified imbalances are associated with the multistructural nature of the Russian economy and its territorial extent, as well as historical conditions (in particular, with the territorial distribution of infrastructure with its centralization in the capital). However, it is advisable to strive to diversify of ICT expenses in different regions of Russia and in different federal districts to ensure sustainable development of the Russian economy and reduce transaction costs associated with the centralization of information resources in Moscow.

The expenses of developing new products and processes are investments in the development of an economic entity. However, Russian enterprises seem to prefer to save expenses for this item, especially with a relatively unfavorable macroeconomic environment. On the one hand, their caution is understandable; on the other hand, it shows the presence of cultural and behavioral barriers (Gadeishina *et al.*, 2016). which both local authorities and civil society may be able to jointly identify and overcome.

5. Summary

As a result of the research, the necessary conditions for the establishment of an information technology center in a region have been identified. In this case, these conditions are, in fact, of an infrastructural nature. In our opinion, in order to more evenly develop the regions in terms of the use of information technologies, it is expedient to encourage development of cooperation ties between regions. Moreover, trade and economic cooperation in this area should be expanded along the lines of the already established specialization of the regions in the area of information technology. This approach is also used when building interregional cooperation in other sectors of the economy (Ermakova and Shestakova, 2017).

In addition, as noted by Zh.A. Ermakova and E.V. Shestakova , currently the most viable are those enterprises that have a high adaptive capacity for changes in the external and internal environment. In this regard, it is necessary to further promote the development of competition in regional markets; in the presence of transparent "rules of the game" there should appear independent players which will perceive market signals and signals from the federal level (in the form of supporting activities related to the development of the software market and other digital technologies) and will be interested in developing their own competencies in this field.

Understanding the key factors that influence the choice of corporate information systems and business process automation tools creates additional opportunities to manage the process of digitalization of the economy, what is important for maintaining sustainable development.

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