International Journal of Sustainable Development and Planning
Vol. 18, No. 5, May, 2023, pp. 1457-1465
Journal homepage: http://iieta.org/journals/ijsdp

Digital Divide of Regions: Possible Growth Points for Their Digital Maturity

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https://doi.org/10.18280/ijsdp.180516

Received: 10 March 2023
Accepted: 4 May 2023

Keywords:
digital economy, digital technology, digitalization of the region, index of the digital potential of the region, internet, socio-economic development

ABSTRACT

The purpose of the study is to research the process of digitalization of the regional economy and society in order to identify the root causes for discrepancy in their progress and determine the main directions for improving regional management systems to reduce their digital inequality. This article analyzes the digital development of regions in Russia, based on statistical data from 2013 to 2020. The results show a significant gap between the leading and the underdeveloped regions. The study identifies the root causes of the imbalance and backwardness in digitalization, and provides insights for the further digital transformation of regions in the implementation of the Digital Economy National Program. The proposed methodology to assess the digital competitiveness of regions provides for an analysis of the key areas of digital transformation directly related to the digitalization of the public services sector, the economy and the social sphere. It enables to consider the innovative potential in the regional context, track the digital transformation of organizations and their involvement in digital ecosystems, and identify changes in households in terms of connecting to ICT and using personal computers, based on their digital literacy and competencies. The article provides valuable insights, which can be useful for managers and members of the scientific community involved in evaluating the effectiveness of developing the digital potential of regions and in promoting digital transformation in Russia.

1. INTRODUCTION

1.1 Background and significance of the study

At present, the world community is entering the era of a new type of economy, which, from the standpoint of different theoretical approaches, is defined as a "post-industrial economy" or a knowledge economy [1-3]. At the same time, the current economic situation features the following: the main resource is information, which is inexhaustible by its nature; the trading areas on the Internet are unlimited; physical resources can be reused to provide different services; the scale of operations is restricted only by the scale of the Internet; the customer is the top priority; for successful competition, companies do not have to be large; there is a constant development and introduction of new technologies and platforms for the provision of services [4, 5]. The above characteristics of economic relations, competition between enterprises, regions and countries, the information phase of science and technology progress have created a new reality. However, the main thing that distinguishes the emerging new reality is the rapid development of information and communication systems and mobile communications. This gives rise to many terms related to the digital - "new technological order", "digital transformation", "digital economy", "API economy", "application economy" [6, 7].

The digital development transformed almost all aspects of economic management and human life. Here there is a manifestation of revolutionary structural changes, which consist not only in digital transformations of individual processes, but also in a fundamental change in the structure of the economy. There is a global transition of value added centers into the sphere of building digital resources and end-to-end digital processes [8, 9]. In some papers, the digital economy is also called the "new economy", "Internet economy" or "web economy" and basically, such an economy covers the areas of digital technology, including digital communication networks, computers, software and other information technology related with them [10, 11].

1.2 The manifestations and consequences of digitalization for the Russian society, state, and business

Numerous studies and expert assessments assume with certainty that the digitalization of the economy and the introduction of automated processes affect the national economy positively. The possible beneficial manifestations and consequences of digitalization for the Russian society, the state and business include: economic and social effect from digital technology for the business and society; a general improvement in the quality of life of the population through the better satisfaction of existing and new needs of people; productivity growth of the social labor due to the increase of individual industries and companies; creation of new business models and new types of business, allowing to boost the profits and competitiveness of activities; greater transparency of

economic operations and ensuring the possibility of their control and monitoring; the emergence of human-replacing automated control systems, for example, for enterprises of certain classes.

For individual companies and production, the general benefits of digitalization can be manifested in eliminating intermediaries in the entire chain of actions from manufacturing a product or service to marketing and receiving feedback; in optimization of costs, in acceleration of all business processes due to the automation of production and marketing processes, reduction of communication time; in reducing the response time to market changes, reducing the time for developing products and services and bringing them to the market; in increasing flexibility when creating new goods and their high adaptability to new expectations or needs of the consumer.

1.3 Assessing the development of digital technology

There are several approaches to assessing the development of digital technology and the readiness of countries, industries and enterprises to implement them. One of them is the ICT Development Index (IDI), a composite index that combines 11 indicators into a composite score. It was used to monitor and compare changes in ICT between countries from 2009 to 2017 [12].

Currently, a whole range of different indices appeared to assess the digitalization level of countries in the world, among them the following can be distinguished: The Network Readiness Index, published by the World Economic Forum in collaboration with the INSEAD International Business School [13]; Global Connectivity Index [14], The International Digital Economy and Society Index (DESI) [15]. They help to track the progress of countries in their digital transformation in different areas or in general in terms of their digital competitiveness.

For example, in GovTech Maturity Index (GTMI), an international ranking of the World Bank that includes 198 countries with different levels of information technology development in the public sector, in 2021 Russia ranks tenth, improving its performance compared to 2020 rating. The GovTech Maturity Index measures key aspects in four priority areas [16].

The International Digital Economy and Society Index (I-DESI) measures the digital economy performance of EU27 Member States and the EU as a whole in comparison with 18 other countries around the world: Australia, Brazil, Canada, Chile, China , Iceland, Israel, Japan, Mexico, New Zealand, Norway, Russia, Serbia, South Korea, Switzerland, Turkey, United Kingdom, and the United States. The 2020 I-DESI utilizes datasets over a four-year period from 2015 to 2018 to provide trend analysis. Russia takes 45th place in the ICT development rating (7.07) with a high level of the sub-index "Practical skills in using ICT" (8.62) that provides it the 13th place in the rating for this component of the ICT index [15].

Constant monitoring enables to uncover gaps in the digital skills of staff, digital business transformation and identify opportunities for making managerial decisions on their development. Thus, according to the results of the analysis, in 2021, as a part of the Digital Decade program, the EU allocated 127 billion euros for the digital technology development. This is an investment in national plans to accelerate the digitalization of European countries. Member States allocate on average 26% of their Recovery and Resilience Fund (RRF) allocations to digital transformation, which exceeds the mandatory threshold of 20% [17].

It is important to realize that the digitalization of our life is not the main task of public administration, it is a tool that helps to ensure better and more transparent provision of various services as well as to monitor and control ongoing processes. Monitoring, big data collection, active use of artificial intelligence contribute to the development of predictive analytics to pursue a more thoughtful state policy to eliminate socio-economic inequality between regions and improve the sustainable development of territories in general.

The digital economy has already been named a priority area for the economic, scientific and technological development of Russia. This is envisaged in the Strategy of the Information Society Development for 2017-2030 and the Digital Economy National Program approved in 2017. The program aims at creating an ecosystem of the Russian digital economy where digital data will be a key production factor in all areas of social and economic activity and which ensures effective interaction, including cross-border, between business, the scientific and educational community, the state and citizens. It is worth emphasizing that studying the economy digitalization in the regional context is of immediate interest. The regional authorities are also concerned with building up digital potential, as one of the main factors for the territory's competitiveness.

1.4 Content framework and innovation of the article

The introduction highlights the emergence of a new type of economy defined as a "post-industrial economy" or a knowledge economy. The methods section discusses the approaches used to assess the development of digital technology, while the results section presents the research findings aimed to determine the vector of further digital transformation in Russia. The discussion section provides an in-depth analysis of the research results. The conclusion summarizes the research findings, highlights the importance of digital transformation for sustainable development, and emphasizes the significance of studying the digitalization of the economy in the regional context.

The innovation of this article is the development of a methodology to assess the level of digital transformation of Russian regions based on a comprehensive analysis of economic, social, and institutional factors. This methodology takes into account the specifics of the Russian economy and the digitalization process in the country, as well as international experience in assessing digital transformation. The article also contributes to the academic discussion on the importance of digital transformation for regional development and provides practical recommendations for policymakers and stakeholders to enhance digital transformation in Russian regions.

2. METHODS

The study was conducted by the Department of State and Municipal Administration of Kazan Federal University in 2022, its purpose is to investigate the process of digitalization of the regional economy and society in order to identify the root causes for the disproportions in their progress and determine the main directions for improving regional management systems to reduce their digital inequality. The

objects of the study were 83 regions of Russia, with the exception of the Jewish and Chukotka Autonomous Regions due to the lack of up-to-date statistical information on a number of indicators. The analysis was carried out for 7 years from 2015 to 2021.

Authors used publicly available data from the Federal State Statistics Service of Russia and the Ministry of Economic Development of the Russian Federation, as well as other sources such as the World Bank and the International Telecommunication Union.

Various methods to assess digitalization of a territory enabled to generalize and conclude that it can be considered as a trend for the effective development of regions only if:

- ✓ digital transformation will cover everything - business, science, social sphere and ordinary life of citizens, it will be accompanied by the effective use of its results,
- ✓ its results will be used both by specialists and by ordinary citizens who will have access to technology and skills to work with it.

A similar approach has been used by the European Commission since 2014 when compiling the DESI (Digital Economy and Society Index), which summarizes the indicators of Europe's digital efficiency and tracks the progress of the EU countries. This methodology includes 32 assessment criteria in 4 key areas of DESI: 1) Human capital includes Internet user skills (At least basic digital skills, Above basic digital skills, At least basic digital content creation skills) and Advanced skills and development (ICT specialists, Female ICT specialists, Enterprises providing ICT training, ICT graduates); 2) Connectivity involves the analysis of Fixed broadband take-up (Overall fixed broadband take-up, At least 100 Mbps fixed broadband take-up, At least 1 Gbps take-up); Fixed broadband coverage (Fast broadband (NGA) coverage, Fixed Very High Capacity Network (VHCN) coverage); Mobile broadband (5G spectrum, 5G coverage, Mobile broad-band take-up) and Broadband prices - Broadband price index; 3) Integration of digital technology includes the analysis of the following Digital intensity parameters (SMEs with at least a basic level of digital intensity); Digital technologies for businesses (Electronic information sharing, Social media, Big data); Cloud (AI, ICT for environmental sustainability, e-Invoices), e-Commerce (SMEs selling online, e-Commerce turnover, Selling online cross-border); 4) Digital public services involves the analysis of the following data: e-Government (e-Government users, Pre-filled forms, Digital public services for citizens) and Digital public services for businesses - Open data.

As a part of our study, the methodology for assessing the digitalization of the economy and society in European countries was transformed and adapted taking into account the specifics of statistical accounting in the Russian Federation. As a result, 27 criteria were identified for assessing the digitalization of Russian regions, which were grouped into five blocks: Innovative potential, Digital potential of organizations, Household access to digital technologies, Digitalization of social institutions, Digitalization of the public services.

We collected statistical data on the selected criteria in dynamics over 7 years (2015-2021) and calculated indices for each parameter, taking into account a direct connection with the level of digital development of the region according to the following formula:

$$I = \frac{Xi - Xmin}{Xmax - Xmin}, \quad (1)$$

where, Xmax is the maximum value among all analyzed regions, Xi is the value of the region for which the calculation is made, Xmin is the minimum value among all analyzed regions.

After calculating the indices for each year, the final index for each year was calculated, and then the composite index was calculated for each of the five blocks using the simple arithmetic mean formula:

$$i = \frac{\sum x}{n}, \quad (2)$$

where, x1, x2, x3, xn are the individual values of the attribute, and n is the number of units in the aggregate.

Index 1 Innovative potential, includes human resources, costs of innovation, the actual level of innovation activity in the region (see Table 1).

Table 1. Index 1 Innovative potential

Criteria
Personnel in research and development (persons)
Internal costs for research and development (million rubles)
Advanced manufacturing technologies used
The number of patents granted
Innovative activity of organizations (% of the total number of organizations surveyed in the respective subject of the Russian Federation)
Share of people employed in the ICT sector (in the total population employed)
Volume of innovative goods, work, services (million rubles)
Index 1 Innovative potential as an arithmetic mean of block indicators

Index 2 Digital potential of organizations covers the technical equipment of small, medium and large businesses and the share of various digital technology in them (see Table 2).

Table 2. Index 2 Digital potential of organizations

Organizations having a website (% of the total number of surveyed organizations of the respective subject of the Russian Federation)
Use of the Internet in organizations (as a percentage of the total number of organizations surveyed)
Organizations using electronic data interchange technologies and automatic object identification technologies (RFID) in the constituent entities of the Russian Federation (% of the total number of organizations)
Use of electronic document management in organizations (% of the total number of surveyed organizations in the respective subject of the Russian Federation)
Organizations using cloud services (% of the total number of organizations)
Share of organizations that used SCM - systems (in the total number of surveyed organizations)
The share of organizations that received orders for manufactured goods (work, services) via the Internet (in the total number of organizations surveyed)
Index 2 Digital potential of organizations as an arithmetic mean for block indicators

Index 3 Access of households to digital technology reveals the technical feasibility and the actual level of consumption of modern technologies by the population of the regions (see Table 3).

Table 3. Index 3 Access of households to digital technology

Share of households with Internet access
Use of personal computers by households (in % of the total number of HHs)
Number of active subscribers of fixed and mobile broadband access to the Internet (per 100 persons)
Lack of engineering capabilities to use the Internet (in % of the total number)
Share of Internet users who ordered goods and (or) services online (in the total population)
Index 3 as the arithmetic mean of block indicators

Index 4 Digitalization of social institutions includes educational institutions, healthcare organizations, cultural institutions and libraries (see Table 4).

Table 4. Index 4 Digitalization of social institutions

Availability of personal computers with Internet access used for educational purposes in educational institutions in the constituent entities of the Russian Federation (units per 100 students)
Computerized workstation with Internet access in libraries in the constituent entities of the Russian Federation (% of the total number of library seats)
The share of educational institutions implementing academic programs using distance learning mode for concentration programs, in the total number of independent educational institutions
Proportion of cultural establishments with a website (out of the total number of cultural institutions surveyed)
The number of personal computers with access to global information networks (per 100 employees in health care facilities)
Index 4 as the arithmetic mean of block indicators

Index 5 is highlighted as a separate block (see Table 5).

After calculating all indices for each region over 7 years, the ranking method was used. Further clustering of the regions was carried out based on the following logic: regions with indices in the range from 0.80 to 1 were classified as “leaders”, from 0.61 to 0.79 - as “average performers”, and “outsiders” were regions with indices in the range from 0.25 to 0.60.

Table 5. Index 5 Digitalization of the public services

Users of Internet to receive state and municipal services in the constituent entities of the Russian Federation (% of the total population receiving public and municipal services)
Satisfaction with the quality of public services
The share of state authorities and local self-government bodies that used the Internet in the total number of surveyed organizations of public and local governments
Index 5 as the arithmetic mean of block indicators

3. RESULTS

According to the calculations made by the methodology described above, the leaders in the ranking of Russian regions are as follows (see Table 6).

It should be noted that the first six regions: Moscow, St. Petersburg, the Moscow region, the Republic of Tatarstan and the Sverdlovsk and Nizhny Novgorod regions hold their positions throughout the entire study period. At the same time, the Perm territory demonstrates an active progressive movement in the ranking from position 13 to 7. In most cases, outsiders of the rating are depressed regions. The exceptions are the Republics of Altai, Khakassia and Sakha (Yakutia), which have demonstrated a transition from the group of “average performers” to the group of outsiders (see Table 7).

Comparing the indicators of leaders and outsiders, one can see a significant gap: for example, Moscow is almost 3 times ahead of the Republic of Dagestan (at the beginning of the study period, the difference was 39%, whereas in 2019 the gap increased to 41%).

One of the largest consumers of digital technology is business, therefore, the assessment of regions by “Digital Potential of organizations” allows us to understand how business is integrated into the digital transformation of the region. The results of the analysis for 2015-2021 made it possible to identify the leaders and outsiders of this sub index (see Table 8).

Table 6. Leaders in the index of digital potential of the region

Region	2015	2016	2017	2018	2019	2020	2021
Moscow	1	1	1	1	1	1	1
St. Petersburg	3	3	3	2	2	2	2
The Moscow region	2	2	2	3	3	3	3
The Republic of Tatarstan	5	5	4	4	4	4	4
The Sverdlovsk region	6	6	5	6	6	5	5
The Nizhny Novgorod region	4	4	6	5	5	6	6
The Perm territory	13	13	8	7	7	8	7
The Samara region	9	14	10	11	8	7	8

Source: Authors’ calculations based on data from [18]

Table 7. Outsiders in the index of digital potential of the region

Region	2015	2016	2017	2018	2019	2020	2021
The Chechen Republic	83	83	83	83	82	82	83
The Republic of Ingushetia	81	71	74	75	83	83	82
The Republic of Mordovia	77	76	79	72	81	75	79
The Republic of Tyva	67	73	82	78	72	82	80
The Republic of Khakassia	77	76	79	72	81	75	79
The Republic of Sakha (Yakutia)	50	61	66	71	65	79	78
The Amur region	45	67	71	77	76	70	75
The Republic of Altai	62	74	77	69	74	67	76

Source: Authors’ calculations based on data from [18]

Table 8. Leaders and outsiders in the digital potential of organizations

Region	2015	2016	2017	2018	2019	2020	2021
The Belgorod region	13	12	14	6	8	2	1
The Nizhni Novgorod region	12	7	9	9	13	5	2
The Smolensk region	39	29	45	42	35	8	3
The Novgorod region	27	6	19	5	2	1	4
The Moscow region	6	10	12	3	6	4	5
The Sverdlovsk region	25	14	11	16	10	9	6
Moscow	1	1	1	1	1	10	10
The Republic of Mordovia	69	80	80	52	38	76	78
The Republic of Kalmykia	61	77	70	81	78	75	79
The Komi Republic	51	52	54	59	59	68	80
The Tyva republic	73	79	74	79	80	82	81
The Nenets Autonomous District	58	40	48	66	79	80	82
The Republic of Dagestan	78	81	83	83	83	83	83

Source: Authors' calculations based on data from [18]

Table 9. Leaders and outsiders in access of households to digital technologies

Region	2015	2016	2017	2018	2019	2020	2021
The Yamalo-Nenets Autonomous Okrug	5	1	1	1	1	1	1
Moscow	2	3	5	3	2	3	2
The Khanty-Mansi Autonomous Okrug	11	12	2	2	5	2	3
St. Petersburg	4	2	4	4	3	4	4
The Magadan region	3	5	7	8	8	5	5
The Murmansk region	1	8	6	6	7	6	6
The Republic of Khakassia	39	71	73	81	73	70	78
The Republic of Mordovia	45	49	75	72	76	81	79
The Ulyanovsk region	73	63	80	74	77	77	80
The Zabaykalsky Krai	57	69	82	82	81	82	81
The Mari El Republic	31	37	59	79	80	79	82
The Altai Republic	40	61	74	18	82	83	83

Source: Authors' calculations based on data from [18]

The Belgorod and Nizhny Novgorod regions turned out to be among the leaders here, they showed significant growth in this sub index during the study period. Moscow, the leader of the rating in 2015-2019, lost its positions over the past two years and ended up in the10th place. Another region traditionally occupying the highest positions in the ratings, St. Petersburg, did not enter the top ten, remaining in 13th place. Significant growth in the subindex under consideration was shown by the Smolensk and Novgorod regions, they leapt from "average performers" to the leaders of the rating.

In general, there is an increase in the use of personal computers and the Internet by organizations. However, the average level of these indicators in Russia is lower than in the developed European countries. It is also worth noting the growing popularity of Internet commerce for the regions of all subgroups.

Utilization of digital technology in organizations remains relatively low. In particular, we analyzed data on the use of cloud services, SCM systems, electronic data interchange and automatic object identification technologies (RFID).

The practice of using cloud services by organizations is gaining popularity, but currently it is far from global indicators. In the leading regions (the Belgorod region, Nizhny Novgorod and Novgorod regions, Moscow), about 40% of organizations apply these services, among outsiders the same indicator is below 20%.

The highest usage of supply management systems (SCM) is seen in the Belgorod region - 14.8%, the lowest indicator is in the Republic of Dagestan - just over 1%. RFID technologies are employed only by 8.8% of metropolitan organizations, in outsider regions (the Chechen Republic, the Republic of Dagestan and Kalmykia) less than 3% of organizations apply this technology.

In addition to organizations, the key users of the "digital" are the citizens and households. Yamalo-Nenets Autonomous Okrug (YNAO) became the top performer in terms of household access to the Internet. The region leads here in 4 out of 5 indicators. The share of the population with access to the Internet in the region is 95%. Such a high rate is typical for countries such as Germany and Denmark. However, as of 2019 in Russia, on average only 70% of the population had access to the Internet.

For low performing regions, this figure barely reaches 65%. There is concern about the reasons why the population does not use the Internet: about 8% of Russians say that they do not have the engineering capacities to access the network (for example, in the depressed regions, such as the Altai Republic, the Mary-El Republic, those who do not use the Internet due to technical reasons accounts for a third of the population).

A significant gap is also seen in the use of personal computers in the regions. In the leading regions, about 90% of the population use a PC, while for the outsider regions this figure ranges from 45 to 55 percent. At the same time, the average level of proficiency in text editors is about 57%.

It is worth noting that, in general, in Russia, PCs and the Internet are applied predominantly for conservative purposes. The trend to apply Internet commerce in Russia, which is developing around the world, has not yet become a popular one. Only 42% of the population turn to online shopping services. For example, in the United Kingdom, Denmark, Germany and Italy, this figure reaches 80-90%. The general composition of leaders and outsiders in this block is presented in Table 9.

Table 10. Leaders and outsiders in the digitalization of the public services sector

Region	2015	2016	2017	2018	2019	2020	2021
The Belgorod region	8	5	4	2	4	2	1
The Yamalo-Nenets Autonomous Okrug	12	43	3	3	10	1	2
Moscow	3	3	9	10	3	3	3
The Republic of Tatarstan	1	1	1	1	1	4	4
The Tyumen region	7	4	6	8	12	6	5
The Lipetsk region	10	8	2	4	14	7	6
Transbaikal region	64	55	80	79	81	75	78
The Republic of Mordovia	20	2	65	21	22	79	79
The Republic of Buryatia	61	82	82	82	71	80	80
The Republic of Kalmykia	75	81	60	78	77	81	81
The Mari El Republic	47	52	44	77	73	82	82
The Magadan region	83	83	83	83	83	83	83

Source: Authors' calculations based on data from [18]

Table 11. Leaders and outsiders in the "Digitalization of social institutions" block

Region	2015	2016	2017	2018	2019	2020	2021
The Yamalo-Nenets Autonomous Okrug,	3	2	3	1	1	1	1
The Khanty-Mansi Autonomous Okrug	13	7	7	3	3	3	2
The Sakhalin region	16	23	16	17	8	4	3
The Tomsk region	4	8	14	5	5	2	4
The Tambov region	8	3	2	6	7	6	5
Moscow	1	1	1	2	2	5	6
The Kabardino-Balkarian Republic	81	80	82	80	80	81	78
The Ulyanovsk region	60	73	67	77	77	80	79
The Krasnodar region	62	57	66	76	79	76	80
The Republic of Kalmykia	80	77	80	82	75	78	81
The Republic of North Ossetia	83	82	81	81	82	82	82
The Republic of Dagestan	82	81	83	83	83	83	83

Source: Authors' calculations based on data from [18]

The analysis shows that in the digital transformation of the population and households Russia faces two key problems:

1) insufficient level of engineering capabilities of households;

2) low level of computer literacy of the population.

The study of social institutions is hampered, first of all, by the lack of necessary statistical data. At present, state statistical bodies collect data only on the computerization and internetization of institutions. According to the calculations obtained for this block, the top performers are the Belgorod region, Yamalo-Nenets Autonomous Okrug and the city of Moscow, followed by the Republic of Tatarstan, the Tyumen and Lipetsk regions. The Republics of Mordovia, Buryatia, Kalmykia, Mari El demonstrate a significant backlog. The position of the YNAO, as in the previous block, is due to the high level of technical equipment of institutions. In the Yamalo-Nenets Autonomous Okrug, there are 57 computers per 100 students. This figure is twice more than in Moscow and 19 times higher than in Ingushetia.

In healthcare institutions, the situation with computerization is best in Moscow, the Perm Territory and the Tyumen region. It can also be noted that the dynamics in terms of block indicators on average in Russia is insignificant. The setting-up and development of electronic state and municipal services system is a priority area for reforming this sphere, as well as for the process digitalization at the federal, regional and local levels. Therefore, a number of indicators were combined into a separate block.

The main means of providing public services via the Internet are the portals of the government services and official websites of ministries and departments. In total, in Russia, as of 2021, about 86% of citizens (as a percentage of the total population receiving state and municipal services) receive public services via the Internet. To compare, in 2015 this figure was below 40%.

Residents of the YNAO, the Belgorod region, Republics of Bashkortostan and Tatarstan have made significant progress in this area. In these regions, about 90% of the population receives state and municipal services via the Internet. However, for outsider regions, the situation looks different. In the Magadan region, the Crimea and the Zabaykalsky Krai, this figure ranges from 38 to 45 percent.

In addition, the block also analyzed the satisfaction level of citizens with the quality of electronic public services. This indicator is the result of a citizen's survey, therefore, on the one hand, it is subjective, and on the other hand, it really expresses the opinion of the people. Those living in the Republic of Adygea are satisfied with the quality of the electronic public services provided most of all. Despite the relatively low level of online services use in Crimea, almost 90% of the population of the republic assessed it positively. In part, this can be explained by the dynamics of the involvement of citizens in obtaining Internet services. To compare, in the Magadan region, only a third of users are completely satisfied with the quality of public services. The general composition of leaders and outsiders in the block is presented in Table 10.

In addition to the existing infrastructure, technologies and services, the digitalization of the social sphere is of particular importance. The process of digital transformation is inextricably linked with the access of the population to digital technologies in education, culture, and healthcare. The Yamalo-Nenets Autonomous Okrug, the Khanty-Mansi Autonomous Okrug and Sakhalin Oblast are the leaders of the subindex. Such results are due to the methodology for calculating statistical indicators in the social sphere and the small population of the leading regions. Moscow, holding the

leading position during 2015-2019 is down 4 points in 2021. Mainly depressed regions are represented among the outsiders, with the exception of the Ulyanovsk region and the Krasnodar territory, which have lost their positions in the group of "average performers" (see Table 11).

4. DISCUSSION

Currently, there are two ratings in Russia that measure the digital transformation of regions. The first one was prepared in 2021 by the RANEPA together with the Ministry for Digital Development, Communications and Mass Media of the Russian Federation. The rating includes 84 Russian regions, Moscow is not included in it because it is several steps ahead of other regions. The main parameters for calculating the rating are indicators of information security, regional measures of financial support for IT, and the transfer of mass socially significant services to electronic form and import substitution. Since our methodology is focused on calculating other parameters, it is inappropriate to compare the results of this rating with ours.

The second national rating of digital maturity of regions was developed by the Ministry for Digital Development, Communications and Mass Media of the Russian Federation [19]. The federal entities included in it were divided into three groups: high (with values over 50% of digital maturity); average (from 25% to 50%); low value of digital maturity (less than 25%). The evaluation criteria were the number of regional specialists using information and communication technologies, the costs of implementing and using digital solutions in industry, agriculture, construction, energy, financial services, healthcare and public administration. The ranking results for 2021 are as follows: nine advanced regions are Moscow, St. Petersburg, the Belgorod, Lipetsk, Moscow, Nizhny Novgorod regions, Tatarstan, Khanty-Mansi Autonomous Okrug - Yugra and Yamalo-Nenets Autonomous Okrug. The group with an average level of "digital maturity" included 62 entities. Low-level digital maturity characterized 14 regions. These are Adygea, Dagestan, Jewish Autonomous region, Ingushetia, Kabardino-Balkaria, Kalmykia, Crimea, the Omsk region, North Ossetia, the Sverdlovsk region, the Stavropol territory, Udmurtia, Chechnya and the Chukotka Autonomous District.

Comparing the results of the rating of the Ministry for Digital Development and our calculations, we see that most of our results coincide: in both ratings, Moscow, St. Petersburg, the Belgorod and Nizhny Novgorod regions, Khanty-Mansi Autonomous Okrug - Yugra and Yamalo–Nenets Autonomous Okrug are among the leaders. The outsiders include traditionally depressed regions of Russia: The Republics of Dagestan, North Ossetia, Kalmykia, Kabardino-Balkaria. In the ranking of the Ministry for Digital Development, the Jewish and Chukotka Autonomous regions also have a low level of digital maturity, and they are excluded in our analysis due to a lack of statistical data. Our calculations coincided with the rating for the "average level of digital maturity" cluster, which included the Altai territory, the Penza, Kirov and Volgograd regions, the Republic of Bashkortostan, Khabarovsk and Krasnoyarsk Territories.

Large-scale programs for the development of the digital economy are being implemented almost all over the world: in the USA, Asian countries and countries of the European Union. In Russia, the topic of developing the digital economy is also being actively discussed, both at the federal and regional levels. Big data serves the basis for making better decisions, the optimal functioning of administrative structures and the efficient allocation of resources within the framework of the implementation of public administration processes, such as revenue management, procurement and interaction with citizens [20, 21]. Digitalization enables governments to provide better quality services with greater efficiency and at lower costs, increases the accountability and transparency of the state, and reduces corruption [22-27].

The potential of modern digital technology suggests possible directions for their use in the cycle of effective public administration. At the stage of results planning, predictive analytics technologies based on "big data" can be used. For example, based on 15 years of historical data, the Pennsylvania Child Protection Bureau developed a solvency calculator using smart modeling. This calculator allows bureau employees to predict in advance the behavior of parents who pay alimony and prevent them from breaking the law. As a result, the level of protection of children rights in Pennsylvania is one of the highest in the United States [28]. Big data can be used for tactical planning and decision making. Thus, the German Federal Labor Agency analyzed the historical data of its clients, including data on unemployed citizens who applied for a job, the measures that the agency took to find them, as well as data on the final results, reflecting how long the unemployed searched for the job timing. As part of the analysis, groups of the unemployed were identified, each having various measures developed to promote their employment. Because of this decision, 10 million euros budgetary savings for the maintenance of the agency were obtained annually, the period for finding a job by the unemployed was reduced, and the level of their satisfaction with the quality of public services in the field of employment increased [29].

Digital technology can significantly transform the processes of monitoring and evaluating the results achieved in the public administration system. In this sense, international initiatives to use "big data" for the purposes of official statistics (including as an alternative to traditionally used methods) are of interest. Such price statistics projects have been implemented in Austria, Belgium, Denmark, Italy, China, Canada, the Netherlands, Norway, Korea, Czech Republic, Hungary, Switzerland, USA and other countries, as well as at the Eurostat level; the main sources of these projects were data from scanners in supermarkets on actual prices for consumer goods, data on product prices published on the Internet.

Thus, the best world practices in digitalization of public administration enable to formulate the key steps that need to be implemented in Russia to expand the use of digital technologies in public administration and reduce the digital divide at the regional level:

1. Setting the task for key information systems. Despite a number of government decisions aimed at coordinating measures for informatization and digital transformation of the public administration system, regional departments continue to be autonomous customers of IT solutions when automating their own activities. The absence of a supra-departmental federal structure that has the appropriate competencies and powers to set system tasks to develop the architecture of IT solutions, plan budget expenditures on information systems and components of the ICT infrastructure, and coordinate informatization in regional departments leads to a further increase in the inefficiency of spending budget funds and lobbying specific IT systems.

2. Auditing the quality of primary data. Making high-quality and timely management decisions is impossible without an adequate assessment of the current situation. Modern challenges of the global digital transformation of the economy are accelerating the pace of managerial decision-making. However, to collect information on basic economic and social processes and indicators, the following outdated hierarchical model is still employed: federation-federal entities-municipalities-primary management bodies. Therefore, very often, the data collected for making managerial decisions become obsolete faster than they are at the disposal of decision makers.

3. Pursuing an evidence-based policy and ensuring the achievement of results. The digitalization of the social life, the emergence of a huge array of "big data" requires a new look at the information basis for making managerial decisions. Without this, the cost of creating digital infrastructure, banks and data centers can be largely inefficient. Taking into account the accumulated problems with the implementation of the plans adopted and decisions made, it is advisable to strengthen the system to ensure the achievement of the results by establishing clear reporting and progress indicators; assistance in drawing up a realistic budget and plans; objective monitoring of the process of achieving results and possible corrective actions, accounting and risk management.

4. Upgrading the strategic planning system. Regional strategies include a significant amount of repetitive analytical materials, the rationale for development scenarios, as a rule, is formal. Dynamic changes in the economy and social sphere devalue the significance of long-term strategic documents. The main attention in strategic planning should be shifted from the analysis of existing trends to the justification and description of the reform, innovation and development.

5. CONCLUSIONS

All regions of Russia over the past 7 years have been demonstrating progressive development in digital transformation, but the overall level of digital maturity of the regions is ambiguous, there is a significant gap between the leading regions and the outsider regions. The identified problems can be explained by the low level of managerial impact on the digitalization system of the regional economy. The article identifies several root causes of the disproportion in the digital development of Russian regions, including:

- immature institutional, administrative-legal and infrastructural base in the digitalization of the territory;
- lack of a systematic approach to digitalization and close interconnection of the digitalization program with other state programs and projects;
- insufficient emphasis on economic tasks related to the development of the digital industry, an on the issues of project financing by all participants;
- lack of an integrated approach to the system of human resources to realize digital transformation projects and the transition to industry 4.0.

Addressing these root causes can help reduce the digital divide between regions and determine the vector of their further digital transformation as part of the implementation of the Digital Economy National Program.

The digital divide between regions can be reduced by developing digital demand, building skills and competencies in the effective use of digital platforms and systems, and creating an environment that allows numerous entrepreneurs to create successful projects on the supply side and stimulates the growth of demand for these projects. The projects implemented by regional administrations may be the creation of effective open digital technology platforms in the region, the transfer of the regional administration to the "digital government" mode, the creation of a regulatory environment that supports the digital transformation of business and digital entrepreneurship, the evolution and implementation of educational initiatives that provide backing the transition to a digital economy.

While digitization may be a key factor in the development of a region, it is important to acknowledge that there may be other reasons for the imbalance and backwardness of digitalization. For example, political and economic factors may play a significant role in determining the level of investment in digital infrastructure and resources in different regions. Socioeconomic factors such as income levels and education may also impact a region's ability to develop and adopt digital technologies.

Limitations include the fact that the paper does not delve into the potential challenges and barriers that may arise in the implementation of the proposed solutions for digital transformation.

In terms of research directions, further studies could investigate the effectiveness of specific initiatives and programs aimed at promoting digital transformation in regions with lower levels of digital maturity. Authors could explore the potential of emerging technologies, such as artificial intelligence and blockchain, to further drive digital transformation in Russia.

In conclusion, we can say that the scientific results obtained by the authors made it possible to reveal the root causes of the disproportion in the digital development of Russian regions and determine the vector of their further digital transformation as part of the implementation of the Digital Economy National Program.

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