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Digitalization of Small and Medium-Sized Cities in the European North of Russia: Trends and Prospects



Irina A. SEKUSHINA

Vologda Research Center, Russian Academy of Sciences

Vologda, Russian Federation

e-mail: i_sekushina@mail.ru

ORCID: 0000-0002-4216-4850; ResearcherID: Q-4989-2017

Abstract. Rapid introduction and spread of digital technology in all spheres of life have led to changes in the economy and society. Digitalization seems to be one of the promising directions in terms of addressing economic, environmental and social issues related to the development of territories, including small and medium-sized cities. However, scientific literature has not paid sufficient attention to the digital transformation of such settlements and their territorial specifics. The aim of our work is to study trends and prospects related to the digitalization of small and medium-sized cities in the European North of Russia. We present a number of indicators characterizing the basic conditions for the development of digital technology in the region. We analyze the extent of penetration of digital services in small and medium-sized cities of the European North of Russia and identify the presence of a developed online trading infrastructure alongside a relatively low level of distribution of services. Main barriers to the digitalization of small and medium-sized cities are high cost of developing and implementing digital technologies and services, lack of funding, and a low level of digital competencies in the population. We propose solutions to the above problems and put forward some conceptual provisions determining the choice of priority areas of digitalization to achieve the sustainable development goals in northern small and medium-sized cities. We focus our attention on the importance of taking into account not only the opportunities, but also the risks of digitalization; the expediency of choosing priority areas of digitalization of the economy for various types of cities; the need to introduce digital technology to address social and environmental issues. The findings of our study may be useful to the

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public authorities of RF constituent entities in finalizing regional strategies on digital transformation of economic sectors, social sphere and public administration.

Key words: small and medium-sized cities, digitalization, European North of Russia, information and communication and digital technology, “smart” city.

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Introduction

Under the conditions of the Fourth Industrial Revolution, digitalization of almost all spheres of human life is becoming a global trend, and the introduction of information and communication and computer technology is a key factor in the socio-economic development of any state. The “black swan” COVID-19 pandemic has become a serious challenge for all countries of the world without exception. However, despite many negative social and economic consequences, due to the forced transition of most organizations to a distance work format, it also served as a powerful incentive for the accelerated digitalization of absolutely all spheres of human life.

In recent years, Russia has paid a lot of attention to the digitalization of industries and the use of new digital solutions and technologies in the public sector. The adoption of the national program “Digital Economy” in 2018 has greatly contributed to this¹. Digital transformation, in turn, has been declared as one of the national development goals of the country until 2030².

According to researchers from the Higher School of Economics, information and commu-

nications technology (ICT) growth in Russia in 2015–2021 exceeded the GDP growth rate by 28 p.p. (35 and 7%, respectively). However, 70% of this rate was provided by imports of digital and information and communication goods and services³. In conditions of aggravation of the geopolitical situation in February 2022 and the subsequent introduction of a number of anti-Russian economic sanctions by Western countries, including restrictions on the supply of high-tech products, the issues of technological development of Russia and import substitution in the information and communication sector have come to the fore and become one of the most important tasks facing the Russian fundamental and applied science.

The President of Russian Federation V.V. Putin during the 25th Saint Petersburg International Economic Forum in June 2022 noted that the key principle of the country’s development is “achieving true technological sovereignty, creating an integral system of economic development, which by critical components does not depend on foreign institutions”⁴. Without exaggeration, we can say that Russia’s future position in the global economy depends on how quickly the country can adapt to the new conditions and what its response to the new technological challenges will be.

¹ Passport of the national project “National Program “Digital Economy of the Russian Federation” (approved by the Presidium of the Council under the President of the Russian Federation for Strategic Development and National Projects, minutes dated June 4, 2019, 7).

² Presidential Decree 204 “On the national goals and strategic objectives for the development of the Russian Federation until 2024”, dated May 7, 2018, and Presidential Decree 474 “On the national goals for the development of the Russian Federation until 2030”, dated July 21, 2020.

³ Experts assessed the threat of sanctions to Russia’s digital transformation. Available at: https://www.rbc.ru/technology_and_media/27/04/2022/62681d139a7947266b64cd9e

⁴ Plenary session of the 25th Saint Petersburg International Economic Forum. June 17, 2022. Available at: <http://www.kremlin.ru/events/president/transcripts/68669>

With the growth of external threats, the problem of digital inequality within the state itself has moved into the background. However, in our opinion, during this difficult time, the issue of preserving the integrity of the country's socio-economic space is more relevant than ever, for which it is necessary not only to reduce the gap in the technological race with other developed countries, but also to develop those areas of the digital economy that will promote the sustainable development of absolutely all Russian settlements.

The approach based on the introduction of digital services and the use of advanced technologies in all social spheres seems to be one of the most promising in terms of solving the problems of sustainable territorial development (Semyachkov, 2021). In the scientific literature, these ideas are more often applied to agglomerations and big cities, because, as a rule, it is agglomerations and big cities that are the birthplace of innovation and new digital technologies. At the same time in Russia, 945 out of 1,117 cities have a population of less than 100 thousand people, that is, belong to the category of "small and medium-sized"⁵. At the local level these settlements are the centers of socio-economic development of the adjacent territories and the nodes of the supporting framework of resettlement. In view of this we can say that to a large extent the sustainable development of the country is provided by the balanced development of the economy, environment and social sphere of small and medium-sized cities.

For the territories of the European North of Russia (ENR), which includes the republics of Komi and Karelia, the Vologda, Murmansk and Arkhangelsk oblasts, including Nenets Autonomous Okrug, the issues related to improving the sustainability of cities in this category are particularly

⁵ According to the set of rules "Urban Planning. Planning and Development of Urban and Rural Settlements" (SR 42.13330.2016) from the Ministry of Construction of Russia, cities are divided into: 1) the largest (with a population over 1 million people); 2) large (from 250 thousand to 1 million people); 3) big (from 100 to 250 thousand people); 4) medium-sized (from 50 to 100 thousand people); 5) small (up to 50 thousand people).

relevant. The vast majority of cities in the region (61 out of 68) are "small and medium-sized", and they are home to almost 36% of the urban population of the ENR. Throughout the history of economic development of the northern territories, these cities, along with large ones, have been the centers of socio-economic development of the regional scale.

Small and medium-sized cities adapted extremely hard to market conditions, which had a negative impact on their socio-economic development. However, more than 30 years have passed since the beginning of market reforms in Russia, and during this time the scientific and technological sphere of the country has changed. The era of digital technology offers great opportunities for the development of even small settlements, solving their socio-economic and environmental problems. However, little attention is paid to the study of small and medium-sized cities digitalization in the North.

In this regard, the purpose of our work was to study the trends and prospects of digitalization of small and medium-sized cities of the European North of Russia. To achieve the purpose, the following tasks were carried out: a review of current research in the digitalization field was conducted; opportunities for the spread of digital technology for sustainable development of small and medium-sized cities were identified; the primary conditions for the digitalization of small and medium-sized cities in the European North of Russia were assessed; the main barriers to the spread of digital technology and possible ways to overcome them were identified; a number of conceptual provisions that determine the choice of priority areas of digitalization of small and medium-sized cities with regard to their northern specifics.

The elements of the study's scientific novelty consist in assessing the existing conditions for the spread of digital technology in small and medium-sized cities of the European North of Russia, and in developing conceptual provisions for the digitalization of these settlements to achieve the goals of sustainable development.

Research materials and methods

Theoretical and methodological research basis consisted of the works of Russian and foreign authors in the field of studying the digitalization of the economy and society, and the implementation and spread of information and communication and computer technology in urban settlements.

One of the key indicators and the main condition for the digitalization of any territory is the Internet access. Due to the absence of municipal statistics for individual cities for understanding the general trends, this paper presents Rosstat (EMISS= Unified Interdepartmental Statistical Information System) data in the context of the subjects of the European North of Russia. As the main indicators we used the data on the share of organizations and population with broadband Internet access; the share of residents who are active Internet users, including the purchase of goods; the share of sales via the Internet in the total volume of retail sales; the share of citizens who use the mechanism of receiving public and municipal services in electronic form.

For the analysis of digitalization processes directly in the small and medium-sized cities of the ENR, we used data from mobile operators' maps of 4G coverage; information about the existing online shopping infrastructure in small and medium-sized cities (pickup points of Wildberries and Ozon); information about the possibility to order a taxi using online applications (Yandex.Taxi, Uber).

Since the attitude to digitalization and the level of digital competence of the population determine largely the speed and depth of digital services distribution, we also used the results of sociological surveys of small cities residents in the Vologda Oblast, presented in a number of works of Russian scientists.

Besides, there was a content analysis of strategies in the field of digital transformation of industries, social sphere and public administration of the entities of the ENR to assess the role assigned to small and medium-sized cities of the region in these processes.

Theoretical aspects of the study

Currently, sustainable development is a strategic goal of social and economic policy in almost all developed countries of the world, both at the national, regional, and local levels. In 2015, UN member states approved 17 global Sustainable Development Goals (SDGs) until 2030, and a plan for their achievement were adopted. Goal 11th is "ensuring openness, safety, resilience and environmental sustainability of cities and human settlements"⁶, which is not accidental, because due to the active and accelerating process of urbanization, cities are becoming the new flagships for promoting sustainable development as a new paradigm of social and economic life (Dorofeeva, Leont'eva, 2021).

The concept of sustainable development involves providing for the needs of the present generation without harm to future generations by achieving environmental, economic and social sustainability. Of course, this topic is not new, there are a large number of works devoted to sustainable urban development in the world scientific literature. The focus of scientists' attention is still on both the problems of the negative impact of urbanization processes on the environment (Bhargava, 2018; Keith et al., 2022), and the issues of assessing the level of sustainability of cities and their achievement of the sustainable development goals (D'Adamo et al., 2022; Xiao et al., 2022). However, in recent years, one of the relevant topics of scientific work is the analysis of the impact of the rapid spread of information and communication and digital technologies on the socio-economic urban development and the state of the environment in them⁷ (Siliang, Heng, 2022).

The concept of "digitalization" itself does not have a universally recognized definition. There is no consensus in the scientific community on this issue,

⁶ Sustainable Development Goals. Official website of the United Nations. Available at: <https://www.un.org/sustainabledevelopment/ru/cities/#>

⁷ Noella V., Fahad A. Digitalization to fight everyone has to move to the big cities. DOI: 10.13140/RG.2.2.15151.05288

and the interpretation of the term depends directly on the field of research and the studied object. In a narrow sense, “digitalization” is an activity directly related to digital technology; in a broader sense, it is the impact of information and communication and digital technology on various spheres of society: economy, politics, culture, education, etc. (Ryazantsev et al., 2021). In terms of Russian law, digitalization or digital development is defined as “the process of organizing the performance of functions and activities (business processes) in a digital environment, previously performed by people and organizations without the use of digital products”⁸.

One of the current topics of modern research directly related to digitalization is the formation of “smart” cities. Many authors consider the solution of socio-economic and environmental problems through the implementation of the “smart city” model (Meijer, Bolívar, 2016; Semyachkov, 2021). At the same time, some foreign researchers are quite critical of this concept as a tool for the transition of a settlement to sustainable development (Colding, Barthel, 2017; Trindade et al., 2017; Martin et al., 2018). In the scientific literature in recent years, more and more attention has been paid to the concept of “smart sustainable cities” (Vukovic et al., 2021; Yigitcanlar et al., 2019; Karagulyan, 2020), which is a kind of symbiosis of other modern urban development concepts (digital city, eco-city, sustainable city, smart city).

Technological progress and the transition to a digital economy provide many new opportunities to address the socio-economic and environmental challenges of cities, helping them to move toward a sustainable development path. However, the impact of digitalization differs for settlements with

different levels of socio-economic development. In particular, in a paper (Abid et al., 2022), by building econometric models, it is proved that in the short term, the development of technology and digital services affects the sustainability of cities with only high and medium levels of economic development, while in less developed settlements these effects can be observed only in the long term.

It is important to note that it is predominantly economically developed large cities that are considered as places of origin and distribution of innovations. At the same time, modern research shows that in order to achieve sustainable and balanced development, it is advisable not only to introduce new digital technologies in metropolises, but also to stimulate their penetration in small and medium-sized cities (Raimbault, Pumain, 2022).

A review of scientific works by Russian authors (Papenov, Nikonorov, 2018; Sekushina, 2019; Rastvortseva, Manaeva, 2022) allows us to conclude that at present the sustainable development of small and medium-sized cities is hindered by a range of problems, many of which emerged during the transition to the market in the 1990s and have a chronic nature. While liberal reforms gave an impulse for economic development in large cities, in the vast majority of small and medium-sized cities, especially mono-industrial ones, led to the destruction of the existing production base (Fauser et al., 2021).

In our opinion, the most significant positive effects of digitalization for small and medium-sized cities include the following. First, for settlements with a traditional way of life, the development and implementation of innovative digital economy projects can be the basis for the emergence of new economic activities, which may become a driver of their economic development (Rabari, Storper, 2014).

Second, the massive spread of digital technology opens up opportunities for remote labor in many areas. If previously one of the main incentives to move from small and medium-sized cities to large

⁸ Clarifications (methodological recommendations) on the development of regional projects within the framework of federal projects of the national program “Digital Economy of the Russian Federation” (approved by Decree 428 of the Ministry of Digital Development, Communications and Mass Media of the Russian Federation, dated August 1, 2019).

cities was high pay, nowadays, with the technical capability, it is possible to work from anywhere in the world.

Third, the problem of obtaining social services is quite urgent for small settlements. The spread of online education services, telemedicine, and the creation of digital platforms for broadcasting cultural events make these services available to anyone in the country. The same is true for the purchase of goods: if earlier residents of small and medium-sized cities sometimes had to travel to a larger city or regional center to buy them, now online commerce services cover this need. The development of digital entrepreneurship stimulates the formation and strengthening of inter-territorial links and can be considered as a tool to restrain depopulation in rural areas and small cities (Rodrigues, Franco, 2021).

Fourth, from the point of view of ensuring the sustainability of the ecological system, the great importance of implementing innovative digital technologies in the housing and utilities and industrial spheres. For example, the installation of smart lighting systems of the city helps save energy and, accordingly, the city budget.

Fifth, digital technologies lead to changes in the system of state and municipal administration, increasingly facilitating its transition to electronic format. Their implementation makes it possible to reduce the labor intensity of city management processes and reallocate the time of government specialists to the intellectual component of their activities (Milekhina, Adova, 2019). Despite the fact that at present the problem of low rates of digital technology diffusion in the public sector is still relevant for Russia (Bezuglaya, Kostyukevich, 2019), already now most state and municipal services are provided to the population through the portal “Gosuslugi”. The availability of such digital platforms reduces the level of differentiation between residents of large and small cities, and provides equal quality of services to all citizens regardless of their place of residence.

Thus, digital technologies, at the level of potential effects, can answer many of the challenges facing small and medium-sized cities. The integration of new technologies into everyday life, such as the creation of online shopping platforms and residential and vehicle-sharing services, has a direct impact on the work, leisure, or consumption habits of the population (Lyons et al., 2018; Kostina, Kostin, 2021).

In general, the results of the scientific literature review show that the objects of studies to identify trends in digitalization processes in most cases are agglomerations, megalopolises and large cities. Similar works devoted to small and medium-sized cities are extremely rare. At the same time, we should note two large-scale Russian studies, which largely served as a basis for our work, conducted by the Higher School of Economics⁹ and the Moscow School of Management “Skolkovo” (Korovkin, 2020). However, the object of the study is all Russian small and medium-sized cities, the authors do not set themselves the task of identifying the specifics of the digitalization of cities in different regions. However, the spread of digital technologies in small and medium-sized cities that are part of the large agglomerations of central Russia will obviously proceed at a faster pace than in similarly sized settlements located in the country’s north and located thousands of kilometers away from the nearest large city. This paper attempts to focus on the small and medium-sized cities of the European North of Russia as one of the Russian regions with its own natural, geographic, and socio-economic characteristics.

Main results of the study

At present, the introduction of digital technologies in the economy and social sphere is one of the key tasks of the implemented state policy. At the same time, one of the important indicators

⁹ Digitalization in small and medium-sized cities in Russia. Available at: https://www.hse.ru/data/2018/06/06/1149766040/2018-06-GSU-HSE_pres_v6.pdf

and the main condition for digitalization of any territory is the availability of access to the Internet. According to data for 2021, on average in Russia 82% of households had Internet access, that is lower than the planned values (89%) approved in the national program “Digital Economy”. The document also states that 97% of households should have access to the Internet by the end of 2024. At the same time, we cannot but note that another indicator – “the share of socially significant facilities with broadband access to information and telecommunications network Internet” – was achieved ahead of schedule as early as December 2021 (100%). Such success is primarily caused by the forced transition of social infrastructure institutions to a remote format of work during the COVID-19 pandemic.

In the regions of the European North of Russia for the period of 2010–2020 the share of organizations using broadband Internet access has increased by 44.2 p.p. (from 50.3% to 94.5%) which is higher than the average Russian values (*Tab. 1*). The level of Internet access for the population is also above the national average, except for Nenets

Autonomous Okrug. According to the data for 2020, the highest indicators are registered in the Murmansk Oblast – more than 86% of the residents have access to the Internet.

The analysis of the level of Internet use in the entities of the ENR revealed some positive shifts. For example, the share of active users in the region from 2015 to 2021 increased by 14.1 p.p. (from 71.2 to 85.3%), which, nevertheless, is lower than the Russian average (87.3%; *Tab. 2*). For 6 years, the share of people who use the Internet to order goods and services has increased by 1.5 times. The residents of the Murmansk Oblast are the most active (2/3 of them make purchases via the Internet). However, on average in the region almost half of the residents (46.7%) do not use these services.

The share of e-commerce in the total volume of retail turnover in the regions is very small, only in the Arkhangelsk Oblast the value of this indicator is higher than the national average. For comparison, in 2021 in the People’s Republic of China (the leader in e-commerce) about 24.5% of total retail sales were in the online sector, in the USA – 14.2%¹⁰.

Table 1. Level of Internet accessibility for the population and organizations of the subjects of the European North of Russia

Region	Share of organizations using broadband Internet access in the total number of organizations (%)				Share of people (households) with access to the Internet (%)			
	2010	2015	2020	Growth rate 2020/2010	2010	2015	2020	Growth rate 2020/2010
Republic of Karelia	66.7	91.4	94.5	27.8	37.4	71.8	83.1	45.7
Komi Republic	43.8	84.2	97.6	53.8	41.8	68.5	81.5	39.7
Arkhangelsk Oblast	48.2	77.5	92.3	44.1	37.5	67.6	81.8	44.3
including Nenets Autonomous Okrug	31.7	83.1	94.4	62.7	33	58.3	79.2	46.2
Vologda Oblast	46.8	81.9	91.6	44.8	28.9	66.9	82.4	53.5
Murmansk Oblast	64.8	88.6	96.7	31.9	47	77.8	86.5	39.5
Average for the ENR	50.3	84.5	94.5	44.2	37.6	68.5	82.4	44.8
Russian Federation	56.7	79.5	93	36.3	28	64.5	79.5	51.5

Source: own compilation according to EMISS (Unified Interdepartmental Statistical Information System). Available at: <https://www.fedstat.ru/>

¹⁰ World e-commerce market: development cannot be stopped. Available at: <https://journal.open-broker.ru/investments/mirovoj-rynok-e-commerce/>

Table 2. Level of Internet use by the population of the entities of the European North of Russia

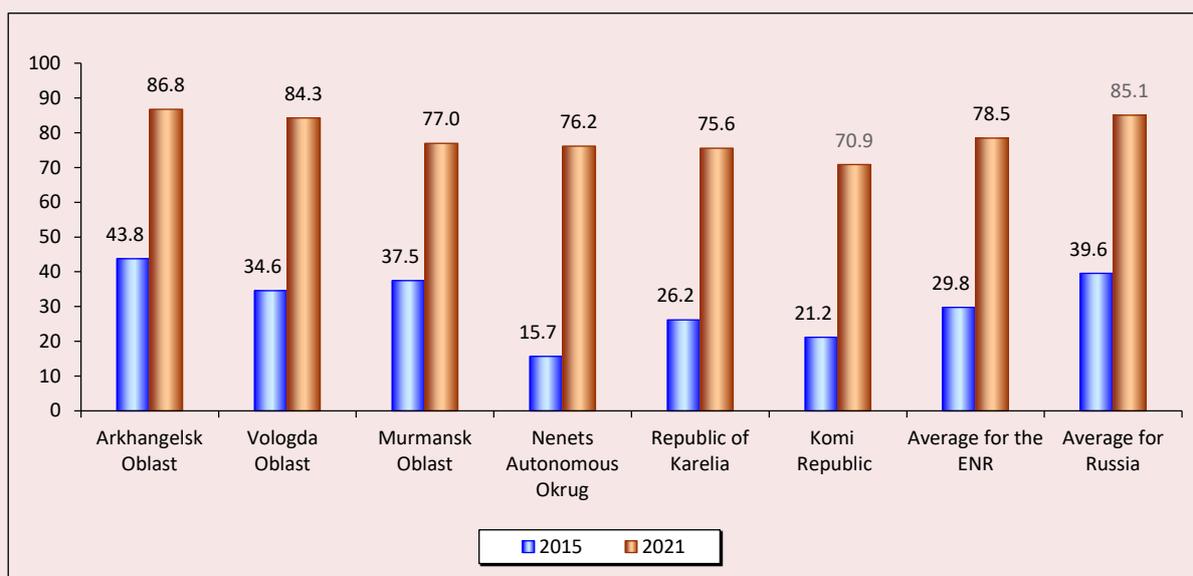
Region	Share of active Internet users in the total population (%)			Share of the population used the Internet to order goods and (or) services in the total population (%)			Share of sales online in the total volume of retail sales (%)		
	2015	2021	Growth rate 2021/2015	2015	2021	Growth rate 2021/2015	2015	2021	Growth rate 2021/2015
Republic of Karelia	71.2	85.2	14.0	27	54	27.0	0.8	1.5	0.7
Komi Republic	73.8	84.3	10.5	31.3	52.2	20.9	0	4.3	4.3
Arkhangelsk Oblast	72.4	84.1	11.7	27.7	44.2	16.5	0.3	4.9	4.6
including Nenets Autonomous Okrug	64	80.6	16.6	36.3	51.2	14.9	0	3.2	3.2
Vologda Oblast	62.5	85	22.5	18	49.4	31.4	0.6	3.3	2.7
Murmansk Oblast	83.5	92.7	9.2	39.7	68.8	29.1	0.3	1.5	1.2
Average for the ENR	71.2	85.3	14.1	30.0	53.3	23.3	0.3	3.1	2.8
Russian Federation	68.3	87.3	19.0	19.6	46.6	27.0	0.9	4/8	3.9

Source: own compilation according to EMISS (Unified Interdepartmental Statistical Information System). Available at: <https://www.fedstat.ru/>

Among the key indicators of the level of digitalization of society is the share of citizens receiving state and municipal services in electronic form. We note that the importance of the development of this area as one of the strategically important is noted in the national program “Digital

Economy”. Based on the data presented in *Figure 1*, we can conclude that, on average, the indicators for the regions of the ENR in 2021 more than doubled compared to 2015 (from 29.8 to 78.5%), which, however, is lower than the average Russian values at the end of the period (85.1%).

Figure 1. Share of citizens using the mechanism of obtaining state and municipal services in electronic form, %



Source: EMISS (Unified Interdepartmental Statistical Information System) data. Available at: <https://www.fedstat.ru/>

As a part of the study, we considered a number of indicators that characterize the level of digitalization directly in small and medium-sized cities of the ENR. So, based on the information of telecom operators¹¹, presented in the coverage maps, it was revealed that all small and medium-sized cities of the region, except for Mezen and Ostrovnoi, have 4G communication.

Also an analysis of the availability of pickup points of online stores Ozon and Wildberries in small and medium-sized cities of the ENR was conducted. The situation is quite favorable: Wildberries is present in 57 out of 61 cities, and Ozon – in 60/12. Thus, we can conclude that the infrastructure for the development of online commerce is created in the vast majority of the reviewed settlements.

Based on open data of transport companies, the availability of online cab ordering services in small and medium-sized cities of the ENR has been revealed. In particular, it is currently possible to use the services of Yandex.Taxi only in 21 cities out of 61/13, and Uber works only in large and large cities of the ENR (Murmansk, Petrozavodsk, Syktyvkar, Severodvinsk, Arkhangelsk, Vologda, Cherepovets)¹⁴.

One of the key factors determining the speed and depth of digital diffusion is the digital competence of the population. It should be noted that sociological studies of the level of digital literacy of residents of small and medium-sized cities are rare in the scientific literature. Let us highlight

¹¹ The analysis was conducted on the basis of data from the coverage map of cellular operators of PJSC “MegaFon”. Available at: <https://vologda.megafon.ru/help/offices/#coverageMap>; PJSC “MTS”. Available at: <https://vologda.mts.ru/personal/podderzhka/zoni-obsluzhivaniya/nasha-set?on=g2>; PJSC “Vimpelkom”. Available at: <https://vologodskaya-obl.beeline.ru/customers/beeline-map/?lat=67.88325753840412&lon=37.40225335693357&zoom=8>

¹² In some cities (Mezen, Solvychegodsk, Ostrovnoy) there are no delivery points, but delivery is made by the Russian Post offices.

¹³ Yandex.Taxi. Available at: <https://y-taxi.ru/>

¹⁴ Uber. Available at: <https://taxi.uber.ru/>

two works of Russian scientists (Guzhavina, 2021; Ryazantsev et al., 2021), which present the results of sociological surveys that allow to make certain conclusions about the level of use of the existing digital infrastructure and services in small cities of the Vologda Oblast.

In particular, there is a slight gap between small cities and large cities in terms of the use of information and communication tools and digital services by the population. Thus, only 80% of the residents of small cities in the Vologda Oblast use smartphones, while in large cities (Vologda and Cherepovets) – 88%. A noticeable gap is also observed in the use of the Internet for information or shopping: in large cities, more than half (53%) of the respondents use it for these purposes, while in small cities – only a third of the residents (Guzhavina, 2021).

In small cities the Internet is used primarily for communication purposes in social networks and via e-mail and somewhat less frequently for such services as online shopping, online banking, etc. In large cities, food ordering and delivery services, online cab ordering, use of paid Internet services, etc. are in greater demand (Ryazantsev et al., 2021).

Thus, we can now talk about the completed transition of most small and medium-sized cities in the ENR from “primary” to “secondary” digitalization. If the task of the first stage was to create the necessary infrastructure for Internet access, in the second stage the key task was to develop individual digital solutions in each sector of the economy and sphere of human activity (Korovkin, 2020).

In our opinion, there are several main barriers to the digitalization in small and medium-sized cities. The main ones are the high cost of developing and implementing digital technologies and services, the lack of financing, and the low level of digital competencies of the inhabitants of small and medium-sized cities. It should be noted that all of them are more or less typical of the vast majority

Table 3. Barriers to digitalization in small and medium-sized cities and ways to overcome them

Barrier	Solution option
High development and implementation cost of digital technologies and services	Active use of public-private and municipal-private partnerships in the implementation of projects to integrate digital technologies into the urban ecosystem
Municipal and regional budget deficits	Using the mechanism of concession agreements to implement projects to modernize and digitalize urban infrastructure
Lack of financial resources of digital technology developers	The use of mechanisms of direct (subsidies, grants) or indirect (tax preferences) incentives for domestic developers of digital services and platforms for small and medium-sized cities
Low level of digital competence among residents of small and medium-sized cities	Development and implementation of measures to improve digital literacy in small and medium-sized cities
Lack of a system policy for the digitalization of small and medium-sized cities	Focusing on the implementation of smart city technologies and the implementation of the digital transition by municipalities in the strategic planning documents of socio-economic development of small and medium-sized cities.
Source: own compilation.	

of Russian small and medium-sized cities, and the possible options to overcome the barriers are characterized by their universality (*Tab. 3*).

At the same time, it is extremely important to take into account regional specifics, which, in our opinion, is currently lacking and not planned in the future. For example, in August 2021, strategies for the digital transformation of economic sectors, the social sphere and public administration were developed and adopted at the level of constituent entities of the Russian Federation. A content analysis of these documents in the regions of the ENR allows us to conclude that their content is almost identical, differing only in the list of spheres and industries that will undergo digital transformation. At the same time, a significant shortcoming of the presented strategies is the lack of attention to the issues of digital transformation of the production sphere, and the lack of reflection of the spatial aspects of their implementation. Obviously, that the degree of readiness to implement digital technologies in a large city will be noticeably higher than in small cities and rural areas, at least due to the higher level of population's digital literacy. Without territorial referencing, that is, a clear understanding of exactly what technology and where it is needed, there is a risk of an even greater "digital divide" between settlements of different size.

In view of the above, in our opinion, we can highlight several conceptual provisions for the use and development of digital technologies and services in small and medium-sized cities of the ENR in order to improve their socio-economic and environmental sustainability.

First, it is necessary to take into account not only the opportunities of information and communication and digital technologies, but also the threats posed by their active implementation. The digitalization of the production sphere of small and medium-sized cities located in harsh climatic conditions, on the one hand, allows to significantly simplify working conditions for the population, but, on the other hand, it is a risk, because it leads to the release of the workforce. Accordingly, the question of creating new jobs inevitably arises. For example, by robotizing enterprises, it is possible to increase output of products while reducing the labor force (Kuz'mitskaya, 2021). At first glance, this is a positive result, because in small and medium-sized cities the issue of qualified personnel is quite urgent. However, solving the problem only through the widespread introduction of innovations at enterprise can lead to a reduction of jobs and, as a consequence, to a decline of living standards of citizens and an increase in migration outflow of the population. This problem is especially relevant for single-industry cities, a

third of small and medium-sized cities (21 out of 61) belong to this category in the ENR.

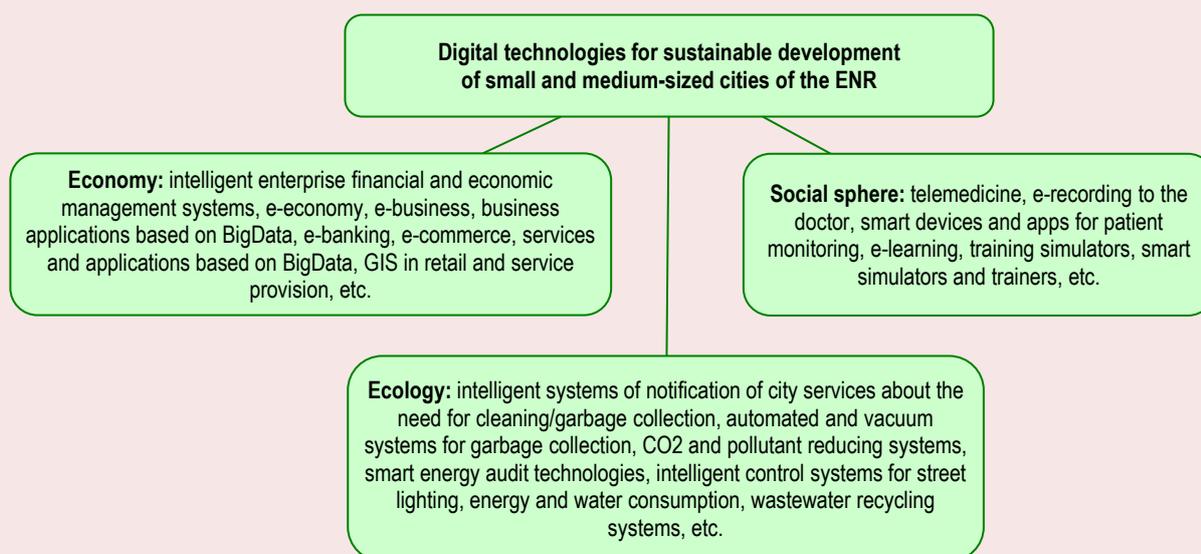
Second, within the framework of the ongoing problem of budget deficit in small and medium-sized cities, it is particularly important to select the priority areas of digitalization of their industries. The cities of the European North of Russia are not a homogeneous group, differing not only by population or geographical location, but also by their economic profile and functions performed in the regional settlement system. In particular, there are several different types of small and medium-sized cities in the region: agrarian and timber, mining, industrial, transport, tourist, etc. (Sekushina, Uskova, 2020). Accordingly, it seems appropriate to introduce digital technologies in those sectors of the urban economy, which the city specializes in and which are most important in the strategic plan. For example, for industrial small and medium-sized cities of the ENR (Novodvinsk, Sokol, Kondopoga, etc.) promising areas will be the use of Internet of Things in manufacturing (IoT); smart technologies for enterprise resource

planning (ERP solutions); robotization of production. For transportation centers (Babaevo, Kotlas, Nyandoma, etc.) – systems of satellite monitoring and navigation of vehicles; BigData in traffic management; IoT in logistics. For tourist cities (Veliky Ustyug, Kirillov, Totma, Kargopol, etc.) it seems appropriate to implement smart city navigation systems; Q-codes for objects of cultural and historical heritage; using robots to provide information and advisory services; video mapping, etc.

Third, if we talk about the sustainable development of small and medium-sized cities, it is important not only to carry out the digitalization of the production sphere, but also to actively apply innovation in solving social and environmental problems. Possible options for the digital technology use for all spheres of sustainable urban development are presented in *Figure 2*.

Fourth, one of the factors determining the intensity of digitalization in small and medium-sized cities of the ENR is the level of digital literacy of the population. For a city to become “smart”,

Figure 2. Digital technologies for sustainable development of small and medium-sized cities of the European North of Russia



Source: own compilation.

it should have “smart” people, accordingly, the question of how to attract them or how to keep the younger generation in the city becomes relevant. At present in Russia within the framework of the national project “Education” there have already been created 123 educational centers for children under the programs of IT competence development “IT-cube”, but only two of them are located in small and medium-sized cities of the ENR (Gryazovets and Sokol). This practice is undoubtedly positive, but it is mostly aimed at children who received a good basic school education, but who will anyway leave for a larger city to continue their education. One solution to this problem could be the creation (or opening of branches) of institutions of secondary vocational and/or higher education, whose activities should be based on the triad “education – research – implementation” (Detter, Tukkel, 2018). Close cooperation of such educational institutions with manufacturing enterprises will help not only to keep young people and attract them to small and medium-sized cities, but also to promote innovative and technological development of the economy of both the municipality and the region.

Discussion on the results and conclusions

In Russia, since the beginning of the implementation of national projects, special attention is paid to the digitalization of settlements. It should be noted that the idea of creating “smart cities” is clearly seen in the current state policy. In particular, as part of the implementation of the national program “Digital Economy” and the national project “Housing and Urban Environment”, the project “Smart City” is being implemented in Russian regions¹⁵.

It has been a relatively short time since the beginning of the project, but we can already

see some positive trends. The number of cities participating in the project is gradually increasing (from 186 to 203), and there is also an increase in the average values of IQ-cities. However, only a small number of small and medium-sized cities take part in the project: in 2021, only 31 out of 945 settlements, and all of them have a quite developed economy, acting as the basis and, to some extent, a key factor for the active implementation of digital technologies in the urban ecosystem. For example, in the European North of Russia, only Naryan-Mar is the fastest growing city in the region, whose economy is based on oil production.

At present, we have to admit that both in the entities of the ENR and in the country as a whole, the implemented measures for the digitalization of cities are characterized mainly by technocentricity, and the attention of public authorities and local government is mainly focused on the implementation of individual technological solutions needed to support the functioning of urban infrastructure systems. At the same time, without solving the decades-long problems of sustainable development in the economic, social and environmental spheres, the transition to a new level is impossible.

The results of our study show that the basic conditions for the development of digitalization processes are generally created in small and medium-sized cities of the ENR. For example, online commerce services are now present in almost all small and medium-sized cities, which contributes significantly to the satisfaction of residents’ needs for goods and services. At the same time, the spread of online commerce carries risks for local businesses, which may not be able to compete with the large digital platforms of the national and world level. The issue of tax revenues to regional budgets is no less relevant in this case, since deductions from the activities of online stores go to the place of registration of the latter.

¹⁵ Departmental project of the Russian Ministry of Construction “Smart City”. Available at: <https://russiasmartcity.ru/about>

Artificial intelligence, augmented and virtual reality technologies offer great opportunities for the development of e-health and education services, which is especially relevant for geographically remote small and medium-sized cities of the North. But despite the fact that according to the adopted strategies for the digital transformation of the regions of the ENR it is supposed to use these digital solutions, at present there are no specific plans for their implementation in one or another city of the region.

The question of how prepared the economy of small and medium-sized cities is in general for the implementation of existing technologies and innovations remains open, since the level of its development in the vast majority of cases corresponds only to the fifth, or even the fourth technological mode. RAS academician S.Yu. Glazyev notes that in the process of changing technological modes, the structure of demand for scientific inventions or discoveries changes, while many of them remain unclaimed for a long time because they “do not fit” into the production and technological systems of the dominant technological mode (Glazyev, 2022). In our opinion, this characterizes the situation in the northern small and medium-sized cities of Russia quite well.

The restructuring of the economy remains one of the most important aspects of the development of small and medium-sized cities in the ENR, and it is precisely digitalization that can be seen as a way of integrating related and forming new industries of specialization (Siliang, Heng, 2022). As part of the challenges facing Russia to achieve technological sovereignty, one of the most important tasks of state policy is not only the search for promising areas of the economy for the implementation of digital solutions and innovations, but also the proper territorial placement of new high-tech industries.

The scientific significance of the research lies in the analyzing the problem field of digitalization of small and medium-sized cities of the European North of Russia, identifying the main problems that hinder the increase in its level. The practical significance of the work consists in the possibility of using the results obtained by public authorities in the development of tools to solve the problems of digital transformation of the economy and social sphere of small and medium-sized cities. The task of the next stage of work on this topic will be to analyze the level of implementation of digital technologies in manufacturing enterprises and social organizations in small and medium-sized cities.

References

- Abid N., Marchesani F. et al. (2022). Cities trajectories in the digital era: Exploring the impact of technological advancement and institutional quality on environmental and social sustainability. *Journal of Cleaner Production*, 377, 134378. Available at: <https://doi.org/10.1016/j.jclepro.2022.134378>
- Bezuglaya N.S., Kostyukevich V.G. (2019). Analysis and evaluation of innovative activity in the Krasnodar krai. *Regionologiya=Regionology*, 27(1), 58–81. DOI: <https://doi.org/10.15507/2413-1407.106.027.201901.058-081> (in Russian).
- Bhargava A. (2018). *Sustainable Urban Development*. Publisher: Lambert Academic Publishing, Europe.
- Colding J., Barthel S. (2017). An urban ecology critique on the “Smart City” model. *Journal of Cleaner Production*, 164, 95–101.
- D’Adamo I., Gastaldi M., Ioppolo G., Morone P. (2022). An analysis of sustainable development goals in Italian cities: Performance measurements and policy implications. *Land Use Policy*, 120, 106278. Available at: <https://doi.org/10.1016/j.landusepol.2022.106278>
- Detter G.F., Tukul’ I.L. (2018). “Smart” digitalization of local innovation ecosystems of the Arctic zone of the Russian Federation. *Innovatsii=Innovations*, 11(241). Available at: <https://cyberleninka.ru/article/n/umnaya-tsifrovizatsiya-lokalnyh-innovatsionnyh-ekosistem-arkticheskoy-zony-rf> (in Russian).

- Dorofeeva L.V., Leont'eva A.N. (2021). Implementation of the sustainable development principles in the strategic planning of urban development. *Ekonomika Severo-Zapada: problemy i perspektivy razvitiya=Northwestern Economy: Problems and Development Prospects*, 3(66), 70–75. DOI: 10.52897/2411-4588-2021-3-70-75 (in Russian).
- Fauzer V.V., Lytkina T.S., Smirnov A.V., Fauzer G.N. (2021). Sustainable development of small and medium-sized cities in the Russian North: Review of works — approaches — practices. *Korporativnoe upravlenie i innovatsionnoe razvitie ekonomiki Severa: Vestnik Nauchno-issledovatel'skogo tsentra korporativnogo prava, upravleniya i venchurnogo investirovaniya Syktyvkerskogo gosudarstvennogo universiteta=Corporate Governance and Innovative Economic Development of the North: Bulletin of the Research Center of Corporate Law, Management and Venture Investment of Syktyvkar State University*, 1(1), 41–57. DOI: 10.34130/2070-4992-2021-1-1-41 (in Russian).
- Glazyev S.Yu. (2022). Global transformations from the perspective of technological and economic world order change. *AlterEconomics*, 19(1), 93–115. DOI: 10.31063/AlterEconomics/2022.19-1.6 (in Russian).
- Guzhavina T.A. (2021). Digitalization for sustainable development of small towns in Russia. *European Journal of Sustainable Development*, 10(1), 401. Available at: <https://doi.org/10.14207/ejsd.2021.v10n1p401>
- Karagulyan E.A. (2020). Smart sustainable cities in the Arctic region. *Vestnik Evraziiskoi nauki=The Eurasian Scientific Journal*, 2. Available at: <https://esj.today/PDF/93ECVN220.pdf> (in Russian).
- Keith M., Birch E., Buchoud N.J.A. et al. (2022). A new urban narrative for sustainable development. *Nat Sustain*. Available at: <https://doi.org/10.1038/s41893-022-00979-5>
- Korovkin V. (2020). *Tsifrovaya zhizn' rossiiskikh regionov. Chto opredelyaet tsifrovoi razryv?* [The digital life of Russian regions. What defines the digital divide?] Moscow: Institut issledovaniy razvivayushchikhsya rynkov biznes-shkoly Skolkovo. DOI: 10.13140/RG.2.2.17835.26400
- Kostina E.A., Kostin A.V. (2021). How do smart city technologies help to cope with the pandemic? *Region: Ekonomika i Sotsiologiya=Region: Economics and Sociology*, 4(112), 160–182. DOI: 10.15372/REG20210406 (in Russian).
- Kuz'mitskaya T.V. (2021). Sustainable development of small and medium-sized cities in the conditions of the agglomeration effect. *Vestnik Polotskogo gosudarstvennogo universiteta. Seriya D. Ekonomicheskie i yuridicheskie nauki=Bulletin of Polotsk State University. Series D. Economic and Legal Sciences*, 6, 30–34 (in Russian).
- Lyons G., Mokhtarian P., Dijst M., Böcker L. (2018). The dynamics of urban metabolism in the face of digitalization and changing lifestyles: Understanding and influencing our cities. *Resources, Conservation and Recycling*, 132, 246–257.
- Martin C., Evans J., Karvonen A. (2018). Smart and sustainable? Five tensions in the visions and practices of the smart-sustainable city in Europe and North America. *Technological Forecasting & Social Change*, 133, 269–278. Available at: <https://doi.org/10.1016/j.techfore.2018.01.005>
- Meijer A., Bolívar M.P.R. (2016). Governing the smart city: A review of the literature on smart urban governance. *International Review of Administrative Sciences*, 82(2), 392–408. Available at: <https://doi.org/10.1177/0020852314564308>
- Milekhina O.V., Adova I.B. (2019). Informational support of regional development project management in the context of digitalization. *Region: Ekonomika i Sotsiologiya=Region: Economics and Sociology*, 4(104), 168–203. DOI: 10.15372/REG20190408 (in Russian).
- Papenov K.V., Nikonorov S.M. (2018). Small cities of Russia in the system “historical heritage – socio-ecological and economic condition – concepts of sustainable development”. *Oeconomia et Jus.*, 3, 12–29 (in Russian).
- Rabari C., Storper M. (2014). The digital skin of cities: Urban theory and research in the age of the sensed and metered city, ubiquitous computing and big data. *Cambridge Journal of Regions, Economy and Society*, 8(1), 27–42. DOI: 10.1093/cjres/rsu021
- Raimbault J., Pumain D. (2022). Trade-offs between sustainable development goals in systems of cities. *Journal of Urban Management*, 11, 237–245. Available at: <https://doi.org/10.1016/j.jum.2022.05.008>
- Rastvortseva S.N., Manaeva I.V. (2022). Modern development of small and medium-sized cities: Trends and drivers. *Ekonomicheskie i sotsial'nye peremeny: fakty, tendentsii, prognoz=Economic and Social Changes: Facts, Trends, Forecast*, 15(1), 110–127. DOI: 10.15838/esc.2022.1.79.6 (in Russian).

- Rodrigues M., Franco M. (2021). Digital entrepreneurship in local government: Case study in Municipality of Fundão. *Portugal Sustainable Cities and Society*, 73. Available at: <https://doi.org/10.1016/j.scs.2021.103115>
- Ryazantsev I.P., Podlesnaya M.A., Pisarevskii V.G., Ryazantsev V.I. (2021). Digitalization in a small town: Religiosity as a factor of influence? *Vestnik YuRGTU (NPI)=Bulletin of the South-Russian state technical University*, 4, 73–92 (in Russian).
- Sekushina I.A. (2019). Trends in socio-economic development of small and medium-sized cities of the regions of the European North of Russia. *Nauchnoe obozrenie. Seriya 1: Ekonomika i pravo=Scientific Review. Series 1. Economics and Law*, 5, 73–90 (in Russian).
- Sekushina I.A., Uskova T.V. (2020). Typology of small and medium-sized cities by economic profile and position in the settlement system. *Sever i rynek: formirovanie ekonomicheskogo porjadka=The North and the Market Forming the Economic Order*, 1(67), 4–18. DOI: 10.37614/2220-802X.1.2020.67.001 (in Russian).
- Semyachkov K.A. (2021). Modeling sustainable development of the territory on basis of the smart city concept. *Voprosy innovatsionnoi ekonomiki=Russian Journal of Innovation Economics*, 11(3), 1015–1034. DOI: 10.18334/vinec.11.3.113448 (in Russian).
- Siliang G., Heng M. (2022). *Can Urban Digitalization Significantly Improve Carbon Emission Efficiency? Evidence from 282 Cities in China. Preprint (Version 1)*. DOI: 10.21203/rs.3.rs-2035590/v1
- Trindade E.P., Hinnig M.P.F., da Costa E.M. et al. (2017). Sustainable development of smart cities: A systematic review of the literature. *Journal of Open Innovation: Technology, Market, and Complexity*, 3(1), 11–35. DOI: 10.1186/s40852-017-0063-2
- Vukovic N.A., Larionova V.A., Morganti P. (2021). Smart sustainable cities: Smart approaches and analysis. *Economy of Regions*, 17(3), 1004–1013. DOI: 10.17059/ekon.reg.2021-3-20
- Xiao H., Xu Z., Ren J., et al. (2022). Navigating Chinese cities to achieve sustainable development goals by 2030. *The Innovation*, 3(5), 100288.
- Yigitcanlar T., Kamruzzaman M., Foth M. et al. (2019). Can cities become smart without being sustainable? *A Systematic Review of the Literature, Sustainable Cities and Society*, 45, 348–365. Available at: <https://doi.org/10.1016/j.scs.2018.11.033>

Information about the Author

Irina A. Sekushina – Candidate of Sciences (Economics), Researcher, Vologda Research Center, Russian Academy of Sciences (56A, Gorky Street, Vologda, 160014, Russian Federation; e-mail: i_sekushina@mail.ru)

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