

# Analysis of the Knowledge-Intensive Sectors Development in Russian Regions

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## Abstract

In the modern world, technological innovations penetrate the field of educational services, approaches to distance educational technologies are radically expanding, changing the entire field of education. To determine the conditions for the propagation of distance educational technologies, it is relevant today to study the factors affecting the functioning of knowledge-intensive segments of regional economies, education, innovation, and information technologies that form the sector of knowledge-intensive services. This study aims to analyze the features of the development of knowledge-intensive segments of regional economies as a determinant of the spread of distance education and to assess their structural changes in dynamics. Based on empirical data from 85 Russian regions for 2014-2018, an integral indicator of the level of development of regional knowledge-intensive sectors was calculated for 9 indicators characterizing education, innovation, and information technology. A rating and a grouping of Russian regions that have different conditions for the development of distance education have been compiled, qualitative and quantitative structural shifts in knowledge-intensive sectors have been analyzed, and their areas of prospective development have been identified. The unevenness of development and a high degree of differentiation, "fragmentation" of regions with a high level of development of knowledge-intensive sectors from each other are revealed, which leads to imbalances in their development. The results of the analysis make it possible to analyze the conditions for the formation of a knowledge-intensive economy in the regions of Russia, show the need for the formation of effective programs and strategies of knowledge-intensive regional segments necessary for the development of distance learning technologies.

## Keywords 1

Distance educational technologies, knowledge-intensive sectors, information technologies, educational services, innovations, region

## 1. Introduction

Over the past 30 years, within the framework of post-industrialization processes, the fifth technological order has been actively developing, in the era in which large-scale technological structural changes are taking place. Trends of modern development: post-industrialization, globalization, transnationalization, softization, serviceization, finance, informatization and innovation, the use of 5G and artificial intelligence, the Internet of things, NBIC, and other advanced technologies affect all spheres of human life [1]. Technological innovations are penetrating the field of educational services, contributing to the development of the paradigm of open educational space. The symbiosis of information technology, technological innovation, the Internet, and open access to information is transforming educational services and leading to the emergence of fundamentally new phenomena in education. Education is modernizing and changing its forms and technologies, new learning formats, resources, and platforms are being created, new Management Learning Systems are being developed.

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These processes also affect distance education, which appeared at the end of the 18th century in the form of "correspondent learning" in shorthand thanks to I. Pitman; in the 20th century, mail was used as a means of communication for "education at a distance", the era of personal computers has taken a step in the automation of education in the late 1980s. Today, for the first time in more than two centuries of evolution, thanks to the use of information technology and the Internet, it is experiencing a real boom all over the world, with an increase in both the number of online courses complementary to basic education programs and full-fledged alternatives to classical education at all levels.

In Russia, the market for technological educational projects in the EdTech sphere, the predominant share of which is occupied by distance education, reached 30 billion rubles in 2018 per year, and the consequences of the COVID-2020 pandemic have led to an exponential pace of its development. In 2021, the EdTech industry showed growth by 30-35% compared to the "dock" period [2]. There is a manifold increase in the number of EdTech participants, the launch of large government projects, the completion of multibillion-dollar deals for the development of new online services, the creation of new content, and the attraction of an audience. According to Smart Ranking and TalentTech estimates, in 2020 50 top Russian EdTech companies expected total revenue of more than 25 billion rubles. In general, the Russian online education market in 2020 is potentially estimated at 60 billion rubles [3].

Approaches to distance education technologies are expanding dramatically, and today they combine the use of the Internet, computer equipment, software, and educational technologies and methods, and pedagogical theory and practice to effectively teach students in the absence of face-to-face contact with the teacher when using devices and tools such as mobile devices, technology, virtual and augmented reality, collaborative learning, social media, cloud computing, gamification. The intensive development of information and communication technologies soon may lead to an increase in the target audience of up to 20-30 million students [4]. Therefore, the issues of studying and developing a strategy for the behavior of participants and propagation into promising segments of the distance education market are relevant.

One of the most important segments of the postindustrial economy for the development of distance learning technologies today is education, science and innovation, and information technology, which form the knowledge-intensive sector and have the greatest innovation potential and a driver for the development of the service sector and economic growth in general [5]. These segments play a key role in the reproduction chain of transformation of intellectual capital into knowledge, in the production of new knowledge, its increment, and dissemination, the prospects for future development will depend on the efficiency of the development of knowledge-intensive sectors.

Thus, H. V. Aslesen believes that knowledge-based services are becoming increasingly important for learning and innovation in the knowledge economy [6]. F. Machlup argues that the main branch of the modern economy is education, which manifests itself in connection with the production, science, and labor market [7]. According to P. Drucker, education is an exclusive source of competitive advantage for society and the economy and makes the "knowledge worker" more productive [8]. According to M. Castells, the main distinguishing feature of the 21st century is not so much the dominance of information as such, but the network logic of its use - nonlinear forms of communication devoid of any spatial and temporal boundaries [9]. V. Shaposhnikov identifies the following tendency: the development of these markets leads to qualitative shifts in traditional sectors of the economy [10].

Therefore, today it is relevant to study the factors affecting the functioning of knowledge-intensive segments of regional economies and to analyze quantitative and qualitative structural changes to determine the conditions for the propagation of distance learning technologies.

The purpose of this study is to analyze the features of the development of knowledge-intensive segments of regional economies: educational services, innovations, and information technologies as determinants of the spread of distance education and to assess their structural changes in dynamics based on data from Russian regions.

The factors that actively influence the development of distance learning technologies are economic factors (the presence of effective demand for these educational services), as well as demographic, institutional, cultural, legislative aspects of regulating the relations of actors in this segment, conservatism (student preferences and recognition of so diploma by employers), skills (sometimes, low IT literacy), but one of the main determinants is the technical aspects of using distance learning technologies and the availability of conditions for their further propagation in Russian regions.

The following main factors can be noted that cause qualitative structural shifts in knowledge-intensive sectors and affect the development of distance education at the present stage:

- increasing the propagation of educational services using distance forms due to their digitalization;
- an increase in the number of users of mobile devices;
- total digitalization of all business processes;
- growth of investments in EduTech-companies based on remote technologies;
- the emergence of marketplaces on the Internet, which do not require material resources and are practically unlimited in resources and audience;
- transformation by market participants of their business models and the desire to create ecosystems;
- personalization of products and services, meeting people's needs for flexible and convenient educational technologies, therefore, until they are satisfied, the world EduTecn industry will continue to actively develop.

In Russian conditions, an important factor in the spread of new technologies is the large extent of the territory, which affects the specificity of the various processes. The decisive role of regions in the generation of innovations and national economic growth makes the issues of analyzing its quality and quantitative measurement of regional innovative efficiency urgent [11]. Information, knowledge, and innovation are unevenly distributed within the boundaries of the territory. T. Kizek and A. Matras-Bolibok in their studies have shown that employment in high-tech production and knowledge-intensive services is not evenly distributed across regions [12]. The problem of differentiation of Russian regions within the framework of this study finds its expression in the different levels of development of information technologies, the education market, and innovation activity in the regions of Russia, which inhibits the **propagation** of distance educational technologies.

## 2. Materials and Methods

In this paper, the study of quantitative structural shifts in knowledge-intensive segments will be carried out on data from Russian regions.

The information base of this study is presented by the statistical data of Rosstat [13]. To assess the dynamics of development and analyze quantitative structural changes, the periods 2014-2018 were selected. This is due to the presence of data in Russian statistics on indicators of the digitalization of the economy only from 2014 to 2018 at the time of the study.

To determine the level of development of knowledge-intensive sectors in the regions of Russia and identify regions with a high potential for the propagation of knowledge-intensive services and the dissemination of innovations, information technologies, education, and distance education technologies, we used the following approach.

Based on empirical data from 85 Russian regions for 2014-2018, an indicator of the level of development of regional knowledge-intensive sectors was calculated for 9 indicators characterizing education, innovation, and information technology:

1) indicators of the development of educational services in the corresponding region (the share of financing of higher education organizations in the total share of financing in the Russian Federation,%; the share of students in the total population aged 17-25,%; the share of highly qualified workers in the total number of qualified workers,%);

2) indicators of the development of innovations in the region (indicators of the share of internal expenditures on research and development,% to GRP; coefficient of inventive activity of the region, units; the share of innovative goods, works, services in the total volume of goods, works, services,%);

3) indicators of the development of digital technologies in the region (indicators of the share of costs for ICT,% of GRP; household digitalization index; business digitalization index).

Indicators characterizing the level of development of the innovation market reflect the financing of innovative activities, their production, and demand. The indicators of the regional educational services market also reflect the level of financing of this market, the level of education of the population, and the availability of highly qualified personnel in the labor market. The indicators of the digital technologies market reflect the share of ICT costs, as well as the level of use of digital technologies by the population and business.

This set of indicators, in our opinion, allows us to consider the dynamics of the development of knowledge-intensive segments in Russian regions in the absence of relevant information, given the limited statistical data on this segment, and to determine the potential conditions for the development of distance learning technologies in the regions.

The initial data were normalized by the linear scaling method, the index was calculated using the arithmetic mean method. The research used methods of comparative, empirical, cartographic, economic, and statistical analysis.

### 3. Results and Discussion

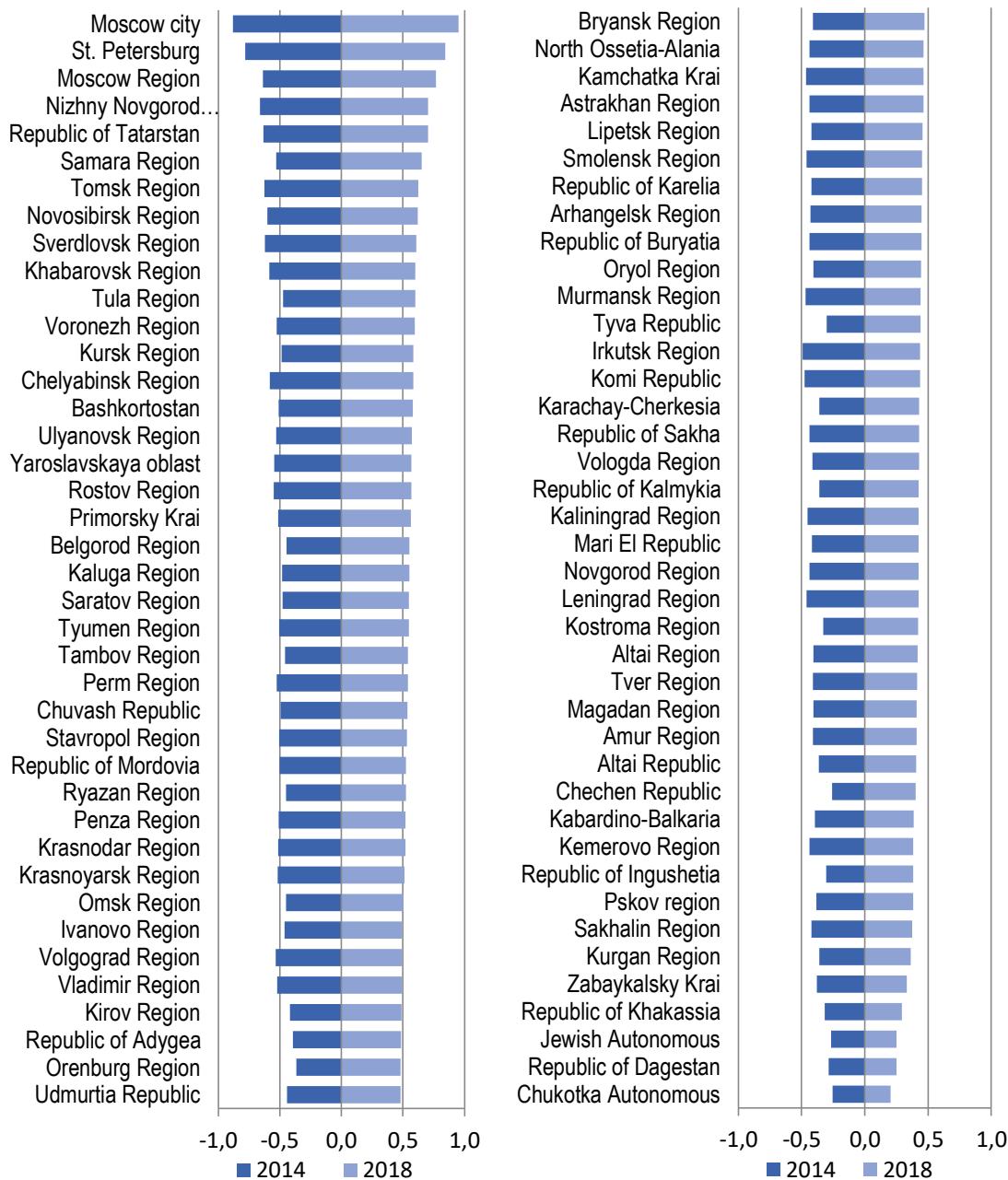
As a result, an integral indicator of the level of development of knowledge-intensive sectors in Russian regions was built on a scale from 0.20 to 0.96, which made it possible to identify 3 groups of regions with different conditions for the development of distance education, presented in the table.

**Table 1**

Groups of regions by the level of development of knowledge-intensive sectors in the regions of Russia

Region groups	Region names
Highly developed regions (0.6 - 0.96)	Voronezh Region, Tula Region, Khabarovsk Territory, Sverdlovsk Region, Novosibirsk Region, Tomsk Region, Samara Region, Republic of Tatarstan, Nizhny Novgorod Region, Moscow Region, St. Petersburg, Moscow
Regions with an average level of development (0.41-0.58)	Amur Region, Magadan Region, Tver Region, Altai Territory, Kostroma Region, Leningrad Region, Novgorod Region, Republic of Mari El, Kaliningrad Region, Republic of Kalmykia, Vologda Region, Republic of Sakha (Yakutia), Karachay-Cherkessia, Republic of Komi, Irkutsk Region, Republic of Tyva, Murmansk region, Oryol region, Republic of Buryatia, Arkhangelsk region, Nenets Autonomous Okrug, Republic of Karelia, Smolensk region, Lipetsk region, Astrakhan region, Kamchatka region, Republic of North Ossetia-Alania, Bryansk region, Udmurt Republic, Orenburg region, Republic Adygea, Kirov region, Vladimir region, Volgograd region, Ivanovo region, Republic of Crimea, Sevastopol, Omsk region, Krasnoyarsk region. Krasnodar Territory, Penza Region, Ryazan Region, Republic of Mordovia, Stavropol Territory, Republic of Chuvashia, Perm Territory, Tambov Region, Tyumen Region, Khanty-Mansi Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Saratov Region, Kaluga Region, Belgorod Region, Primorsky Territory, Rostov Region, Yaroslavl Region, Ulyanovsk region, Republic of Bashkortostan, Chelyabinsk region, Kursk region
Underdeveloped regions in terms of development level (0.21- 0.40)	Chukotka Autonomous Okrug, Republic of Dagestan, Jewish Autonomous Okrug, Republic of Khakassia, Trans-Baikal Territory, Kurgan Region, Sakhalin Region, Pskov Region, Republic of Ingushetia, Kemerovo Region, Kabardino-Balkaria, Chechen Republic, Republic of Altai

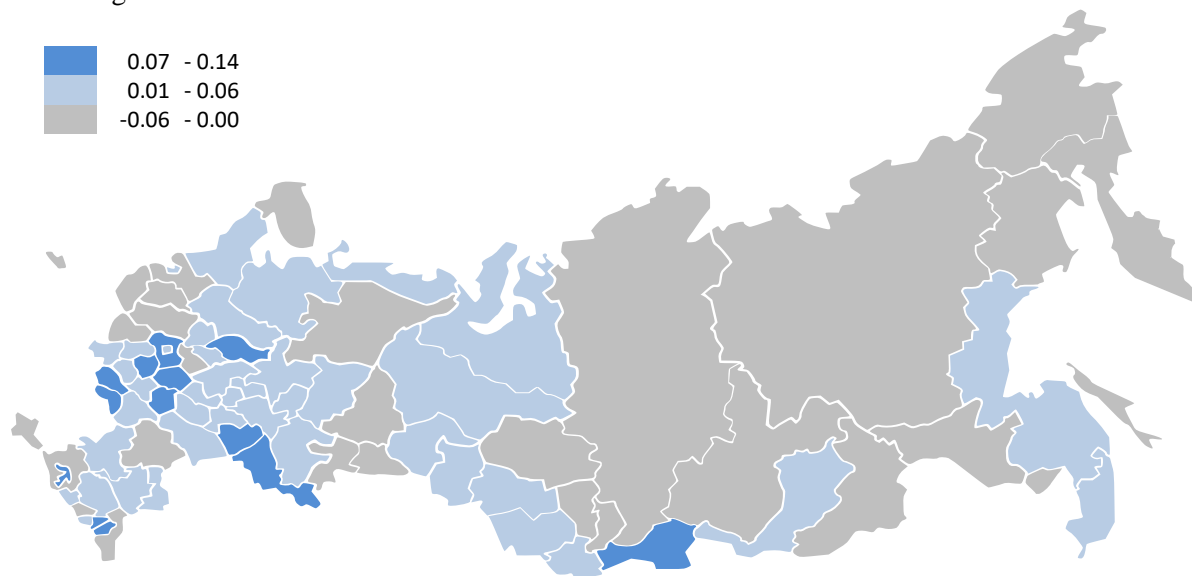
Figure 1 shows the dynamics of the development of knowledge-intensive segments in the Russian regions for 2014 - 2018.



**Figure 1:** Dynamics of development of knowledge-intensive sectors in Russian regions 2014-

It highlights the regions that have shown growth (the value of the indicator is from 0.01 to 0.14) and the decrease in the growth of knowledge-intensive sectors (the value of the indicator is from 0.0 to -0.6). The results of the analysis were the identification of high differentiation in the level of development of knowledge-intensive sectors in the regions. The level of differentiation of regions as the ratio of the leading region to the closing one increased: in 2014 it was 3.46 times, and in 2018 it was 4.64 times. The growth of this indicator indicates the weakening of measures to stimulate these processes in the regions on the part of the federal center. The change in 2018 compared to 2014 in the number of regions covered affected the first group of strong regions, their increase was 2 times - from 10 to 21 subjects). In the second middle and third group of weak regions, the changes are insignificant, there was a decrease in the number of regions. In 2018, as in 2014, the three leaders included Moscow (1st place) and St. Petersburg (2nd place). The Nizhny Novgorod region lost its position (if in 2014 it took 3rd place, then in 2018 it was 4th), yielding to the Moscow region (in 2014 this region took 5th place).

Figure 2 shows the regions in which there was the greatest change in the level of development of knowledge-intensive sectors in 2014 - 2018.



**Figure 2:** Regions with the greatest growth or decline in knowledge-intensive regional segments in comparison between 2014 and 2018

The schematic map demonstrates the areas of prospective development of knowledge-intensive sectors, a technological cluster is highlighted in the central part of Russia, we can talk about its sufficient resource provision and the potential for enhancing strategies for the propagation of distance educational technologies.

At the same time, the schematic map demonstrates the "fragmentation" of regions with a high level of development of knowledge-intensive sectors from each other; these regions are also few (15%). This leads to disproportions in the development of knowledge-intensive sectors, to ineffective use of the common economic space, and makes it difficult to effectively spillover knowledge and transfer innovations and technologies in the country. Interregional imbalances in the development of knowledge-intensive segments lead to the formation of predominantly local markets in the regions, characterized by significant differences and spatial unevenness of regional development.

Therefore, today it is necessary to support the cultivation of "medium regions" and bring them to the level of "strong regions". The prospects for the transformation of the Russian economy following the requirements of the development of a new technological order will be associated, first of all, with these "medium" regions, which have the potential to create a knowledge-intensive economy [14]. Their scarcity necessitates the creation of supra-regional innovation systems, within which the flow of knowledge and innovation from the most developed regions to the less developed ones is possible [15].

#### 4. Conclusion

This study analyzed the trends and factors in the development of knowledge-intensive sectors that affect the functioning of knowledge-intensive segments of regional economies and analyzed quantitative and qualitative structural changes to determine the conditions for the propagation of distance learning technologies, as well as the dynamics of their development and qualitative and quantitative structural shifts in these sectors in Russia. regions, regions with high potential for knowledge dissemination were identified.

In general, the structural transformations that have taken place can be characterized by the following trends - uneven development and high differentiation.

Information, knowledge, and innovation are unevenly distributed within the boundaries of the territory. There is a significant differentiation of regions in the level of development of knowledge-

intensive sectors and an increase in the gap between regions. The problem of differentiation of Russian regions within the framework of this study affects the differences in the level of development of information technologies, the education market, and innovation activity in the regions of Russia and inhibits the effective transfer of technologies and the spillover of knowledge in these markets. Most likely, distance learning technologies will be more actively disseminated in strong and medium-sized regions, where there is a high potential for the development of knowledge-intensive sectors and the corresponding infrastructure.

The results of the study show the need for the formation of effective programs and strategies in the development of markets for knowledge-intensive segments of the economy within the framework of the policy of regional alignment and stimulation of the development of the market for intellectual goods and services.

The results of the analysis allow us to analyze the conditions for the formation of a knowledge-based economy in the regions of Russia, which are necessary for the development of distance learning technologies. The research results can be used to analyze changes in the educational services market, when conducting research on the innovative and informational development of regions, predicting qualitative and quantitative trends in the development of distance education, diagnosing the potential of the Russian market and online education, and distance education technologies and EdTech in today's growing market.

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