ATLANTIS PRESS

Advances in Economics, Business and Management Research, volume 105

1st International Scientific and Practical Conference on Digital Economy (ISCDE 2019)

Human capital as a determining resource for the introduction of digital technologies in the region's economy

Gundorova M.A.
Vladimir state University named after Alexander Grigorievich and Nikolai Grigorievich Stoletov
Vladimir, Russia
mg82.82@mail.ru

Grachev S.A.
Vladimir state University named after Alexander Grigorievich and Nikolai Grigorievich Stoletov
Vladimir, Russia
grachev-sa@yandex.ru

Donichev O.A.
Vladimir state University named after Alexander Grigorievich and Nikolai Grigorievich Stoletov
Vladimir, Russia
donoa@vlsu.ru

***Abstract* - The article deals with the analysis of the processes of human capital development in the context of the introduction of digital technologies in the Federation subjects. The hypothesis of the study is the assumption that the human capital accumulating in the regions has a decisive influence on the formation of conditions and prerequisites for the active introduction of digital technologies. The complexity of the proof lies in the lack of the sufficient amount of required statistics. The base for research methodology is the use of statistical and comparative analysis methods. Based on their application, the state of higher and secondary education in Russia for the period from 2000 to 2018 is analyzed, then a comparison is made with the number of specialists of higher and secondary levels working in the digital economy of the Russian Federation in the whole. The assessment of the main indicators of the digital economy development in the federal districts of the Russian Federation made it possible to establish significant differences in the use of various types of digital technologies, which allowed ranking the territories. A further analysis of the formation and development of human capital by sectors of the economy revealed its highest rate in education, healthcare and culture. In manufacturing, the accumulation of this capital turned out to be 2 times lower, and in construction - 4 times lower. An assessment of the use of digital innovations in the Russian Federation and the Central Federal District showed that all areas of the use of digital products are showing growth. The analysis made possible to draw a conclusion about the priority influence of the education level of human capital on the state of general digitalization of the regional economies.**

Keywords - educational level, human capital, digitalization of the economy, economic growth, resource, regions.

I. INTRODUCTION

The formation and development of the digital economy in Russia and the regions, which is currently one of the main tasks of the state and society, depends on several factors. Among the latter, it should be noted not only the equipping of production and institutions with modern equipment, but also the presence in the country of appropriately trained specialists capable of servicing and improving this equipment. These specialists, being the carriers of human capital, generate creative ideas. This circumstance acquires a special significance in connection with the need to overcome the existing lag in development and ensure the economic growth of the state with the help of digital innovations. Therefore, the success of economic transformations mostly depends on the state and level of human capital in the country and regions.

This problem in the context of digitalization seems to be new and poorly studied, therefore, studies conducted in this direction bring updated data and may be of great scientific interest. Based on this, the analysis of the formation and development of human capital processes as a resource of the digital economy seems appropriate and relevant, which determines the goals and objectives of the study.

II. METHODOLOGY

The research methodology is based on the techniques and methods of statistical and comparative analyzes. The article discusses the indicators of training specialists with higher and secondary specialized education, which are compared with the number of employees of higher and intermediate levels of qualification in the Russian system of information and communication technologies (ICT). It is concluded that the percentage of these specialists in the number of people employed in the economy lags significantly behind the indicators of the leading countries of the world. The analysis of the digital economy development in the federal districts of Russia made possible to rank them and draw a conclusion about the uneven implementation of digital technologies in the regions of the Russian Federation.

Analysis of the distribution of accumulated human capital by type of economic activity led to the conclusion that the main areas that form human capital are education, healthcare and culture. They concentrated 23.4% of the total, 12.9% in manufacturing, and 6.2% in construction. Assessment of statistical data on the introduction of digital technologies in the Russian Federation showed that for the period 2008-2017 all indicators increased.

III. THE MAIN PART

The problem of digital transformation is widely discussed among Russian and foreign scientists, representatives of government and business.

So Y.M. Akatkin and his colleagues believe that since the digital economy is based on the knowledge economy, the formation of a semantic core, which acts as the carrier of knowledge in the ecosystem of the digital industry, becomes especially important [1].

Confirming our earlier opinion about the importance of human capital, V. Ananyina et al. emphasizes that, as part of the digital transformation of business, specific changes are taking place in the organizational culture of the company, which is impossible without a deep transformation of management approaches, as well as changes in organizational and human capital [2] .

Foreign scientists also pay significant attention to digitalization processes. Thus, D. Meisner and E. Karayannis, from the digitalization perspective, pay attention to the innovative development of enterprises based on a long-term and comprehensive amount of knowledge and the unification of innovative technologies [3].

F. Duchin and St. Levine emphasized the development for these purposes of technological integration of enterprises with the use of modeling scenarios based on economic and mathematical models [4].

Meanwhile, it is also argued that the digital economy is expressed in the equal use of online innovation and digital technologies by all participants in the economic system, from individuals to large companies, and digital transformation will affect all sectors of the international economy by 2025 [10].

The importance of highly educated human capital is reflected in the works of B. Balsmaer and M. Walter who believe that the increase in digitization investment leads to an increase in the employment of highly skilled workers and a decrease in persons with low qualifications, although this brings some positive effect [6].

Meanwhile, it should be noted that when using digital technologies, completely new, more significant conditions for the development of research are created. I.V. Uporova claims that in the field of the digital economy success can only be achieved by an organization capable of creating the conditions for realizing the creative potential of employees, competently building business processes based on information and communication technologies [7]. Digital transformation can increase drastically the level of human capital creating improved scientific, technological and business processes, which helps to create a new product and bring it to the market. At the same time, this happens within a very short time and is also accompanied by automation of the process of making managerial decisions.

According to O.A. Rodionova and E.V. Kulchitskaya, the identification of capable employees and their use in the implementation of organization and region goals allows for maximum efficiency of the human capital functioning [8]. Therefore, we can argue that talent management is one of the most promising activities in the management of modern organizations' human resources. This is due to the fact that it is talents from among the staff, their creativity and uniqueness that underlie the competitiveness of enterprises against the background of modern flooding the markets and the high dynamics of the transformations in technology and the digital sphere.

According to S. Zemtsov and Yu. Smelov, human capital concentrated in cities is a significant factor in the development of regions along with attracting investments [9].

According to Y. Kharitonova, the efficiency of firms is largely determined by their innovative level, which is directly related to the level of intellectual capital management. The latter is one of the important strategic factors of economic development and a condition for the introduction of digital technologies which predetermines the intellectualization of human capital [10].

According to the calculations of O.A. Baranova and her colleagues, faster growth of human capital leads to an increase in the gross output of the industries share that themselves form human capital, including education, healthcare and culture, as well as manufacturing, while reducing extractive industries [11]. It was also emphasized that an increase in investment in human capital causes a significant increase in the rate of labour productivity which forms more diversified production structures and contributes to an increase in the share of services and industries that meet the needs of the population.

However, in our opinion, these processes are significantly affected by the existing differentiation between economic entities which are both individual companies and federal entities. Thus, the inequality of regions in wages, according to N.A. Buranshina and L.I. Smirnykh, to a large extent affects the potential of human capital, which in turn leads to a decrease in economic growth and the formation of "poverty traps", which increases social tensions in society [12]. Therefore, when making decisions on the redistribution of labor resources between regions, factors of internal migration of the population should be taken into account in order to convert the territory according to the level of wages.

According to E.A. Ostapenko, an increase in the degree of human capital influence on the formation of an internal regional product is possible only if there is a corresponding increase in the level of labour costs with a simultaneous decrease in the share of fixed capital in an internal regional product [13].

At the same time, intellectual capital is an important and integral part of human capital. Moreover, the effectiveness of human capital use according to Y.N. Lapygin and P.Yu. Makarova largely depends on the intellectual potential of the company, on the presence of mental labour representatives, on the level of creativity of employees, including scientists, engineers, creative workers, who form the middle class of the region and the country with their production [14]. In other words, the position of the middle class determines the state and quality of intellectual capital and the innovative potential of the territory.

Meanwhile, in Russian periodicals it is reported that the ratio of the middle class in comparison with other categories of the population in the country is steadily decreasing [15]. This fact allows us to argue that there is a reduction in the innovative potential of the state, causing some concern among representatives of government and administration. At the same time, A. Shurobovich believes that the share of human capital

increases sharply in the processes of integration and economic modernization of the regions. It becomes the main driving force of the ongoing transformations. The processes of economic modernization themselves are carried out mainly according to the creative type and are determined, first of all, by its innovative potential [16]. At the same time, there is an increase in the attractiveness of special education, the development of scientific and scientific-pedagogical activity, provided that the remuneration of scientists is increased.

In this regard, D. Sorokin notes that the transition to a digital economy should be interpreted as qualitative changes in the way the social productive forces function, generating a civilization shift, consisting in combining digitalization programs with the transition to a new technological structure and creating a system of economic interest in this for business entities and workers [17]. This should mean that changes will be made in approaches to organizational and economic management and the formation of a new level of human capital.

At the same time, foreign scientists are discovering an interesting experience in the use and development of human capital. So, according to M. Fujit and P. Krugman, human capital along with favourable institutional conditions and agglomeration effects are advantages in spatial development [18].

Hence, according to Z. Grilichi, the amount of accumulated knowledge, which is a condition for the growth of human capital, depends on the costs of scientific research of past periods and determines economic growth [19]. T. Brenner considers that for developing countries an important role in increasing labor productivity is played by the increase in human capital expressed in the duration of training [20].

IV. RESULTS

Meanwhile, in the conditions of the regions, human capital is formed and has an impact on the digitalization of their economies directly through the level and condition of higher and secondary special education and, consequently, on the quality of this education. It is formed in the sectors of the economy and directly affects the indicators of the implementation of information and communication technologies and the degree of digitalization of the regions.

Table 1 shows that for the period 2000-2018 in the Russian Federation the number of higher education institutions first grew and amounted to 1115 thousand units and 7050 thousand students in 2010-2011, and then slightly decreased. The number of colleges and their students is constantly increasing. Of course, all this forms the basis for the growth in the economy of the volume and quality of human capital.

TABLE I. The number of higher and secondary special educational institutions and the number of their students in the Russian Federation for 2000-2018

	Number of higher education institutions	**Number of students, thousand.**	**Number of specialized secondary schools**	**The number of students, thousand.**
2000/2001	965	4741	2703	2361
2010/2011	1115	7050	2850	2126
2016/2017	818	4399	3552	2305
2017/2018	766	4246	3956	2388

Table 2 shows the status of personnel in the digital economy for 2018.

It can be seen from it that as of 2018, 1 million 617.4 thousand people or 2.24% of the total number of people employed in the economy were employed in ICT sectors, which is significantly lower than in some leading countries. For example, in Sweden and Finland this figure is 6.6% and 6.8%, in the UK 5.1%, in the USA 4.1%, in Canada 4.7%, in Estonia 5.6%. At the same time, 904.1 thousand people or 1.25% of the total number of employed people belong to the highest qualification level, 195.1 thousand people belong to the average qualification level. Accordingly, these personnel are rather unevenly distributed across the federal districts of Russia. This, in turn, affects the differentiation in terms of digitalization, as shown in Table 3.

Unfortunately, such statistical data are presented only for 2017; there are no more recent indicators in the HSE directories. Nevertheless, the Table gives an idea of the development of digital technology in the federal districts. For almost all of the recorded positions, with the exception of two, the Central Federal District occupies the first place. It is followed by the Northwest District and in third place occupies the Ural Federal District. The North Caucasian Federal District closes the table.

TABLE II. ICT SPECIALISTS: 2018

	thousand of people	**Percentage of total**	**Percentage of total employment**
all	1617.4	100	2.24
senior officials			
Heads of services and departments in the field of ICT	66.1	4.1	0,09
Highest level of qualification			
ICT specialists	904.1	55.9	1.25
Software and application developers and analysts	654.4	40.5	0.90
Database and networking specialists	249.7	15.4	0,35
Other ICT-related activity groups	245.9	15.2	0.34
Electronics engineers	128.8	8.0	0.18
Telecommunications engineers	76.3	4.7	0.10
Information and communication technology (ICT) marketing specialists)	13.0	0.8	0.02
Graphic and multimedia designers	21.5	1.3	0,03
Teachers for computer education	6.3	0,4	0.01

Average skill level			
ICT technicians	195.1	12.1	0.27
ICT operation and user support technicians	126.6	7.9	0.18
Telecommunications and broadcasting technicians	68.5	4.2	0,09
	thousand of people	**Percentage of total**	**Percentage of total employment**
Electronics technicians	57.2	3.5	0.08
qualified worker			
Installers and repairers of electronic and telecommunication equipment	149.0	9.2	0.2

Specialists of the Institute of Economics and Industrial Engineering of the SB RAS under the guidance of A.O. Baranova, Doctor of Economics, Professor, and her colleagues calculated the distribution of accumulated human capital in the Russian Federation, using their materials selectively we were able to create Table 4.

For types of economic activity in the Russian Federation, we provide information only for the main group of species, which accounts for 51% of the total accumulation of human capital. Moreover, the main share belongs to industries that the authors have designated as "shaping human capital" - education, healthcare, and culture. They account for 23.4%, in manufacturing this figure is 12.9%, while they account for the bulk of specialists with higher and secondary specialized education, which, of course, indicates the advantages from the standpoint of the growth of human capital.

Table 5 presents the development indicators of information and communication technologies that characterize the implementation of the digital economy in Russia and the Central Federal District in 2008-2017. It can be seen that, according to all estimates of the introduction of digital technologies, growth is observed.

TABLE III. KEY INDICATORS OF DIGITAL ECONOMY DEVELOPMENT IN FEDERAL DISTRICTS OF THE RUSSIAN FEDERATION: 2017*

	Broadband Internet access subscribers per 100 people (units).				**Proportion of population that uses the Internet (percent)**						**The share of organizations (the total number of organizations) that use (interest):**					
	fixed	***rank on Russian Federation***	***mobile***	***rank on Russian Federation***	***in total population***	***rank on Russian Federation***	***for orders of goods, services***	***rank on Russian Federation***	***for public services in electronic form***	***rank on Russian Federation***	***broadband Internet***	***rank on Russian Federation***	***«cloud services»***	***rank on Russian Federation***	***The sum of the ranks in Russia Federation***	***Places in Russia Federation***
Russian Federation	20.9	-	79.2	-	83.7	-	29.1	-	64.3	-	80.5	-	20.5	-		
The Central Federal district	24.6	1	92.8	1	86.2	1	33.5	3	71.3	1	85.6	2	23.2	1	10	1
North-West Federal district	24.4	2	78.5	3	85.6	2	33.6	2	56.0	7	86.8	1	22.5	2	19	2
South Federal district	16.6	7	32.2	6	83.5	3	28.8	4	64.3	3	73.9	8	19.0	7	35	5
North Caucasus Federal district	7.5	8	65.7	8	81.8	7	15.6	8	53.0	8	79.5	4	19.4	6	49	8
Volga Federal district	21.7	4	71.4	7	82.0	6	26.4	6	67.2	2	79.3	5	17.7	8	38	6
Ural Federal district	24.0	3	76.9	3	83.4	4	33.7	1	58.9	5	80.3	3	21.1	3	22	3
Siberian Federal district	18.9	5	75.0	5	80.7	8	24.5	7	59.6	4	75.0	7	19.6	5	41	7
Far Eastern Federal district	16.0	6	90.0	2	85.8	5	31.2	5	46.2	6	73.7	6	23.4	4	34	4

** - education, health, culture*

TABLE IV. DISTRIBUTION OF ACCUMULATED HUMAN CAPITAL BY TYPES OF ECONOMIC ACTIVITY IN THE RUSSIAN FEDERATION, BASIC PRICES 2015, BILLION. RUB.

indicator	CHK total	Including the employed			The structure of the CHK, %
		with higher education	*with average prof. education*	*else*	
All	92165	67579	22409	2177	100.0
Agriculture, hunting and forestry, fishing	3152	1513	1320	319	3.4
The industry, forming the Cheka*	21553	17047	4267	239	23.4
extraction of minerals	1736	1152	535	49	1.9
manufacturing activity	11870	7912	3628	330	12.9
Production and distribution of electricity, gas and water	2953	2062	829	62	3.2
construction	5471	3736	1809	206	6,2

TABLE V. USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN ORGANIZATIONS

	The share of organizations that used (in % of the total number of surveyed organizations of the relevant subject of the Russian Federation)							
	personal computer		*Computers of other types (servers)*		*local area network*		*global information network*	
	2008	2017	2008	2017	2008	2017	2008	2017
Russian Federation	93.7	92.1	14.5	50.6	59.3	61.1	74.7	89.7
Central Federal district	93.1	94.9	15.0	55.3	59.4	64,2	72.6	93.0

V. CONCLUSION

Thus, the analysis performed and the comparison of the growth of number of specialists with higher and secondary specialized education in the Russian Federation as a whole and regions and the growth of human capital by sectors of the economy depending on the educational level of the population, we can conclude that the processes of raising the educational level and human capital have direct impact on the implementation of information and communication technologies. However, it should be noted that Russian indicators are significantly inferior to world ones. The ranking of federal districts by the level of introduction of digital technologies allowed us to determine significant differences in their use across the country, as well as the formation of human capital for various types of economic activity. In addition, it was stated that for all types of digital innovations in Russia for the period 2008-2017, a growth is observed.

References

[1] Akatkin Yu.M., Karpov O.E., Konyavskiy V.A., Yasinovskaya E.D. Tsifrovaya ekonomika: kontseptual'naya arkhitektura ekosistemy tsifrovoy otrasli // Biznes-informatika. 2017. № 4 (42). S. 17–28.

[2] Anan'in V.I., Zimin K.V., Lugachev M.I., Gimranov R.D., Skripkin K.G. Tsifrovoe predpriyatie: transformatsiya v novuyu real'nost' // Biznes-informatika. 2018. № 2 (44). S. 45-54.

[3] Meissner D., Carayannis E. Value generation from industry-science linkages in light of targeted open innovation// Journal of Knowledge Management. 2017. Vol. 21. No. 2. P. 295-307.

[4] Duchin F., Levine St. Choosing among alternative technologies: conditions for assuring the feasibility of an input–output database or scenario // Economic Systems Research. 2017. Vol. 29. Iss. 4. P. 541-559. HRT http:// hall. handle.net / 10.1080/ 0953 5314/ 1301396/ 2017.

[5] Stafford, Philip. You can believe the Hype Cycles take on technology // Financial Times. 2018. Vol. 30. P. 29-38.

[6] Balsmeier B., Woerter M. Is this time different? How digitalization job creation and destruction // Research Policy in press corrected prof. Available 13 April 2019.

[7] Uporova I.V. Upravlenie trudovymi resursami v kontekste tsifrovoy ekonomiki // Ekonomika i upravlenie. 2019. №1. S. 78-86.

[8] Rodionova O.A., Kul'chitskaya E.V. Vozmozhnosti integratsii neyromarketinga v upravlenie chelovecheskimi resursami // Ekonomika i upravlenie. 2018. №5. S.35-43.

[9] Zemtsov S.P., Smelov Yu.A. Faktory regional'nogo razvitiya v Rossii: geografiya, chelovecheskiy kapital ili politika regionov // Zhurnal novoy ekonomicheskoy assotsiatsii. 2018. №4. S. 84-108.

[10] Kharitonova Yu.V. Evolyutsiya sistemy upravleniya personalom v protsesse intellektualizatsii chelovecheskogo kapitala // Vestnik instituta ekonomiki RAN. 2019. №2. S. 165-178.

[11] Baranov O.A., Pavlov V.N., Stepanova Yu.M., Tagaeva T.O. Ispol'zovanie dinamicheskoy mezhotraslevoy modeli s blokom chelovecheskogo kapitala v prognozirovanii ekonomiki Rossii // Problemy prognozirovaniya. 2018. №6. S.104-116.

[12] Buranshina N.A., Smirnykh L.I. Chelovecheskiy kapital migrantov i konvergentsiya rossiyskikh regionov po zarabotnoy plate // Voprosy ekonomiki. 2018. №12. S. 121-138.

[13] Ostapenko E.A. Otsenka chelovecheskogo kapitala v razvitii regional'noy ekonomiki // Regional'naya ekonomika: teoriya i praktika. 2019. T.17, vyp.4. S. 703-717.

[14] Lapygin Yu.N., Makarov P.Yu. Intellektual'nyy kapital kak indikator innovatsionnogo potentsiala stran i regionov // Innovatsii. 2018. №6. S.39-50.

[15] Zhurenov K. Neschast'ye byt' srednim // Ogonek. 2019. S. 4-5.

[16] Shurobovich A.V. Evraziyskaya integratsiya i ekonomicheskaya modernizatsiya: rol' chelovecheskogo kapitala // Vestnik instituta ekonomiki RAN. 20149. №1. S.126-143.

[17] Sorokin D.E. Tsifrovaya ekonomika: blago ili ugroza natsional'noy bezopasnosti Rossii // Ekonomicheskoe vozrozhdenie Rossii. 2018. №2. S. 36-40.

[18] Fujita M., Krugman P. The New Economic Geography: Past, Present and Future. - Papers in Regional Science. 2004. Vol. 83. P. 139-164.

[19] Griliches, Z. R&D Patents and Productivity. Chicago: University of Chicago Press. 1984.

[20] Brenner T. Science, Innovation and National Growth. Philipps University Marburg, Department of Geography. 2014. № 3.