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Digital economy: Concepts and Russia's readiness to transition

Abstract. The purpose of the paper is to evaluate the level of Russia's digital economy readiness. By analysing approaches used to understand its nature, the article identifies the key production factor in the digital economy and assigns maturity of the information and communication technologies a special role to determine the capabilities for transition to the new digital reality. The methodological basis of the research includes conceptual principles of the post-industrial society theory within the context of the digital economy. The study employs the methods of comparative and functional analyses, systematisation of information, expert evaluation, and inductive reasoning. Statistical aggregations used to characterise the maturity of the ICT in the developed countries and described in the UN International Standard Industrial Classification are discussed. It is concluded that, as opposed to the sectoral division adopted in the International Standard Industrial Classification, Russia employs the concept of "information technology industry", however, a single approach to understanding the nature of this phenomenon is yet to be developed. Russia's IT industry appears to be represented exclusively by the service sector with no regard for manufacturing lines of activity or commerce. A system of indicators to measure regional digital readiness is analysed. The researcher proposes a conceptual framework to assess to what extent the Russian Federation is ready to embrace the digital reality and integrate it into the economy, performs a qualitative and quantitative analysis of the variables where each variable is assigned an appropriate level, and makes a final conclusion from a comprehensive assessment.

Keywords: digital economy; information and communication technologies; ICT sector; standardised aggregation; alternative aggregation.

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Introduction

Computation paradigms form the basis of one way to explore our complex modern world. A new rating system appears approximately once a decade. First came mainframes followed by personal computers, and later our life was fundamentally changed by the Internet [Semyachkov, 2017]. As estimated by Gartner, by 2020, the Internet of Things installed base will comprise about 26 billion units of various types and functions, and the turnover of the Internet Economy will reach 1.9 trillion US dollars[1]. Managing transactions between these devices will require the "Internet of Money" [Omohundro, 2014] and the corresponding cryptocurrency, whereas micropayments between connected devices may develop into a whole new level of economy [Dawson, 2014].

In his time, when describing the symptoms of the coming "post-industrial" epoch, D. Bell [1973, p. 18] listed a number of distinctive features of a post-industrial society:

[1] Garter Says the Internet of Things Installed Base Will Grow to 26 Billion Units by 2020. (2013). 12 December. Available at: http://www.gartner.com/newsroom/id/2636073

- shift from the production of goods to the economy of services;
- pre-eminence of the professional and technical class in the employment structure, as well as an increasingly larger role of scientists and engineers;
- primacy of theoretical knowledge as a source of innovation and policymaking;
- particular significance of technology and technological assessments;
- emergence of a new "intellectual technology".

It is worth noting that in the early 1970s when describing the "post" direction D. Bell and his followers who advocated various ideological trends – from conservative W. Rostow and moderate liberal K. Tominaga to socialistic A. Touraine and Czech Marxist R. Richta **[Inozemtsev, 2001, p. 140]** – predicted the future fundamental changes in the system of socioeconomic relations, the quality and scale of which could not be estimated objectively. Even today, it is still not clear in which way the postindustrial reality will be integrated into the modern world, but we can take the liberty to make the following assumption. It is becoming increasingly obvious that a number of indications spotted by D. Bell – "the shift from the production of goods to the economy of services", "the special role of technology and technological assessments and "the rise of a new intellectual technology" – describe a specific manifestation of post-industrial reality, namely, a new economy operating through the digital ecosystem.

While the new economy is a natural manifestation of the post-industrial economy, the digital economy represents an evolutionary form of the new economy's manifestation **[Zubarev, 2017, p. 178]**. Digital technologies as a discrete system based on data encoding and transmission methods are certainly not something fundamentally new now at the beginning of the 21st century. Their continuous improvement accelerates the process of humanity's departure from the third industrial revolution. In this regard, professors of the Massachusetts Institute of Technology very aptly named this period the "second machine age" **[Brynjolfsson, McAfee, 2017]**.

"Digital economy" as a commonly used term was coined by N. Negroponte (the Massachusetts Institute of Technology) more than twenty years ago when he pertinently described this phenomenon as a "… change from the movement of atoms to the movements of bits"**[Dobrynin et al., (2016)]**. There are other opinions on this subject. Yu. Khokhlov, one of the Russian experts in this field, the Chairman of the Board of Directors of the Institute of the Information Society, notes that D. Tapscott, the author of "Digital Economy" published in 1994, was first to propose and popularise the term "digital economy" (refer to **[Swan, 2017]**). Despite such a long time since the term was introduced into scientific discourse, today there is not only a number of definitions of the digital economy, but also many approaches to describing its concept that feature different structural components. The discussion around defining the nature of the digital economy goes many directions **[Rozhkova, 2017, p. 3]**. Although the experts have largely reached a consensus on the goals of digital transformation, the concept of "digital economy remains quite vague and is more of a marketing nature since it follows the market trends in the interests of main players" **[Akatkin et al., 2017, p. 18]**.

The objective of this study is to evaluate to what degree the domestic economy is ready to accept and implement the new digital reality. The conceptual framework of this evaluation relies on the tools proposed by T. V. Ershova, O. V. Petrov, and Yu. E. Khokhlov **[2018]** (Fig. 1).

Achievement of this objective involves performing the following tasks:

- to analyse the approaches to describing the content of the "digital economy";
- to review the statistical aggregations used to characterise the ICT in the developed countries and in the Russian Federation;
- to identify indicators describing the degree of the digital economy readiness of the Russian Federation with regard to the global experience;

- to analyse the selected indicators and their characteristic variables;
- to map the digital economy readiness of the Russian Federation using a radar chart.

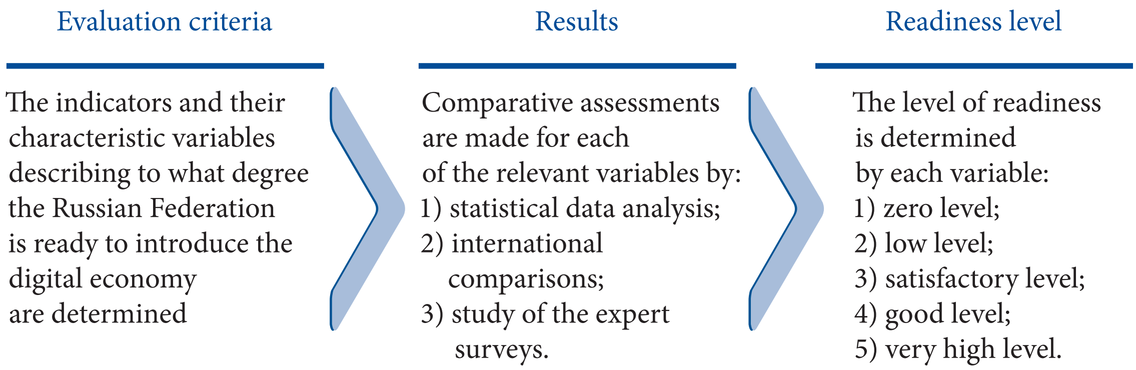

Fig. 1. Conceptual framework to evaluate the digital economy readiness of the Russian Federation
Рис. 1. Концептуальная схема оценки готовности РФ к цифровой экономике

The main terms and concepts of the digital economy

Speaking of the digital economy, it is necessary to systematise the approaches to its description and to clarify the language. "Over the past few years, the information space has been flooded with various reviews and concepts by leading analytical agencies and ICT leaders concerned with the digitalisation of both the economy as a whole and its individual sectors" [Akatkin et al., 2017, p. 17].

One of the approaches proposed by the World Bank is based on a totality of relations between the subjects, where the digital economy is defined as "… a system of economic, social, and cultural relations based on the use of digital information and communication technologies"[1].

Another approach taken in the Decree No. 203 of the President of Russia "On the Strategy for the Development of the Information Society in the Russian Federation for 2017–2030" dated May 09, 2017, centers around the concept of "activity". In these terms the digital economy is defined as an "… economic activity, where the key production factor is big digital data, processing and analytics of which compared to the traditional business patterns help drive various types of production, technology, equipment, storage, sale, delivery of goods and services"[2].

The third approach, along with the first one, is based on the totality of relations, but the emphasis here is made not on their subjects but rather on specifics of the ongoing processes. The Programme for the Development of the Digital Economy of the Russian Federation until 2035 defines that "… a digital economy is a set of social relations that arise with the use of electronic technologies, electronic infrastructure and services, big data analysis and forecasting technologies in order to optimise the production, distribution, exchange, consumption and to raise the level of social and economic development of states"[3].

Despite the width and difference in the approaches to defining the content of the digital economy, with some generalisation it can be noted that all interpretations name data in the digital form as a key production factor in the digital economy, and its beneficial use is possible through the introduction of processes and the use of information handling methods known as

[1] Digital business transformation on the basis of next generation communication technologies: A round table discussion. (2017). National Research University Higher School of Economics, 28 March. Available at: https://bi.hse.ru/rt/. (in Russ.)

[2] Decree of the President of the Russian Federation No. 203 of 9 May 2017 "On the Strategy for the Development of the Information Society in the Russian Federation for 2017-2030". Available at: https://www.prlib.ru/en/node/681488

[3] The Programme for the Development of the Digital Economy in the Russian Federation until 2035

information and communication technologies. With this approach, it is the level of the ICT maturity that obviously determines the potential capabilities and conditions for the emerging digital economy in any state. The ICT sector is at the core of the information industry [Koval'chuk, 2017, p. 26] and remains the main driving force of innovation accounting for the largest share of R&D spending by businesses among the OECD members and more than a third of all patent applications in the world”[1]. That is why it is particularly important to analyse the development of information and communication technologies as a basis for creating and operating the digital economy. At the same time, the large-scale adoption of the information and communication technologies (ICT) in various spheres of human activity and the steady growth of their influence on production and economic relations promoted the emergence of various stances on the role of the ICT in the economy [Veyler, 2011]. Moreover, the scientists and experts are yet to form a unified approach as to what should be included in the ICT.

In this regard, the author suggests covering various approaches used to describe the aggregations (types of activities, economic industries and sectors) included in the ICT on the one hand, and selecting and analysing a number of criteria describing the state of the relevant statistical units that would affect the general level of the ICT maturity, on the other.

Depending on the field of application application, the analysis of capabilities and conditions for an economic phenomenon, of which the emerging digital economy is obviously an example, requires statistical classification resulting from a compromise that would take into account the theoretical calculations, practical considerations, and the rate at which the reality around us is changing.

Definition of standardised and alternative aggregations characterising the ICT

According to researchers exploring the digitalisation of various spheres of human existence, the new technological revolution involves at least a transformation of humanity, and the complexity and ambiguity of the events occurring in this process and the changes that follow are beyond doubt. For this reason, the standardised economic aggregations (industries, sectors) that serve as a source of data for the analysis and are used in both Russian and international statistics cannot be fully applied to assess the prerequisites for the capabilities and conditions for the digital economy development. Taking this fact into account, for the purposes of the analysis in the international practice a certain alternative aggregation is considered which is based on those already existing and described in the UN International Standard Industrial Classification of All Economic Activities (ISIC). Considering that the ICT evolve in parallel with the most complicated processes affecting all aspects of social and economic relations, the ISIC introduces the definition of the information and communication technology sector that the developed countries have been using since 2007. As follows from the content of the ISIC, the activities (sectors) included in the ICT sector are already described in other ISIC sections and included in the subgroups of a number of its subsections. However, being aware of the growing demand for data associated with the information economy, the information and communication technologies and the so-called content, the ISIC introduces the following criterion for assigning a particular industry to the ICT sector: “The production (of goods and services) of a candidate industry must primarily be intended to fulfill or enable the function of information processing and communication by electronic means, including transmission and display”[2]. According to the authors of the ISIC, the definition of the ICT sector “… provides a statistical basis for the measurement, in an internationally comparable way, of the part of economic activity that is

[1] 13.10 – 19.10.2017 News headlines. Available at: http://ac.gov.ru/files/attachment/14808.pdf

[2] International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4. Available at: https://unstats.un.org/unsd/cr/registry/isic-4.asp.

generated by the production of ICT goods and services." Thus, according to the international classification, the ICT sector includes the aggregates of the ICT manufacturing, ICT trade, and ICT services industries.

The ICT manufacturing industries involve the manufacture of:

- electronic components and boards;
- computers and peripheral equipment;
- communication equipment;
- consumer electronics;
- magnetic and optical media.

The ICT trade industries include the wholesale of:

- computers, computer peripheral equipment and software;
- electronic and telecommunication equipment and parts.

The ICT services industries are comprised of:

- software publishing;
- wired, wireless, and satellite telecommunications activities;
- other telecommunications activities;
- computer programming;
- computer consultancy;
- computer facilities management;
- other information technology and computer service activities;
- data processing, hosting and related activities;
- web portals;
- repair of computers and communication equipment;
- repair of computers and peripheral equipment;
- repair of communication equipment.

It should be noted that in the Russian Federation, the ICT sector is not described as any (standardised or alternative) aggregate that would fully characterise the structure of the information and communication technologies, whose maturity determines the capabilities for the digital economy development. As opposed to the sectoral division adopted in the ISIC, the domestic legal environment does describe the concept of an "IT industry", but the content of this concept varies from document to document. For example, according to the "Strategy for Development of the Information Technology Industry in the Russian Federation for 2014 to 2020 and Projected until 2025", the IT industry is a combination of domestic companies engaged in the following activities:

- development of mass-production software;
- provision of IT services, in particular custom software development, information system design, implementation and testing, IT consulting;
- development of hardware and software systems with high added value of the software part;
- remote processing and provision of information, in particular on websites of the information and telecommunication network[1].

According to the Order No. 502 of the Ministry of Digital Development, Communications and Mass Media of the Russian Federation dated December 30, 2014, the IT industry includes an aggregated classification group of the following types of economic activity (as per OKVED 2):

1) software development;
2) computer consultancy and services;
3) computer facilities management activities;

[1] Strategy for Development of the Information Technology Industry in the Russian Federation for 2014–2020 and until 2025.

4) data processing, hosting and related activities[1].

Analysing the above definitions of the IT industry, we come to understanding that, within domestic legal boundaries, the information industry is viewed as an aggregate of subjects of economic relations (companies) on the one hand, and as certain economic activities meeting the specified criteria on the other. Comparing the corresponding definitions with that of the ICT sector adopted in the UN classification, we can notice that they are to some extent similar to what is described in the ISIC relative to the alternative aggregation for the ICT. On closer inspection it becomes obvious that the aggregated classification group describing the IT industry in relation to the domestic economy is only represented by those economic activities where the resources are pooled into the production process with the sole purpose of providing services, which, in our opinion, is not entirely true. In this regard, K. A. Semyachkov notes that the core of the digital economy is not only the service sector but also the manufacturing of digital goods, which stresses the importance of the ICT trade [Semyachkov, 2017]. In addition, the main task in the Programme for the Development of the Digital Economy of the Russian Federation until 2035 is to formulate the approaches to organizing the manufacturing, trade, and services industries, which also supports the fact that provision of services is not the only factor to determine the composition of the IT industry. Nevertheless, the industrial and trade economic activities in the ICT sector of the Russian Federation are not included into the "IT industry".

Criteria for the ICT maturity level as the basis of the digital economy

The ambiguous theoretical definition of the digital economy and the lack of a unified comprehensive statistical aggregation describing the ICT in Russia prevent from using clear criteria to determine the country's level of readiness for transition to the digital economy.

In order to assess readiness for such transition in other countries the European Commission intending to analyse the level of development of the digital economy in the European Union and 15 more countries (Australia, Brazil, Israel, Canada, China, Mexico, New Zealand, Norway, the Republic of Korea, Russia, the United States, Turkey, Switzerland, and Japan) identified the focal points (criteria) for the study:

- digital infrastructure;
- maturity of data communication, storage and transmission services;
- human capital development;
- digitalisation of businesses including the level of automation of internal processes;
- informational security;
- regulatory environment and barriers to the development of digital technologies.

The system of indicators developed by the Organisation for Economic Co-operation and Development (OECD) is intended to assess the capabilities for adaptation of the digital economy and characterises the following dimensions:

- development of the high-tech economic sector and its share in the output of the manufacturing and services industries;
- investment in research and software development;
- expenses on education and retraining;
- design and production of information and communication equipment;
- creation of jobs in science and high technology sector;
- cooperation between corporations, venture capital firms, universities, and research organisations;
- international knowledge flows, international cooperation in science and innovation;

[1] Order No. 502 of the Ministry of Telecom and Mass Communications of the Russian Federation of 30 December 2014 "On Approval of the Aggregated IT Industry Classification Groups".

- mobility of scientists, engineers, and students;
- the Internet penetration rate;
- share of high-tech products in the cross-border trade [Semyachkov, 2017].

Some of the dimensions, such as the "development of the high-tech economic sector" or "international knowledge flows, international cooperation in science and innovation" are quite abstract. At the same time there are some clear criteria that we propose using as basic so that the degree Russia's digital economy readiness could be analysed using the domestic statistics. Such indicators from the list of those proposed by the OECD, in our opinion, include:

1) development of the high-tech economic sector and its share in the output of the manufacturing and services industries;

2) mobility of scientists, engineers, and students;

3) investment in research and software development.

The first indicator. It should be clarified that while conducting the analysis the author focused on description of economic activities given by the Federal State Statistics Service of the Russian Federation (Rosstat)[1]. For this reason, Table 1 shows data for "computer and office equipment manufacturing" and "electronic components and radio equipment manufacturing", which in our opinion are most consistent and compatible with the ISIC. As a characteristic variable we used the share of innovative products in the total volume of in-house goods produced in the course of these activities.

Table 1. **The volume of shipped goods and the share of innovative products by industry in Russia in 2012–2016**

Таблица 1. Объем отгруженных товаров и доля инновационных товаров по видам отраслей в России в 2012–2016 гг.

Economic activity	2012	2013	2014	2015	2016
Manufacturing of computer and office equipment, million roubles	46,202.4	48,389.3	45,598.4	57,377.5	59,546.3
Share of innovative products in manufactured computer and office equipment, %	2.2	1.7	8.8	11.0	8.0
Manufacturing of electronic components and telecommunication and radio equipment, million roubles	265,555.0	281,185.6	313,132.2	323,153.2	380,201.5
Share of innovative products in manufactured electronic components and telecommunication and radio equipment, %	10.5	13.4	16.0	13.3	23.5

We believe that, to get the whole picture, the absolute data on production volumes should be complemented with information on the size of the innovative component. This in turn gives the most comprehensive view of the quality of information and communication equipment manufactured in the Russian Federation. On the one hand, from 2012 to 2016, there appear to be no dramatic changes in the dynamics towards the decline in innovation among the companies manufacturing office equipment, computers, electronic components, or radio and telecommunication equipment; but, if we compare this data with the performance in a number of developed countries, the picture will become depressing. Unfortunately, we only managed to retrieve the open-source comparable information that refers to the end of 2013, but the current situation, according to experts, is little or no different from that of five years ago. For the purposes of comparison, we analysed the innovation across companies operating in a number of developed countries and obtained the following results: Israel – 75.2 %, Germany – 66.9,

[1] Tables 1–4 are compiled using the data from the Federal State Statistics Service of the Russian Federation. Available at: http://www.gks.ru

Canada – 63.5, Italy – 56.1, Sweden – 55.9, Austria – 54.4, France – 53.4, Japan – 48.5, New Zealand – 45.1, Australia – 42.2 [Skazochkin et al., 2016]. In Russia, as can be seen from Table 1, as of the end of 2013, the share of innovative products in manufactured computer and office equipment amounted to 1.7 %, while the share of innovative products in manufactured electronic components and telecommunication and radio equipment was 13.4 %. For the sake of clarity, the indicators in developed countries describe the situation as a whole, with the companies not broken down by economic sectors. The innovation values for the developed countries would be even higher if we take the corresponding indicators of the manufacturers of high-tech products which certainly include computers, electronic components, and radio and telecommunication equipment. Therefore, comparison indicates an extremely low share of innovative products in the total output of computer and office equipment, as well as in the production of electronic components and radio and telecommunication equipment; this fact, along with the previously suggested conceptual scheme for evaluating the readiness of the domestic economy to accept and implement the new digital reality, allows us to rank the level of readiness by this characteristic variable as zero.

The digital economy leaves the industrial enterprises no chances for survival without modernisation serving as an improvement and transformation process aimed at making irreversible qualitative changes in line with the basic principle of the systems theory, namely, the principle of development [Koreysha, Parshina, p. 35]. In his article V. B Betelin [2017, p. 25], the member of the Russian Academy of Sciences, provides the data demonstrating Russia's critical dependence on the imports of IT equipment (from 80 to 100 % in various categories) and software (around 75 %).

The second indicator. When analysing this factor migration flows should be considered including assessment of the level of migrants' education. Human capital is undoubtedly one of the key factors contributing to the digital economy development as it characterises the quality of workforce which largely depends on population movement. E. I. Dubravskaya [2017, p. 16] believes an internal migration to play an important role in shaping the workforce. This fully applies to external migration as well.

The author analysed the statistical data on the quality of migration flows by the level of education (Table 2), and compared it with the OECD countries performance in terms of immigration/emigration.

Table 2. **Distribution of immigrants/emigrants aged 14 years and older by the level of education and reasons for changing their place of residence in Russia in 2011-2015, people**

Таблица 2. Распределение иммигрантов/эмигрантов в возрасте 14 лет и старше по уровню образования и причинам смены места жительства в Российской Федерации в 2011–2015 гг., чел.

Year	Incoming/outgoing migrants aged 14 and older	Migrants incoming/outgoing for working reasons	Highly educated migrants incoming/outgoing for working reasons
2011	2,979,478/2,679,190	435,853/350,318	154,811/147,464
2012	3,652,355/3,652,355	600,114/525,396	200,009/192,231
2013	3,887,568/3,614,486	667,622/589,351	213,764/208,375
2014	3,973,100/3,729,161	659,586/628,434	214,586/209,645
2015	4,015,141/3,811,242	560,516/609,566	217,923/213,472

In most OECD member countries, the number of highly educated emigrants is significantly lower than that of immigrants with the same level of education [Rubinskaya, 2011, p. 57]. For Russia, the numbers of highly educated incoming and outgoing migrant workers are typically more or less equal. However, considering that the main immigration flow into the Russia comes from the neighboring states, the issue of the quality of human capital incoming from the donor countries is getting sensitive [Kuvaeva, Mikryukov, Serebrennikova, 2017, p. 43]. An important point is that a relatively high proportion of emigrants have scientific degrees. In the period from 2002 to 2011 alone, more than 93 thousand highly educated people left the country, which included over 640 candidates of sciences and more than 250 doctors of sciences[1]. Therefore, to summarise the analysis of all the described facts, the national economy has a low level of digital readiness in terms of quality of migration flows by level of education.

The third (generalised) indicator, in the opinion of the international community, represents the readiness of an economy for transition to a new transformational level. This refers to investment in research and software development, and in this regard, we should focus on several variables that have both qualitative and quantitative dimension:

- funding for basic and applied research;
- inventive activity;
- inventive to innovative activity ratio.

First of all, we will discuss the funding of basic and applied research indispensable for creating new technologies that show signs of changes in economic systems and are often called the driver of economic development [Kuvaeva, Kotova, Serebrennikova, 2017]. The stage of inception and exploration of an innovative idea consists of theoretical, experimental, and exploratory studies; applied research and experimental models [Boytseva, Pavlova, 2016].

Investments in applied scientific research in the context of developing scientific and technical potential have a short-term effect, and in the future this practice leads, at best, to their modernisation and often to application of the already existing technologies. For this reason, the national industrial policy in the developed countries is undergoing fundamental changes in order to stimulate the long-term sustainable development, the key to which is the full support for basic research and development. The analysis of funding allocated to domestic basic research in the period from 2012 to 2016 confirms a steady trend when this cost element accounts for a little less than 1/3 of all expenses allocated to scientific research (Table 3).

Table 3. **Federal R&D budget spending**

Таблица 3. Финансирование науки из средств федерального бюджета

Indicator	2012	2013	2014	2015	2016
Total federal budget spending on citizen science, million roubles	355,920.10	425,301.70	437,273.30	439,392.80	402,722.3
Including: basic research, million roubles	86,623.20	112,230.90	121,599.50	120,203.80	105,247.6
As above, %	24.33	26.38	27.80	27.35	26.13
Applied research, million roubles	269,296.90	313,070.80	315,673.80	319,188.90	297,474.7
As above, %	75.67	73.62	72.20	72.65	73.86

It is noteworthy that reduction in the amount of funding for basic research, percentage-wise, in 2013–2016 is accompanied by a 13.14% rise in the federal budget spending on civil science in the same period. This demonstrates that the basic science funding is not the main focus of the state policy [Rozhkova, 2017]. In 2016, the Presidium of the Russian Academy of Sciences formulated a number of proposals aimed at increasing the efficiency of financial investments in the development of basic scientific and exploratory research, noting that the "… current situation with budgetary funding for basic science in Russia will not only continue in the nearest

[1] "Emigration from Russia in the late 20th and early 21st centuries". A report of the Citizen's initiative committee. (2016). Available at: https://openrussia.org/post/view/18292/. (in Russ.)

future but will actually exhibit a negative trend"[1]. Now we shall conduct a comparative analysis of budgetary funding for scientific research in the United States, China, and Japan, and compare the obtained data with the situation in the Russian Federation. In 2015, the amount of public funding for research in the United States amounted to 62.7 billion US dollars, in China 59.1 billion US dollars, in Japan 33.1 billion US dollars. In Russia, the same indicator as of the end of 2015 was recorded by Rosstat at 7 billion US dollars. The amount of public funding for all scientific organisations (826 entities at the beginning of 2015) within the jurisdiction of the Federal Agency for Scientific Organisations of Russia was 1.4 times less than the total state funding for the four research institutes in the United States: the Johns Hopkins University (1.8 billion US dollars), the University of Washington (0.82 billion US dollars), Stanford University (0.71 billion US dollars), and the Massachusetts Institute of Technology (0.65 billion US dollars)[2]. Therefore, comparison of the basic and applied science funding in the Russian Federation with the foreign funding practice allows us to assign a low level of digital readiness with respect to "funding for basic and applied research".

The practical outcome of investment in scientific research and software development is the development of innovative products indispensable for the digital economy functioning. Patent activity, as it is justly noted, should be considered as a quantitative measure of innovation processes since it provides the most complete characteristic of technological changes in the economy **[Askhadullina, 2017; Kuvaeva, Mikryukov, Serebrennikova, 2017]**. Patent activity (application and grant of patents) is based on the records of inventions resulting from scientific research and development that have significant technical differences in addressing the problems in any sector, social sphere, or defence, and arise from intellectual activity aimed at satisfying specific needs of the society **[Askhadullina, 2017]**. In this regard, particular attention should be given to the analysis of patent activity followed by its correlation with the innovative activity at the domestic enterprises.

Russian science keeps working under the paradigm of the Soviet industrial model that has long ceased to meet the realities of the modern world. We believe that this circumstance entails a significant difference between the total volume of registered intellectual properties and the extent to which the relevant innovations are introduced for various applications. As noted by Loren Graham, a historian of Russian and Soviet science, while pushing ingenious ideas and making breakthrough discoveries, Russian scientists most often only observe these ideas being successfully implemented in the West **[Panov, 2016]**. The strategy for innovative development of the Russian Federation up to 2020 also contains a disappointing observation that Russia failed to achieve the planned level of indicators related to the demand for innovation in the real sector of the economy by the end of 2015, and has been unable to scale up the innovative activity and performance of companies, including the state-owned ones, or to create a competitive environment that would stimulate the use of innovations. Now we shall turn to statistics and analyse some indicators of the innovative activity in the Russian Federation over the past six years (Table 4).

The data from Table 4 indicates that in the given period, the dynamics of application and grant of patents was unstable, with an increase in the number of patents granted for inventions in 2017 as compared to 2012. It is important to note that the number of applications for registration of intellectual properties and the number of patents granted are not essential on their own to assessing the possibility for Russia's transition to the digital economy. In this regard, the

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[1] Investing in science: Towards a knowledge economy. Proposals of the Russian Academy of Sciences to improve the return on investments in the development of basic and exploratory research. (2016). Available at: http://onr-russia.ru/sites/default/files/investicii_v_nauku_-_na_puti_k_ekonomike_znaniy.pdf. (in Russ.)

[2] Ibid.

calculation of the relative variable "inventive activity coefficient" on the one hand and the comparison of the calculated coefficient with that in a number of countries on the other appear to be interesting (Table 5).

Table 4. Application and grant of patents in the Russian Federation in 2012–2017, units

Таблица 4. Поступление патентных заявок и выдача охранных документов в РФ в 2012–2017 гг., ед.

Indicator	2012	2013	2014	2015	2016	2017
Total number of filed applications	44,211	44,914	40,308	45,517	41,587	36,454
of which the Russian applicants filed	28,701	28,765	24,072	29,269	26,795	22,777
Total number of granted patents	32,880	31,638	33,950	34,706	33,536	34,254
of which the Russian applicants were granted	22,481	21,378	23,065	22,560	21,020	21,037

Table 5. Inventive activity coefficient in Russia and other countries[1]

Таблица 5. Коэффициент изобретательской активности в России и странах мира

Country	Value, %
Israel	7.29
Germany	7.62
Canada	9.37
Italy	1.52
Sweden	2.45
Austria	2.84
France	2.56
Australia	1.04
New Zealand	15.25
Japan	25.92
Russia	2.49

It may seem that next to New Zealand and Japan, Russia will be forever and hopelessly lagging behind in terms of inventive activity. However, the estimated indicator for our country is at the level of Sweden, Austria, and France, exceeding that for Australia and Italy. Therefore, we believe it possible to assign a satisfactory level of digital readiness to the variable "inventive activity".

This fact inspires no optimism, since the comparison of the inventive activity coefficient with the innovative activity of domestic companies (see Table 1 and footnotes in relation to the developed countries) suggests that despite a good (as compared with the other territories) inventive activity coefficient, the innovative activity of the Russian enterprises is at an extremely low level. Therefore, we recorded a zero level of "inventive to innovative activity ratio".

Results of the study are presented in Fig. 2.

Conclusion

The study revealed the ambiguity of approaches to defining the essence of the digital economy, where the data in the digital form is considered to be a common key production factor. The level of the ICT development was established to determine the possibilities and conditions for the transition to the digital reality. The research identified the problem of lacking identical statistical aggregations used for analysing digital readiness of the developed countries and the Russian Federation. The concept of the "information and communication technology sector" is

[1] Calculated as a number of patent applications for inventions per 10,000 population in the corresponding territory in 2013

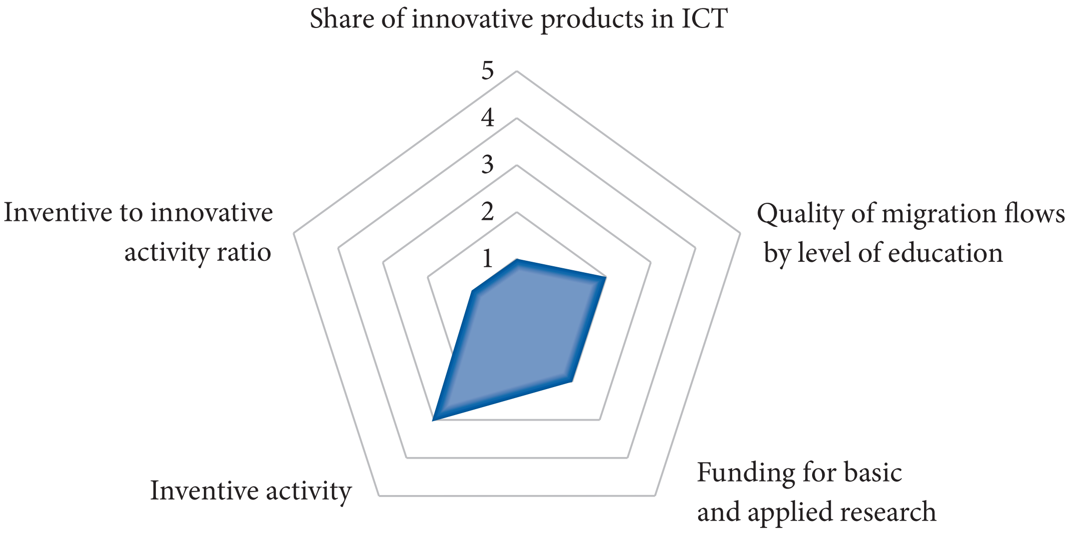

Fig. 2. Assessment of variables characterizing the level of digital readiness:
1 – zero level, 2 – low level, 3 – satisfactory level, 4 – good level, 5 – very high level

Рис. 2. Оценка показателей, характеризующих уровень готовности к цифровой экономике:
1 – нулевой уровень; 2 – низкий уровень; 3 – удовлетворительный уровень; 4 – хороший уровень; 5 – очень высокий уровень

not currently in use in Russia unlike in most developed countries, whereas its clear description in the ISIC could provide a better assessment of Russia's capability for transition to the digital economy.

The conceptual framework for assessing the level of Russia's digital economy readiness was proposed:

- indicators describing Russia's digital economy readiness are revealed;
- comparative assessments are made for each of the relevant variables through the statistical data analysis, international comparisons, and the study of expert surveys;
- the level of readiness by each of the proposed variables is determined.

By all the analysed variables describing such indicators as the high-tech sector development and its share in the output of the manufacturing and services industries; mobility of scientists, engineers, and students; investments in research and software development, the level of readiness of the domestic economy to move to a new digital level should be regarded as quite low.

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Цифровая экономика: концепции и уровень готовности РФ к переходу

Аннотация. Статья посвящена оценке уровня готовности РФ к цифровой экономике. Автор анализирует подходы к ее сущностному пониманию, определяет ключевой фактор производства в цифровой экономике, отмечает особую роль развития информационно-коммуникационных технологий, определяющих возможности перехода к новой цифровой реальности. Методологической базой исследования явились положения теории постиндустриального развития общества в контексте цифровой экономики. В работе использованы методы сравнительного и функционального анализа, систематизации информации, экспертных оценок и индукции. Рассмотрены статистические совокупности, используемые для характеристики уровня развития ИКТ в развитых странах и описанные в Международной стандартной отраслевой классификации. Сделан вывод о том, что в отличие от секторального деления, принятого в Международной стандартной отраслевой классификации, в России используется понятие «отрасль информационных технологий», однако единый подход к пониманию сущности данного явления не выработан. Выявлено, что отрасль информационных технологий представлена в России исключительно сферой услуг без учета производственных направлений деятельности и сферы торговли. Проанализирована система индикаторов, позволяющих оценить готовность территории к внедрению цифровой экономики. Предложена концептуальная схема оценки степени готовности РФ к восприятию цифровой реальности и ее адаптации в экономике. Проведен качественный и количественный анализ показателей, каждому из которых присвоен соответствующий уровень и по результатам комплексной оценки сделан заключительный вывод.

Ключевые слова: цифровая экономика; информационно-коммуникационные технологии; сектор ИКТ; стандартизованная совокупность; альтернативная совокупность.

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