Digital technologies: main directions of development

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Key words
Post-industrial society, digital economy, Internet technologies, cost-benefit analysis

Abstract

The article is devoted to the analysis of the main directions of development of digital technologies. At the beginning of the 21st century, when the advanced part of mankind begins to live in a post-industrial society, a "global digital divide" becomes a characteristic feature of the world's polarization. The social antithesis of the owners of the means of production and wage-workers, which existed earlier, is replaced by a division into Internet-haves and Internet-poor people. And Russia in this new world even after the reforms of the 1990s. does not reduce, but increases the gap from developed countries. The more developed the country, the higher incomes the population has, and, accordingly, has greater access to the Internet and other technologies associated with it.

The article shows the influence of digital technologies development on reducing transaction costs and increasing the efficiency of companies' activities. The last section is devoted to the prospects for the Russian economy digitalization and obstacles on this path.

1. The rapid development of Internet technologies

D.Bell linked the scientific and technological revolution in 1980, first of all, with the revolution in telecommunications. If in the XIX - 1 half of the XX century two main forms of communication were newspapers, magazines and books, on the one hand, and telegraph, telephone, radio and television, on the other, in the second half of the 20th century. The main thing is the development of computer communications. In this regard, in his work "The Social Framework of the Information Society" in 1980, he formulated 5 problems that he believed would solve mankind in the coming decades:

1. Merging telephone and computer systems, telecommunications and information processing into one model
2. Replacement of paper by electronic means
3. Expansion of the television service through cable systems
4. Reorganization of information storage and computer-based query systems into an interactive information network accessible to all
5. Expansion of the education system based on computer training[1].

Table 1. The Global Digital Gap, 2000. (by M.Castells)

WORLD REGIONS	The share of the Internet users total number, %
North America	42,6
Western Europe	23,8
Asia	20,6
Eastern Europe	4,7
Africa	0,6

At the beginning of the XXI century. about 15-20% of people began to live in a post-industrial society, 60-70% remained in an industrial society, and another 15-20% couldn't even pass through primary industrialization. The characteristic of this polarization is the "global digital gap" (Table 1). The social antithesis of the means of production owners and wage-workers, which existed earlier, was

[1] Bell, D. Social framework of the information society. In the book .: The New Technocratic Wave in the West. Moscow: Progress, 1986. p. 330-342 (In Russian)

replaced, according to M. Castells, by a division into those who have the access to the Internet and those who do not. In this new world and even after the reforms of the 1990s. Russia does not reduce, but increases the gap from developed countries.

Thus, the theories of a post-industrial society pretend to play the role of a new social philosophy, which shows strategic development guidelines to both developed countries and mankind as a whole. But these theories have not yet reached such a level as to formulate direct recommendations of a tactical level for socio-economic regulation. Therefore, the regulatory institutions formation occurred in the second half of the twentieth century either with the support of Keynesian theories or even in a spontaneous manner.

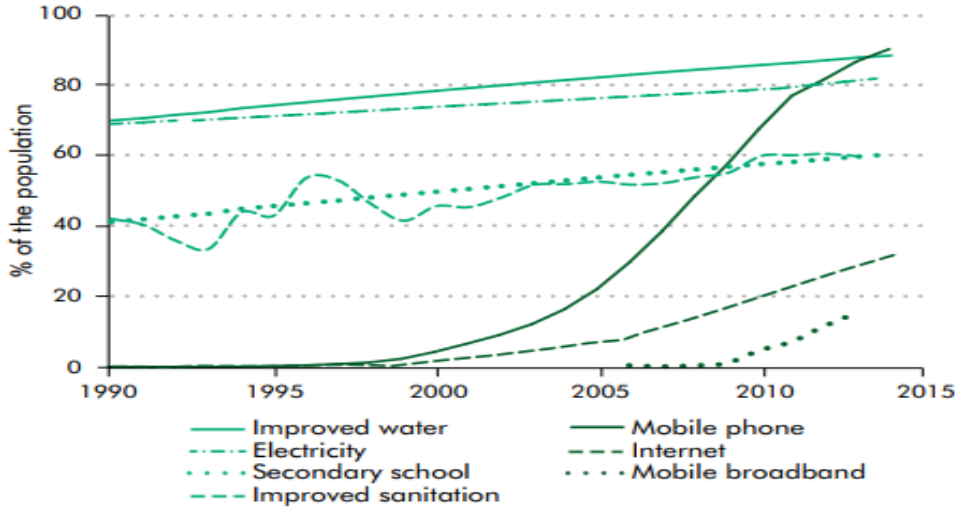

Fig. 1. Digital technologies development in developing countries.
Source: World Development Report 2016. Digital Dividends. P. 6

The rapid development of the Internet at the beginning of the 21st century radically changed the face of modern civilization. This becomes particularly evident when compared with other changes that took place in countries at the turn of the century (see Figure 1)..

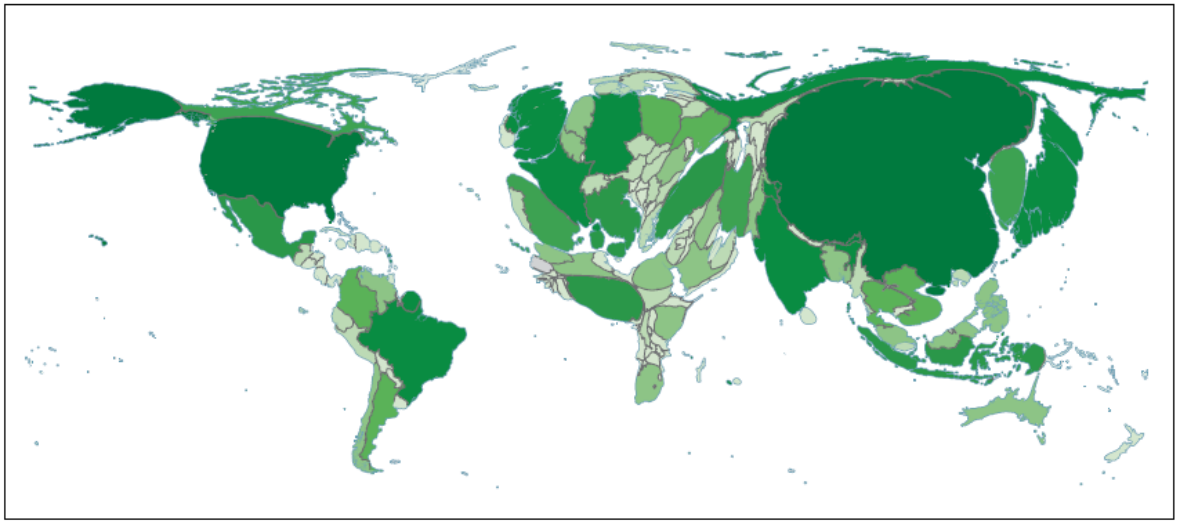

Fig. 2. Anamorphic map of Internet users in the world in 2014.
Source: World Bank. Data at http://bit.do/WDR2016-MapO_1

The anamorphic map of Internet users in the world in 2014 is shown in Fig. 2. It clearly depicts that the world has divided, as M. Castells rightly noted, into those who have the access to the Internet and those who do not.

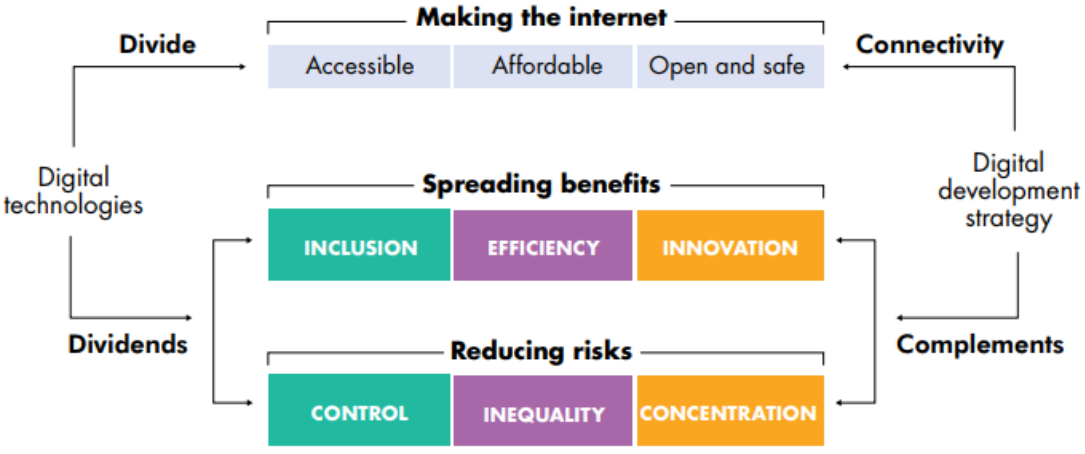

Fig. 3. Why the pace of distribution of digital dividends are low
Source: World Development Report 2016. Digital Dividends. P. 4

Not every country managed to make the Internet accessible, inexpensive, open and safe. The World Bank's World Development Report 2016 analyzes the reasons for the slow pace of the digital technologies spread and outlines a strategy for the Internet development. It helps to understand how to spread the benefits and reduce the costs of digital technology development (see Figure 3).

The average daily demand for various Internet services in 2015 is shown in Fig 4. The society becomes networked. The density of information flows has increased dramatically. Every day 36 million purchases through Amazon, 152 million Skype calls, 186 million publications on the Instagram social network, 803 million short messages in Twitter, 4.2 billion requests go through the Google search system are made. And it all happens every day!

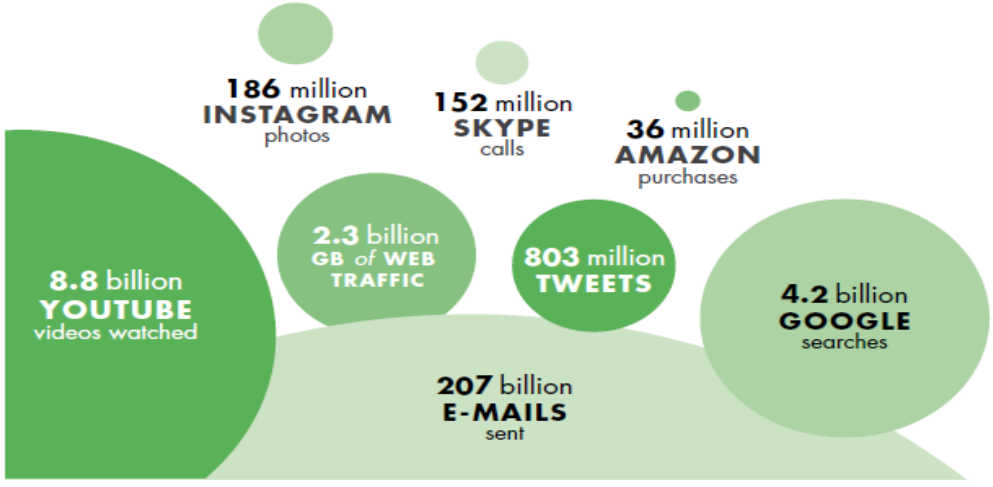

Fig. 4. Average daily demand for various Internet services (2015).
Source: World Development Report 2016. Digital Dividends. P. 6.

Meanwhile it is obvious that this is not typical for all countries. The degree of development of the Internet in different countries in 2015 is shown in Fig. 5. With an aggregate population of 7.4 billion people, mobile communication is already available (to some extent) for almost 7 billion users. However, a large part falls on mobile phone owners, whose number in 2015 reached 5.2 billion. Among 3.2 billion people using the Internet, high-speed data is currently available for only 1.1 billion users.

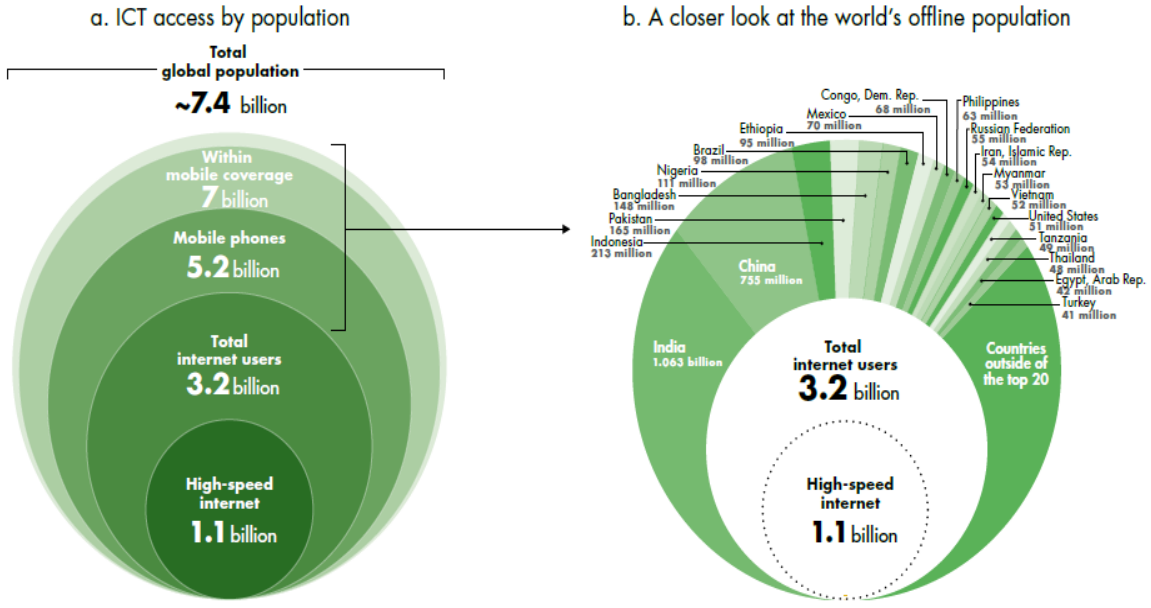

Fig. 5. The degree of the Internet accessibility different countries (2015).
Source: World Bank 2015; Meeker 2015; ITU 2015; GSMA, https://gsmaintelligence.com/; UN Population Division 2014. Data at http://bit.do/WDR2016-FigO_5
Note: High-speed internet (broadband) includes the total number of fixed-line broadband subscriptions (such as DSL, cable modems, fiber optics), and the total number of 4G/LTE mobile subscriptions, minus a correcting factor to allow for those who have both types of access. 4G = fourth generation; DSL = digital subscriber line; ICT = information and communication technology; LTE = Long Term Evolution.

Evidently, the quality of the Internet technologies increases with income growth (see Figure 6). The growth in incomes allows us to take advantage of all the new benefits that modern Internet can provide. New technologies and applications create new quality of life which was never possible before.

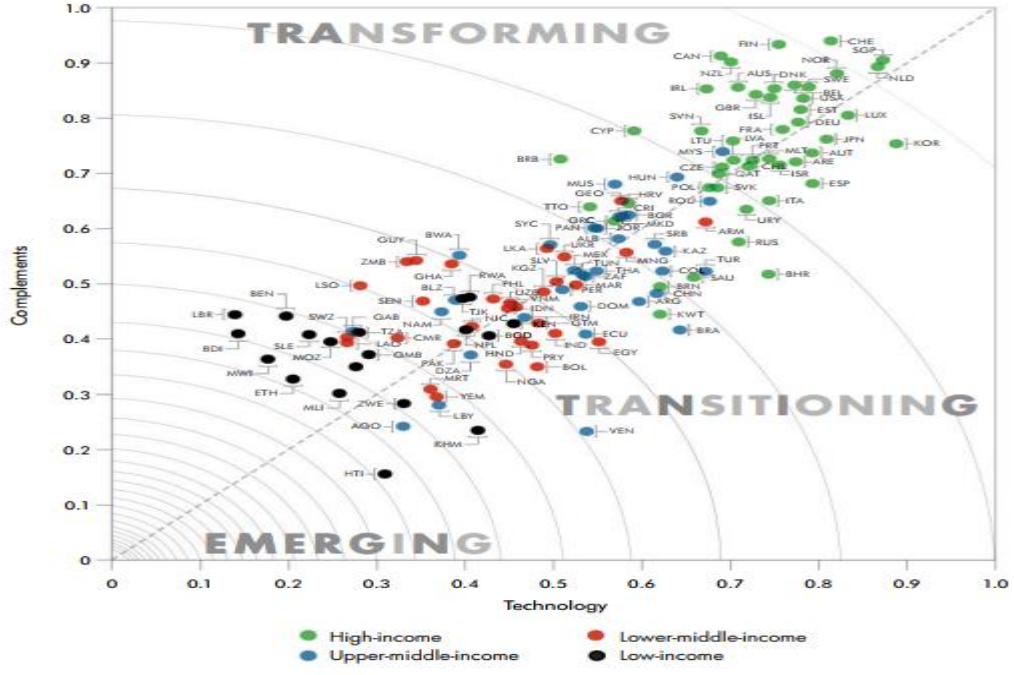

Fig. 6. The quality of technologies add-ons increases with the income growth
Source: World Development Report 2016. Digital Dividends. P. 30

2. The digital technologies development impact on the transaction costs reducing

One of the most obvious and at the same time significant consequences of the ubiquitous spread of the Internet is the significant decrease in transaction costs, including, first of all, costs of information. A potential consequence of this decline may be almost complete elimination of information asymmetry, affecting the speed and quantity of economic relations (transactions) between entities due to the lack of trust to each other, which is typical for the developing countries. Figure 7 shows the change in transaction costs for the two types of society: before and after the Internet spread. As it can be seen, in the second case, the cost is reduced to almost zero.

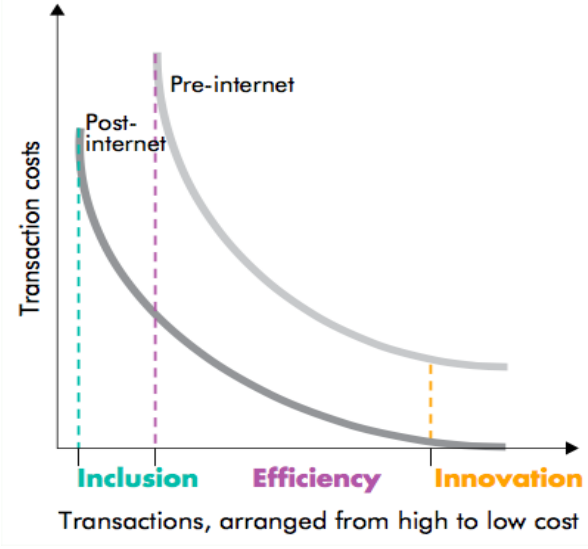

Fig. 7. Transaction costs reduction by the Internet use

Source: World Development Report 2016. Digital Dividends. P. 45

Figure 8 shows the dependence between the share of companies that have the fastest Internet access and the countries income where they are located, as well as how the Internet is used. Obviously, the more income the country's population has, the wider is the spread of broadband Internet access and the more it is used. It is worth noting that the diagrams represent broadband Internet access, not any access to the Internet. While access to the network can be accessible to the majority of the population and, accordingly, companies, its effective use is only possible when the minimum required transmission speeds are provided, otherwise its use will be lack of the economic sense.

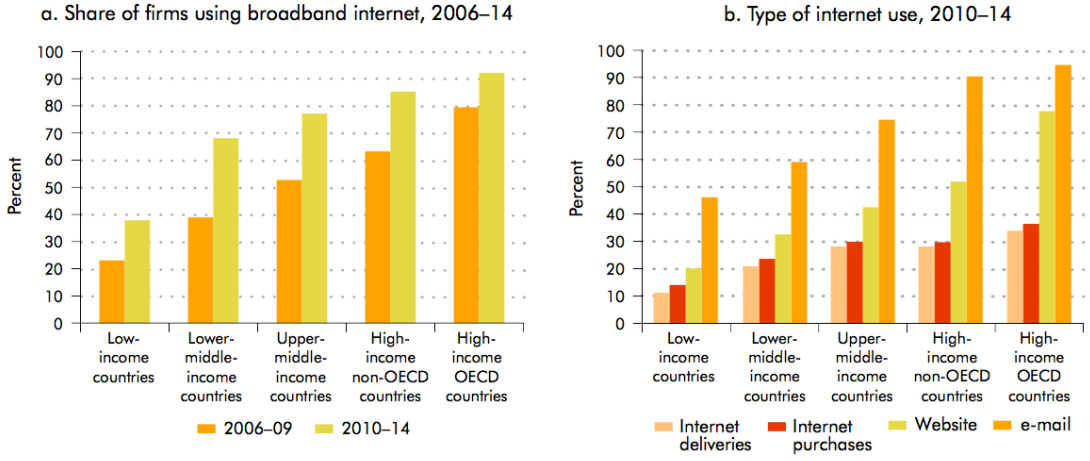

Fig. 8. The share of companies with broadband Internet access and analysis of its use in countries with different income levels

Source: World Development Report 2016. Digital Dividends. P. 52

Among all the ways of the Internet use, irrespectively of the income level, companies most frequently practice e-mail communication. Websites surfing is placed on the second place while Internet purchases and Internet delivery are at the approximately same level in all types of countries, with the exception of the poorest.

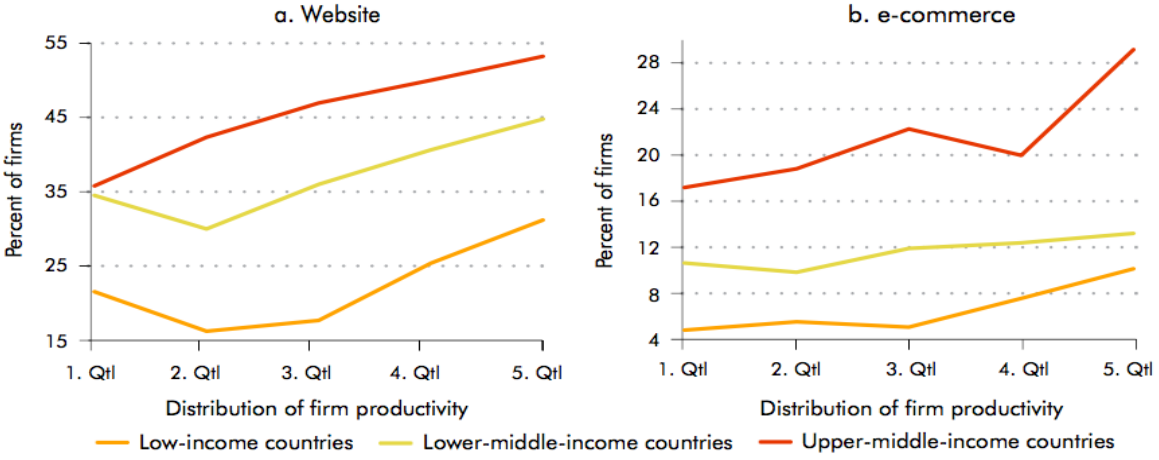

Fig. 9. The use of the Internet by companies with various levels of productivity in countries with different levels of income during 2010-2014.
Source: World Development Report 2016. Digital Dividends. P. 54

All of the above activities in Internet are directly dependent on how productive the company is. Figure 9 shows the shares of companies which use the Internet, divided by their productivity per five quintiles in low-, middle- and high-income countries between 2010 and 2014. As expected, the more productivity is shown by companies, regardless of the country in which they operate, the wider is the use of the Internet and e-commerce. Also, we it is possible to say that the difference between primitive use of websites among the most productive companies in high and low income countries is less than twice, while the difference in the distribution of the required knowledge and skills of e-commerce among the same companies can reach a triple volume.

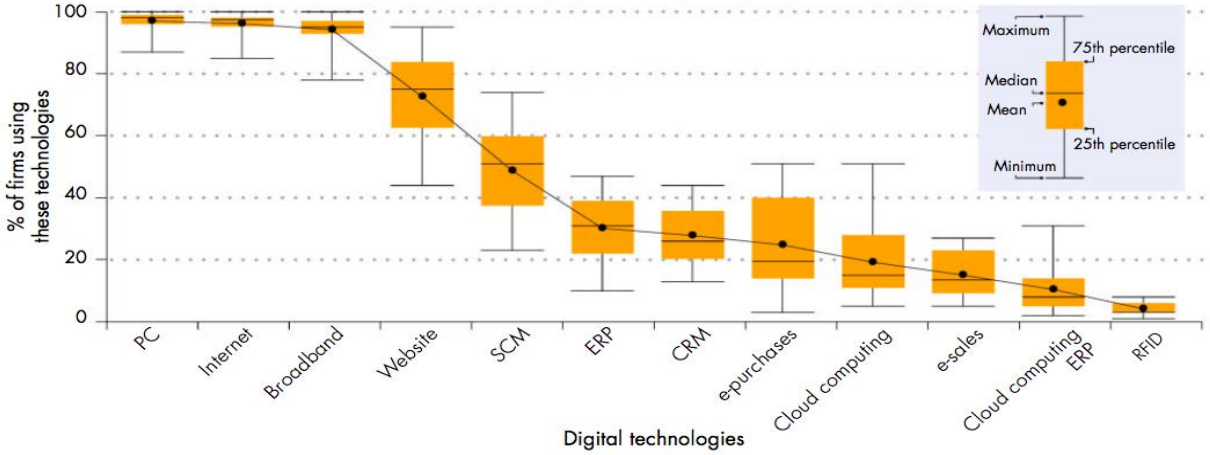

Fig. 10. The spread of advanced digital technologies among high-income countries
Source: World Development Report 2016. Digital Dividends. P. 53

However, the use of digital technologies is not limited by the most primitive methods of the Internet use. While personal computer and proper access to the Internet is common among almost 100% of the population in high-income countries, there is more advanced technologies applying.

Figure 10 shows several advanced technologies that imply a high degree of public involvement in the process of digital transformation. As it can be seen from the figure, the most common practiced technology is Supply Chain Management (SCM), applied on average among half of the companies in high-income countries and allows to optimize and control the entire cycle of raw materials purchases, producing material goods and their further distribution. On the second and third place with approximately the same indicator of 30% spread the systems of effective use of human resources (Enterprise Resource Planning, ERP) and customer relationship management (CRM) were placed. After that, with a gradually decreasing percentage of the latitude of distribution, online shopping, sales and cloud computing systems are located. The last place is the use of Radio Frequency Identification (RFID), which spreads among only about 5% of companies. However, this may be occurred due to the fact that this technology is mainly applicable among companies directly interacting with customers e.g. retailers.

While considering the degree of digital technologies implementation among enterprises, the question about their share in the overall economy growth arises. Figure 11 shows the share of information and communication technologies in the GDP of OECD countries and the share of ICT in GDP growth among developed and developing countries. First of all, it is worth noting that the 6% average share of the digital economy among the OECD countries is quite significant, given that the world community is at the very beginning of the transformation process. Compare to this, the 12% value of Ireland's looks abnormally high, but this can be explained by the efforts made by the government in order to attract foreign technology companies which consist of the creation of comfortable conditions for the business, including tax policy

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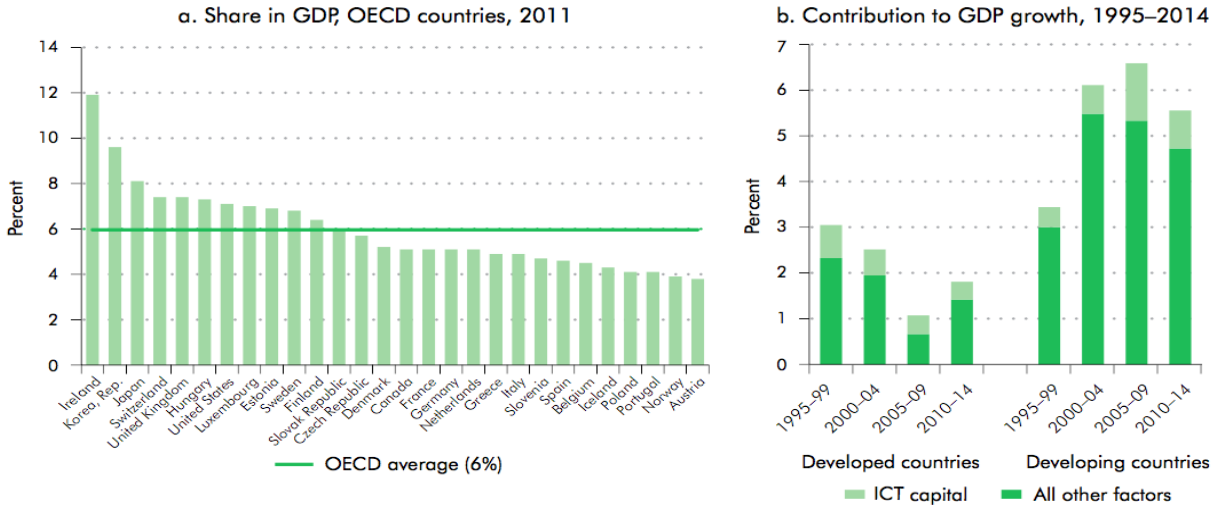


Fig. 11. The size of information and communication technologies and their share in the GDP of developed and developing countries

Source: World Development Report 2016. Digital Dividends. P. 13

On the other hand, it can be seen that the faster growth of the economy does not affect the proportional performance of digital technologies but the low growth rates typical for the developed countries are largely composed of ICT. So, for the period from 2005 to 2009, the economic growth of developed countries was about 1%, and for developing countries - about 6.5%. At the same time, the digital economy accounted for approximately 40% and 25%, respectively. Over the next four years, the situation has not changed dramatically: about 30% of digital technologies in aggregate growth of 1.9% for developed countries and about 15% for growth of 5.6% for developing countries. This, again, can be explained by the fact that the more developed the country is the higher incomes and greater access to the technologies the population has.

3. Russian economy digitalization: perspectives and obstacles.

The question about Russian economy digitalization is especially actual now as well as its perspectives and obstacles. First of all, it should be noted that in July 2017 the Government of the Russian

Federation approved the state program "Digital Economy of the Russian Federation", which determines the main directions of the country's development in the digital age. Among them:

- infrastructure creation;
- information security ensuring;
- development of the legislative regulations;
- research and digital developments stimulation;
- training and educational programs.

Main dimensions	Sub-dimensions	Indicators	Tier-1		Tier-2	
			2015	2014	2015	2014
1. Connectivity	1.1. Fixed Broadband	1.1.1. Fixed BB Coverage	•	•		
		1.1.2. Fixed BB Subscriptions	•	•	•	•
	1.2. Mobile Broadband	1.2.1. Mobile BB Subscriptions	•	•	•	•
		1.2.2. 3G Coverage	•	•	•	
	1.3. Speed	1.3.1. Average Connection Speed	•	•	•	•
		1.3.2. Fast BB Subscriptions	•	•	•	•
	1.4. Affordability	1.4.1. Fixed BB Subscription charge	•	•	•	•
2. Human Capital	2.1. Basic Skills and Usage	2.1.1. Daily Internet Users	•	•	•	•
		2.1.2. Regular Internet Users	•	•	•	•
	2.2. Advanced skills and development	2.2.1. ICT specialists	•	•		
		2.2.2. STEM graduates	•	•	•	•
3. Use of Internet	3.1. Content	3.1.1. Reading News Online	•	•		
		3.1.2. Music, Videos and Games	•	•	•	•
		3.1.3. Video on Demand	•		•	
	3.2. Communication	3.2.1. Social Networks	•	•	•	•
	3.3. Transactions	3.3.1. Online Banking	•	•	•	•
		3.3.2. Purchase online products	•	•	•	•
4. Integration of Digital Technology	4.1. Business digitization	4.1.1. Electronic Information Sharing	•			
		4.1.2. RFID	•			
		4.1.3. Social Media	•			
		4.1.4. Online Presence	•	•	•	
		4.1.5. Cloud Services	•			
	4.2. eCommerce	4.2.1. SMEs Selling Online	•	•	•	•
		4.2.2. eCommerce Turnover	•	•		
5. Digital Public Services	5.1. eGovernment	5.1.1. eGovernment Users	•	•	•	•
		5.1.2. Transactional services	•	•	•	•
		5.1.3. Connected Services	•	•	•	•
		5.1.4. Open Data	•	•	•	•

Fig. 12. The structure of I-DESI indicators and their application for the countries of the first and second groups.

Source: International Digital Economy and Society Index (I-DESI). Final report 2016. P. 16

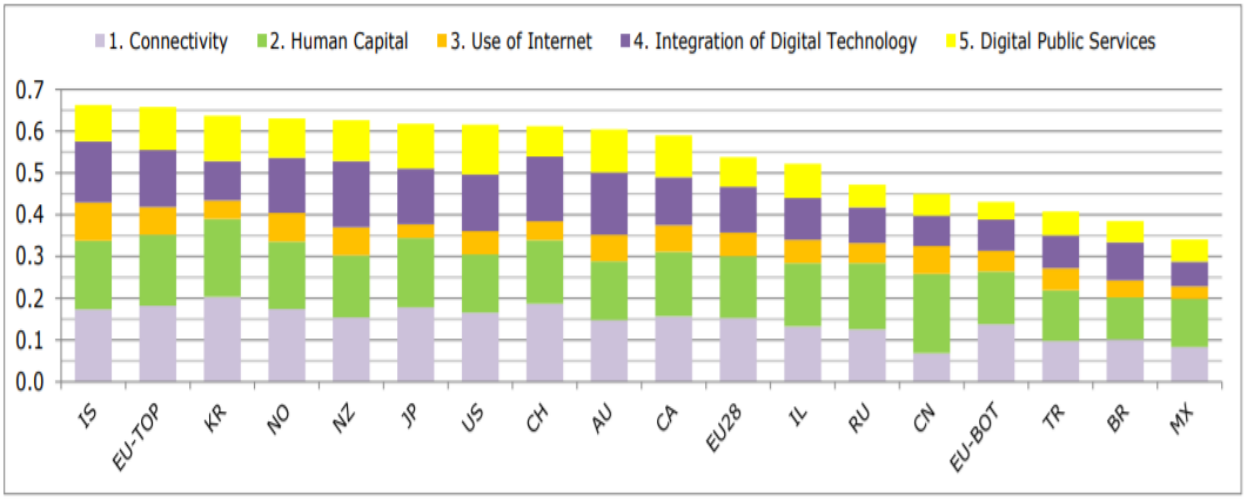
On the one hand, the official documents adoption at the federal level is certainly a significant step forward, but on the other – a similar program was adopted in Saudi Arabia in 2005, while in various countries state institutions were established: in Australia, the Agency for digital transformation in 2015, in Denmark - the Agency for Digitalization in 2011, and in Singapore - the Agency for the Development of Information and Communication Technologies already in 1999.

The soonest response to world trends in the field of digital technologies, should have a respective outcome, expressed in their ubiquity. Among the approaches to this question there is the International Digital Economy and Society Index (I-DESI), developed by the European Commission, which assesses the digitalization of EU members and compares some of the indicators with 15 other countries, including Russia. This rating includes five components:

- communication;
- human capital;
- use of the Internet;
- introduction of digital technologies;
- public digital services.

The full list of indicators for each of the components and their application are shown in the Fig. 12. Countries are divided into two groups according to the principle of data collection accessibility. In the first group, the figures were calculated for all 28 EU members, as well as Australia, Canada, Iceland, Japan, South Korea, Norway, Switzerland and the United States. The second group included all countries from the first group, plus Brazil, China, Israel, Mexico, New Zealand, Russia and Turkey.

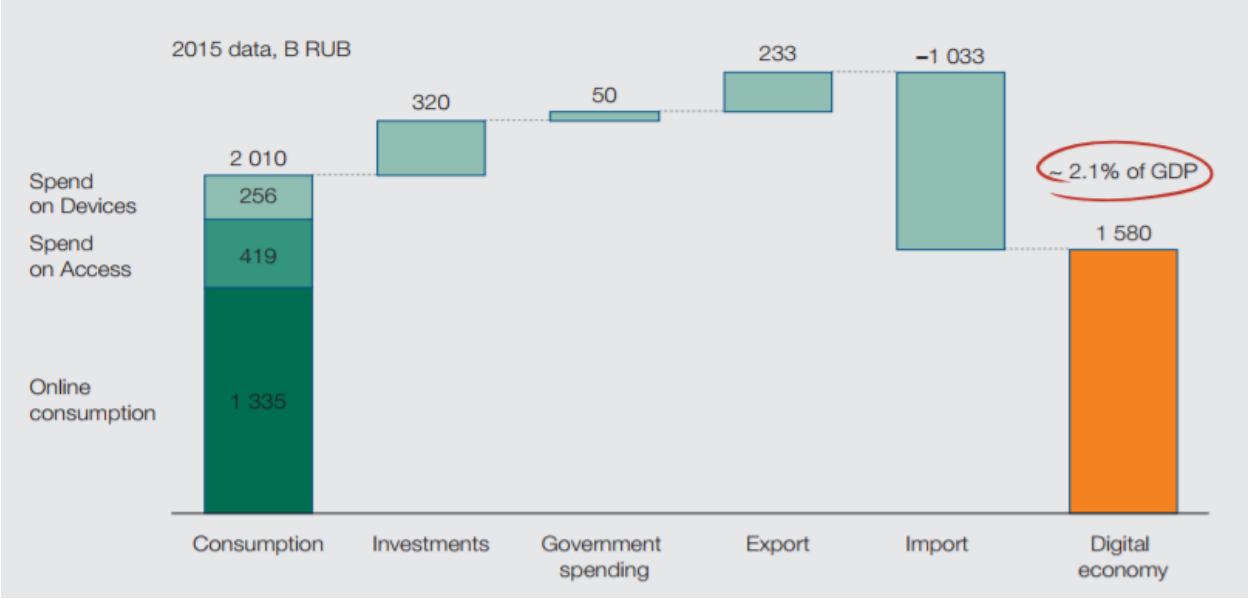
The shares of each of the five components are weighted as follows: communication - 25%, human capital - 25%, use of the Internet - 15%, introduction of digital technologies - 20%, public digital services - 15%. The results of the calculation are shown in Fig.13.



Puc. 13. I-DESI for the second group countries (2015).
Source: International Digital Economy and Society Index (I-DESI). Final report 2016. P. 48

According to the results, in 2015 Russia was inferior to almost all the countries of the first group and Israel, but ahead of China, Turkey, Brazil and Mexico. Taking into account all the Russian features it is difficult to say whether these results are satisfactory or not; further researches are necessary.

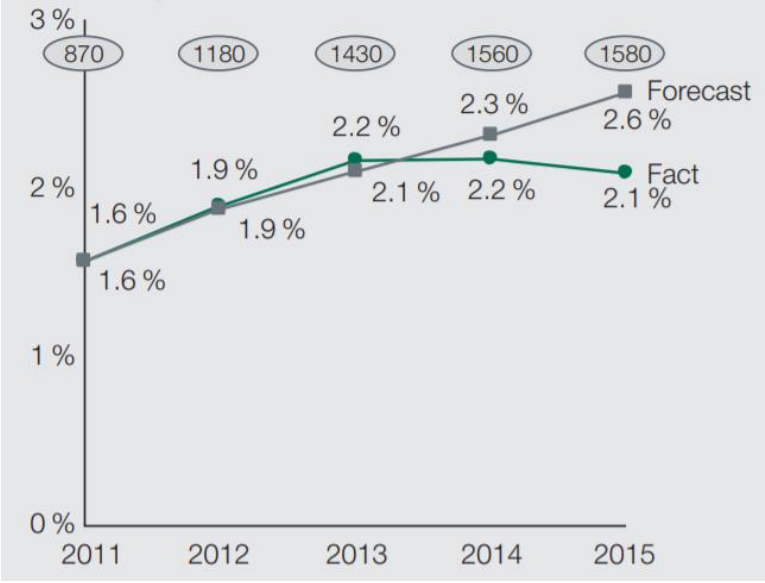
After getting acquainted with the ranking of the overall countries digitalization, it seems consistent to estimate the technologies share in the countries' GDP. However, at this stage there is an uncertainty with the methodology of such calculations. The Boston Consulting Group analysts suggest such an approach where the share of the digital economy is the sum of consumption, investment, government spending and net exports in the following categories: expenditures for online consumption, acquisition of access devices and Internet access expenses; the results are shown in Fig. 14.



Puc. 14. The volume of online consumption, expenses on devices and access to the Internet in Russia in 2015

Source: The Boston Consulting Group, Russia Online? 2016 P. 15

Figure 14 shows that the largest share of GDP is consist of online consumption, exceeding the amount spent on devices and Internet access by almost 50%. Nevertheless, it should be noted that, taking into account all components, the total amount of 1.6 trillion rubles. is only approximately 2.1% of GDP; the dynamics of the relationship is shown in Fig.15.



Puc. 15. Dynamics of the digital economy share in Russian GDP.

Source: The Boston Consulting Group, Russia Online? 2016 P. 14

At this stage, it becomes clear that in recent years, the technological part of the Russian GDP has been fluctuating at the level of two percent, which is definitely not the economy's driver. Also, it is obvious that an immediate breakthrough in the short term perspective to the developed countries level is unlikely. It raises the question about fundamental steps which should be taken now to take a better place

on the international arena in the future. In this regard, BCG analysts identify four categories of instruments designed to influence the development of digitalization in Russia:

1. Digital privatization;
2. A digital leap;
3. Self-digitization;
4. Digital reinvestment.

The essence of digital privatization is the transfer of ineffective areas of government responsibilities (such as housing and utilities) to the private sector, which should lead to greater focus on the result and, as a consequence, greater efficiency. The idea of a "digital leap" consists of active promotion in the state development of advanced technologies, including big data, artificial intelligence and others. At the same time, state self-digitalization should be aimed at maximizing the government services via the Internet for both citizens and businesses, which should also increase the effectiveness of these processes. According to the plan, all of the above should free up significant resources through savings, including transaction costs reduction, and increase the amount of incoming funds that the government will need to reinvest in health and education which will bring a long-term positive effect.

Analyzing the need to take certain actions aimed at the development of the digital economy, it can be noted that today, a significant number of initiatives have been proposed by government, private sector, and non-profit organizations. Usually, the proposed measures intersect or duplicate one another: it is known that investments normally stimulate development or that a more educated person is more likely to contribute to the development of technologies in the country. At this stage, of course, it is necessary to mobilize and move towards digitalization, but it is also worth noting that it will not come sooner than it is possible.

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