AN INNOVATIVE COMPONENT OF WIDESPREAD DIGITALIZATION: SCOPES AND PERSPECTIVES

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Abstract: The digitalization process as a process of introducing digital technologies into all spheres of society's life includes both a traditional component associated with scaling the use of well-known digital technologies and an innovative component associated with the creation of new digital technologies and conditions for their implementation. The article examines those aspects of the digitalization process that are associated with the development and implementation of digital technologies. The size of the innovative component in the process of digitalization and its structure has been determined. The dynamic indicators of the use of the innovative component in the digitalization process are investigated and a forecast of trends in the change in the innovative component of the digitalization process in the future is made. The relationship between the volume and structure of innovation of economically significant processes under the influence of digitalization is revealed and a system of recommendations is proposed to improve the efficiency of the innovation process when using digital technologies in Russia in the medium term.

Keywords: Communications, Digitalization, Economic process, Globalization, Innovation, National economy, Regional economy, Trends.

1 Introduction

The beginning of the development of digital technologies in the global economy dates back to the early 1980s when the world community realized the economic and production potential of electronic computing machines and began to actively invest in the development of technologies for its production and operation. Initially the concept of digitalization was voiced as the concept of computerization that is the concept of maximum replacement of other tools for providing the economic and production process with a computer while permanently increasing its productivity.

From 1980 to 2021 digitalization as a ubiquitous process went through several stages the change of which was due to the technological reorientation of business and the modification of consumer demand. Among the most important such changes are:

- 1990s which saw a shift in the interest of a global innovator from technologies of the production of electronic computing machines itself to technologies for its network use and the formation of the Internet. The economic result of this shift is the “dot-com boom” in the USA and the beginning of the movement of global business and social relations into the web;
- Period 2000 – 2010 characterized by the expansion of the digital component of global business and social sphere; the innovative component of the digitalization process during this period is shifting to the sphere of applied use of ready-made solutions and its modernization, corporations are formed – leaders of the modern digital economy such as Google, Amazon. The importance of combined innovative solutions is growing including both an innovation-technological and an innovation-management component. An economy built on combined innovative solutions of a new type is called “web 2.0”;
- Digitalization of the period 2010 – 2020 characterized by the replacement of traditional forms of economic and social interaction with digital ones. The innovation process during this period ensures the formation of fundamentally new forms of dominant interaction of subjects in the digital environment such as social networks, e-commerce, electronic payments, remote work, e-government, digital security systems. A feature of the innovation process during this period is the predominance of its organizational component over the economic one. Thus new spheres of economic and social interaction are based on previously known technologies however the organizational component of its use is significantly modified due to the need for its larger and more complex use for each business solution.

In the period 2021 – 2030 the innovative component in ubiquitous digitalization will undergo significant changes. The trends of these changes were formed under the influence of a number of factors primarily the Covid-19 pandemic the emergence of technological alternatives to currently existing business solutions and the strengthening of the competitive confrontation between countries for dominance in the digital solutions market amid its saturation.

2 Materials and Methods

When conducting the study the authors focused on domestic and foreign experience in using advanced technologies as part of the process of widespread digitalization. A review of the experience of using innovative technological solutions by domestic and foreign businesses and the economic results of such use within a specific economic context allowed the authors to draw conclusions about the most promising directions for the development of the innovation process in the context of widespread digitalization. In the article considerable attention is paid to the issues of the current and future state of the prevalence of innovative digital technologies which at present can be considered critical or will become such by 2030.

The conclusions and suggestions made by the authors based on the results of the preparation of the article are supported by a comparative analysis of statistical data characterizing the innovative process in the field of digitalization. These data were collected from the websites of state authorities in Russia and foreign countries that oversee digitalization processes, reports of the largest institutional participants in the global digital process.

In preparing the article the works of leading scientists dealing with the economic issues of the technological development of the digital space in Russia in the pre- and post-coronavirus period were used.

3 Results

The digitalization process in the modern world after 2010 has become the mainstream of the transformation of all types of business taking the form of widespread digitalization [3, 4, 7]. The following should be noted as catalysts for the transformation of digitalization into a global trend:

1. Completion of the formation of the infrastructure of the digital economy which made it possible to switch to a digital format of interaction for each category of business regardless of its industry and regional affiliation. For the financial sector an element of such an infrastructure has become a network of terminals and reading devices as well as systems of cameras and other devices for monitoring the conscientiousness of customers; for trade – technical capabilities for collecting and transferring large amounts of data on goods offered in the digital segment and the availability of sufficient hardware and software for customers interaction with electronic stores online; for the production sector – the technological capabilities of transmitting and processing large amounts of data using satellite communications and a server system.

The most indicative are data on the volume of access of the population to broadband Internet since it is this parameter that determines the customer base and market capacity for a potential participant in the digital economy. The corresponding data are presented in Figure 1 [17, p. 32].

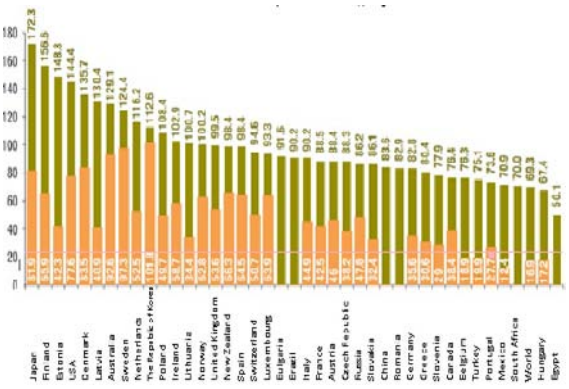

Figure 1 – The number of broadband (mobile) subscribers in 2011 (bottom indicator) and 2018 (top indicator) per 100 people

The results presented in Figure 1 show that in a little less than 10 years the volume of users of high-speed mobile Internet in the countries of the world has almost doubled and in developing countries – three times or more thereby creating a capacious market for users of an innovative digital product.

In developed countries there is an excess of mobile high-speed Internet users per 100 people in 2018 is equal to 100% which is explained by the presence of a significant number of subscribers with more than one device of mobile access to high-speed Internet.

Along with it the asymmetry of the penetration of high-speed mobile Internet in different regions of the world combined with the differences in the socio-economic models of these countries led to the asymmetry of the structure of demand for digital products. Let's pay attention to the fact that the sales efficiency of a digital product is largely determined by the scale of its sale due to the high initial investment costs for its creation and promotion and minimal subsequent costs. It led to the fact that until 2020 a single global market for an innovative digital product was not formed due to the excessively high costs of creating fundamentally new digital solutions and insufficient market capacity for its payback.

The digital product market until 2020 can be conditionally divided into three categories:

- A pioneering (unparalleled) digital product used by the most technologically equipped participants in the economic process most often created on demand;
- A modified digital product adapted to the economic and technological capabilities of the region of its sales; this category also includes a counterfeit digital product that duplicates the official one and is in demand due to significant differences in the economic and social models of its country of origin and the country - the target market;
- An import-substituting digital product created with state funds to prevent the technological backwardness of its own economy or the emergence of problems of its economic security; note that such a product is often a truncated analogue of the product of the first of the three categories under consideration.

2. Another catalyst for the transformation of digitalization into a mainstream trend in the technological and economic development of mankind is the growth of the economic potential of suppliers of a digital product. Table 1 presents data for 2001 – 2016 relatively TOP-5 global companies in terms of their capitalization [10].

It is apparent that throughout the first decade of the XXI century companies that are leaders in the industrial economy (fuel and energy complex, finance, manufacturing) are being replaced by companies engaged in digital products. Since the second decade of the XXI century there has also been a tendency to oust a number of traditional companies primarily financial from its own markets. Thus the PayPal system originally created by Elon Musk as a digital product for making fast payments in small volumes by 2020 has seriously competed with traditional bank products either displacing it from the payment market or interacting with it on the basis of economic and technological conversion.

Using the PayPal payment system as an example one more trend can be noted that has become a catalyst for widespread digitalization.

Table 1: Sectorial structure of TOP-5 global companies in terms of capitalization

Ranking position	Company	Capitalization, billion US dollars	IT industry affiliation
2001			
1	_	406	Oil
2	Microsoft	365	IT
3	Exon	272	Oil
4	Citi	261	Finance
5	Walmart	260	Trade
2006			
1	Exon	446	Oil
2	_	383	Oil
3	Total	327	Oil
4	Microsoft	293	IT
5	City	273	Finance
2011			
1	Exon	406	Oil
2	Apple	376	IT
3	PetroChina	237	Oil
4	Shell	228	Oil
5	ICBC	222	Mixed
2016			
1	Apple	582	IT
2	Alphabet	556	IT
3	Microsoft	452	IT
4	Amazon	364	IT, trade
5	Facebook	359	IT, communication

This trend is the consolidation of digital business and universalization. The acquisition of PayPal by eBay allowed the first to significantly diversify its digital product, increase its availability for the target buyer and the economic security of transactions and also created the conditions for the formation of a complex innovative product.

It should be noted that building up the financial potential of digital giants coincided with the trend of increasing the level of provision of digital infrastructure in developing countries. This increase was made possible by technological development which reduced the cost of the primary infrastructure product and increased competition among its suppliers. In addition in 2010 - 2020 in developing countries due to the decentralization of the global economy there is a trend towards an increase in technological sovereignty which in the modern world is impossible without a developed digital infrastructure.

Returning to the data presented in Figure 1 it can be argued that in developed countries the problem of oversaturation of the market for traditional digital products has managed to acquire maximum relevance. The lack of fundamentally new solutions led to duplication of goods by the buyer with the maximum demand for a digital product and developing countries have entered the final stage of import substitution of a foreign digital product.

Of particular note are the large growing economies of the modern world such as China which managed to reduce dependence on basic imported digital products of the collective west in 2010 – 2020 and compete in digital innovation markets especially in the 5G communications markets.

The indicated state of the digital technology market contributed to the formation in the preceding global pandemic of a trend for the technological improvement of a digital product in parallel with its scaling of its sales.

The dynamics of growth indicators for the manufacturer's investment in a digital product is shown in Figure 2. Let`s analyze the presented dynamics in terms of assessing the prospects for the development of the innovation process for the digital solutions market [2, p. 20].

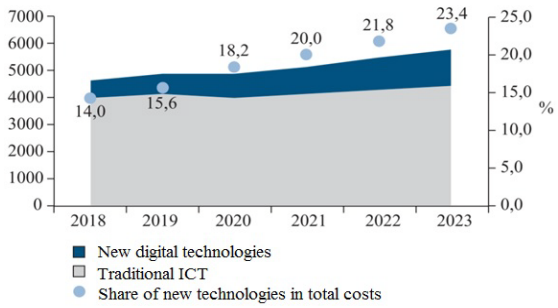

Figure 2 – Assessment of the dynamics and structure of investments of international ICT companies in a digital product in the global market, billion dollars in 2018 - 2020 and forecast until 2023

The trends characteristic of the dynamics and structure of investments of global ICT companies in the development of a digital product are likely to continue in the post-coronavirus period. At the same time they will be more pronounced due to the increased attention of a significant part of global business to the digital component of the economic process [5].

The study of the structure of investments of global companies in digital innovation makes it possible to make a fairly clear forecast as to which areas of innovative development of digital technologies will become the most in demand in 2021 – 2030.

The structure of investments in digital innovation is determined by the expected digital product market by 2030. This structure based on the UNCTAD assessment of the structure of the digital economy is shown in Figure 3.

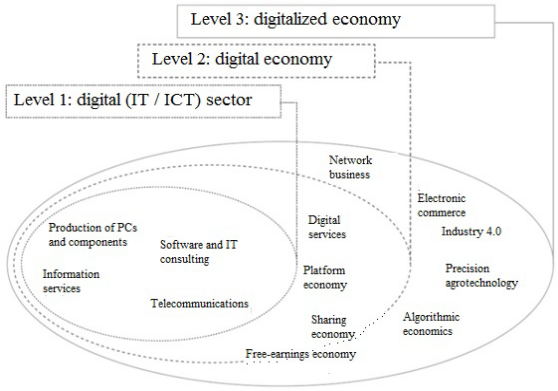

Figure 3 – The structure of the digital solutions market proposed by UNCTAD for 2021 – 2030 [6]

The most significant changes in the short term are expected for digital Layer 3 solutions of the structure shown in Figure 3. It is due to the short-term economic impact of the Covid-19 pandemic which includes the following aspects.

A significant increase (more than 1.7 times) occurred in consumers of an existing digital product for the end of 2019 – the beginning of 2021 which will lead to an intensification of the struggle between suppliers of this product and an increase in their need for innovative solutions [11]. First of all in this respect the field of electronic commerce should be noted. Moreover this change affected the most conservative part of the digital product markets where its promotion was restrained by non-economic factors. Let's refer to the data in Figure 4 [1].

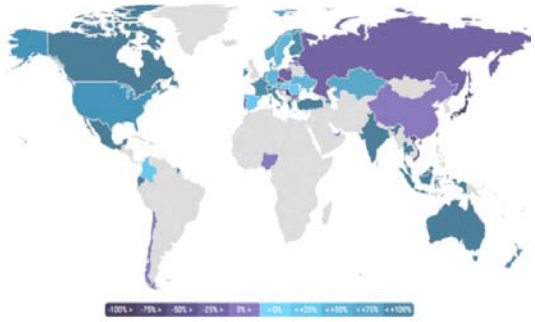

Figure 4 – Assessment of changes in demand for e-commerce services and related digital products during the Covid-19 pandemic in the countries of the world in 2020 as a percentage of the average annual indicators of 2019

The growth in consumption of a digital product of the third level in the amount of more than 75% is accounted for mainly by developed countries in which the income of the average consumer and infrastructure opportunities provided similar growth before. In other words the Covid-19 pandemic caused first of all a psychological shift in these countries reformatting the consciousness of consumers of a digital product.

Since there is a significant reserve for scaling for the use of basic technological solutions both in business and in the social sphere technological innovations in the market of digital products of the third level will be focused on more efficient scaling of the use of basic solutions. Let`s note the most popular technological innovations at the third level of the digital economy and offer brief forecasts of their implementation.

Interaction between the supplier of a digital product and its customers will be provided by technological platforms or ecosystems. In the market for these solutions significant competition is expected between leading multinational suppliers and national manufacturers [6, 8]. The issue of ensuring information security of clients will become a fundamental issue. Given the deteriorating international economic and political situation, the growing global contradictions between the United States, China, the EU and Russia the issue of information security will be directly linked to the issue of organizing the storage of data received by the supplier. If large transnational suppliers of a digital product use traditional servers localized in Western countries it makes sense to expect an intensification of efforts by national states to create alternative technological platforms. In part this tendency is manifested in Russia in the format of initiatives of state authorities in the field of transferring certain sections of the public administration system and strategically important national industries to the use of domestic software. An example of an extreme form of abstraction of the national digital market from the solutions offered by foreign suppliers at the level of the organization level 3 of the digital economy is the “great Chinese firewall”.

The issue of information and economic security of the use of digital solutions from third-party suppliers is especially acute in the financial sector [18]. An innovative technological alternative to segmentation of the global market according to the criterion of using exclusively national digital platforms or digital platforms originating from currently “loyal” states for the purpose of concluding transactions is the development of blockchain technologies. These technologies exclude the possibility of cost-effective manipulation of the information flow by all its participants including the root initiator of the data flow process.

An example of the successful use of blockchain technologies for the formation of open digital platforms autonomous from each

specific participant is the cryptocurrency exchange platforms. From the point of view of the client of this digital product its strong point is the impossibility of any participant including the state.
At the same time the implementation of well-known blockchain solutions for use in the work of global digital platforms has a number of limitations including:

- Does not allow the organizer of the auction to correct the information in the event of a force majeure situation (errors in entering information, the need to reorganize the obligations of the parties to the transaction by agreement of the parties etc.) [9];
- Does not always correspond to the national security priorities of the participating country [12];
- Do not have sufficient bandwidth to provide uninterrupted service to industry ecosystems on a national scale [15].

Consider other innovative technologies of the web 4.0 group which can be considered as a system priority for 2021 – 2030.

A sought-after innovative solution for the global digital sphere 2021 – 2030 are technologies of "smart" ecosystems that allow automated control of the functioning of large hardware systems. "Smart" technologies from existing technologies for automated control of hardware systems in that they cover the whole spectrum of the management process and allow at least 80% automation including such stages as:

- Analysis and planning of the structure of the system, its reorganization;
- Creation and automatic distribution of reserve capacities;
- Formation of alternative management strategies based on big data analysis.

For Russia supporting the innovation process in the context of the trends of widespread digitalization for 2021 – 2030 proposed in the following areas:

- Increasing economic security by modifying and diversifying the suppliers of the digital component of technological platforms for systemically important organizations and institutions [14];
- The use of a priority development strategy when creating a Russian import-substituting digital product [6];
- Maximum decentralization of technological interaction with the support of both "western" and "eastern" vectors of cooperation [16].

2010 – 2020 the Russian economy has provided conditions for the effective implementation of innovative digital technology platforms as evidenced by the following achievements:

- Outstripping growth in the use by Russians of a digital financial product including bank cards;
- Formation of an effective digital infrastructure for interaction between the state and citizens and business first of all the "Gosuslugi" system and a network of related portals;
- A high level of provision of citizens with ICT products.

Under these conditions the Russian market is attractive for innovative digital solutions of the 4.0 group. The creation of products of this group principally on the basis of Russian software and if available hardware solutions is a condition for improving the quality of human capital in Russia and the country's readiness for a period of post Covid-19 economic turbulence.

At the same time the decline in real incomes of citizens is seen as an obstacle to the spread of digital innovations. Based on this it can be assumed that the success of the timely implementation of digital innovations of the web 4.0 group on an appropriate scale will depend on the effectiveness of the implementation of government programs the most comprehensive of which is the national program "Digital Economy of the Russian Federation".

An important direction in the development of the innovative component of national digital technologies is the elimination of regional and sectorial imbalances in the implementation of innovative technologies. Figure 5 shows the percentage of the provision of individual sectors of the Russian economy with innovative digital solutions [2, p. 31].

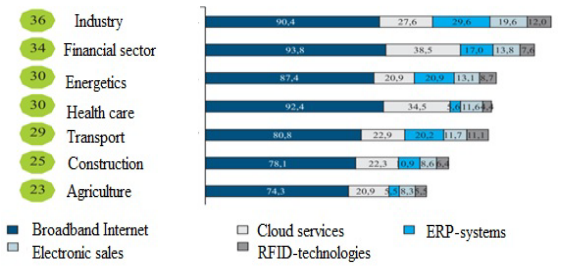

Figure 5 – Percentage ratio of the provision of the Russian economy with innovative digital solutions

An important condition for ensuring the development of the domestic economy to the trends of widespread digitalization 2021 – 2030 is the prevention of the replacement of existing expensive innovative digital solutions with their less effective in the long term, cheap outdated counterparts as well as the degradation of digital competencies of human capital.

4 Conclusion

Thus in 2021 – 2030 we should expect an increase in the share of investments of global and national businesses in the innovative component of the digitalization process which can increase up to 25% of their gross value. An increase in the number of competing technological solutions offered and used by different poles of the global economy on the one hand, and a decrease in their compatibility on the other, is expected.

The process of widespread digitalization in terms of the innovation process in 2021 – 2030 will represent the formation of digital ecosystems based on such solutions that are not widely used at present such as: blockchain technologies; "Smart" automated control technologies, cloud databases.

Developing innovative solutions for the digital market in 2021 – 2030 significant attention compared to the previous decade will be given to issues of information and economic security as well as protection from unfair behavior of the supplier of a digital product.

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