Digital Supply Chain Trends in the World Economy

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***Abstract*— In connection with the ongoing changes in the world economy, associated with the acceleration of scientific and technological progress, changing as a result of the introduction of new technologies, the structure of production, the expansion of the use of digital technologies - there are positive structural changes in many industries. Views and approaches to solving various tasks and problems of innovative development are also changing. The paper presents the results of analyzing the trend of the digitalization process. It is concluded that public policy is the main factor and tool for the development of the digital supply chain of economy, and a forecast is made for the number of participants using various types of communication. The development of an innovative economy and the introduction of digital technologies clearly lead to the transformation and revision of the foundations of the global economy, as the modern economy is the economy of database management. In this paper, as far as statistical information is available, the main trends in the development of digital technologies in supply chain process are considered. The paper focuses on the availability of the Internet for households, the quality and speed of communication, the reasons that affect it, and the presence of cause-and-effect relationships. Analytical data on the share of the digital supply chain in GDP, government support for digital technologies, and investment in this area of the economy are provided for some developed and developing countries. The most frequently used digital technologies in supply chain that have prospects for both developed and developing countries are highlighted. The study provides data on the possibility of using digital technologies in the banking sector in order to reduce cash transactions.**

***Keywords*—** *Digital economy, Supply chain management, Internet of Things, digital technologies*

1. Introduction

Digital supply chain is a smart, value-driven, efficient process to generate new forms of revenue and business value for organizations and leverage new approaches with novel technological and analytical methods. Digital supply chain is not about whether goods and services are digital or physical; it is about how supply chain processes are managed with a wide variety of innovative technologies, e.g. unmanned aerial vehicles, cloud computing, and Internet of Things, among others. Currently, digital transformation processes in various sectors of the economy are increasingly developing, based on “transversal” digital technologies. Such changes have a significant impact not only on production processes, but also on relationships with consumers, and change business models. At the same time, there are currently no statistics that reflect the ongoing processes in the world economy that are balanced in the areas of research. Separate, local estimates are formed only within the framework of research by consulting companies and, as a rule, are fragmented: big data will add about 15 trillion dollars to the global economy by 2030; quantum computing technologies will generate 1.9 billion dollars by 2023, and by 2027 - 8 billion dollars; 0.8-1.4% - annual growth of global GDP due to automation, taking into account that human resources, replaced by robots, remain among the employed in various sectors of the economy; the global GDP will grow by 15.7 trillion dollars due to artificial intelligence by 2030; the global market for engineering software will exceed 46 billion dollars by 2022; 28.5% - the combined average annual growth rate of the global Internet of things market until 2020; the added value created by businesses using the distributed registry system (block chain) will reach 176 billion dollars; the combined average annual growth rate of the global telecommunications market, including through the development of wireless communication technologies, in 2017-2021 will be 13.7%; 1384 billion dollars - the size of the market for virtual and augmented reality (VR/AR) technologies in 2030, of which 557 billion is commerce, 827 billion is hardware, content and services [1-5].

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2. Materials and methods.

The IoT holds real potential for optimizing supply chain operations, especially in companies' need to collect data from across millions of devices and measure performance in real time. IoT devices provide real-time visibility of operations throughout the manufacturing process, from production through distribution. Manufacturers can embed IoT sensors in most items moving through their supply chain, gaining unprecedented visibility and traceability of parts for assembly, finished goods, and more. The paper uses system, comparative, economic and mathematical, and other research methods. Published works of research institutions of the Russian Academy of Sciences, statistical materials at the Federal level were used as the materials.

3. Results and discussion

Digitalization in supply chains has come to encompass digital products and services as well as the handling of supply chain processes within companies undergoing these rapid changes. At the present stage, there is another concept – "Digital supply chain", the essence of which is the way of organizing people's activities, aimed at creating goods (products and services) that they need for consumption, and directly related to the development and implementation of digital technologies in supply chain that allow processing a large amount of information and developing services (providing online services, electronic payments, etc.) [6-9].

Over the past decade, the leading industrial countries of the world have also made some efforts to develop "common digital agendas", i.e., to find joint effective solutions and mechanisms for regulating digitalization processes at the interstate level. At the same time, the obvious leader in this direction is the European Union, whose leaders have identified the formation of a single digital market in Europe (digital single market) as a general long-term goal. For the first time, the need to develop such a common strategy was officially announced by the President of the European Commission, Jean-Claude Juncker, in October 2015.

The process of implementing "digital technologies of supply chain" in the Russian economy is at the stage of analyzing the expansion of potential opportunities. Imperfection of the technical base, software, computer literacy of the population, lack of proper legal regulation, legislative framework are constraints for the widespread introduction of computer technologies and integration of new "digital technologies" into the business environment [10].

However, it is worth noting that the role of the state is significant in the development of the digital supply chain. In order to implement the Strategy for the development of the information society in the Russian Federation for 2017-2030, approved by the Decree of the President of the Russian Federation on May 9, 2017 No. 203 "On the Strategy of information society development in Russian Federation to 2017 – 2030", this Program is aimed at creating conditions for the development of the knowledge society in the Russian Federation, improving the welfare and quality of life of our citizens by improving the availability and quality of goods and services produced in the digital supply chain with the use of modern digital technology, increasing awareness and digital literacy, improve access to and quality of public services for citizens as well as security within the country and abroad [11-13].

According to FSSS, 73% of the world's population uses the Internet. Of which, 83% in Europe, 70% in Asia, 54% in Africa, 73% in the Americas, 87% in Australia and Oceania (table 1). The analysis uses data from 42 developing and 23 developed countries. From the data provided, it is clear that the gap in the share of developed and developing countries is decreasing every year. If in 2010 the gap between developed and developing countries was 46%, in 2017 it was only 18%. The increase in the share of the population using the Internet in the developing world is growing at a small rate of 1-11%, while in the developed countries the annual growth is 3-18%. It is obvious that this trend will continue in the developed world for the next 3-5 years.

Table 1- Proportion of the population using the Internet in the world

	Years							
	2010	2011	2012	2013	2014	2015	2016	2017
Russia	…	…	…	64	67	70	73	76
Europe	66	69	71	74	76	77	79	83
Asia	31	34	37	41	45	48	52	70
Africa	15	16	19	22	24	28	30	54
America	48	53	56	58	60	66	69	73

Australia and Oceania	78	80	81	83	85	87	88	87
World	48	50	53	56	58	61	64	73
Developing countries	31	34	37	42	45	49	52	70
Developed countries	77	78	80	82	83	84	86	88

Experts estimate that in developed countries the slow and steady growth of digital technologies in SCM has increased the share of the population using the Internet, from 51.3% in 2005 to 80.9% in 2018. In developing countries, growth was much more robust, from 7.7% in 2005 to 45.3% at the end of 2018. Of all the regions, the largest growth was recorded in Africa, where the proportion of people using the Internet increased from 2.1% in 2005 to 24.4% in 2018. It is estimated that the regions with the lowest growth rates were Europe - 79.6%, and in the Americas -69.6% of the population using the Internet. In the Commonwealth of Independent States (CIS) region, 71.3% use the Internet; 54.7% in the Arab States and 47% in the Asia-Pacific region.

At the same time, experts estimate that 51.2% of the world's population, or 3.9 billion people, used the Internet at the end of 2018, which is an important step towards creating a more inclusive global information society. However, too many people around the world are still waiting to take advantage of the digital SCM. Therefore, it is necessary to create a good environment for attracting investment, as well as support technology and business innovation, so that the digital revolution does not leave anyone out of the network.

Mobile access to basic telecommunications services is becoming increasingly prevalent. If in 2010 20% of the world's subscribers had mobile access, in 2016 it was 73%, and in Australia and Oceania 116% of subscribers per 100 people (table 2). The number of fixed-line Internet subscribers is growing only slightly – by only 7% from 2010 to 2016 worldwide, while broadband Internet is growing from 20% in 2010 to 73% in 2016. In the developed world, there are 97 mobile access subscribers per 100 people, while in developing countries this figure is 56.

Table 2 – Number of broadband Internet subscribers(per 100 people)

	Subscribers of fixed broadband access to the Internet		Subscribers of mobile broadband access to the Internet[2)]	
	2010	2016	2010	2016
Russia	12	19	48	72
Europe	24	30	32	82
Asia	8	13	19	59
Africa	1	2	5	33
America	14	19	17	77
Australia and Oceania	25	32	47,	116
World	12	19	20	73
Developed countries	29	35	48	97
Developing countries	7	12	10	56

Broadband access continues to show steady growth. The number of fixed broadband subscribers is constantly growing. It is worth noting that almost the entire world population (96%) currently lives within the reach of a mobile cellular network. In addition, 90% of the world's population has access to the Internet via 3G or higher speeds.

In 2018 almost half of all households in the world had at least one computer. In developed countries, 83.2% of households had a computer in 2018, compared to 36.3% in developing countries. The highest growth rates were observed in the Arab States and the CIS region. In

Africa, the percentage of households with access to a computer increased from 3.6% in 2005 to 9.2% in 2018.

Internet access at home is gaining momentum. About 60% of households have Internet access at home in 2018, compared to less than 20% in 2005 [14, 15]. In developing countries, almost half of all households have Internet access at home, a significant increase from 8.4% in 2005. Thus, we observe a general trend of increasing the availability of various types of communication.

Thus, it can be predicted that by 2021, the number of mobile subscribers will increase to 139.1 billion people, or 30% compared to 2018; individuals using the Internet – to 57.4, or 12%; the number of people using the broadleaf Internet - 78.9 [16].

It is known that digital SCM flows are currently responsible for the growth of GDP in the world more than for trade in traditional goods. And this is clearly seen in the example of countries such as the United States, China, Great Britain, Germany, Italy, France, and Sweden, whose share of the digital SCM in GDP is from 8.2 to 10.9% (table 3). In these countries, about half of the expenditures related to the digital sector of the economy are household expenditures in the digital sphere. This means that much of the growth of the digital SCM in the above-mentioned countries is driven by household demand for services provided by organizations, including through the Internet. The rest, about 60%, of the digital sector of the economy is accounted for by services and production. Investment in the digital sector of the economy in the above-mentioned countries of the world is from 1.8 to 5.0% of GDP. Accordingly, the more investment in the digital sector of the economy, the greater the share of this sector in GDP. This can be seen in both developed and developing countries. Similar trends are observed with regard to government spending on digitalization in SCM. The highest spending in the developed world: the United States and some EU countries. In the developing world, government spending on digitalization of SCM is 2 times less. However, this does not prevent them from being leaders in the export of digital technologies. Leaders in the export of digital technologies are: China, Poland, Czech Republic, and India. It is obvious that this leadership is due to the export of not only technologies, but also goods produced using digital technologies in countries such as China and India. The main reason is the cheapness of goods and technologies, due to the cheapness of labor and resources used in these countries. The situation is different in Russia and Brazil, where digital technology imports exceed their exports by three to ten times. These two countries are the drivers of development of digital technologies in SCM. Thanks to cheap labor and resources, these countries are well positioned to increase the digital SCM share of GDP. Obviously, they can go the same way as China. To do this, in addition to creating favorable economic conditions, it is necessary to increase investment and government spending in the digital SCM sector by at least 2 times. One of the problems of implementing digital technologies in these countries is the low purchasing power of the population. It is the purchasing power of the population at the first stage of the introduction of digital technologies that motivates the creation of platforms for the sale of goods and services. The example is China, where a large part of the population orders food and goods over the Internet, without bothering to prepare food at home or spending time going to supermarkets to select and purchase certain products. It is obvious that in the near future, the level of digitalization of the non-manufacturing sector of the developed world's economies will increase. At the same time, if there are motives, digital technologies should be introduced into the production sector. In developing countries, the main problem will be the lack of investment and government support for the digital SCM sector. In addition, it will be necessary to solve the problem of staffing the digital sector of the economy.

As for the export and import of digital technologies, as well as high-tech goods produced using digital technologies, it is obvious that the following factors will prevail: state support for research and development costs, export support, sanctions policy, the cost of labor and resources, the demand for and competitiveness of the technologies presented.

Table 3 - Contribution of the digital SCM of some countries to GDP and its components (in % of GDP) [17]

Indicator	USA	China	Great Britain, Germany, Italy, France, Sweden	Poland, the Czech Republic	Brazil	India	Russia
Share of the digital SCM in GDP	10,9	10,0	8,2	6,3	6,2	5,5	3,9
Household spending in the digital sphere	5,3	4,8	3,7	3,2	2,7	2,2	2,6
Companies' investment in digitalization	5,0	1,8	3,9	2,7	3,6	2,0	2,2
Government spending on digitalization	1,3	0,4	1,0	0,6	0,8	0,5	0,5
ICT export	1,4	5,8	2,5	5,9	0,1	2,9	0,5
ICT import	2,1	2,7	2,9	6,1	1,0	2,1	1,8

The most commonly used digital technology in SCM used by businesses is creating their own website. Of the top ten countries in the world where businesses use the website, eight are developed countries and only two are developing countries. The top ten countries are the EU countries. From 83 to 96% of organizations have their own website, which they use to promote their own products and services. It is obvious that the main reason for the active use of such a tool as a website is the globalization of business - the need to promote their products and services not only in the country where the business is located. It is obvious that in the future the share of organizations using this tool of the digital SCM will increase, displacing retail and various intermediaries, making the products sold more accessible to consumers.

The second most important digital technology used by business companies is cloud technology. In terms of popularity, cloud technologies are ahead of services related to the purchase and sale of goods. The most frequently used cloud service currently is email. From 25 to 50% of organizations use email, this is 75-80% of the structure of all cloud services. From 6 to 17% of organizations use cloud services to host and run their own software.

In the IT sector, the main positive effect is expected from the introduction of cloud computing, AI technologies, as well as new technologies for working with BigData and business analytics. Thanks to only cloud computing, average business costs for IT services will be reduced by 25 to 50%. In the longer term, great expectations are put on quantum computing [19].

Table 4 – Organizations with a website for some countries of the world, 2017 [18]

Country	Percentage of business sector organizations with a website	including those that publish a list of products and services on their website
Finland	96	80
Denmark	95	68
Sweden	91	42
Germany	87	74
Netherlands	86	75
Austria	86	61
Great Britain	84	60
Belgium	83	69
Czech Republic	83	54
Slovenia	83	81

Table 5 – Organizations using cloud technologies in some countries of the world, 2017 [20]

Country	Cloud services - total	including email	hosting and running their own software
Finland	66	50	10
Denmark	51	36	17
Sweden	48	32	12
Norway	48	35	15
Japan	47	…	…
Belgium	40	16	8
Ireland	36	25	8
Netherlands	35	20	7
Great Britain	35	22	8
Croatia	31	25	6

The third most important digital technology used by businesses is services for purchasing and selling goods. It should be noted that organizations that use the service to sell goods are about 1.5 times less than organizations that use the services to purchase goods. It is obvious that when purchasing goods, there are clear motives for increasing profits, while when selling via the Internet, such motives are still not enough. This can be partly explained by existing economic ties, distrust of new forms of product promotion, and other factors. It is obvious that in the near future, the share of organizations that use services for selling goods via the Internet will grow slightly. Here, most likely, it will be possible to talk about wholesale sales, both in the national market and in foreign markets. The development of e-commerce not only expands consumer choice, helps reduce business costs, but also encourages innovation in product distribution.

Table 6 – Organizations using the Internet to purchase and sell products via the Internet, 2017 [21]

Country	Selling online	Purchasing online
Ireland	30	42
Denmark	29	…
Norway	29	39
Sweden	29	28
Belgium	24	23
Germany	24	34
Czech Republic	24	57
Japan	24	…
Lithuania	22	26
Finland	21	39

Digital technologies should take an important place in the banking sector. Currently, in a number of developed countries, the share of cash payments exceeds 60% , in accordance to [23]. These are European countries: Spain 87%, Italy 86%, Germany 80%, France 68%. Among Asian countries, on the contrary, the share of non-cash payments is quite low: China 40%, South Korea 14%. The exception here is Japan, where the share of cash payments is 82%. However, Japan has adopted the “Cashless vision” program, according to which the share of non-cash payments should grow to 40% by 2025.

Table 7 - Share of cash payments in total payments in some countries of the world (2018)

Country	Share of cash payments in the total amount of payments
Spain	87
Italy	86
Japan	82
Germany	80
France	68
Great Britain	42
China	40
USA	37
Sweden	20
South Korea	14

Despite the fact that in a number of developed countries, a significant part of payments are made in cash, in the near future, the financial sphere of a number of countries will undergo significant changes. Cash payments are gradually disappearing in most countries of the world. Asia is the fastest growing non-cash payment market in the world. If in 2017 the volume of non-cash transactions in Asia was $96 billion, by 2022 it will grow to $352 billion. You can make money on this technological shift. For more information, see the paper below. Digital payments have grown steadily in the US and North America over the past decade, but the largest growth in non-cash payments is in Asia. The non-cash payment market is estimated to grow from $96.2 billion in 2017 to $352.8 billion in 2022 for developing Asia.

Table 8 – Number of non-cash transactions in the world: dynamics forecast, billion dollars

	Years					
	2016	2017	2018	2020	2021	2022
North America	152,9	160,6	168,2	184,5	192,8	201,8
Europe	124,4	133,8	144,2	170,4	185,9	203,6
Asia	72,6	96,2	123,7	208,7	269,5	352,8
Middle and East Africa	31,3	49,3	61,9	90,8	111,2	139,3
South America	39,8	43,1	45,5	51,1	54,3	57,7

The developed countries of the world have a highly developed digital SCM, powerful dynamics and development opportunities. They encourage innovation by using effectively their advantageous

position, allocate significant government funding, and encourage the export of digital technologies. However, it is very difficult to maintain high growth rates over time, and innovation is often an unreliable foundation for expanding economic influence. Obviously, in order not to lose their positions, these countries must create new demand, and the development of innovative solutions must be at full speed, which requires significant investment and government support. Otherwise, they risk losing their positions as "digital powers".

To a large extent, it is government policy, including state support, and the creation of conditions for the active functioning of the digital SCM that determines its success. For effective development of the digital economy, it is necessary to ensure by legislation: public-private cooperation in the field of digital innovations; more active use of automation, information flows and new technologies in the economy; investment in professional retraining and training of students in schools in skills and thinking for a successful existence in the digital world; improving access to investment and digital infrastructure and reducing inequality; sound legal rules that keep pace with changing competition rules and demonstrate a dynamic approach to consumer protection without slowing down innovation.

4. Conclusions

The global digital SCM is in a position where opportunities and risks are in balance. However, there are still many barriers to digitalization. Obviously, this is largely due to the dynamics of growth of the digital economy in different countries, as well as the systemic nature of the forces that govern digital development. There is no doubt that developed countries benefit from a combination of a high level of digitalization and government participation in forming their digital SCM. Moreover, all countries of the world are striving to develop the digital SCM, as it contributes to an increase in GDP (according to a study by the consulting company McKinsey, digitalization of the economy can increase Russia's GDP by 4.1-8.9 trillion rubles). It is also considered that the digital SCM is the future not only of particular countries' economies, but also of the world economy as a whole.

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