DIGITAL DEVELOPMENT DYNAMICS IN RUSSIA IN 2015 – 2018

Sergey Petrov[1], Mikhail Maslov[2] and Alexey Karpovich[3]
[1) 2) 3)] *Novosibirsk State Technical University, Faculty of Business, Russia*
E-mail: petrov.s.p@mail.ru; E-mail: feraj@mail.ru; E-mail:
karpovich383@gmail.com

Abstract
The digitalization process augments and widens our reality, giving people, organizations and countries new capabilities and better ways of different goods production and meeting their needs. The article considers current situation of digitalization in Russia basing on many indicators of digital economy development. These indicators are divided into six groups: digital skills of people, availability of digital goods for people, quality of working life and social sphere in conditions of digitalization, state electronic services and security of people informational activities. For these groups the analysis of digitalization process in all Russian regions was made for the years 2015 – 2018 and most notable specific features of indicators dynamics in different regions and for the whole country were described, as well as the first results of implementation of the state digitalization program adopted in Russia. Finally, the method of analysis of investments effectiveness into digital assets and digitalization was suggested, this method is assumed to be used in the future research when more data on the results of digitalization program implementation in Russia are available.

Keywords
digital transformation, digitalization program, regions of Russia, effectiveness of investments in digitalization

JEL Classification
J01, O18, R10

Dynamics of digitalization indicators in Russia on 2015-2018
The process of digitalization creates new types of economic activity as well as changes or cancels many existing ones, allowing to produce and consume many new types of products and services and in overall creates the whole new economic sectors, jobs, ways of life and work. In this section we present the results of analysis of ongoing digitalization process in Russia and its current state. For the purposes of analysis different statistical data sets were used such as (Indikatory tsifrovoj ekonomiki, 2019; Informatsionnoe obshhestvo, 2019; Regiony Rossii, 2019), from which 49 indicators were selected and after excluding 12

indicators by the results of correlation analysis 37 remained ones were united into the following 6 groups: digital skills of people, availability of digital goods for people, quality of working life and social sphere in conditions of digitalization, state electronic services and security of people informational activities, so that the analysis was done for each group of indicators separately.

Digital skills of people. In the whole, the skills level of digital devices use in Russia increased in 2018 comparing to 2015. The shares of total population aged from 15 to 72 changed for the following indicators:

- working with text editors – increased from 53.4 to 57%;
- file transfer between computers and peripheral devices increased from 37.9 to 43.2%;
- using software for editing photo-, video- and audiofiles slightly increased from 29.3 to 29.4%.

Along with that some decrease was observed for working with electronic table from 29.9 to 28.9%. Also, it should be mentioned that in 2018 the level of working with text editors indicators decreased comparing to 2017 by 2.5 percent units. Other indicators either slightly increased or remained the same. As a result, we could say that basic skills of working with digital devices grew though by the end of considered period the negative dynamics for one of indicators appeared. However special skills showed steady increasing dynamics and all users possessing them have also basic skills of computer using.

At the same time the increase of factors significance preventing from using the Internet was observed. They are measured as a percent rate of total population aged from 15 to 72 who do not use the Internet or used it more than a year ago. So far, the unnecessity indicator value increased from 69.7% in 2015 to 69.8% while lack of skills for Internet use increased from 21.8 to 30.5%. Such a dynamics shows the growth of digital inequality in the Russian society.

Availability of digital goods for people. Level of personal computers use by Russian households slightly decreased in the considered period from 72.5% in 2015 to 72.4% in 2018. This can be explained by saturation of such devices consumption by the people and switching to other ones such as smartphones and tablet computers. Along with that the highest increase rates occurred in the Republic of Ingushetia (15.1% percent units), while the largest decrease rates were on the Republic of Mari El (16.1%).

Dissemination of digital devices in households stipulated advancement of broadband Internet access. In the whole Russia this indicator reached 73.2% in 2018 comparing to 66.8% in 2015. Such a growth could be explained by increased availability of broadband access, widening of ways of its application due to multiplying of types of used devices. The highest growth rates are again in the Republic of Ingushetia (by 52.7 percent units), the increase is also considerable in the Magadan region (44.8%). The biggest contraction occurred in the Yaroslavl region (-5.4%), the Arkhangelsk region (-6.5%), the Republic of Kalmykia (-5.0%), the Chechen Republic (-30.8%). We could outline two main reasons of people abstaining from using the Internet. Whereas the indicator of technical ability absence to connect to the Internet slightly decreased from 7.7% to 7.2% in 2018, the people refusal from the Internet due to high costs of getting Internet access point as a percent rate of total population aged from 15 to 72 who did not use the Internet or used it more than a year ago increased from 12.3% to 14.6%. The latter could be connected with ruble devaluation happened in 2014-2015 which led to the increase of costs for firms providing Internet access and rising their prices. The highest growth rates of refusal from Internet due to high costs were observed in the Chukotka Autonomous Region (27.6%), and in the Ulyanovsk region this indicator decreased by 18 percent units. Therefore, the indicators shown above lead to conclusion that full availability of digital technologies is still not achieved in Russia. Not all households have personal computers and the Internet access. The main reason of access absence is in high costs for getting Internet access.

Quality of working life in conditions of digitalization. High rates of personal computers use were observed in the organizations in Russia, excluding small entrepreneurship companies, so this indicator grew by 1.7 percent units in 2018 comparing to 2015 and reached 94%. In the Republic of Ingushetia it reached 100%, in the city of Moscow it was at 100% in 2017 but decreased by 0.1% in 2018. The lowest value was in the Republic of Dagestan (67.6%).

Despite high levels of personal computers use their numbers per 100 workers have not very high values and they do not show notable changes. So far there were 49 computers per 100 workers in 2015 and 51 ones in 2018. This could be explained by the absence of necessity to use them for all types of jobs and absence of necessity to digitalize all types of economic activities. Despite the large spreading out of computer techniques in organizations the local information network was used only by 63,9% of them in 2018 slightly increasing by 0.4% comparing to 2015. The use of electronic document flow systems increased from 62.7 to 68.6%. A good dynamics is shown by the expenses on information and communication technologies development in organizations. While in 2015 the average levels of such costs in Russia were 8.08 mln rubles per 1000 people, then in 2018 they reached 11.42 mln rubles. However high level of inequality is observed. These costs are significantly higher in the city of Moscow. In 2018 they reached 72.33 mln rubles per 1000 people which is almost 2 times higher than in 2015. In other regions they are much lower, for instance the second region by this indicator is the Nenets autonomous okrug, which has the value of 23.96 mln rubles per 1000 people, though it is still higher than Russian average value. The lowest expenses are in the Republic of Dagestan with the value of 0.44 mln rubles per 1000 people.

Digitalization of social sphere and services. During the period of 2015-2018 the growth rates of educational institutions share having broadband Internet access were not very high. The reason is that fast growth of this indicator of education digitalization was going in Russia in the earlier years, so in the considered period the country has already came to the point of saturation. The same relates to the share of educational institutions having a web-site – currently this indicator is close to 100%. However, the growth of computer numbers in educational institutions continues, at the present time for different regions it is about 20-25 computers per 100 students, or in other words, 1 computer per 4-5 students, which is still not quite enough for educational activities. We could expect that this indicator would get saturated at the level of 35-40 computers per 100 students.

The process of digitalization of other spheres of social services is 1-2 steps back from educational sphere. For instance in medical organizations saturation in numbers of computers and level of Internet access is still not achieved, the growth of this indicator from 2015 to 2018 reached 21% on the average in Russia and in 2018 it reached 35 computers per 100 workers of medical organizations versus 33 in 2017, i.e. 1 computer per 3 workers. This value is higher than the analogous indicator in educational institutions (per 100 students), however saturation level (target value) for this indicator is also higher for medical organizations, as it should be at least 1 computer per 2 workers (50 computer per 100 workers) of medical organizations, so its potential of growth is steal at least 50%. The same situation is with Internet access – this indicator shows fast growth (33% on the average in Russia during the considered period), but in 2018 there were only 24 computers with Internet access per 100 workers of medical organizations, i.e. 1 computer per 4-5 workers which looks very insufficient. In other words, the level of digitalization of medical organizations is lower than educational ones, which is also backed by the share of medical organizations having web-site that is quite far from 100% (in contrast to educational institutions) and was at 80% in 2018. During 2015-2018 it grew by 10%.

Culture organizations and museums lag behind analogously. Fast growth of indicators of their digitalization (number of culture organization having web-site; share of museum items included in electronic catalogue; volume of electronic catalogues in libraries etc.) by dozens and hundreds percent during the considered period is itself a positive development but it is

another confirmation of this retardation though with perspective of its liquidation in the future. At the same time low level of digitalization for these indicators provides low comparative basis in relation to which high growth rates are computed.

Finally, the fast growth in the considered period is shown by the share of people using the Internet for purchasing goods (35% on average in Russia in 2018, while in 2015 it was only 14%). As households in Russia are ahead of many social organizations in their level of digitalization and are approximately at the same level as educational institutions we could say that they are also entered the second stage of digitalization – after vast majority of people (households) obtained computers with Internet access they are now more and more capable to use the new advantages provided by this access.

State electronic services. During the years 2015-2018 there was considerable growth of population share aged from 15 to 72 interacting with state and municipal authority bodies for getting electronic state services. While in 2015 it was 29.9% then in 2018 it reached 72.9%, i.e. it grew 2.5 times during 4 years. Among people getting services from state authorities bodies the share of those using the Internet for such purposes had also increased by 2.5 times, namely from 35.2% in 2015 to 74.8% in 2018. So far fast growth of the Internet using for getting state electronic services could be explained by active implementation of measures aimed at digitalization in wide variety state services – in taxation, documents processing etc., in particular through the special Internet portal "Gosuslugi". The level of success of this program is reflected in particular in how people estimate quality of state and municipal services supplied through the Internet. The share of people using the Internet for getting state services and fully satisfied with their quality grew from 57.5% in 2015 to 73.2% in 2018.

Speaking of most prominent regions in that respect we could say that highest share of people used electronic state services were in the Yamalo-Nenetsk autonomous okrug, Kurgan region, the Republic of Bashkortostan, the Republic of Altai, while the lowest share was in the Republic of Adygeya, Oryol region and Twer' region.

As a result, we could note that among different directions of digitalization of Russian economy and social sphere the electronic state services supply has become one of the most successful. However despite already reached good results it is too early to speak about saturation and target level achievement, as the growth continues with quite high rates (in 2018 the share of people using electronic state services grew by appr. 11%). We could expect that saturation will occur when this indicator value is more than 90%.

Security of people informational activities. During the period of 2015-2018 the gradual growth of people's share not facing informational security problems in Russia was observed (from 66 to 72%), and this growth happened in the majority of federal districts, only in the North Caucasian and Volga federal districts a slight decrease occurred. At the same time, the share of people using the tools of information protection remains at appr. the same level during the years 2015-2018 (about 83 – 86%). The combination of these two trends allows to conclude that as a result of people's growing skills on using computers and the Internet the people's realization of information security principles improves, namely which actions are better not to make in order not to face data leaks and other problems, not relying only on computer tools of information protection (on antivirus programs, for example).

First results of implementation of the national program "Digital economy in the Russian Federation"

In 2018 the national program "Digital economy in the Russian Federation" aimed at providing accelerated implementation of digital technologies into economy and social sphere was adopted in Russia. The planned period of program activity is from 1 October 2018 to 31 December 2023. Execution of the national programs suggests implementation of such projects as "Normative regulation of digital environment", "Staff for digital economy", "Information

security", "Digital technologies" and "Digital government control" (Passport of the national program, 2018).

Each separate project has its own planned parameters detailing the general ones (Directions of implementation of the national program, 2019). Basing on published statistics for 2018 we could consider some program parameters on which current factual statistical data are available. For preliminary analysis of the national program ongoing implementation let's consider several parameters included for some of its directions (table no. 1).

Table no. 1 Some planned parameters for different directions of implementation of the national program "Digital economy in the Russian Federation".

№	Parameters	Period, years						
		2018	2019	2020	2021	2022	2023	2024
	"Staff for digital economy" project							
1	Share of people having digital literacy skills and key competences of digital economy, %	26	27	30	32	36	38	40
	"Information infrastructure"							
2	Share of households with available broadband Internet access, %	75	79	84	89	92	95	97
3	Share of medical organizations of state and municipal health care systems (hospitals and clinics) having Internet access, %	95	100	100	100	100	100	0
4	Share of state (municipal) educational organizations implementing educational programs of general education and/or secondary professional education having Internet access, %	39.5	56.6	79.8	100	100	100	100
5	Share of government authority bodies, local authority bodies and state extrabudgetary funds having Internet access, %	18.8	18.8	18.8	18.8	59.4	79.7	100
	"Digital government control" project							
6	Share of citizens and commercial organizations interaction with state (municipal) bodies and budgetary organizations carried out in a digital mode, %	20	25	30	40	50	60	70
7	Share of prioritized state services corresponding to the target model of digital transformation (supply without necessity of personal attendance of state bodies and other organizations with the use of registry model online (automatically, proactively), %	3	6	15	40	60	50	100

Source: Composed by the authors basing on (Directions of implementation of the national program, 2019)

Basing on the parameter of digital literacy and possessing digital economy skills we could observe some positive trends in Russia. It follows from, as shown above, factual values of such indicators as working with text editors, file transfer between computers and peripheral devices and using software for editing photo-, video- and audiofiles in 2018 surpass the planned one by 26%. Of course, the parameter of digital economy skills is wider and includes many other aspects besides factual indicators listed above, however these indicators could witness about positive development in this direction. For instance, 57% of Russian population can work with text editors. The lowest value has factual indicator of working with electronic tables which is only 28.9% of population, though it still surpasses planned value of general parameter for 2018.

The factual availability of broadband Internet access in 2018 was slightly lower than planned one, namely 73.8% versus 75%. The reason could be in the growing significance of reasons abstain from using the Internet by the people, which was described in the previous section.

While the planned parameter of "Share of medical organizations of state and municipal health care systems (hospitals and clinics) having Internet access" is equal to 95%, factual share of medical organizations having web-site was 79.61% in 2018. Unfortunately, there are no available data on the factual indicator of medical organizations share having Internet access. Planned share of state (municipal) educational organizations implementing educational programs of general education and/or secondary professional education having Internet access was only modest 39.47% for 2018, while factual share of educational organizations of higher professional education having Internet access was 75.26%. Such a discrepancy could be explained by increased financial resources of higher professional education institutions, first of all due to paid forms of education.

Some questions arise concerning planned parameters of citizens and commercial organizations interaction with state (municipal) bodies and budgetary organizations carried out in a digital mode (parameters No. 5, 6 and 7 on the table 2), which have low values. Factual values of indicators of state electronic services supply are notably higher, as was shown in the previous section. For instance, the share of people using the Internet for getting state and municipal services was 74.8% in 2018, while planned parameters were not higher than 20%.

Method of analysis of investments effectiveness into digital assets and digitalization

The authors suggest the following method for analysis of effectiveness of investments into digital assets and the whole process of digitalization, as they intend to use it in future research when more data are available on the results of state digitalization program implementation in Russia. Within the available data base effectiveness of investments (financial resources) could be analyzed, for instance, in a region-wise or branch-wise way granting corresponding production functions built.

Production functions (in a broad sense) are interrelations between production factors used (materials, labor, finance, natural resources) and production output (a certain final outcome) (Badmaeva, 2019; Dolan, 2013)

$$F(x, y, a) = 0,$$

where y is an output vector, x – resources vector, a – parameters vector.

Such a description of relation between resources utilization and production results suggests that effects connected to longevity of production cycle are not taken into account. This in turn could be considered acceptable assuming that temporal unit for which a production function is built considerably surpasses production cycle duration. Instead of general representation of a production function given above one often uses its partial case called output function:

$$y = \varphi(x, a).$$

The idea of production function is closely connected to the condition of production capacities set which is defined as a set of all possible combinations of production costs and outputs:

$$\{x, y\} \in G(a),$$

where $G(a)$ is a set in the space of resources and outputs depending on a. A transition from a set of production capacities to a production function (function of output) requires construction of a subset of all effective (Pareto-optimal) points of the set $G(a)$ or its Pareto frontier. The production function itself is a depiction of Pareto frontier for the set $G(a)$

Let's consider a scalar power-law production function which is most often used in economic and mathematical studies:

$$p = \pi(\mathrm{x}) = \pi(x_1, x_2, ..., x_n) = a\prod_{j=1}^{n} x_j^{\alpha_j} = ax_1^{\alpha_1} x_2^{\alpha_2} ... x_n^{\alpha_n}, \tag{1}$$

where *a* is a positive parameter.

Marginal effectiveness of a jth recourse looks like:

$$\frac{\partial p}{\partial x_j} = \frac{\alpha_j}{x_j} \pi(x), \quad x_j > 0, j = 1, 2, ..., n \tag{2}$$

Average effectiveness of a resource is

$$\frac{p}{x_j} = \frac{\pi(x)}{x_j} = ax_1^{\alpha_1} x_2^{\alpha_2} ... x_j^{\alpha_j - 1} ... x_n^{\alpha_n} \tag{3}$$

Elasticity function could be used for analysis of resources (investments) effectiveness in case of suggested underfunding of a certain economic subject. For a power-law production function the elasticity function would look like

$$\Theta = f(\Delta) = 1 - \prod_{j=1}^{n}(1 - \Delta_j)^{\alpha_j} = 1 - (1 - \Delta_1)^{\alpha_1}(1 - \Delta_2)^{\alpha_2} ... (1 - \Delta_n)^{\alpha_n} \tag{4}$$

where $\quad \Theta = \dfrac{p^0 - p}{p^0}; \qquad \Delta_j = \dfrac{x_j^0 - x_j}{x_j^0}, \quad j = 1, 2, ..., n \tag{5}$

Basing on (5) we have: $\quad \dfrac{p}{x_j} = \dfrac{p^0(1 - \Theta)}{x_j^0(1 - \Delta_j)};\quad$ when $\Theta < \Delta_j$, i.e. when a subject has an

adaptive (compensating) ability towards undersupply of a jth resource then effectiveness of a given resource utilization increases comparative to a normative (planned, program) one; when $\Theta > \Delta_j$ then effectiveness decreases; when these parameters are equal the effectiveness remains constant.

Conclusions
In a whole, skill level of digital devices utilization in Russia increased comparing to 2015, but some indicators remained unchanged in 2018 comparing to 2017, while the indicator of using text editors skills decreased. This could a signal of decreasing rates of people digital literacy growth.
Speaking of availability of digital products for people we could say that the necessary level of capital is nearly reached. Along with that growth of broadband Internet access availability occurred but 100% level is still not reached. The main reason – refusal from Internet use due to high costs of getting access to the Internet.
High level of personal computers use is observed for organizations in Russia excluding small business organizations. However this level divided per 100 workers is not so high and does not show significant changes during the years 2015-2018. A good dynamics is demonstrated expenditure on information and communication technologies in organizations. While in 2015 such expenditures were 8.08 mln rubles per 1000 people on average in Russia, then in 2018 they reached 11.42 mln rubles.
In the accepted government program "Digital economy in the Russian Federation" ambitious targets aimed at high level of digitalization achievement by 2024 in general, while by some separate indicators even earlier are set. Considering planned and available actual indicators values for 2018 we could say that in general trends of the program implementation are positive, though for some indicators planned levels remain unachieved. However, the problems with analysis could arise because of complexity of getting actual statistics on many indicators included in the program.

Analysis of main indicators of digitalization of social sphere institutions (education, medicine, culture) allows to conclude that they are on different stages of digitalization. For instance, in educational institutions the necessary level of saturation with computers, Internet access etc. has been mainly achieved, therefore they can use the newly gained capabilities in the digital sphere for educational purposes. This relates all before to online (distant) education which is a principally new method of educational activity. It should also be noted that readiness for online education revealed itself in the current pandemic situation when nearly all educational institutions in Russia managed to switch to fully online regime of education without significant problems.

Russian households are also on the second stage of digitalization, i.e. they use new digital capabilities, which is reflected, for example, in such indicator as purchasing goods through the Internet and distant consumption of services.

At the same time medical and culture institutions are still on the first stage of digitalization, i.e. saturation for digitalization indicators necessary for full-fledged use of digital capabilities is still not achieved in these spheres. It should be noted that in contrast to education, the medicine is not suggested to transit massively to the online form, but digital capabilities could be used in many other directions in the medical sphere.

Speaking of electronic state services we can see that during the considered period of time it has essentially transited from the first stage of digitalization to the second, i.e. from increasing digital capabilities to their intensive utilization and this sphere is so far takes intermediate position in the level of digitalization between education and medicine. In other words, active growth of digitalization indicators in the sphere of electronic state services allowed to come very close to the levels of saturation if not to achieve them.

Acknowledgment

References/Bibliography

Badmaeva, V.G., 2019. Grounds for changing the strategy of the international company based on the analysis of the production and elasticity functions. In V.G. Badmaeva, G.P. Litvintseva, A.I. Karpovich (eds.). *14 International Forum on Strategic Technology (IFOST 2019): Proceedings.* Tomsk, 14–17 Oct. 2019. Tomsk: TPU Publ. House, 2019. pp.717–720.

Bocken, N.M.P., Short, S.W., Rana, P. and Evans, S., 2014. A literature and practice review to develop sustainable business model archetypes. *J. Clean. Prod.*, 65, pp.42–56.

Directions of implementation of the national program, 2019. *Digital economy in the Russian Federation*, 4 June 2019, [online] Available at: <https://digital.gov.ru/ru/activity/directions/858/> [Accessed at 11 February 2020].

Dougherty, C., 2001. *Introduction to Econometrics.* Moscow: Finance and statistics publishing house.

Karpovich A.I. and Litvintseva, G.P., 2018. Essence and estimation of economic system sustainability. In A.I. Karpovich and G.P. Litvintseva (eds.) *IECS 2018: Innovative Business Development— a Global Perspective: The 25 International Economic Conference.* Sibiu, Romania. Springer Proceedings in Business and Economics, pp.99-110.