

Digitalization of Innovative Process: Evolution and Problems

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Abstract — The main objective of work became studying the impact of digitalization on innovative process through identification of evolutionary changes and definition of the main problems. The research of two interconnected concepts characteristic of digital economy is conducted – digitization and digitalization. As a result it was revealed that in the foreign literature concerning these processes differentiation of essence of these concepts, though not full whereas at works of the Russian scientists and experts there is some "theoretical confusion". On the basis of the analysis the similarity and distinction of the concepts "digitization" and "digitalization" are defined and also their concrete interpretation is given. The evolution of innovative process happens on the basis of alternation of generations (models), each of which was characteristic of the time. The authors offered to consider digitalization process as macro-level process which leads to essential and in certain cases to cardinal, to changes in all spheres of activity society. Thus, the assumption is made that the innovative process based on broad use of digital technologies will belong already to the sixth generation. Digital technologies will lead to the transformation of each of stages of this process that will create a number of the positive moments. In this case decrease or disappearance of a part of the risks connected with innovations that will create more favorable conditions for activation of innovative activity at various levels of economy is possible. In turn, this circumstance will positively affect all development of the Russian Federation. However, it is necessary to consider a certain circle of the problems created by digitalization of innovative process that elimination will demand development of certain management decisions and mechanisms for their negative impact. It is noted that transition to digital economy will demand formation of a certain methodological device which could be used as to the new directions arising in the digital sphere, and to transformation of traditional activities, including connected with innovations.

Keywords — *innovation, innovative process, digitalization, digitization, innovative activity, generation of innovative process, stages of innovative process.*

I. INTRODUCTION

Modern society is more and more full in the life and development relies on digital technologies. The scale of their application is enormous – from use in daily affairs before application for automation of the whole productions. The

trends which are developed in the world unambiguously indicate that digital transformation will affect practically all countries and branches of economy that predetermines some of the priority directions of development of the Russian Federation in the near future.

The structural crisis of the Russian economy which is most fully burst in the second decade of the 21st century predetermined necessary changes in the domestic industries. These changes, certainly, have to be based on widespread introduction of innovations. However the developed strategy of development for Russia till 2020, though described certain scenarios of innovative development with the corresponding indicators, in general it was not executed [1]. The basis of the current strategy was made by national projects which effective implementation has to provide by 2025 development of the country on three basic of the direction – the human capital, the comfortable environment for life and economic growth.

The Digital Economy project aimed at providing digitalization of economy through development of information infrastructure, shots in IT sphere, information security, digital technologies and digital state regulation acts as one of such projects aimed at providing economic growth.

Emergence and widespread introduction in public life of computers predetermined further development of humanity. The quantum leap of development of many industries is inseparably linked with use of the modern equipment and advanced technologies, and their application with transformation of one of the defining present resources – information. For the last hundred years cardinally changed as ways of search, information transfer and storage, and technologies of its processing – from analog to digital.

Today digital technologies are widely used more and more and, naturally, appear in attention of many scientists and experts studying various spheres of activity of society. They have the impact also on innovative process that is reflected in E.N. Bykovskaya, E.A. Gorin, Yu.N. Kafiyatullin, S.V. Kuznetsov, E.N. Smirnov, A.A. Trifilova, D.D. Tsiteladze, G.P. Harchilava's works and others.

These researches and also our work, allow analyzing and estimating the main evolutionary transformations in modern

innovative process, revealing the main positive and problem points and also giving a basis for the development of mechanisms with which use transition of the Russian Federation to an innovative way of development within digital economy will be carried out.

Research objective is to define the impact of digitalization on innovative process (further SP). In modern conditions, developing and forming mechanisms of management of innovative processes it is necessary to consider that they have to correspond to the trends which are available in Russia on introduction of mechanisms of digital economy. Digitalization of economic space will lead to removal of some barriers characteristic of innovative activity now. There will be an activation of drivers of innovative development due to use of digital technologies.

II. RESULTS

The basis of a research was made by the scientific works of foreign and domestic authors concerning problems of digitalization and digital transformation and also various parties of transformation of innovative processes during transition of economy to uses of a wide range of digital technologies. The existence of uncertainty of rather many processes happening during the forming and development of digital economy demands their further studying, the analysis, systematization and generalization, both on theoretical, and at the practical level.

The concept of digital economy is closely connected with two other concepts – digitization (digitization) and digitalization (digitalization). And though the words expressing these concepts both in English and in the Russian language are conformable, nevertheless they designate, according to us, different processes.

In foreign scientific literature of the concept "digitization" and "digitalization" are treated unequally. In Scott J. Scott Brennen and Daniel Kreis's article [2], based on definition of the Oxford dictionary of English (OED), digitization (digitization) is treated as material process of transformation of analog flows of information to digital bits, and digitalization (digitalization) – a way of reorganization of many areas of social life around infrastructure digital and media of communications.

In the works of Jeff Gray and Bernhard Rumpe [3] digitalization is represented as the integration of a set of technologies into all aspects of everyday life which can be digitized. Proceeding from this concept, it is possible to draw a conclusion that if it is impossible to digitize any data, then process of digitalization can not be carried out. Smart houses, electronic health care and smart cities act as examples of digitalization. In the sphere of trade digitalization allows answering questions, as where to buy and sell how to advertise how effectively to make and transport and also how to keep in touch with the client. In production digitalization provides design of products in a digital form, virtual creation and check of components before production of a product and also maintenance of the relations between the sold or leased product, its users and the making company. In the field of water supply and power supply and also in the field of

transport digitalization can inform on a state, physical distribution or a state of affairs and people, a condition of objects of communications and infrastructure, etc.

Another, quite interesting work devoted to the study of the two above concepts is the article by Andreas Schumacher, Wilfried Sihm, Selim Erol [4]. Having analyzed more than 40 sources the authors made the table in which carried out differentiation of these concepts. Thus, digitization, according to them, covers purely technical and technological transformation of analogs to digital signals and also their storage and transfer. Digitalization describes all effects, influences and consequences of availability of digital information.

The definition of a concept digitalization is given in on the website of the Gartner Company ¹[5]. In their glossary it is noted that digitalization is use of digital technologies for change of a business model and granting new income and opportunities for obtaining cost; it is process of transition to digital business.

Thus, we further, will define digitization as process of transformation of information from analog in a digital format, digitalization as the process based on effects of use and integration of digital information and technologies, leading to changes in many spheres of activity of society and in business. It is necessary to designate this view of these two terms as the further analysis of the Russian scientific literature showed that a clear idea of these two concepts at many scientists and experts dealing with problems of digital economy no.

In the Russian scientific literature differentiation between the concepts "digitization" and "digitalization" is not always carried out. Thus in article B. G. Halin and G.V. Chernov [7] the concept "digitization" is absent, and digitalization is considered in narrow and broad sense. And in a broad sense this concept is noted as "... the universal trend of development of economy and society which is based on transformation of information to a digital form and leads to increase in efficiency of economy and improvement of quality of life". The authors noted what term needs to be used in case the efficiency of economy does not increase, and improvement of quality of life does not happen.

In A.N. Kozyrev [7] perfectly sorted chronology of digitalization, but literal definition of digitalization isn't given, though it is noted that this process provided "... an opportunity for creation of many modern technologies which received the name "digital technologies" owing to use in them digital submission of information".

In turn E.N. Smirnov [8] notes that digitalization is "... a fundamental trend of development of world economy, changing its structure and having transferred it to a new qualitative state when digital technologies dominate in all spheres of economy and public life". Into what state the economy passes it isn't specified, however, because it will rely on digital technologies, according to us, the author meant a digital state.

¹Gartner, Inc. — the American company specializing in researches of the market of information technologies. The headquarters is located in the city of Stamford, State of Connecticut. Comment of authors.

In the article of E. N. Bykovskaya, Yu.N. Kafiyatullin and G.P. Harchilava [9] in definition of digitalization about any effect the speech doesn't go, and process is connected "... with mass implementation of digital technologies" and processes "... search, creation, processing, exchange and information transfer". The concept "digitizations" at authors is also not given, and it is noted that the concept "digitalization" of the English interpretation is presented as "... to digitization and also sometimes digitalization" though these words have different value.

The differentiation of the concepts "digitizations" and "digitalizations" is presented in M.A. Sklyar and K.V. Kudravtseva's work [10]. So authors pay attention that digitization is "... the translation of information from physical carriers on digital ...", and this process "... it allows improving only already existing business models ..." and also "... to a basis of formation of digital economy". Digitalization creates "... a new digital product and new business models ..." and also "... is the cornerstone of digital economy". For us the position of the authors is rather close, however it would be desirable to pay attention that process of digitization of information is "directly" at the heart of digitalization and through it "indirectly" in digital economy.

As digitalization has an impact on many spheres of activity of society and also on business and business models, this process will lead to change of model of SP. As the purpose of article doesn't assume to give definitions to the concepts "innovation" or "innovative process" within this research, we consciously lower them. Especially as according to [11] in the Russian theory of innovations exist the problem with the conceptual and categorical device requiring the solution with involvement of a large number of scientists and researchers. In too time, leaning on a number of scientific works of foreign and domestic authors [12–16] and also on modern educational literatures [17–20], it is possible to draw a conclusion that the approach to evolution of SP offered by Roy Rothwell [21] was enshrined in the Russian theory of innovations. Alternation of generations (G) of SP from the first 1 to 5 is its cornerstone. And the fifth generation (5G) of SP is based on broad application of the information and communication technologies (ICT) which promptly changed and change in the course of digitalization, besides, some scientists and researchers' transformation of SP in the 6th generation (6G). Thus in the work of M. MoisésMir and MartíCasadesús is noted that use of the R&D² become feature 6G in A.V. Tebekin and A.A. Tebekina's research – use of information technologies, in A.P. Savchenko's article – development of informal structures of exchange of knowledge and competences, at T.A. Blatov is open innovations, in the textbook under S.V. Maltseva's edition – technologies of the semantic analysis of information and extraction of knowledge from information sources of various nature. We will pay attention that all listed features are directly connected with process of digitalization and with digital transformation. On the basis of such transformation becomes possible to provide basic change not only stages of SP and the most life cycle of innovations, but also organizational structures [22, 23] connected with SP, up to their full decentralization and

dematerialization. Thus, the sixth generation will develop in the conditions of digital economy which feature will be using not only ICT, but also digital technologies in SP.

The use of digital technologies will have a significant impact on SP which faces in Russia a number of problems now. Is the reason shortcomings of the innovative environment and also existence of a number of barriers and obstacles for innovative activity created in Russia? In particular, it concerns a perspective of various stages of SP.

In Russia there is a developed system of support of the innovative projects which are at an early stage, however at the following stages of innovative process they often face vital issues, including due to the lack of means for investment into creation of innovative production and also weak interest of business in financing of high-risk projects.

Weak interest of a business sector in financing of researches (whether it be fundamental or applied developments), insufficiency of public financing, a gap between results of basic researches for which directions are chosen at the state level and requirements of a business sector is characteristic of SP in Russia. The gaps in a chain of innovative process result in slowing-down innovative processes or doing them at all by unrealizable result.

The use of digital technologies at various stages of life cycle of SP is an important task which solution will allow creating new more favorable environment for development of the innovative sphere in Russia. At the same time, it is necessary to take into account that to innovative process on the basis of digital technologies essential risks and potential dangers (Table 1) will be characteristic.

Similar provided in the table approaches are used in scientific literature, but they or concern separate stages of innovative process [24], or place emphasis on certain types of risks [25, 26]. There are separate researches considering innovative activity in general without features of digital economy [27].

III. CONCLUSION

In conclusion, it is necessary to note that now integration of digital technologies into innovative process at various stages is necessary. It will improve the process of forecasting of innovative activity and will reduce risks. In addition, there will be a possibility of increase in efficiency and support of adoption of management decisions in the innovative sphere.

However, it is necessary to consider that possible transition of innovative process to the sixth generation as which basis digitalization and application digital technologies acts besides the positive moments, creates a wide range of problems. For their elimination or decrease in negative effects it is necessary to carry out quickly improvement of tools of economic researches within development of digital economy. It is caused as need of formation of the methodological device necessary for the new directions within digital economy, and change available concerning traditional activities taking into account transformational changes as a result of implementation of digital technologies. Substantially it belongs to scope of innovative processes which within digital economy will rely on essentially other principles and mechanisms.

²Research, Development and Innovation. Comment of authors.

TABLE I. DIRECTIONS OF IMPACT OF DIGITAL TECHNOLOGIES ON SP

Stage of innovative process	Positive influence	Potential problems and risks
1. Basic researches		
2. Applied research and development		
3. Market researches of the potential market		
4. Production preparation.		
5. Development of new products.		
6. Organization of industrial (serial) production.		
7. Selling of new products in the market.		

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