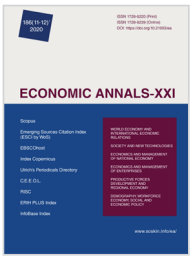

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Digitalization as a tool for innovative economic development

Abstract. Under modern economic conditions, digitalization of the economy is a strategic development priority in many countries. The introduction of technologies that promote digitalization of the economy allows the state, businesses and society to interact effectively in order to increasingly large-scale and dynamic process. Digital economy is becoming a critical driver of innovation, economic growth and competitiveness. Introduction of digital technologies opens up new opportunities for cooperation at all stages of the innovation process. The constant exchange of ideas and data sharing accelerate the innovation process fast and make it sustainable.

A model of innovative development based on digitalization tools has been proposed. The authors have identified opportunities, detected threats in view of the pandemics events of 2020, revealed constraints of economic activity under lockdown, developed support measures by taking into account the specifics of digital transformation, summarized the results and focused on improving the ICT infrastructure and integrating digital technologies into the real sector of the economy.

The conclusions and generalizations made in the course of the research, aswell as the model of innovative development and recommendations for increasing the efficiency of the implementation of measures to support innovation in the context of digital transformation can be used to develop plans and programs for the development of territories.

Keywords: Digitalization; Digital Economy; Digital Transformation; Innovation; Innovation System; Innovation Activity; Innovative Development

JEL Classification: O31; O32; O38

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Цифровізація як інструмент інноваційного розвитку економіки

Анотація. У сучасних економічних умовах у багатьох країнах цифровізація економіки є стратегічним пріоритетом розвитку. Впровадження технологій цифровізації економіки, що дозволяють державі, бізнесу й суспільству ефективно взаємодіяти, стає все більш масштабним і динамічним процесом. Цифрова економіка стає найважливішим драйвером інновацій, економічного зростання й забезпечення конкурентоспроможності.

Упровадження цифрових технологій дозволяє відкрити нові можливості для співпраці на всіх етапах інноваційного процесу. Постійний обмін ідеями, а також спільне використання даних роблять інноваційний процес прискореним і безперервним.

У статті запропоновано модель інноваційного розвитку на основі інструментарію цифровізації, визначено можливості та загрози з урахуванням подій пандемії 2020 року, виявлено стримуючі фактори, розроблено заходи підтримки економічної діяльності при локдауні з урахуванням специфіки цифрової трансформації, узагальнено результати, зроблено акцент на вдосконаленні інфраструктури ІКТ та інтеграції цифрових технологій у реальний сектор економіки.
Висновки та узагальнення, зроблені в процесі дослідження, модель інноваційного розвитку, а також рекомендації щодо підвищення ефективності реалізації заходів підтримки інновацій в умовах цифрової трансформації можуть бути використані при розробці планів і програм розвитку.
Ключові слова: цифровізація; цифрова економіка; цифрова трансформація; інновації; інноваційна система; інноваційна діяльність; інноваційний розвиток; інноваційна активність.

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Цифровизация как инструмент инновационного развития экономики

Аннотация. В современных экономических условиях во многих странах цифровизация экономики является стратегическим приоритетом развития. Внедрение технологий цифровизации экономики, позволяющих государству, бизнесу и обществу эффективно взаимодействовать, становится все более масштабным и динамичным процессом. Цифровая экономика становится важнейшим драйвером инноваций, экономического роста и обеспечения конкурентоспособности.
Внедрение цифровых технологий позволяет открыть новые возможности для сотрудничества на всех этапах инновационного процесса. Постоянный обмен идеями и совместное использование данных делают инновационный процесс ускоренным и непрерывным.
В статье предложена модель инновационного развития на основе инструментария цифровизации: определены возможности и угрозы с учетом событий пандемии 2020 года, выявлены сдерживающие факторы, разработаны меры поддержки экономической деятельности в условиях локдауна с учетом специфики цифровой трансформации, обобщены результаты, сделан акцент на совершенствовании инфраструктуры ИКТ и интеграции цифровых технологий в реальный сектор экономики.
Выводы и обобщения, сделанные в процессе исследования, а также предложенная модель инновационного развития и рекомендации по повышению эффективности реализации мер поддержки инноваций в условиях цифровой трансформации, могут быть использованы при разработке планов и программ развития территорий.
Ключевые слова: цифровизация; цифровая экономика; цифровая трансформация; инновации; инновационная система; инновационная деятельность; инновационное развитие; инновационная активность.

1. Introduction

In today's realities, the awareness of the instability and unviability of the export-raw material model of the Russian economy has matured and was aggravated by the global recession in 2020.

All world expert communities predicted an economic downturn by the end of 2020. In our opinion, overcoming the crisis in the country is possible with the help of a transition to innovative development which can provided due to the stability of the economy, continuous updating of technical and technological base of production, development, releasing new competitive products and accessing world markets for goods and services.

Experts have noted that the world economy will grow by 4.1% in 2022, provided that the financial aid packages are fully used and the fiscal policies of countries remain unchanged. In the event that countries' policies change towards austerity, there is a likelihood that the recession will continue in late 2021 - early 2022. (UNCTAD Trade and Development Report 2020).

In our opinion, today's economy, including the innovation sector, more than ever needs strong support from the state, and digitalization is one of the promising instruments for the transition to an innovative development direction.

2. Brief Literature Review

In 2019-2020, a large number of scientific works by Russian and foreign authors dedicated to digitalization of the economy and digital development were published.

Let us consider the most important of them.

Studies that reveal general issues of the formation of the digital economy are reflected in «Digital Economy» by A. Bradford (2020) and «The Digital Economy» by M. Bazzoun (2019).

There is a number of studies on the digitalization processes in different countries: A. L. Gardner (2020); V. M. Kutovoi & A. Dulguun (2019); N. Ha; R. K. Intansari (2020), etc. The difference between the digital economy and the non-digital economy is revealed in a study by R. Esaheh (2019) who examines in detail the functions of information and communication technologies, their impact on the growth of labour productivity, sustainable development, social sphere and the economy as a whole. One chapter in the book «Digital Business Processes» by A. Jabłoński and M. Jabłoński (2020) is devoted to theoretical aspects of the digital economy.

Certain aspects of innovative development in the digital economy are disclosed in the works by F. Gault (2019), and N. Hamid and F. Khalid (2016).

Despite the contribution of scientists to the theory and practice of the formation and development of the digital economy, there are issues that require further study, in particular a detailed consideration of digitalization as a tool for innovative development.

3. Purpose

The purpose of the paper is to analyze trends of innovative development in the context of digital transformation in foreign countries and the Russian Federation and, by taking into account the specifics of digital transformation, build a model of innovative development, including targets and support tools.

4. Methods

Methods of various types of analysis, including systemic and comparative analyses, as well as logical-semantic and structural-functional modelling have been used in the study. The authors have reviewed ratings characterizing the processes of digitalization and innovative development of both the Russian Federation and foreign countries, and studied international reports and publications which assessed the events of 2020 and their impact on innovative processes, digital transformation and innovation potential.

5. Results

Support and implementation of innovations is the most important area of economic development, the basis for building a national innovation system, contributing to the formation of a research sector, a developed innovation infrastructure, increasing the competitiveness of economic entities and enhancing economic development.

Difficulties in reviving economic activities during a pandemic are discussed in the World Economic Outlook, October 2020 by the IMF. It stated that the global economy was projected to contract sharply by 4.4% in 2020 (the April report predicted a 3% decline), which is much worse than the slowdown during the 2008-2009 financial crisis. While the April report predicted economic growth at a 5.8% rate in 2021 due to government support, the October report predicted economic growth at a 5.2% rate. For 2020, a decline was forecasted for all countries, except for China with its growth of 1.9%. A decline of 4.1% was forecasted for Russia. Also, it listed a forecast of economic growth for the year 2021, with the largest growth in India (8.8%) and China (8.2%). The economic growth in the Russian Federation was projected at a 2.8% rate (The Global Innovation Index, 2020).

Considering the latest trends in the development of the digital economy, it is important to understand what countries will be the drivers of economic growth in the long term and what industries will stimulate this growth most.

Rostelecom annually publishes the results of the study known as «Global Digitalization Trends Monitoring», which is used to form a rating of countries depending on the contribution of each state to the international development of digitalization trends. Over the past 5 years, China has systematically taken the lead in contributing to the development of digitalization. Russia took the 9th place in the overall ranking, ahead of Canada, Italy and Australia. In 2019, there was an increase in absolute values in almost all indicators: an increase in investment activity + 217%, an increase in the number of scientific publications + 28% and grants + 24% (Global Digitalization Trends Monitoring, 2020).

New technologies and new business models based on the use of data are gradually approaching maturity for large-scale implementation and will have an increasing impact on all economic

realms. According to forecasts, by 2030, the total additional investment in digital technologies in the EU GDP may amount EUR 2.2 trillion, which is 14.1% more than in 2017. This figure compensates for all the necessary investment injections. By 2030, employment in the EU countries will have decreased by 2.9%. This trend may also depend on demographic factors, which creates an objective need for an increase in labour productivity that digitalization can provide (Formation of Digital Transformation in Europe, 2020).

To assess the trends of innovative development and the digital transformation process, we will consider the main international rankings on a given issue.

1. The ICT Development Index (IDI)

This index has been compiled since 2009 for most countries (176 countries in 2017), including Russia. It was updated in 2017. In 2019, the indicators for assessment were revised. Now they include 3 groups of indicators, on the basis of which the sub-indices are formed: the access to ICT, the use of ICT and ICT skills.

In 2017, Russia took the 45th place, compared with the 43rd in 2016. The greatest strength is ICT skills, weaknesses are access to ICT and their use.

2. The Digital Economy and Society Index (DESI)

This index tracks Europe's overall digital indicators and the progress of the EU member states in digital competitiveness. By providing data on the digitization status of each member state, it helps them identify areas for priority investment and action.

DESI 2020 reports are based on 2019 data and assess the state of the digital economy and society before the pandemic. The DESI 2020 index unites 37 indicators and includes 5 elements: communication, digital skills, Internet use, digital technologies and digital public services.

Finland, Sweden, Denmark and the Netherlands have the most advanced digital economies in the EU, followed by Malta, Ireland and Estonia, as shown by the 2020 the digital economy and society index ranking of member states based on 2019 data. Bulgaria, Greece, Romania and Italy have the lowest scores on the index. (The Digital Economy and Society Index, 2020).

Research data suggests that in recent years, enterprises in the real sector of the economy are becoming more digitalized, however this trend has mainly affected large companies. In 2019, 38.5% of large companies used advanced cloud services, 32.7% - big data analytics. Among small and medium-sized businesses, these indicators were 17% and 12%, respectively. Online sales were actively used in their activities by 39% of large enterprises and 17.5% of small and medium enterprises.

In connection with the events of the year 2020, the role of the electronic format of public services has increased. In the EU member states, before the pandemic, there was a trend towards the growth of digital public services. Both the quality and the use of digital government services increased in 2019, accounting for 67% of Internet users who applied now use online channels (The Digital Economy and Society Index 2020).

***3. The International Digital Economy and Society Index (I-DESI)*,** which measures the digital economy of the EU-27 member states and the EU as a whole, compared to 18 other countries in the world. The I-DESI will help countries identify areas for investment and action to reach the leading countries in the Digital Economy Index. The I-DESI is calculated in the same directions as the DESI. The I-DESI 2020 uses datasets from 2015 until 2018 to provide a trend analysis. It brings together a set of 24 indicators similar to the current EU-28 DESI digital policy mix. The EU-27 member states ranked five of the top ten positions in the I-DESI 45-country index. The average score over four years for Russia was between the 39th and the 36th place among 45 countries. China has an average index of 38. However, it should be noted that China's index is growing at a faster pace and, in terms of 2018, China is ahead of Russia.

The average index value (score) for Russia was 39 over four years, 36th out of 45 countries; the leading countries have an average score of 63, and the outsider - 30.

In the area of «Communication», Russia's score was 45.8 in 2018, while the leading country's score was 74.5 and the outsider's - 43. In the area of the «Use of Internet services», Russia's score was 47.8, compared with 75.4 for the leading county and 25.2 for the outsider. In the area of «Digital skills» Russia's score was 37.2 in 2018, compared with 65.7 for the leading country and 23 for the outsider. In the area of «Using Internet services», Russia's score was 47.8, compared

with 75.4 for the leading country and 25.2 for the outsider. In the area of «Integration of digital technologies» Russia's score was 27.8, compared with 86.1 for the leading country and 10.3 for the outsider. In the area of «Digital public services» Russia's score was 60.5, compared with 85.3 for the leading country, and 34.1 for the outsider (The International Index of Digital Economy and Society, 2020). Thus, the weak points of the I-DESI index for Russia are communication and integration of digital technologies.

4. The World Digital Competiveness Index (WDCI)

This index measures the potential and readiness of economies to adopt and explore digital technologies as a key driver of economic transformation in business, government and society as a whole (The IMD World Digital Competitiveness Ranking Results, 2020). This rating has been compiled since 2017 and covers 63 countries, including Russia.

The ranking is based on three key groups of indicators: knowledge, technology, and readiness for the future (The IMD World Digital Competitiveness Ranking Results, 2020).

The rankings are calculated based on 52 ranked criteria: 32 quantifiable and 20 survey data. The ranking provides country profiles according to the level of global digital competitiveness. According to the 2020 results, Russia ranks 43rd in the rating, we admit a downgrade in its position by 5 points, compared to the previous year. Russia ranks 26th in the group of indicators that characterize knowledge, 47th in the group of indicators that characterize technology and 53rd in the group of indicators that characterize readiness for digital transformation.

5. The Digital Intelligence Index (DII)

It defines trust in the digital economy and its evolution in 90 countries of the world. The index uses a total of 160 indicators to measure the state and quality of digitalization in the economy, with its 198 indicators to measure the level of digital trust. The assessment of the competitiveness of the country's digital economy is made as a function of two factors: its current state of digitalization and the rate of digitalization over time measured by the growth rate of its digitalization indicator over a twelve-year period (2008-2019). According to the overall Digital Evolution Index, Russia ranks 49th with an indicator of 52.78, compared with 98.82 for the leading country and 21.11 for the outsider. According to the general Digital Evolution Index: Russia ranks 10th with its 58.9. The leading country has 85.51 and the outsider has 27.6.

6. The Global Competitiveness Index (GCI)

The Global Competitiveness Index assesses the competitiveness landscape of 141 economies, providing insight into the driving forces behind their productivity and prosperity. At the end of 2019, Russia ranked 43rd. The index value was 66.7, with 84.8 for the leading country and 35.1 for the outsider. According to the GCI, Russia's strengths are its macroeconomic environment, innovation potential (improving the quality of research institutions, increasing R&D spending and ICT implementation). Meanwhile, Russia's weaknesses are human resources and difficult access for enterprises in the real sector of the economy in terms of their financing (The Global Competitiveness Report, 2019).

7. The Global Innovation Index (GII)

The 2020 Global Innovation Index (GII) presents the latest global innovation trends and an annual innovation rating of 131 countries, assessing the state of innovation development based on 81 indicators and providing a multilateral characteristic of innovation, including the political environment, education, infrastructure and the level of business development, based on the results of the assessment of two groups: conditions/resources of innovative development (Innovation Input) and its results (Innovation Output).

According to the results of 2020, Russia ranks 47th among 131 countries. The index value was 35.63, compared with 66.08 for the leading country and 13.56 for the outsider. The input sub-index was 46.64 (42nd place in the rating), with a 70.2 index value for the leading country, and 19.85 for the outsider. The output sub-index was 24.62 (58th place in the rating), compared with 62.75 for the leading county and 6.47 for the outsider. The Entry Index indicated the following results: «Institutions» - 71st place, «Human Capital and Research» - 30th place, «Infrastructure - 60th place, «Market Stability» - 55th place, «Business Stability» - 42th place. Exit index showed the following results: «Results of Knowledge and Technology Use» - 50th place, «Creative Results» - 60th place. Those

are the international comparisons in terms of indicators characterizing the prospects and opportunities for innovative development.

According to this indicator, the United States is the leading country with its USD 42.73 billion as of 2019. China takes the second place with its USD 34.37 billion. For Russia, this figure is USD 6.87 billion, which is 6 times less than the indicator for the United States. During the period under review, the largest increase in the studied indicator was in Sweden (356.88%), India (223.57%), China (163.59%) and Germany (126.96%). The increase in the volume of payments for the use of intellectual property in Russia for 9 years amounted to 41.81% (The Global Innovation Index, 2020).

China, with its USD 715.84 billion in 2019, is the undisputed leader in the export of high-tech goods. A similar indicator for Russia is 66 times less and amounts to USD 10.86 billion, despite the high growth rate of the export of high-tech goods of 102.33% over the period under review.

The largest share of R&D spending in 2018 was for Israel - 4.95% and Korea - 4.81%. In Russia, this indicator was extremely low and amounted to 0.99%, compared to 2010, the indicator decreased by 12%.

In today's realities, state research funders need to identify and communicate their capacity quickly and support research in the coming years, as well as their strategic priorities, so that research organizations can develop realistic long-term plans.

Going forward, science, technology and innovation (STI) policies should be adjusted to address long-term challenges of sustainability, inclusiveness and resiliency (OECD Science, Technology and Innovation Outlook, 2021).

In 2019, the leaders in terms of fixed broadband access (per 100 people) were France (45.69), Korea (42.76) and Germany (41.99). In Russia this indicator was 22.64. Among the countries considered, Russia was in the third place in terms of growth rate for the period under review (106.9%).

The most important indicators of digitalization that must be taken into account in order to assess the prospects and opportunities for innovative development can be presented by 4 groups:

1. ICT infrastructure. Access to fast and reliable broadband connections (including fixed and mobile) is critical in today's environment where key social and economic services are provided online.
2. Human capital's digital skills. Digital skills are the basis of a digital society. They enable people to use digital services and engage in basic online activities, especially when mobility is limited (IMD World Digital Competitiveness Ranking Results, 2020).
3. ICT use by households and the population. The use of the Internet by individuals has increased dramatically during the pandemic.
4. Integration of digital technologies in business.

Russia's main indicators of the four abovementioned groups are presented in Table 1.

Table 1:
Key indicators of the ICT infrastructure

Indicator	2015	2016	2017	2018	2019
Number of fixed broadband Internet subscribers per 100 population	18.3	18.6	21.0	21.7	22.2
Number of mobile broadband Internet subscribers per 100 population	68.1	71.1	79.9	86.2	96.4
Number of students in the field of Information and Computer Science training per 10,000 population	10	11	12	14	15
Number of graduates in the field of Information and Computer Science training per 10,000 population	6	7	8	8	8
Percentage of households with a personal computer	72.5	74.3	74.4	72.4	69.4
Percentage of households with access to the Internet	72.1	74.8	76.3	76.6	76.9
Percentage of the population using the Internet to receive public and municipal services	18.4	28.8	42.3	54.5	56.5
Percentage of the population using the Internet to order goods and (or) services	19.6	23.1	29.1	34.7	35.7
Number of personal computers per 100 employees within organizations	49	49	50	51	51
Number of personal computers with access to the Internet per 100 employees within organizations	31	32	33	35	35
Percentage of organizations with a website	42.6	45.9	47.4	50.9	51.9
Percentage of organizations using ERP systems	9.3	10.7	12.2	13.8	14.8
Percentage of organizations using CRM-systems	9.9	9.4	10.3	13.2	13.9
Percentage of organizations that placed orders on the Internet	41.3	41.6	41.2	42.2	43.3
Percentage of organizations that received orders for manufactured goods (works, services) via the Internet	18.2	19.3	20.1	22.5	23.7

Source: Compiled by the authors based on the «Monitoring the development of the information society in the Russian Federation» by the Federal State Statistics Service (2020)

The number of fixed and mobile broadband Internet access subscribers tends to grow by 21 and 42%, respectively. The indicator of the number of fixed broadband Internet subscribers per 100 population is not high and in 2019 it was 22.2 subscribers.

In Russia, the number of students and graduates in the field of Information and Computer Science is extremely low, which leads to a lack of ICT specialists in the labour market.

The percentage of households with a personal computer tends to decrease. In 2019 the indicator was 69.4%. The percentage of households with access to the Internet tends to grow. In 2019 the indicator was 76.9%. The percentage of the population using the Internet to receive public and municipal services was slightly more than 50% in 2018-2019, which is not a high. The percentage of the population using the Internet to order goods and (or) services had low values during the period under review. It accounted for 35.7% in 2019.

The number of personal computers per 100 employees of organizations did not change much during the period under review and amounted to approximately 50 units. The number of personal computers with access to the Internet per 100 employees was about 33-35 units, which is a low indicator. The percentage of organizations with special software means for managing the procurement of goods by using ERP systems or CRM systems tend to grow, however the values are extremely low. It should be noted that among the indicators characterizing the integration of digital technologies in business activities no downward trends have been identified.

Figure 1 presents a generalization of the study in the form of a model of innovative development in the context of economy digitalization in view of the events of 2020.

In order to create innovations in the context of economy digitalization, it is necessary to build new business models, forming new managerial and organizational competencies that require the investment of a significant amount of financial resources (Bessonova & Battalov, 2019).

Thus, in today's realities regarding innovative development, there are various threats, the main of which is reduced funding of research and development. Crises are often a source of creativity and innovation, and sometimes industrial renewal.

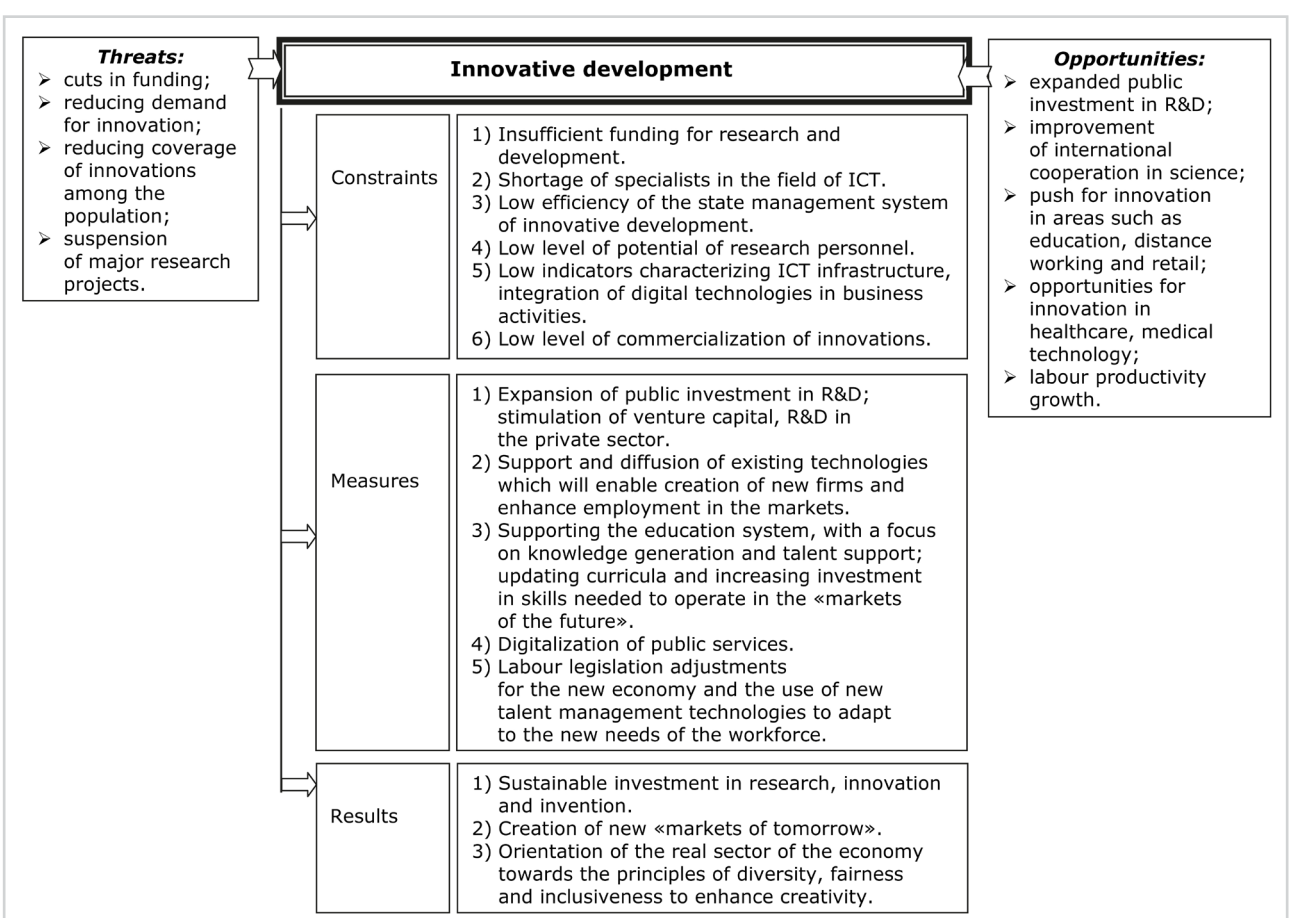

Figure 1:
Model of innovative development in the context of economic transformation
Source: Compiled by the authors

As long as innovation exists, the main challenge which innovators around the world face is mobilizing stable and affordable mechanisms of funding. Funding affects all stages of the innovation cycle from an idea to commercialization, expansion and, ultimately, the long-term sustainability of a business (The Global Innovation Index, 2020).

6. Conclusions

Digitalization as the basis of the modern economy stimulates the development of not only technological innovations and high technologies, but also positively affects all spheres of social life, including the labour market, the education system, and healthcare. At the same time, in the institutional provision of digital transformation the key role is played by the state, whose instruments of influence on economic relations should be carefully weighed and worked out. At the transformation stage, attention should be shifted to creating incentives for channelling financial resources to attract long-term investments and strengthening stability while expanding population coverage.

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