Prospects for Russia Under the Digital Domination of China and the United States

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Abstract—The article discusses the opportunities and risks for Russia in a situation where China and the United States are claiming world leadership in the development of digital technologies. It is shown that the specifics of competition in the markets of digital goods encourage countries that claim to dominate in these markets to accelerate actions that require large resources. The scale of investments by Russia, China and the United States in artificial intelligence (AI) technology is compared. The difficulties of ensuring the digital sovereignty of our country in the formation of two digital ecosystems in the global economy, led by China and the United States, are discussed. Promising areas of competence of Russia are identified, which retain the possibility of leadership for it with limited resources.

Keywords: digital technologies, artificial intelligence, digital sovereignty, unique competencies, global leadership

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Introduction. Competition in the digital sphere will largely determine the future geo-economic and, with it, the geopolitical situation. The policy of both China and the United States proceeds from the fact that the country that dominates the development of digital technologies will also dominate the global economy [1]. Significantly inferior to these countries in terms of economic potential, Russia runs the risk of being pushed to the margins of digital competition, which threatens not only with economic losses. Digital sovereignty is becoming a fundamental condition for national sovereignty and national security.

As stated in [2, p. 32], “the current system of almost monopoly control over the primary (microelectronics and 5G technologies) and secondary (AI platforms and technologies) levels of digital infrastructure, dominated by transnational corporations from China and the United States, does not leave developing countries, including the Russian Federation, a chance to maintain economic independence and independence in the course of digitalization processes, forcing them to use the technologies of one of these countries.” The reality of such a prospect is also indicated in [3, p. 45]: “The most difficult tasks are facing Russia, which is not able to really resist the technological hegemony of the United States or China and may find itself on the periphery of the global technological space as a catch-up economy with limited chances of success.”

Russia’s delay in the development of digital technologies is estimated at 5–10 years, which is associated, in particular, with the negative impact of sanctions, which made it difficult to access advanced foreign developments [4]. Russia’s position in a number of ratings also testifies to the lag of our country in the digital sphere. So, in the Global Competitiveness Rating of the countries of the world1 (IMD World Digital Competitiveness Ranking (WDCR)) 2021 Russia occupies only 42nd place [5]. Russia was in the same position in 2017 as well. There is no approach to the leaders in terms of Knowledge and Technology. As for assessing how ready the country is for digital transformation, our country has dropped from 42nd to 47th place in this parameter since 2019 (Table 1).

While it has become commonplace during the COVID-19 crisis to view the ongoing processes as a sharp acceleration in the formation of an inclusive digital ecosystem, the increase in demand for information technology should not create illusions. The volume of production in Russia according to the collective classification grouping of types of economic activity “Sector of information and communication technologies” in 2020 increased by one and a half times compared to 2018.2 However, both these volumes and the scale of domestic investment in digital technologies remain

1 The annual global study and the accompanying economic competitiveness rating of the countries of the world according to the Institute of Management Development (IMD).
2 https://rosstat.gov.ru/folder/11189.
positive network effects coupled with economies of scale. Such features of competition in the markets of digital goods induce applicants for dominance in these markets to accelerated actions, which implies an appropriate concentration of resources.

The fact that Russia has significant scientific and technological “reserves,” a relatively good level of human potential, has its downside. There is a risk that the resources allocated for digital development will not be concentrated due to the presence of many applicants for their use, the general limitation of allocated resources and weaknesses in allocation procedures. In this regard, “rigid selective concentration of resources on the development of a number of high technologies should become the main priority of a long-term economic strategy and overcoming the formed technological gap with the leaders” [3, p. 45–46].

The fundamental research of big business is an important feature of the digital age. The speed of technological change characteristic of the digital age is a competitive factor. Under these conditions, large companies cannot be satisfied with the commercialization of other people’s discoveries. So you can give up the initiative to a competitor. To avoid this, partnerships are being established with universities, venture business is being supported, and promising startups are being monitored and bought up. However, large companies focused on long-term competitiveness are not limited to such measures, they are beginning to more actively finance their own fundamental research.

For example, the well-known Chinese company Huawei has been devoting more than 10% of its income to research and development (15.9% in 2020) for a number of years, seeking to provide a breakthrough in advanced technologies. Approximately 15000 Huawei employees are involved in basic research, including 700 PhD’s in mathematics and more than 200 PhD’s in physics and chemistry. The company actually acted as a coordinator of fundamental research when, in 2020, it published a list of 10 mathematical problems facing the information and communication technology industry.3

Attention should also be paid to the employment structure in the United States and Canada for new PhD graduates who specialize in artificial intelligence. In recent years, more and more of these graduates are choosing to work in industry rather than academia. Thus, the share of those who chose work in the manufacturing sector increased from 44.4% in 2010 to 65.7% in 2019, while in the academic sector it decreased over the same period from 42.1% to 23.7% [8, p. 12].

Digital technologies are changing the relationship between suppliers and consumers. First, it expands the opportunities for data exchange with all partners in the

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3 Huawei Investment & Holding Co., Ltd. Annual Report 2019. Annual Report 2020. https://www.huawei.com/en/annual-report.
In 2017, the State Council of China published a development plan aimed at making the country a world leader in artificial intelligence by 2030.\textsuperscript{6} For the sake of such leadership, China is ready to invest $150 billion in relevant developments.\textsuperscript{7} The country’s annual nondefense AI R&D spending is estimated at between $1.7 billion and $5.7 billion [12].

As for private investment in artificial intelligence, the United States and China are leading by a clear margin [8, p. 95]. As can be seen from Table 2, China’s private investment in AI exceeds that of the rest of the world, minus their volume in the United States.

The United States and China account for up to 94% of all funding for start-ups in the field of artificial intelligence in the period from 2016 to 2020 [13, p. 41]. At the same time, we can talk about the global trend of reducing the number of new startups in the field of AI after 2017 [8, p. 94]. The publication activity of China on the subject of AI is comparable to the activity of the European Union (EU 27), although it is inferior to the United States [14].

Artificial intelligence technologies play a big role also because they are dual-use technologies, and digital competition is also unfolding in the military sphere. The US military budget for R&D in the field of AI in fiscal year 2021 is estimated at more than $5.0 billion [8, p. 168].

The US leads in the total number of AI-related patents. Among these types of patents filed with the US Patent and Trademark Office (USPTO) from early 2008 to late 2018, the United States (87244) accounted for the largest number of patents, followed by Japan (9787) and South Korea (4798) [15].

The distribution by country of patents registered in 2018 is presented in Table 3.

It should be noted that the top ten holders of AI-related patents issued by the USPTO between January 2008 and December 2018 included only companies, but not a single university. IBM is in the lead (about 7100), followed by Microsoft (about 5000) and Google (about 4000) [15].

As can be seen from the above data, in both China and the United States, the state and business are making great efforts to ensure leadership in the field of AI.

\textbf{Federal project “Artificial Intelligence.”} The National Strategy for the Development of Artificial Intelligence for the period up to 2030 notes that the Russian Federation has significant potential to become one of the international leaders in the development and use of AI technologies. Despite the losses suffered in the 1990s, Russia demonstrated the ability to develop and implement “disruptive innovations,” as

\begin{table}[h]
\centering
\begin{tabular}{|l|c|}
\hline
The country & Volume of investments, billion dollars \\
\hline
USA & 23.6 \\
China & 9.9 \\
EU & 2 \\
The rest of the world & 6.7 \\
\hline
\end{tabular}
\caption{Private investment in AI, 2020}
\end{table}

\begin{itemize}
\item \textsuperscript{4}https://www.federalregister.gov/documents/2019/02/14/2019-02544/maintaining-american-leadership-in-artificial-intelligence.
\item \textsuperscript{5}https://www.nitrd.gov/pubs/FY2022-NITRD-NAIJO-Supplement.pdf.
\item \textsuperscript{6}China’s New Generation of Artificial Intelligence Development Plan, July 2017. https://flia.org/notice-state-council-issuing-new-generation-artificial-intelligence-development-plan/.
\item \textsuperscript{7}https://www.analyticsinsight.net/artificial-intelligence-investment-by-top-10-countries/.
\end{itemize}
can be seen from the products of the domestic defense industry. Pretty strong positions in the scientific field, a high level of competencies in the field of cybersecurity and face recognition are maintained, and institutional conditions for digital development are being improved. There is experience in the industrial use of digital technologies at a very advanced level. Thus, augmented reality technology is used in the assembly of Su-57 aircraft. Generated digital images tell workers where certain parts and components are located, allow you to see virtual cables and connectors, internal rivets and attachment points. A large number of cases of digital transformation are presented on the website of ANO Tsifrovaya ekonomika.

The ability of our country to claim the role of one of the global digital leaders is recognized by experts from the World Bank [16]. The national program “Digital Economy of the Russian Federation,” which includes six federal projects, is called upon to bring the country to a leading position. The roadmap “Artificial Intelligence and Neurotechnologies” is dedicated to the development of AI; it is one of nine such maps developed as part of the federal project “Digital Technologies.” In 2020, the Artificial Intelligence direction became a new federal project of the national program “Digital Economy of the Russian Federation.” The passport of the federal project “Artificial Intelligence” provides that 29410 million rubles will be allocated to solve its problems in four years (from 2021 to 2024) will be budgeted and 6903 million rubles from extrabudgetary funds. Thus, budgetary funds will prevail on funding from extrabudgetary funds. Their share, even with an additional allocation from the budget of 33.2 billion rubles, should have been 79%. This funding structure was reminiscent of the US approach to AI development.

The Russian National Strategy for the Development of Artificial Intelligence for the period up to 2030 does not contain guidance on what funding model will be used for its implementation. In general, the volume of funds invested in Russia in the development of AI technologies is many times lower than the corresponding costs of China and the United States. What are the prospects for Russia’s preservation of digital sovereignty in such a situation, in fact, remains an open question.

**Digital sovereignty: electronic components.** The ability of a state to pursue an independent policy in digital space (digital sovereignty) depends on the level of available digital technologies. The very possibility of achieving such sovereignty remains debatable [17]. Even in relation to China, one can speak of still limited digital sovereignty. The component basis of digital technologies are semiconductors and microcircuits. Almost half of their sales come from US companies, although only 13% of semiconductor manufacturing capacity is located in the US, 20% in Taiwan, 19% in South Korea, 17% in Japan and 16% in China. As for high-tech microcircuits with dimensions less than 10 nanometers, 92% of the corresponding capacities are located in Taiwan and 8% in South Korea [18].

According to the Semiconductor Industry Association, to meet the growing demand for semiconductors, it will be necessary to invest about three trillion US dollars over the next ten years in R&D and production capacity [18]. While China is striving to catch up with the technological gap in this area and investing billions in its chip manufacturing companies, this is a very difficult task. First, the United States is making very active efforts to maintain its leadership. The United States Innovation and Competition Act 2021 (United States Innovation and Competition Act of 2021) provides 52 billion dollars to the semiconductor industry. Second, a significant factor complicating overcoming the backlog in microchip production technologies is the monopolization of the market for the most advanced equipment for such production. The largest supplier of photolithography systems for the semiconductor industry and the only supplier of equipment for photolithography using light in the extreme ultraviolet range from a wavelength of about 13.5 nm (Extreme ultraviolet lithography, EUV) is...
Dutch multinational corporation ASML. The Japanese Nikon has a relatively small market share. ASML has partnered with Lam Research (United States), which introduced a new technology in 2020 that provides significant improvements in resolution and performance in EUV lithography. The US may influence the supply of advanced lithographic equipment to other countries.

If the ASML equipment uses photomasks for the production of microcircuits, then in Russia it is proposed to develop a maskless lithography technology that does not require such a template [19]. The development of such technology is provided for by the state program “Development of the Electronic Industry of the Russian Federation in 2018–2027,” but this development is not funded enough. Nevertheless, the mindset remains that by the end of the decade, the share of inhouse electronic components for the digital transformation of the industry should exceed 40%.

**Data processing.** The Russian National Strategy for the Development of Artificial Intelligence for the period up to 2030 states that by 2030 specialized data processing centers based on Russian microprocessors should be opened. Data processing is another fundamental aspect of digital sovereignty. Its big risks are the situation with hyperscale data centers capable of guaranteeing modern consumers an almost unlimited increase in computing power. By the end of 2020, the United States accounted for 39% of the total number of such data centers, China 10%. Japan closes the top three with 6% [13, p. 39]. Leading information firms are based in the United States and China. As a consequence, these countries gain a competitive advantage from the collection and use of data.

The prospect of forming a model of international relations “center—periphery” in the digital economy is real. Moreover, the United States and China will be in the center, and the rest of the world on the periphery [20]. Risks for national security involve the loss of control over cross-border data flows, shown in the article [21] using the example of collecting and processing data using artificial intelligence.

The implementation of the Russian national program “Digital Economy” should increase the digital sovereignty of the country. Thus, the federal project “Digital Infrastructure” included in this program until 2024 outlines the creation of a global competitive infrastructure for processing and storing data based on domestic developments.

**Digital standards.** The federal project “Information Security” provides for the development of security standards for cyber—physical systems, including the Internet of Things, systems that implement cloud, fog, quantum technologies, augmented reality systems, as well as systems that implement AI functionality. Currently, the United States and China are making active efforts to ensure that their standards play a decisive role in digital development. This activity brings results. The first common standard in the field of the Internet of Things was adopted by the International Telecommunication Union based on the one developed in China [22, p. 26]. It is believed that one of the most important undeclared goals of developing the Industry 4.0 concept was to position Germany as a global leader in the standardization of the Industrial Internet of Things [23, p. 102]. The fact that the largest share of the global Internet of Things market belongs to China could play a role in the international recognition of the Chinese standard [23, p. 50].

The Digital Silk Road project takes into account countries’ wary attitude towards open Chinese expansion. The introduction by Chinese corporations of their digital technologies and standards to other countries does not attract much attention from their public. Digital standards serve to subordinate foreign markets of high—tech products to China. In the global division of labor, China seeks to move towards specialization in precisely such products.

On the agenda is the development of guidelines regarding the prospect of dividing the entire digital sphere into two ecosystems, one of which will be dominated by China, and the other by the United States. There is an opinion that Russia, “refusing on its own initiative or being forced to use American technologies, ... will objectively focus more and more on Chinese technologies, which is already observed at the

### Table 4. Financial support for implementation of the Artificial Intelligence federal project, thousand rubles

| Funding                     | The volume of financial support by years of implementation | Total 2021–2024 |
|-----------------------------|----------------------------------------------------------|-----------------|
|                             | 2021 2022 2023 2024                                      |                 |
| Total                       | 7123942.2 10395476.2 9416790.8 9376790.8                | 36313000.0     |
| Total: federal budget       | 6233275.5 8112476.2 7552124.1 7512124.1                | 29410000.0     |
| Total: extrabudgetary sources | 890666.7 2283000.0 1864666.7 1864666.7                 | 6903000.0      |

Source. Passport of the Artificial Intelligence federal project. https://sudact.ru/law/pasport-federalnogo-proekta-iskusstvennyi-intelлект-natsionalnoi-programmy/.
present time” [3, p. 45]. One of the arguments for this choice is that “our partners in the EAEU have become increasingly oriented towards Chinese technologies” [3, p. 46]. At the same time, the author of the cited work reasonably warns that “no one is going to just share their competitive advantages in the technological field. And first of all, this applies to China, which would like to receive more from Russia than to give it” [3, p. 46]. The question of Russia’s strategy in the event of the formation of two digital blocks of countries in the world remains open.

**Leadership opportunities with limited resources.** Russia seeks to ensure digital sovereignty, significantly yielding to the United States and China in the amount of public and private resources that can be invested in the country’s digital transformation. The reality of the digital economy is that to ensure a strong position in the digital sphere, Russia will have to perform a kind of digital miracle. The Russian digital development strategy should provide for increasing competencies in a wide range of areas. At the same time, it is important to determine in what digital technologies the achievement and preservation of unique competencies are real, which will give a chance to reduce discrimination in transnational technological ties.

It is generally accepted that the most advantageous from the point of view of value-added distribution are the initial and final links of the chain of its creation, i.e., R&D on one end, marketing services and after-sales service on the other. Graphically, this distribution of value added is depicted as a U-shaped curve, which appears in the literature as a “smiling curve.” In practice, the chains of creating complex products have a very branched structure. A significant increase in spending on R&D and intangible assets does not always occur on the “stem” fragment of this structure. The most important competencies can be accumulated in separate branches, which affects the distribution of value added across the value chain [24]. Situations in at least several industries are answered by a smiling curve, in which conceptual development, final product design, together with sales and service, find themselves in one of its “corners,” and the creation of unique components in another (figure 1).

The development of unique digital competencies that provide significant synergies in combination with other technologies is an acceptable leadership option in a resource-limited environment. This option preserves opportunities for true partnerships in global value chains.

**Conclusions.** From a strategic point of view, Russian priorities in the development of digital technologies should cover areas in which the lack of competencies creates great risks for the country.

As a promising area for the formation of unique competencies, one can single out the development of artificial intelligence using digital twins. Relevant competencies will ensure the competitive advantages of our economy in the context of the transition from the sale of high-tech products to the sale of the time of its real use. Digital twins are a tool for analyzing changes in the parameters of such products as a result of virtual tests during operation [26].

The absence of digital twins of the main processes is one of the fundamental barriers to the introduction of artificial intelligence in the oil and gas industry [27]. The development of digital twins can contribute to increasing the competitiveness of other sectors of the Russian economy.

With good engineering and mathematical schools and qualified programmers in our country, this option of focused leadership in digital technologies seems to be real, even though Russia is inferior to China and the
United States in terms of financing the digital transformation of the economy.

As noted in the World Bank report, “the digital transformation of manufacturing and related traditional industries is a priority for all industrialized countries that created their competitive advantages during the industrial revolution of the 20th century” [16, p. 69]. According to experts, Russian companies can become leaders in digital solutions, primarily for basic industries, for metallurgy, the oil and gas sector, and petrochemistry [28].

The presence in the country of a number of industries capable of generating significant demand for domestic developments in digital technologies gives Russia chances to form its own niche in the digital sphere. Financial organizations and government services can play a big role here. Of particular note are traditional industries that retain a significant share in Russian exports.

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