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Large AI Spaces and Russia's Strategy in the Context of the "Sanctions War"

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Abstract. The article is devoted to the study of the role of technological development in the field of artificial intelligence (AI) in the international political processes, the formation of large policy spaces in the field of AI, as well as the development of Russia in this area. The author provides an analysis of national AI strategies, examines the priority spheres and directions of development of these technologies for different countries, the availability of resources for the goals set, and the specifics of national AI policies of the leading states. The article compares the data on the volume of funding for AI developments, patent activities, and the existing infrastructure for high-performance computing in the countries, that occupy leading positions in the field of AI. The paper provides a brief overview of the key scientific and technological areas that are crucial for the creation of next-generation AI technologies: quantum computing and neuromorphic technologies within the framework of existing major national projects on the study of the brain. The author devotes a special place to the study of international political aspects of technological development in the field of AI in the work. From the perspective of the impact of AI policy on integration processes, the conclusion is made about the formation of two spaces: the first unites the OECD countries with the unconditional leadership of the USA and the EU in the field of research, development, infrastructure, resources, and international standards. The second, restrained space, relies on the technological and financial power of China, where are starting to get involved countries, including Russia, that are facing with narrowing range of opportunities for cooperation with Western countries. The author concludes that the confrontation between the two AI spaces is influenced by a more general trend of decoupling of the economies of the USA and China, which in turn contributes to technological isolation trends at the global level. A special place in the article is devoted to the analysis of the development of AI technologies in Russia; it considers official documents, leading players, and Russia's positions at the international level. The possible directions of Russia's cooperation with the world leading players are considered, which allows to develop AI technologies and at the same time maintain technological sovereignty in this area.

Key words: technological cooperation, artificial intelligence, industry 4.0, fourth industrial revolution, technological spaces, decoupling, sanctions policy

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Большие ИИ-пространства и стратегия России в условиях санкционной войны

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Аннотация. Статья посвящена изучению роли технологического развития в области искусственного интеллекта, или ИИ, в международных политических процессах, формирования больших пространств политики в области искусственного интеллекта, а также направлений дальнейшего развития России в этой сфере. Проанализированы национальные стратегии в области ИИ, рассмотрены приоритетные для государств мира сферы и направления развития этих технологий, обеспеченность ресурсами поставленных целей, а также особенности национальной политики в области искусственного интеллекта ведущих государств мира. Сопоставляются данные об объемах финансирования разработок в области ИИ, патентной деятельности, имеющейся инфраструктуре для высокопроизводительных вычислений в странах мира, занимающих лидирующие позиции в области искусственного интеллекта. Представлен краткий обзор ключевых научно-технологических направлений, имеющих решающее значение для создания технологий ИИ следующего поколения: квантовые вычисления и нейроморфные технологии в рамках существующих крупных национальных проектов по изучению мозга. Отдельное место в работе отведено исследованию международных политических аспектов технологического развития в области искусственного интеллекта. В ракурсе воздействия политики в области ИИ на интеграционные процессы делается вывод о формировании двух пространств: первое объединяет страны Организации экономического сотрудничества и развития с безусловным лидерством США и ЕС в области научных исследований, разработок, инфраструктуры, ресурсов, международных стандартов. Второе, сдерживаемое пространство, опирается на технологическое и финансовое могущество Китая, куда начинают втягиваться страны, в том числе и Россия, для которых спектр возможностей сотрудничества с западными странами в последнее время резко сузился. Сделан вывод, что противоборство двух ИИ-пространств испытывает на себе влияние более общей тенденции декаплинга экономик США и Китая, что на глобальном уровне способствует развитию тенденций технологической изоляции. Особое внимание уделено анализу развития технологий ИИ в России — официальных документов, ведущих игроков, позиций на международном уровне. Рассматриваются возможные направления сотрудничества России с ведущими мировыми игроками, которые позволяют успешно развивать технологии ИИ и одновременно сохранять технологический суверенитет в этой сфере.

Ключевые слова: технологическое сотрудничество, искусственный интеллект, индустрия 4.0, четвертая промышленная революция, технологические пространства, декаплинг, санкционная политика

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Introduction

One of the main trends in the development of information technologies at the present stage is the development of artificial intelligence (AI) and its application to an ever wider and more complex range of tasks. AI technologies, being at the center of those grand socio-economic transformations, which are usually associated with the fourth industrial revolution, began to acquire a pronounced political context

in international relations. One of the main ideologues of the fourth industrial revolution, K. Schwab, in his opening speech at the 49th Davos Economic Forum on January 22, January 2019, emphasized: “Artificial intelligence, big data and the ability to create technology platforms for mass use are beginning to define the national power of states” (Schwab, 2019, p. 82).

Many researchers attribute economic growth in the 21st century to the introduction of

AI into various industrial sectors. The official documents of the European Commission emphasize that in the 21st century AI will be a major driver of economic growth and increased productivity and will contribute to the sustainability and viability of industrial production.¹ According to the forecasts of the International Data Corporation (IDC), the size of the market for AI technologies by 2024 will be 554.3 bln USD.²

In this sense, mastering AI technologies and introducing them into production promises significant economic benefits for states and leading positions in the global system of labor division. As stated in the materials of European Conference on AI Policy on December 1, 2020: “This technology is geopolitically important. Many countries are looking to achieve a global innovation advantage in AI because they understand that it is a fundamental technology that can increase competitiveness and help solve social problems.”³

National AI Policies

In 2017, when Canada adopted the world’s first National AI Strategy, it began the process of formalising AI technology as a policy priority for many states. According to the latest data, 43 states have already adopted national AI strategies and 14 are working in this direction (Table 1).

¹ Re-finding Industry: Defining Innovation // Publications Office of the European Union. April 24, 2018. P. 5. URL: <https://op.europa.eu/en/publication-detail/-/publication/28e1c485-476a-11e8-be1d-01aa75ed71a1> (accessed: 16.02.2022).

² IDC Forecasts Improved Growth for Global AI Market in 2021 // International Data Corporation. February 23, 2021. URL: <https://www.idc.com/getdoc.jsp?containerId=prUS47482321> (accessed: 16.02.2022).

³ Castro D. European AI Policy Conference Report — 2020 // Center for Data Innovation. April 9, 2021. URL: <https://datainnovation.org/2021/04/european-ai-policy-conference-report-2020/> (accessed: 21.12.2021).

Table 1

Dates of National AI Strategies Adoption, 2017—2021

Year	States
2017	Canada, China, Finland, Japan, UAE
2018	France, Germany, Great Britain, India, Mexico, Sweden
2019	Colombia, Czech Republic, Denmark, Estonia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Qatar, Republic of Korea, Russia, Singapore, Slovakia, USA
2020	Bulgaria, Cyprus, Hungary, Indonesia, Latvia, Norway, Poland, Saudi Arabia, Serbia, Spain
2021	Brazil, Chile, Ireland, Italy, Slovenia, Türkiye, Vietnam
In development	Argentina, Australia, Austria, Belgium, Greece, Israel, Kenya, Malaysia, New Zealand, Romania, Sri Lanka, Tunisia, Ukraine, Uruguay

Source: A European Approach to Artificial Intelligence // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/strategy-artificial-intelligence> (accessed: 15.11.2021); The AI Index Report: Measuring Trends in Artificial Intelligence // Stanford University Human-Centered Artificial Intelligence. 2021. URL: <https://aiindex.stanford.edu/report/> (accessed: 16.11.2021); Government AI Readiness Index 2021 // Oxford Insights. URL: <https://www.oxfordinsights.com/government-ai-readiness-index2021> (accessed: 11.04.2022).

National strategies differ in terms of approach, level of detail of proposed actions and sectoral focus. The strategies vary in conceptual form, from a high-level political umbrella strategy covering many different policy initiatives, to operational strategies with concrete actions and allocated budgetary funding. There are significant differences in the priority areas of state policy. Some countries (e.g., Malta and Slovakia) have taken a horizontal approach and have not identified specific priority sectors for the deployment of AI technologies. Others (notably Portugal and France) have focused on economic sectors that have high growth potential or provide competitive advantages.⁴

⁴ A European Approach to Artificial Intelligence // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/strategy-artificial-intelligence> (accessed: 15.11.2021).

It should be stressed that only a few countries have indicated specific amounts of funding for the adopted strategies. For example, China (about 32 bln USD until 2030), the EU (20 bln euro per year, a significant part of which falls on Germany and France), the USA (about 30 bln USD per year, of which about 24 bln USD in 2020 accounted for private investment), UK (1.3 bln USD), India (about 950 mln USD).⁵ The Russian federal project “Artificial Intelligence” envisages funding of about 36.3 billion rubles until 2024.⁶ In most cases, data on the size and sources of funds for the implementation of national AI strategies are not available, which underlines the declarative nature of the adopted documents, which do not imply a fixed roadmap for their implementation, but only illustrate the ambitions of the state to follow the global technological trend.

Scientific and Technological AI Leadership

At present, many experts acknowledge that the EU, China and the US are leading the technology race for artificial intelligence, in some respects pulling ahead and in some respects catching up with each other.

⁵ The AI Index Report: Measuring Trends in Artificial Intelligence // Stanford University Human-Centered Artificial Intelligence. 2021. URL: <https://aiindex.stanford.edu/report/> (accessed: 16.11.2021).

⁶ Passport of the federal project Artificial Intelligence of the National Program Digital Economy of the Russian Federation (Appendix No 3 to the Protocol of the Presidium of the Government Commission on Digital Development, the Use of Information Technologies to Improve the Quality of Life and Business Conditions dated August 27, 2020 No 17 // Judicial and regulatory acts of the Russian Federation [Паспорт федерального проекта Искусственный интеллект национальной программы Цифровая экономика Российской Федерации (приложение № 3 к протоколу президиума Правительственной комиссии по цифровому развитию, использованию информационных технологий для улучшения качества жизни и условий ведения предпринимательской деятельности от 27.08.2020 № 17) // Судебные и нормативные акты РФ]. URL: <https://sudact.ru/law/pasport-federalnogo-proekta-iskusstvennyi-intellekt-natsionalnoi-programmy/> (accessed: 16.11.2021). (In Russian).

For example, experts from the U.S. Center for Data Innovation in their latest report indicate that the United States holds leading positions in four of the six categories they study: talent (number of high-class researchers, participation in scientific conferences, etc.), research (number of publications, citations, R&D spending etc.), development (number of companies, start-ups, patents etc.) and equipment (semiconductor manufacturing and research, computer chip manufacturing etc.), while China is the world leader in adoption categories (number of employees in AI-related companies) and data (the number of mobile payment users, the level of adoption of digital health records, the Internet of things, etc.). At the same time, both China and the EU have recently managed to narrow the gap with the United States in a significant number of parameters.⁷

The development of AI technologies is closely related to the need to quickly process large amounts of data. Therefore, many countries pay special attention to the creation of affordable infrastructure for high performance computing. For example, Chinese tech giant Tencent is actively developing the Angel platform for enterprises with data-intensive needs.⁸ For the development of high-performance computing and innovative supercomputing technologies the European Joint Venture for High-Performance Computing (EuroHPC JU) was established in 2018 in the EU, bringing together the resources of 32 countries and private partners.⁹

⁷ Castro D., McLaughlin M. Who Is Winning the AI Race: China, the EU, or the United States? // Center for Data Innovation. August 19, 2019. URL: <https://datainnovation.org/2019/08/who-is-winning-the-ai-race-china-the-eu-or-the-united-states/> (accessed: 21.12.2021).

⁸ The AI Ecosystem in China 2020 // Daxue Consulting. March, 2020. URL: <https://daxueconsulting.com/wp-content/uploads/2020/03/AI-in-China-2020-White-Paper-by-daxue-consulting-2.pdf> (accessed: 10.03.2022).

⁹ The European High Performance Computing Joint Undertaking // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/high-performance-computing-joint-undertaking> (accessed: 21.12.2021).

According to the latest TOP500 data, the world leaders in terms of supercomputers and their combined performance are China — 214 systems (42% of the total), the USA — 113 systems (22.6%), Japan — 34 systems (6.8%). At the same time, in terms of aggregate performance, the US systems occupy the first place — 668.7 petaflops (27.5% of the global level), Japan has the most productive supercomputers in the world, producing a total of 593.7 petaflops (24.4%) on a significantly lower number of systems than competitors, China ranks third with 566.6 petaflops (23.3%). The cumulative performance of the EU countries is 79 systems (15.5%) with a performance of 374.4 petaflops (15.4%). Russia currently has seven supercomputers included in the 500 most productive world systems, producing a total of 61.8 petaflops (2.5%).¹⁰

A qualitative leap in the field of high-performance computing is associated by many experts and analysts with the development of quantum computers (Giglavay et al., 2013). In this area, the palm is contested by China and the United States. In the world's leading scientific journals, one publication after another appears to show that scientists from different countries have managed to achieve “quantum superiority” on a larger number of qubits than the rest. In 2019, Nature published an article on Google's 54-qubit Sycamore quantum computer (Arute et al., 2019). In late 2020, information appeared about the Chinese Jiuzhang quantum computer with 76 qubits, which, according to the creators, is many times more powerful than Sycamore (Zhong et al., 2020).

An important driver for the development of AI technologies is the electronic component base. In this area, the leaders are the EU, China and the United States. For example, among AI microchip companies, 14 are located in the EU, 29 — in China, and 62 — in the US.¹¹

¹⁰ List Statistics // TOP500: The List. November, 2021. URL: <https://top500.org/statistics/list/> (accessed: 20.12.2021).

¹¹ Castro D., McLaughlin M. Who Is Winning the AI Race: China, the EU, or the United States? // Center for

The policy of the leading players provides for significant investments in their own research and development. For example, the European Commission at the EU level has planned at least 1 bln euro per year for these purposes until 2027.¹² In the US Federal Funding for AI R&D was 1.5 bln USD in 2021.¹³

The global AI research and development agenda is driven by China and the United States, which are the absolute leaders in the number of publications and patent applications. According to the latest data in the ranking by the number of patents, China is the leader (103.9 thousand applications), followed by the USA (23.5 thousand) and Japan (12.2 thousand). Russia is in 15th place (387 applications)¹⁴. Looking at the list of the top-500 organizations by number of AI patents, China is represented by more than 100 organizations. For comparison, this list includes 20 organizations from the US and 4 each from Europe and Japan. Russia ranks 7th in this list between Japan and Saudi Arabia.¹⁵ However, it should be noted that many researchers emphasize China's focus on patent activity, which largely explains its quantitative superiority in this area. Some Chinese authors point out: “Chinese scientists are afraid that their good ideas will be taken up by Western

Data Innovation. August 19, 2019. URL: <https://datainnovation.org/2019/08/who-is-winning-the-ai-race-china-the-eu-or-the-united-states/> (accessed: 21.12.2021).

¹² A European Approach to Artificial Intelligence // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/strategy-artificial-intelligence> (accessed: 15.11.2021).

¹³ The Final Report // National Security Commission on Artificial Intelligence. URL: <https://reports.nsc.gov/final-report/table-of-contents/> (accessed: 21.02.2022).

¹⁴ Development of individual high-tech areas: White paper [Развитие отдельных высокотехнологичных направлений : Белая книга]. Moscow : NRU “Higher School of Economics”, 2022. URL: https://www.economy.gov.ru/material/file/ba6a7585c4b23c85931aace99682ad30/belaya_kniga_2022.pdf (accessed: 21.02.2022). (In Russian).

¹⁵ WIPO Technology Trends 2019 — Artificial Intelligence. Geneva : WIPO, 2019. P. 61—63. URL: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_1055.pdf (accessed: 21.02.2022).

researchers who work faster and have a language advantage to describe results faster... We must learn to protect our own interests in terms of intellectual property rights, commercialization developments and military applications” (Qiu, 2016, p. 541).

From the very beginning, the creators of AI technologies were inspired by fundamental research of the human brain. One of the pioneers in the field of AI, Marvin Lee Minsky, outlined the main goal of one of his famous works as follows: “Develop theories about how the human brain works, and develop a mechanism capable of feeling and thinking. Then we can try to use the received ideas both to study ourselves and to develop artificial intelligence” (Minsky, 2006, p. 9). Today, only seven countries in the world are implementing their own large-scale brain research projects: the EU (Human Brain Project, 2013), the USA (BRAIN Initiative, 2013), Japan (Brain / MINDS, 2013), Australia (Australian Brain Alliance, 2016), China (China Brain Project, 2016), South Korea (Korea Brain Initiative, 2016), Canada (Canadian Brain Research Strategy, 2017) (Vykhodets & Ruschin, 2021).

The key research priorities of national projects on the study of the human brain unambiguously fix the fundamental discoveries of neuroscience as the main source of development of AI technologies. For example, one of the leaders of the China Brain Project emphasizes that one of the two main areas of the project, along with brain medicine, is the development of AI technologies (Poo et al., 2016).

For many years, Russian specialists have emphasized the high importance of brain science for the development of AI technologies. For example, K.V. Anokhin in one of his articles directly pointed out that the creation of new AI systems is largely due to fundamental research in neurophysiology (Anokhin, 2010, p. 61). Eight years after the start of the first national projects to study the human brain, in the summer of 2021, the media reported that the Russian government was planning to launch the

Brain: Health, Intellect, Innovations program developed by the Russian Academy of Sciences with a budget of 54 billion rubles until 2029.¹⁶

Thus, today the circle of countries that have reached the world’s leading positions in the field of AI has been determined. While many AI developments are now taking off globally, there is a disproportionate distribution of benefits in favor of countries able to support the full range of AI scientific and technological innovations, reinforcing international inequalities.

Large AI Spaces

Scientific and technological leadership gives a state significant advantages in the global system of division of labor and in the global political arena. At the same time, of no less importance than the high step on the technological ladder in the world policy space is the integration potential associated with developments in the field of AI, which is manifested in investments, education, technology transit, multilateral infrastructure projects, development and dissemination of norms, standards, ethical principles, approaches to ensuring security, etc. when creating and introducing AI technologies.

The global technological trend in the development of AI today largely determines the context of bilateral and multilateral relations between countries, shapes a new agenda in integration projects, and contributes to the active development of international cooperation.

Expert groups on AI are being created at the level of international organizations. For example, in February 2020, the first meeting of the OECD Expert Network on Artificial Intelligence was held.¹⁷ High-Level Expert Group on Artificial Intelligence was set up within the European

¹⁶ Brain Government [Мозгоправительство] // Kommersant. August 22, 2021. No. 105. P. 7. (In Russian).

¹⁷ List of Participants in the OECD Expert Group on AI (AIGO) // OECD. URL: <https://oecd.ai/en/list-of-participants-oecd-expert-group-on-ai> (accessed: 03.03.2022).

Commission.¹⁸ UNESCO hosts Expert Group on Guidelines for the Ethics of Artificial Intelligence.¹⁹

International platforms and major international forums are actively developing. These include AI for Good Global Summit (UN-sponsored),²⁰ AI Partnership for Defense (organized by the Joint Center for Artificial Intelligence and the US Department of Defense),²¹ China — ASEAN AI Summit (organizers: China Science and Technology Association, Guangxi Zhuang Autonomous Region).²²

At the same time, the struggle for technological leadership in modern conditions fits into a wider context of geopolitical contradictions and often goes beyond ordinary competition, manifesting itself as one of the main components of the sanctions policy. Instead of comprehensive international cooperation, open platforms for the exchange of knowledge, experience and talent, there is an increasing trend towards technological decoupling — concentration of technology and technological isolation (Leksyutina, 2020). Two large spaces in the field of AI arena are emerging on the international stage.

The first space is formed along the line of the OECD with the unconditional leadership of the US and the EU in the field of research,

¹⁸ High-level Expert Group on Artificial Intelligence // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/expert-group-ai> (accessed: 03.03.2022).

¹⁹ Recommendation on the Ethics of Artificial Intelligence // UNESCO. URL: <https://ru.unesco.org/artificial-intelligence/ethics> (accessed: 24.02.2022).

²⁰ 2020 AI for Good Global Summit to Scale AI-powered Problem Solving for Global Impact // AI for Good. URL: <https://aiforgood.itu.int/2020-ai-for-good-global-summit-to-scale-ai-powered-problem-solving-for-global-impact/> (accessed: 03.03.2022).

²¹ National Artificial Intelligence Initiative: Overseeing and Implementing the United States National AI Strategy // U.S. Government. URL: <https://www.ai.gov/> (accessed: 03.03.2022).

²² 17th China — ASEAN EXPO // ASEAN. December 1, 2020. URL: <https://asean.org/17th-china-asean-expo-china-asean-business-investment-summit-conclude/> (accessed: 03.03.2022).

development, infrastructure, resources, and international standards. In May 2019, OECD member countries adopted the AI Principles, based on the OECD Council on Artificial Intelligence Recommendations, which set standards for national policy and international cooperation on AI development in areas such as privacy, digital security risk management and responsible business conduct. In addition to OECD members, Argentina, Brazil, Costa Rica, Malta, Peru, Romania and Ukraine also adhered to the Principles.²³

In June 2020, the Global Partnership on Artificial Intelligence (GPAI) was created, a multi-stakeholder initiative developed within the G7, whose participants today are Australia, Belgium, Brazil, Canada, Czech Republic, Denmark, France, Germany, India, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Poland, Republic of Korea, Singapore, Slovenia, Spain, Sweden, UK, US, and EU. At the same time, the OECD Secretariat is a permanent observer in the governing bodies of GPAI and sends experts to participate in working groups and the annual plenary meeting of the multi-stakeholder group of experts.²⁴

These two initiatives bring together the world's major AI leaders, creating a large space for cooperation based on common principles and approaches to standards, security, business and implementation. Within this framework, bilateral and multilateral formats for AI cooperation are actively developing. For example, in July 2018, India and the UAE signed a memorandum of understanding and cooperation in the development of AI innovation ecosystems²⁵; in

²³ Recommendation of the Council on Artificial Intelligence. Legal 0449. Adopted on: 22.05.2019 // OECD Legal Instruments. URL: <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449> (accessed: 28.12.2021).

²⁴ About GPAI // The Global Partnership on Artificial Intelligence. URL: <https://gpai.ai/about/> (accessed: 25.12.2021).

²⁵ Invest India and UAE Ministry Sign MoU for Technological Cooperation // Press Information Bureau, Government of India, Ministry of Commerce & Industry. July 27, 2018. URL: <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1540480> (accessed: 25.12.2021).

October 2019, France and Germany signed a roadmap for the Franco-German Research and Innovation Network on AI²⁶; in October 2020, India and Japan completed an agreement that focuses on cooperation in digital technologies, including 5G and AI²⁷; in September 2020, the United States and the United Kingdom signed a declaration on cooperation in the field of AI.²⁸

Some authors point to a characteristic feature of the Western approach to international scientific and technological cooperation, which is the emergence of politically motivated large-scale research projects, closely woven into a broad integration context (Ulnicane, 2020, p. 79). For example, official EU documents clearly establish the priority of cooperation in the field of AI with developed countries that have a strong position in the field of R&D and investment.²⁹

It should be emphasized that the focus of the most developed countries on prioritising cooperation, primarily among themselves, as well as putting forward their own principles and vision of how AI should develop as a condition for cooperation with other countries in this area, creates the basis for building artificial barriers that prevent development of international cooperation and contributing to the strengthening

of the technological isolation of developing countries. In this aspect, some researchers point out: “There are many obstacles to the progressive development of AI technologies in African countries. One of the most urgent tasks for African states is a serious qualitative modernization of the education system in order to increase fundamental digital literacy” (Pantserev, 2020, p. 32).

Such a policy largely contributes to the formation of an alternative competitive space, into which countries are beginning to be drawn, for which the range of opportunities for cooperation with the collective West has recently narrowed sharply.

The second space is based on the technological and financial power of China. Between 2015 and 2018, China adopted strategic AI development programs at various levels that provided a systematic approach, control and burden sharing for the industry as a whole, which, coupled with large-scale government funding, enabled China to become a world leader in AI (Reshetnikova, Pugacheva & Lukina, 2021; Strukova, 2020).

In the global AI arena, China has a data and implementation advantage, making it an ideal location for companies in any industry to develop new high-tech directions. In this regard, the rapid growth of the Chinese AI market is quite natural: more than 44% per year, while the global figure is about 26%.³⁰ Of the top-50 global AI companies with the highest growth rates in the world, 14 are resident in China.³¹

China’s AI technology goals look rather ambitious. Table 2 presents two priority areas of the 2017 Next Generation Artificial Intelligence Development Plan, as well as planned financial indicators within three milestones.

²⁶ French-German Declaration of Toulouse (16 October 2019) // Ministère de l’Europe et des Affaires étrangères. URL: <https://www.diplomatie.gouv.fr/en/country-files/germany/events/article/french-german-declaration-of-toulouse-16-oct-19> (accessed: 25.12.2021).

²⁷ India, Japan Finalise Pact for Cooperation in 5G, AI, Critical Information Infrastructure // The Economic Times. October 7, 2020. URL: <https://economictimes.indiatimes.com/news/defence/india-japan-finalise-pact-for-cooperation-in-5g-ai-critical-information-infrastructure/articleshow/78534833.cms> (accessed: 25.12.2021).

²⁸ Declaration of the United States of America and the United Kingdom of Great Britain and Northern Ireland on Cooperation in AI Research and Development // Gov.uk. September 25, 2020. URL: <https://www.gov.uk/government/publications/declaration-of-the-united-states-of-america-and-the-united-kingdom-of-great-britain-and-northern-ireland-on-cooperation-in-ai-research-and-development> (accessed: 25.12.2021).

²⁹ A European Approach to Artificial Intelligence // European Commission. URL: <https://digital-strategy.ec.europa.eu/en/policies/strategy-artificial-intelligence> (accessed: 15.11.2021).

³⁰ The AI Ecosystem in China 2020 // Daxue Consulting. March, 2020. URL: <https://daxueconsulting.com/wp-content/uploads/2020/03/AI-in-China-2020-White-Paper-by-daxue-consulting-2.pdf> (accessed: 28.12.2021).

³¹ Global Artificial Intelligence Industry Whitepaper // Deloitte. URL: <https://www2.deloitte.com/cn/en/pages/technology-media-and-telecommunications/articles/global-ai-development-white-paper.html> (accessed: 28.12.2021).

Table 2

Goals of AI-Development in China, 2020—2030

Year	Priority Areas	Planned Financial Indicators
2020	Big data intelligence, autonomous intelligence systems, cross-medium intelligence, swarm intelligence, hybrid enhanced intelligence, AI foundational theories	Core industry revenue of RMB 150 bln; AI related industry revenue of RMB 1,000 bln
2025	Intelligent manufacturing, intelligent medicine, intelligent city, intelligent agriculture, national defense construction, AI laws and regulations, AI security assessment and control capabilities	Core industry revenue of RMB 400 bln; AI related industry revenue of RMB 5,000 bln
2030	Social governance, national defense construction, industrial value chain	Core industry revenue of RMB 1,000 bln; AI related industry revenue of RMB 10,000 bln

Source: Hsin i tai jen kung chih neng fa chan kuei hua te t'ung chih [State Council Notice for the Release of the Next Generation Artificial Intelligence Development Plan] // Government of the People's Republic of China. July 8, 2017. URL: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm (accessed: 10.01.2022). (In Chinese).

Analyzing China's success in the development of high technologies over the past 20 years, some authors point out that China has already reached the forefront in a number of areas and has prepared the conditions for a scientific and technological "jump" (Kheyfets, 2020). Today, China has reached the level of technological, financial and competence power in order to convert its scientific and technological achievements into international political influence.

At the international level, China's cooperation with other countries in the field of AI is often included in a broader context related to the high technologies of the fourth industrial revolution, primarily through the Digital Silk Road initiative, which is the technological dimension of the One Belt, One Road (OBOR) integration megaproject. The content and

structure of the "Digital Silk Road" is revealed in a number of strategic documents adopted in 2015—2019: "Made in China 2025," "Manufacturing Superpower," "Big Data Strategy," "Cloud Technology Development Strategy," "Internet Plus," "Cyber-sovereignty," etc. (Liu & Avdokushin, 2019).

According to some authors, the Digital Silk Road has become one of China's priorities, aimed at reducing production costs, increasing the global competitiveness of Chinese products and increasing trade with countries participating in the initiative (Balakin & Alikberova, 2019, p. 313). At the same time, when implementing the Digital Silk Road, China focuses not only on next-generation technologies, but also relies on next-generation markets. For example, more than half of the world's population growth by 2050 is expected in Africa, where Huawei has built 70% of its 4G networks. A Chinese submarine cable linking Pakistan and Djibouti will be the shortest Internet connection between Asia and Africa, two regions where international bandwidth has grown the fastest in recent years. China even positions itself as a central link between Nigeria and Belarus, which, with the assistance of Beijing, signed a contract to provide backup services for each other (Hillman, 2021).

This approach greatly enhances China's international political influence by claiming to be the most active in setting norms and standards in the field of high-tech and cybersecurity. Some scholars have focused on AI-related threats in discussions of cybersecurity models, pointing to a range of such threats to individuals and society (Kefeli, 2020, p. 47).

Therefore, the vision and approaches in this area, based on financial and technological strength, will allow China to play a leading role in defining the principles of international agreements, for example, in the process of developing common principles for international cybersecurity at the UN level. Under the already mentioned "Next Generation Artificial Intelligence Development Plan," China is actively embarking on the creation of standards

in the field of AI technology and intellectual property, the development of safety monitoring and evaluation systems, and their promotion in international standardization organizations such as ISO, IEEE, WIPO.³² It is because of China's success in the field of advanced technologies that President Donald Trump launched an all-out trade and economic war with Beijing, which includes duties, export controls, repression against Chinese scientists, and sanctions against Chinese high-tech companies (Park, 2020).

Thus, at the international level in the field of AI technology development, there is currently a process of “closure” of scientific and technological development in this area within the framework of two large technological spaces in the context of a more general trend of decoupling of the US and Chinese economies (Vinogradov, Salitsky & Semenova, 2019). According to some researchers, the ideology of decoupling of the world's two largest economies is centered on advanced digital technologies (5G communication standard, Internet of things, big data, artificial intelligence, etc.), which are of fundamental importance for the economy of the future and, more broadly, for strengthening China and USA geopolitical influence (Danilin, 2020, p. 161). Despite the fact that in certain high-tech areas, dependence on the United States remains, primarily in the production of semiconductors and microchips, China is forming an alternative to the Western space in the field of the most advanced technologies, relying on which it is increasingly projecting its geopolitical ambitions.

Russia between Large AI Spaces

The formation of the state policy in the field of AI began in Russia in 2019 with the adoption of the National Strategy for the Development of

³² Hsin i tai jen kung chih neng fa chan kuei hua te t'ung chih [State Council Notice for the Release of the Next Generation Artificial Intelligence Development Plan] // Government of the People's Republic of China. July 7, 2017. (In Chinese). URL: http://www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm (accessed: 10.01.2022).

Artificial Intelligence for the period up to 2030. As a follow-up to the Strategy, in 2020 the federal project “Artificial Intelligence” was developed and adopted, containing a roadmap of specific activities and planned key indicators until 2024. According to the documents, Russia should take one of the leading positions in the world in this area. It is assumed that by 2024 Russia will significantly improve its position in the development of AI technologies, and by 2030 it will close the gap with developed countries and achieve world leadership in certain areas related to AI. The Strategy emphasizes that “the Russian Federation has significant potential to become one of the international leaders in the development and use of artificial intelligence technologies”.³³

Higher education institutions and large companies are the main centers of competence and growth drivers of AI technologies. Thus, the Government of the Russian Federation has identified 6 research centers in the field of AI: Skolkovo Institute of Science and Technology, Moscow Institute of Physics and Technology, Higher School of Economics, ITMO, Innopolis University, Institute for System Programming of the Russian Academy of Sciences. These organizations will receive RUR 900 mln budget funding until 2024 to conduct R&D and create applied solutions in the field of AI. Russian companies have created individual products based on world-class AI — Yandex voice assistant Alisa, Salyut virtual assistant and SmartSpeech speech recognition solution from Sberbank, Digital Oil and Cognitive Geologist from Gazprom Neft PJSC.³⁴

³³ Decree of the President of the Russian Federation “On the development of artificial intelligence in the Russian Federation” No. 490 dated 10.10.2019 [Указ Президента Российской Федерации «О развитии искусственного интеллекта в Российской Федерации» № 490 от 10.10.2019] // President of Russia. (In Russian). URL: <http://static.kremlin.ru/media/events/files/ru/AH4x6HgKWA-NwVtMOiPDhcbRpvd1HCCsv.pdf> (accessed: 10.01.2022).

³⁴ Development of individual high-tech areas: White paper [Развитие отдельных высокотехнологичных направлений : Белая книга]. Moscow : NRU “Higher School of Economics”, 2022. URL: <https://www.economy.>

According to a study conducted by TAdviser together with Rostelecom, 85% of Russian companies are already using AI solutions in business.³⁵ But, despite this, against the background of world leaders, Russia's position in the field of AI looks very modest. The contribution of Russian researchers to the global volume of scientific publications on AI technologies is at the level of 1.3%, the share of patent applications is 0.2%,³⁶ Russia's share in the global AI technology market is 0.2%.³⁷

However, these low indicators, as well as rather ambitious strategic goals in the field of AI technology development, equally dissolve in a situation of uncertainty after February 24, 2022. Already at the very beginning of the special military operation of the Russian Federation on the territory of Ukraine, it became quite obvious that the conduct of active hostilities on a limited territory is part of a complex confrontation between Russia and the collective West. As a result, Russia was not just involved, but in fact, at the forefront of global decoupling, which, after the outbreak of hostilities, acquired additional dimensions. The geoenergy, monetary and financial, informational and military dimensions have been added to the previously existing economic and technological ones, and in each of them the confrontation is becoming more and more acute.

gov.ru/material/file/ba6a7585c4b23c85931aace99682ad30/belaya_kniga_2022.pdf (accessed: 21.02.2022). (In Russian).

³⁵ Effects from the implementation of solutions based on artificial intelligence in Russian companies [Эффекты от внедрения решений на базе искусственного интеллекта в российских компаниях] // Rostelecom, TAdviser. (In Russian). URL: https://www.tadviser.ru/images/8/89/ROSTELECOM_AI_0112.pdf (accessed: 10.01.2022).

³⁶ Ibid.

³⁷ Roadmap for the development of "end-to-end" digital technology "Neurotechnologies and artificial intelligence" [Дорожная карта развития «сквозной» цифровой технологии «Нейротехнологии и искусственный интеллект»] // Ministry of Digital Development, Telecommunications and Mass Media of the Russian Federation. (In Russian). URL: <https://digital.gov.ru/ru/documents/6658/> (accessed: 10.01.2022).

A few days after recognising the sovereignty of the Lugansk (LPR) and Donetsk (DNR) People's Republics and the start of a special military operation, Russia became the absolute leader in terms of the number of sanctions imposed against it. Of course, the Russian high-tech sector also came under attack. Leading manufacturers of microprocessors Intel and AMD have suspended imports of their products to Russia,³⁸ Taiwanese TSMC, the world's largest manufacturer of semiconductors and microcircuits, joined these restrictions.³⁹ The latter fact significantly exacerbates the existing backlog of Russia in the electronic component base. Thus, the future of Baikal and Elbrus processors, which were supposed to become an alternative to the products of the collective West, turned out to be a big question in connection with the decision of TSMC. Similar restrictions exist for software. In addition, there is an outflow of highly qualified IT specialists from Russia, the question of the return of which in the future, according to some experts, has not yet been answered.⁴⁰

There is an opinion that the situation will change very quickly due to the establishment of logistics chains for the supply of sanctioned high-tech products through third countries. However, in this case, one should expect an increase in the cost of such supplies, which may

³⁸ Integral Outcome: AMD and Intel Have Suspended Deliveries of Their Products to Russia [Интегральный исход: AMD и Intel приостановили поставки своей продукции на территорию России] // RBC. February 27, 2022. (In Russian). URL: https://www.rbc.ru/technology_and_media/27/02/2022/621a7f4f9a79473d8899b18d (accessed: 28.02.2022).

³⁹ The Sanctions Curtain: What Restrictions on Technology Imports Await Russia [Санкционный занавес: какие ограничения на импорт технологий ждут Россию] // Interfax. February 25, 2022. (In Russian). URL: <https://www.interfax.ru/digital/824627> (accessed: 28.02.2022).

⁴⁰ Kaspersky: "Herd" of IT Specialists Left Russia [Касперская: Россию покинул «табун» IT-специалистов] // Gazeta.ru. March 22, 2022. (In Russian). URL: <https://www.gazeta.ru/tech/news/2022/03/22/17460589.shtml> (accessed: 22.03.2022).

adversely affect the investment opportunities and competitiveness of Russian companies.

In the context of global uncertainty which is becoming systemic in the face of an escalating sanctions policy, the possibilities for building long-term development strategies, as well as their theoretical understanding, are quite limited. However some significant points regarding Russian AI policy should be emphasized.

Despite the existing positive examples of cooperation with Western countries in the field of AI, after the first sanctions attacks in 2014 Russia increasingly gravitated towards the Chinese big AI space. In 2022, this path seems to have no alternative, at least in the short term. At the same time, it should be taken into account that while maintaining the public neutrality of the Chinese government there is more and more information about the tacit observance by companies from the PRC of the sanctions regime against Russia.⁴¹ In the event of mass confirmation of such facts, Russia faces serious risks of finding itself in a situation of technological autarchy with a gradually widening gap in the field of high technologies.

The global technological confrontation also plays the role of a centrifugal force in the most important integration formats for Russia which threatens to lose its leadership role in them. For example, Russia's partners in the EAEU, even before the start of the acute phase of decoupling, were guided by Chinese technologies. For example, Huawei published its national ICT priorities for the Republic of Belarus in May 2018, which include recommendations on "public safety" technologies such as video surveillance, drones, citizenship identification systems.⁴²

⁴¹ Have Chinese Companies Secretly Joined the West's Sanctions against Russia? What Is Known [Китайские компании тайно присоединились к санкциям Запада против России? Что известно] // *Telegraf.by*. March 10, 2022. (In Russian). URL: <https://telegraf.by/ehkonomika/kitajskik-kompanii-tajno-prisoedinilis-k-sankciyam-zapada-protiv-rossii-chto-izvestno/> (accessed: 11.03.2022).

⁴² Cave D., Ryan F., Xu V.X. Mapping More of China's Tech Giants: AI and Surveillance // *Australian*

Among the EAEU member states only Russia has a national AI development strategy that includes technological development and ethical aspects of AI application as the main priorities. At the same time at the EAEU level the issue of the need to develop a unified allied policy in the field of AI is more of a subject of expert discussions and the topic of political statements included in the broader context of the "digital agenda" than the sphere of political management. For example, in February 2018 the Eurasian Economic Commission (EEC) launched an expert platform on the data economy and regulation of data circulation, one of the areas of work of which is the development of an EAEU strategy for the development of AI technologies.⁴³ This situation paves the way for the EEU member states to be "dragged" into the policy orbit of stronger powers, which, in turn, will have a negative impact on the internal integration potential. At the same time, a scenario is not ruled out, in which Russia from a technological metropolis in the format of the EAEU will become dependent on the import of Western and Chinese technologies from partner countries.

However, some experts point to the dependence of many Western countries on the supply of certain Russian goods of critical importance, such as hydrocarbons, grain, fertilizers, the reorientation of supplies of which to the markets of Southeast Asia will contribute to the rejection of the sanctions policy.⁴⁴

In the context of the well-known international discrediting of Western monetary

Strategic Policy Institute. November 28, 2019. URL: www.aspi.org.au/report/mapping-more-chinas-tech-giants (accessed: 17.12.2021).

⁴³ Collection "Digital Agenda of the EAEU 2016—2019—2025" [Сборник «Цифровая повестка ЕАЭС 2016—2019—2025»]. Moscow: Eurasian Economic Commission, 2019. P. 137. (In Russian).

⁴⁴ Glazev S.Yu. Win and Build a New World Economy [Побеждать и строить новый мирохозяйственный уклад] // *Glazev.ru*. April 16, 2022. URL: <https://glazev.ru/articles/6-jekonomika/101067-pobezhdat-i-stroit-novyy-mirokhozjajstvennyy-uklad> (accessed: 16.04.2022). (In Russian).

and financial instruments, it is more likely that alternative systems will receive further impetus. For example, within BRICS, India, China and Russia are working on the BRICS Pay, an international payment system⁴⁵ that is largely based on AI technologies. BRICS Pay can be considered as a real alternative to the SWIFT system, not only when making purchases on the territory of the participating countries, but also when trading with countries under Western sanctions.

Russia's actions to support the information technology industry in the face of sanctions should also be pointed out. Recent political decisions include budget subsidies for Russian companies operating in the IT sector zero income tax, as well as a number of support measures for employees of such companies including a preferential mortgage rate and deferment from the army.⁴⁶

In addition to mobilizing internal resources for progressive technological development in the field of AI, Russia needs to focus on multilateral cooperation to develop its own scientific and technological developments in this field and to preserve its relative technological sovereignty.

Conclusion

Artificial intelligence is a priority direction of the scientific and technical policy of many countries. Mastering AI technologies and introducing them into production promises states significant economic benefits and leading positions in the global system of labor division.

The leaders in the global technological race for AI are the EU, China and the US, which have technological sovereignty in this area. This is

⁴⁵ BRICS Pay // BRICS Digital Bank. URL: <https://digitalbankbrics.com/index.php/ru/brics-pay> (accessed: 11.03.2022).

⁴⁶ Decree of the President of the Russian Federation of March 2, 2022 No. 83 [Указ Президента Российской Федерации от 02.03.2022 г. № 83 «О мерах по обеспечению ускоренного развития отрасли информационных технологий в Российской Федерации»] // President of Russia. (In Russian). URL: <http://kremlin.ru/acts/bank/47593> (accessed: 11.03.2022).

confirmed by data on the volume of investments, the presence of our own fundamental scientific research and R&D, the infrastructure necessary for the development of AI etc.

In the international arena, there is a process of formation of two large spaces in the field of artificial intelligence technologies:

— *the first space* brings together the OECD countries with the unconditional financial, technological and value-normative dominance of the US and the EU;

— *the second space* is formed around China, whose orbit includes countries for which cooperation with the West is complicated by a wide range of international contradictions; Russia is one of these countries.

The interaction between the two AI spaces follows the general decoupling trend of the US and Chinese economies, which in turn contributes to the development of technological isolation trends at the global level and the formation of a bipolar “world-system.”

In the conditions that are developing after February 24, 2022, Russia faces a non-trivial task — not to remain on the sidelines of global technological progress and at the same time not to lose its sovereignty in the field of high technology, while maintaining, albeit in a limited form, the possibilities of multilateral cooperation with leading players.

Russia, located between two large AI spaces, is interested in maintaining multi-vector cooperation in the field of AI and developing its own R&D in priority areas, while at the same time offering partners unique developments and opportunities for cooperation in those areas in which they are most interested. As for China, this area should primarily include projects related to geo-positioning and unmanned vehicle control, including military developments. Obviously this direction acquires synergies in conjunction with the close cooperation between the two countries in building the Chinese early warning system (missile attack warning system).

A key opportunity to engage with the AI Space of the West is AI-based developments for

the environment. Thus, in November 2021, the GPAI working group developed a strategic document “Climate Change and AI: Recommendations for Government Action,”⁴⁷ which is a milestone in developing a global

strategy for responsible deployment of AI to combat climate change and biodiversity conservation under the Paris Agreement.

The most important aspect for Russia in the development of AI technology seems to be to depoliticise the field, or at least keep it at a “low” policy level, which would enable progressive development and multilateral cooperation with all of today’s leading actors.

⁴⁷ Climate Change and AI: Recommendations for Government Action // The Global Partnership on Artificial Intelligence. November, 2021. URL: <https://gpai.ai/projects/responsible-ai/environment/climate-change-and-ai.pdf> (accessed: 10.01.2022).

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References

- Anokhin, K. V. (2010). The last great frontier of the life sciences. *Economic Strategies*, 12(11), 56—63. (In Russian).
- Arute, F., Arya, K., Babbush, R., Bacon, D., Bardin, J. C., et al. (2019). Quantum supremacy using a programmable superconducting processor. *Nature*, 574, 505—510. <https://doi.org/10.1038/s41586-019-1666-5>
- Balakin, D. A., & Alikberova, A. R. (2019). Digital Silk Road in the context of the People’s Republic of China. *Opción*, 35(22), 308—318.
- Danilin, I. V. (2020). The U.S. — China technology war: Risks and opportunities for P.R.C. and global tech sector. *Comparative Politics Russia*, 11(4), 160—176. (In Russian). <https://doi.org/10.24411/2221-3279-2020-10056>
- Giglavay, A. V., Sokolov, A. V., Abdrakhmanova G. I., Chulok, A. A., & Burov, V. V. (2013). Long-term trends in the ICT sector. *Foresight-Russia*, 7(3), 6—24. (In Russian).
- Hillman, J. E. (2021). *The Digital Silk Road: China’s quest to wire the world and win the future*. London: Harper Business.
- Kefeli, I. F. (2020). *Asphatronics: On the way to the theory of global security*. Saint-Petersburg: IPC SZIU RANHiGS publ. (In Russian).
- Kheyfets, B. A. (2020). China’s technological rise: New challenges for Russia. *Voprosy Ekonomiki*, (6), 104—120. (In Russian). <https://doi.org/10.32609/0042-8736-2020-6-104-120>
- Leksyutina, Y. V. (2020). U.S. — China Relations in 2018—2019: Trade war and the process of decoupling. *World Economy and International Relations*, 64(6), 85—93. (In Russian). <https://doi.org/10.20542/0131-2227-2020-64-6-85-93>
- Liu, Y., & Avdokushin, E. F. (2019). Forming the foundations of the “Digital Silk Road”. *The World of the New Economy*, 13(4), 62—71. (In Russian). <https://doi.org/10.26794/2220-6469-2019-13-4-62-71>
- Minsky, M. (2006). *The emotion machine: Commonsense thinking, artificial intelligence, and the future of the human mind*. New York: Simon & Schuster.
- Pantserev, K. A. (2020). States of Sub-Saharan Africa on the way to the creation of the artificial intelligence: The myth or the reality? *Asia and Africa Today*, (10), 29—33. (In Russian). <https://doi.org/10.31857/S032150750011108-0>
- Park, S. (2020). Trade conflict between the U.S. and China: What are the impacts on the Chinese economy? *International Organisations Research Journal*, 15(2), 213—235. <https://doi.org/10.17323/1996-7845-2020-02-10>
- Poo, M., Du, J., Ip, N. I., Xiong, Z., Xu, B., et al. (2016). China Brain Project: Basic neuroscience, brain diseases, and brain-inspired computing. *Neuron*, 92(3), 591—596 <https://doi.org/10.1016/j.neuron.2016.10.050>
- Qiu, J. (2016). Research and development of artificial intelligence in China. *National Science Review*, 3(4), 538—541. <https://doi.org/10.1093/nsr/nww076>

- Reshetnikova, M. S., Pugacheva, I. A., & Lukina, Yu. D. (2021). Trends in the development of artificial intelligence technologies in China. *Russian Journal of Innovation Economics*, 11(1), 333—350. (In Russian). <https://doi.org/10.18334/vinec.11.1.111912>
- Schwab, K. (2019). Globalization 4.0. A new architecture for the fourth industrial revolution. *Eurasian Integration: Economics, Law, Politics*, (1), 79—84. (In Russian).
- Strukova, P. E. (2020). Artificial intelligence in China: The current state of industry and development trends. *Vestnik of Saint Petersburg University. Asian and African Studies*, 12(4), 588—606. (In Russian). <https://doi.org/10.21638/spbu13.2020.409>
- Ulnicane, I. (2020). Ever-changing big science and research infrastructures: Evolving European Union policy. In K. C. Cramer & O. Hallonsten (Eds.), *Big science and research infrastructures in Europe* (pp. 76—100). Cheltenham: Edgar Elgar. <https://doi.org/10.4337/9781839100017.00010>
- Vinogradov, A. O., Salitsky, A. I., & Semenova, N. K. (2019). US — China economic confrontation: Ideology, chronology, meaning. *Vestnik RUDN. International Relations*, 19(1), 35—46. (In Russian). <https://doi.org/10.22363/2313-0660-2019-19-1-35-46>
- Vykhodets, R. S., & Ruschin, D. A. (2021). The role of big brain science in technological leadership in artificial intelligence. *Society. Environment. Development*, (3), 11—16. (In Russian).
- Zhong, H., Wang, H., Deng, Y., Chen, M., Peng, L., et al. (2020). Quantum computational advantage using photons. *Science*, 370, 1460—1463. <https://doi.org/10.1126/science.abe8770>

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