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BEYOND INDUSTRY 4.0 AND COMPETITION: DATA AND INFORMATION TECHNOLOGY MARKETS AS A BATTLEFIELD FOR DIGITAL LEADERSHIP

ЗА МЕЖАМИ ІНДУСТРІЇ 4.0 І КОНКУРЕНЦІЇ: РИНКИ ДАНИХ Й ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ ЯК АРЕНА ЗМАГАННЯ ЗА ЦИФРОВЕ ЛІДЕРСТВО

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Abstract. *The purpose of the article is to analyze the transformational potential of the digital economy as an environment for acquiring new competitive characteristics in the context of global innovation and technological competition. Groups of countries are identified according to the criterion of technological leadership. The importance of institutional support for innovative development is noted and the technological development strategies of key players in the innovation race are analyzed. The article analyzes the strategy of the PRC government to implement a digital economy integrating ICT and transformed factors of production as the main economic structure, the key innovative and strategically important resource of which is data resources, and their leading carrier is information networks. The advantages of the digital platform economy are analyzed. Key technologies of the digital economy are highlighted, with an emphasis on the role of*

big data, the IoT, cloud technologies, augmented reality technologies. We have included the following technological drivers that ensure the close interconnection of data and ICT markets in the context of the emergence of global digital competition: (1) artificial intelligence and machine learning; (2) cloud computing; (3) Internet of Things; (4) Big Data. It has been established that the growth of demand for cybersecurity solutions is a key driver of the growth of the interdependence of data and ICT markets. Analysis of the relationship between the data market and the ICT market indicates their deep structural integration and interdependence. The main characteristics of this relationship are: (1) technological convergence; (2) economic synergy (organizations that effectively combine ICT technologies with data analytics demonstrate significantly higher profitability and competitiveness); (3) global growth trends; (4) regional differentiation.

The concepts of IoT, Industrial IoT and Industry 4.0 are compared. It is established that, unlike Industry 4.0, which focuses on production and management of production processes, the cornerstone of the use of IoT is the collection and analysis of data. All three concepts are realized through the use of new technologies. The role of artificial intelligence and machine learning in the digitalization of economic relations is emphasized. The role of Data Science tools in foresight analysis is defined. Attention is focused on the role of Big Data in the development of the digital economy and on the transformation of the role of information as a factor of production. The impact of Data Science tools on costs, profitability and profitability of business, on the specifics of choosing a business model using digital technologies for managing business risks is characterized. We attribute the following economic effects of digitalization and platformization: changes in the life cycle of economic development strategy; changes in the ratio of strategic and tactical development goals; changes in business cycles; changes in approaches to competition; changes in approaches to pricing; automation and modification of business processes; revision of management systems; management of transaction costs; formation of a new economic and social environment; changes in business processes; reformatting of value chains; reformatting of supply chains; formation of a new economic geography.

Key words: *technological development, techno-globalism, international competitiveness, competition, digitalization, inclusiveness, technology transfer, digital economy, digital inclusion, digital technologies, digital risk, strategic management, CRM, Internet of Things, AI, Industry 4.0, ICT, ICT infrastructure, IT sector, IT services market, ICT market, data market, AR, Big Data, startup, Digital Silk Road, China, USA, EU, Germany.*

Анотація. *Мета статті полягає в аналізі трансформаційного потенціалу цифрової економіки як середовища набуття нових конкурентних ознак в умовах глобального інноваційного й технологічного суперництва. Виокремлено групи країн за критерієм технологічного лідерства. Відзначено важливість інституційного сприяння інноваційному розвитку та проаналізовано стратегії технологічного розвитку ключових гравців інноваційних перегонів. Проаналізовано стратегію уряду КНР до впровадження цифрової економіки, що інтегрує в собі ІКТ та трансформовані фактори виробництва, як основного економічного укладу, ключовим інноваційним та стратегічно важливим ресурсом у якому є ресурси даних, а провідним їх носієм – інформаційні мережі. Проаналізовано переваги цифрової платформної економіки. Виокремлено ключові технології цифрової економіки з акцентом на ролі великих даних, Інтернету речей, хмарних технологій, технологій доповненої реальності. До технологічних драйверів, що забезпечують тісний взаємозв'язок ринків даних та ІКТ в умовах становлення глобальної цифрової конкуренції, нами зараховано: (1) штучний інтелект та машинне навчання; (2) хмарні обчислення; (3) Інтернет речей; (4) Big Data.*

Встановлено, що зростання попиту на рішення кібербезпеки є ключовим драйвером зростання взаємозалежності ринків даних і ринків ІКТ. Аналіз взаємозв'язку ринку даних і ринку ІКТ свідчить про їх глибоку структурну інтеграцію та взаємозалежність. Основними характеристиками цього взаємозв'язку є: (1) технологічна конвергенція; (2) економічна

синергія (організації, що ефективно поєднують ІКТ-технології з аналітикою даних, демонструють значно вищі показники прибутковості та конкурентоспроможності); (3) глобальні тренди зростання; (4) регіональна диференціація. Здійснено порівняння концепцій IoT, Промислового IoT та Індустрії 4.0. Встановлено, що на відміну від Індустрії 4.0, яка фокусується на виробництві та управлінні виробничими процесами, наріжним у використанні IoT стає збір та аналіз даних. Усі три концепції реалізують себе за допомогою нових технологій. У цифровізації економічних відносин підкреслено роль штучного інтелекту та машинного навчання. Визначено роль інструментів Data Science у форсайт аналізі. Акцентовано увагу на ролі Великих даних у розвитку цифрової економіки та на трансформації ролі інформації як фактора виробництва. Охарактеризовано вплив інструментів Data Science на витрати, прибутковість та рентабельність бізнесу, на особливості вибору бізнес-моделі із застосуванням цифрових технологій для управління бізнес-ризиками. До економічних ефектів цифровізації та платформізації ми ставимо: зміну життєвого циклу стратегії економічного розвитку; зміна співвідношення стратегічних та тактичних цілей розвитку; зміна бізнес-циклів; зміна підходів до конкуренції; зміна підходів до ціноутворення; автоматизація та модифікація бізнес процесів; перегляд систем керування; управління трансакційними витратами; формування нового економічного та соціального середовища; зміна бізнес-процесів; переформатування ланцюгів створення вартості; переформатування ланцюгів постачання; формування нової економічної географії.

Ключові слова: *технологічний розвиток, техноглобалізм, міжнародна конкурентоспроможність, конкуренція, цифровізація, інклюзивність, трансфер технологій, цифрова економіка, цифрова інклюзія, цифрові технології, цифровий ризик, стратегічний менеджмент, CRM, Інтернет речей, ШІ, Індустрія 4.0, ІКТ, ІКТ-інфраструктура, IT сектор, ринок IT послуг, ІКТ ринок, ринок даних, AR, Big Data, стартап, Цифровий шовковий шлях, КНР, США, ЄС, Німеччина.*

Introduction. Technological innovations have a positive impact on the rate of economic growth, which once again confirms the key role of innovation in increasing the overall productivity of production factors, reducing production costs, creating more competitive products and supporting sustainable development processes. This statement is fully consistent with the main theoretical provisions of Romer's endogenous theory of economic growth and is confirmed by numerous modern empirical studies. Numerous studies have revealed the existence of a close relationship between the level of scientific specialization of a country, the intensity of its technological (patent) activity and the degree of complexity of its export structure. Thus, countries with a developed scientific base in certain priority industries usually demonstrate a higher intensity of patent activity in technologically related areas, and also, as a rule, have a more complex export structure focused on the production and sale of products with a high share of added value. Thus, it can be argued that fundamental scientific achievements serve as a necessary basis for technological breakthroughs, which, in turn, provide the basis for a country's long-term competitiveness in international trade. that higher indicators of economic complexity – regardless of whether they are measured through the analysis of scientific output, patent activity or export structure – are an important prerequisite for accelerated GDP per capita growth in the medium and long term. In other words, countries characterized by a more complex and more diversified economic structure tend to demonstrate higher rates of economic growth. This is explained by the fact that such economies are more able to adapt effectively to rapid global technological changes, are able to generate and export products with higher added value and have better opportunities for successful integration into global high-tech value chains. Analysis of global innovation processes shows that ensuring long-term economic growth is inextricably linked to the progressive development of science, technology and increasing the level of production complexity within individual countries. Therefore, to ensure sustainable development of the global economic system, it is necessary not only to increase the internal

innovation potential of individual states, but also to create effective mechanisms for effective international technology transfer, because it is the effective international exchange of knowledge and technology that provides a real opportunity for developing countries to gradually overcome existing barriers to technological lag, as described in the model of catch-up development, and successfully integrate into modern global value chains. Therefore, effective mechanisms for the transfer of innovations and technologies are becoming an important tool not only for the implementation of national strategies for accelerated development, but also for the formation of a more just and balanced global economic order as a whole. New technologies are rapidly changing the economy and society radically, and today this is happening much more actively than in previous periods. This process is at different stages in different countries and regions, but the general trend and pattern is digital transformation.

The purpose of the article The purpose of the article is to analyze the transformational potential of the digital economy as an environment for acquiring new competitive characteristics in the context of global innovation and technological rivalry.

Literature review. The literature describes the digital imperative of the development of the global economy, namely the features of digital technologies as the basis for building a new economic system and a system of new competitive relations *(Lukyanenko.D., Pavlovskyi, D., & Sydorenko, O., 2023; Tymoshenko, M., Saienko, V., Serbov, M., Shashyna, M., & Slavkova, O., 2023).* An analysis of scientific research on the problems of digitalization of the digitalized economy *(Bennish, A., 2024; Brennen, S., & Kreiss, D., 2014)* allows us to distinguish several levels. The level of the digital economy is the ICT industry itself *(Desyatnyuk, O., Krysovatyy, A., Ptashchenko, O., & Kyrylenko, O., 2025)*, which includes information technology and telecommunications services *(Desyatnyuk, O., Krysovatyy, A., Ptashchenko, O., Kyrylenko, O., & Kurtsev, O., 2025)*. The second level – the digital economy – is the first level supplemented by network business and digital services *(Krysvatyi, A., Desiatniuk, O., & Ptashchenko, O., 2023)*, as well as those activities that are based on innovative technologies and digital business models (platform economy) (*(Reznikova, N. V., Bulatova, O. V., Shlapak, A. V., & Ivashchenko, O. A., 2023)*. The third level of the digital economy, or "digitalized economy", is based on the use of "digitized" data and includes network business, e-commerce, algorithmic economy, and digital technologies *(Reznikova, N. V., Bulatova, O. V., Shlapak, A. V., & Ivashchenko, O. A., 2023).* We draw attention to the authors' attempt to systematically comprehend the role of the digital economy in international economic development *(Perfilieva, A., Siliutina, I., Antypenko, N., & Vlasenko, D., 2022)*, taking into account a set of insoluble global problems *(Tulchynskyi, R. V., & Horbatiuk, M. R., 2023),* that actualize the transition to sustainable development *(Reznikova, N., Panchenko, V., Karp, V., Grod, M., & Stakhurska, S., 2024; Tsybuliak, A., Spasiv, N. ., Tyshchenko, O., Oliinyk, K. ., & Yermolenko, O., 2025).* The availability and widespread penetration of digital technologies for the country as a whole are assessed positively *(Bulatova, O. V., Reznikova, N. V., & Ivashchenko, O. A., 2023)*, while digitalization has negative consequences in terms of increasing regional inequality *(DiMaggio, P., & Hargittai, E.,2001)*, which exacerbates the problem of equal and fair development and forces us to reconsider approaches to defining the digital divide. In fact, the awareness of the ambiguity of the consequences of digital development on human development and the development of human and labor potential *(Panchenko, V., Reznikova, N., Ivashchenko, O., & Rusak, D.,2024)* leads to the fact that the problem of intergenerational relations *(Reznikova, N. V., Chuhaiiev, O. A., Ptashchenko, O. V., &Ivashchenko, O. A., 2023; Reznikova, N. V., Ptashchenko, O. V., Chugayev, O. A., & Ivashchenko, O. A., 2022)* is intensifying as technological globalization *(Reznikova, N. V., Bulatova, O. V., Shlapak, A. V., & Ivashchenko, O. A., 2023; Reznikova, N. V., Karp, V. S., & Ivashchenko, O. A.,2023; Zuboff, S., 2019)* intensifies, because it radically changes the concept of the right to development. Research into new forms of dependence and tools for generating competitive advantages, economic growth and development in the context of changing economic landscapes and business conditions is becoming especially relevant *(Reznikova, N. V., 2013; Reznikova, N. V., & Panchenko, V. H., 2023; Panchenko, V. H., 2018; Orlovska, Yu. V., Chala, V. S., & Varlamova, O. A.,2016).* The issue of gaining competitive advantages in the face of

increasing leadership in the digital era is central to the discussion platforms of international organizations, non-governmental organizations, business associations, and other institutional actors concerned with the problem of developing new digital markets *(Crémer, J., de Montjoye, Y.-A., & Schweitzer, H., 2019; Capobianco, A., 2022; OECD, 2022; Schallbruch, M., Schweitzer, H., & Wambach, A., 2019; McMahon, M., Calligaris, S., Doyle, E., & Kinsella, S., 2021; Monopolies Commission, n.d.; OECD, 2023).*

Main results of the research. The global information technology market includes several main segments: computer hardware (global market); communication equipment (global market); software (global market); IT services (global market); information security (global market). IT is included in a broader concept – information and communication technologies (ICT), which combines information technologies and communication services. According to the OECD classification, information and communication devices include: computers and peripheral equipment (external devices); communication equipment, consumer electronic equipment, electronic parts and components, measuring and high-precision instruments, other equipment (*OECD, 2022*). The classification of information and communication devices adopted in the USA includes: high-performance computers, personal computers, direct access storage devices, computer printers, computer terminals (for entering and displaying information), data storage devices, communication equipment, telecommunications equipment, etc. The formation of the global information technology market involves the development of the high-tech sector in terms of involving both medium-tech sectors ("structural inclusion") and regions of various types ("spatial inclusion") in the vector of technological development. Inclusivity is a property associated with the inclusion of any object in a certain phenomenon or set. The concept of "structural technological inclusion" means the involvement of medium-tech industries in the process of new industrialization and the modernization of low-tech industries. When speaking about the contribution of the IT sector to economic growth, they most often mean the contribution of IT as infrastructure: systemic, network and synergistic effects that arise when introducing IT into all sectors of the economy (*Capobianco, A.,2022)*. Of course, the ratio of the effects of the development of the IT industry as such and the effects of the actual development and implementation of IT in all sectors of the economy is not equal to one. And neither in theory nor in practice is there yet an exhaustive and unambiguous answer to the question regarding their relationship. ICT technologies expand the possibilities for achieving the goals of socio-economic development. Effective use of ICT can help organizations use their available resources more rationally and increase their competitiveness, improve economic indicators, and increase their investment attractiveness. At the macroeconomic level, the use of ICT increases the level of market competitiveness and increases expert assessments of the investment attractiveness of the national economy. The dynamic development of the information and telecommunications sector creates the basis for the prompt, organized, and effective solution of business problems within international groups. Information and telecommunications technologies are a tool for reducing transaction costs.

The implementation of information technology in the activities of companies has caused fundamental changes in their operating models. Automation of business processes has allowed organizations to significantly increase the efficiency of performing routine tasks, freeing up human resources for more strategic activities. Customer relationship management (CRM) and enterprise resource planning (ERP) systems have created opportunities for deep data analysis and making informed management decisions. Changes in communication processes have been especially revolutionary. Cloud technologies and remote collaboration tools have transformed traditional ideas about the workplace, allowing companies to attract talent regardless of geographical location. This has not only expanded the opportunities for finding qualified personnel, but also contributed to the formation of new organizational cultures focused on results, rather than physical presence. Digital platforms have radically changed customer interaction models. E-commerce, mobile applications and personalized digital services have created new sales channels and ways of providing services. Companies have gained the ability to collect and analyze vast amounts of data on consumer behavior, which has allowed them to develop more accurate marketing strategies and personalized

offers. Artificial intelligence and machine learning have opened up new horizons for optimizing business processes. Predictive analytics allows companies to anticipate market trends and customer needs, automated decision-making systems increase the speed of response to changes, and chatbots and virtual assistants provide 24/7 customer support. States have also undergone a profound transformation under the influence of information technology. The large-scale implementation of information technology has led to the emergence of new sectors of the economy and the transformation of traditional industries. The IT industry has become one of the most dynamic segments of the global economy, creating millions of jobs and generating significant investment flows. The digital economy is shaping new business models based on data exchange, the platform economy, and network effects.

We propose to consider the ICT sector, revealing each of its components.

1. IT services: Data centers, cloud computing, Artificial intelligence and BigData analytics, IT consulting services, IT outsourcing, Operational applications, Software applications.

2. ICT services - IT services, television and radio broadcasting services, publishing services.

3. ICT production - electronic components segment, computer and peripheral equipment production segment, communications equipment production segment, consumer electronics production segment.

4. ICT sector - ICT services, as well as ICT production.

Depending on their attitude towards technology, states are divided into the following groups: states that view global digital transformation as an instrument of geopolitical influence; states that introduce private digital solutions to the market; states that copy technologies; states that import technologies. In today's globalized world, countries are developing large-scale national strategies to manage technological development and maintain the competitiveness of their manufacturing sectors. These initiatives are aimed at transforming traditional manufacturing through the integration of advanced digital technologies, ensuring technological independence and creating new opportunities for economic growth. The most influential and illustrative examples of such strategies are the "Advanced Manufacturing Partnership" in the United States, the German "Industrie 4.0" initiative, the "European Factories of the Future" program, and the Chinese "Made in China 2025" strategy.

The Advanced Manufacturing Partnership (AMP) *(Manufacturing.gov, 2025)* was launched in 2011 by President Obama as a national initiative that brings together industry, universities, and the federal government to invest in new technologies. The primary goal is to create high-quality manufacturing jobs and increase the global competitiveness of the United States. The strategy focuses on three key objectives: (1) developing and deploying new manufacturing technologies; (2) educating and training the manufacturing workforce; (3) empowering domestic manufacturing supply chains.

The AMP sees digital technologies as a key driver of manufacturing transformation. The initiative supports the integration of information technology, biotechnology, and nanotechnology into manufacturing processes. Particular attention is paid to the development of "smart manufacturing" through the use of artificial intelligence, the Internet of Things (IoT), and cyber-physical systems. Manufacturing USA, a network of manufacturing innovation institutes established under AMP, focuses on advanced manufacturing technologies, including additive manufacturing (3D printing), digital technologies, and automation. The National Advanced Manufacturing Strategy 2022 identifies 11 strategic goals, including deploying advanced manufacturing technologies to support the bioeconomy and accelerating manufacturing innovation for microelectronics and semiconductors.

The German "Industrie 4.0" *(Platform Industrie 4.0, 2025)* initiative, launched in 2011 by the Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Economic Affairs and Energy (BMWI), is a national strategic initiative aimed at the digital transformation of production. A distinctive feature of the German approach is the emphasis on combining production methods with modern information and communication technologies to create intelligent value chains. Key features of Industrie 4.0 include: (1) high customization of products in conditions of

highly flexible mass production; (2) introduction of self-optimization, self-configuration and self-diagnosis methods; (3) intelligent support of employees in their increasingly complex work.

The German strategy of digital transformation "Industrie 4.0" is based on the intelligent connection of people, machines, objects and ICT systems horizontally and vertically. The Industrie 4.0 Platform, established in 2013, brings together over 350 stakeholders from over 150 companies, associations and trade unions to develop concepts for a networked industry. Digital technologies within the scope of Industrie 4.0 include: Cyber-Physical Systems (CPS); Internet of Things (IoT); Cloud and cognitive computing; Artificial intelligence as a national priority; Automation and robotics. The German federal government has allocated almost 100 million euros for two programs: "Autonomics for Industrie 4.0" and "Smart Service World" to promote research and innovation in the respective areas. More than 65% of German companies are already planning to implement specific Industrie 4.0 technologies.

"The Factories of the Future" programme *(EFFRA, 2025)* of European Union is a €1.15 billion public-private partnership of the European Union for research and innovation in advanced manufacturing. This initiative is the EU's flagship programme for the next industrial revolution and the materialisation of the Factories 4.0 concept. The main objective of the partnership is to ensure a more sustainable and competitive European industry at the heart of the European economy, generating growth and securing jobs. The programme supports European manufacturing companies in strengthening their technological base through cross-sectoral projects focusing on manufacturing technologies from different sectors. Digitalisation in the European context to be implemented by The Factories of the Future sees digital technologies as a key element in the transformation of manufacturing. The "Factories 4.0 and Beyond" programme takes into account the growing impact of advanced ICT technologies in manufacturing in synergy with advanced material handling technologies and mechatronic systems.

The programme's research and innovation domains include: (1) advanced manufacturing processes and technologies; (2) mechatronics for advanced manufacturing systems; (3) ICT and manufacturing strategies; (4) modelling, simulation and forecasting. In parallel, the EU is launching a new initiative, AI Factories, as part of the AI Continent Action Plan 2025. By the end of 2026, at least 15 AI Factories are planned to be operational, combining computing power, data and talent to create advanced AI models and applications. China's Strategy "Made in China 2025" *(Made in China, 2025)* is a national strategic plan and industrial policy signed by Premier Li Keqiang in May 2015 *(Chen, K., Guo, R., & Pei, R., 2022)*. It is a 10-year plan aimed at further developing China's manufacturing sector, moving from the status of the "world's factory" to a leader in high-tech industries with the ambitious goals. They include: (1) reducing dependence on foreign technology; (2) achieving 40% domestic content of key components by 2020 and 70% by 2025; (3) creating globally competitive Chinese companies; (4) dominating the domestic market, followed by capturing overseas markets *(Hancock, T., 2024)*.

Made in China 2025 is directly inspired by the German Industry 4.0 strategy and focuses on ten strategic industries, including the next generation of information technology, robotics, aerospace, and new energy vehicles. The five national strategic initiatives include: (1) building R&D centers (40 centers by 2025); (2) developing high-tech projects in all key industries; (3) sustainable development and global leadership in green manufacturing practices; (4) smart manufacturing, including robotics and digitalization; (5) building cyber-physical systems for lean-agile manufacturing capacity *(Chen, K., Guo, R., & Pei, R., 2022)*.

An important component of Horizon Europe is the European Innovation Council, which purposefully finances the development of breakthrough technologies, supports innovative start-ups and actively promotes the commercialization of research and innovation results. This innovation ecosystem is complemented by the European Institute of Innovation and Technology (EIT), which, by stimulating multi-stakeholder partnerships between business, scientific institutions and educational institutions, ensures the accelerated transfer of new knowledge and technologies directly to the market. The EU also implements the Digital Europe Programme, supports innovation activities in the SME sector (through the COSME programme and the EEN network), and co-

finances innovation projects through structural funds, in particular the European Regional Development Fund (ERDF). It is worth mentioning separately the financing of joint technological initiatives and enterprises in strategically important sectors, a vivid example of which is the Clean Sky initiative in the field of aviation.

The Digital Silk Road (DSR) of the PRC involves the merging of public functions of the state and private interests of large technology companies, setting economic and geopolitical objectives of the Chinese technological initiative and managing the development of digital competition on a global scale. The Digital Silk Road initiative is aimed at achieving important geopolitical goals for the PRC to ensure and maintain technological dominance primarily in the Asia-Pacific region and Africa through the use of the following technological and ideological management tools: implementation in the countries of presence of the idea of creating a single mechanism for global integration based on the principles of institutional openness, cooperation, mutual assistance, mutual benefit, inclusiveness ("community of common destiny"); development of its geopolitical strategy based on the slogan about the inadmissibility of the dominance of one country and one currency in the context of an open digital economy; digital expansion of China within the framework of the DSR, which is built on a platform model for the formation of a business environment. is aimed at eliminating digital imbalances between economic sectors and regions of China, as well as introducing modern digital solutions in neighboring countries using the potential of large high-tech corporations; establishing unified technological standards focused on the Chinese digital economy and infrastructure (implementation of 5G mobile networks and the BeiDou satellite navigation system); forming cyber governance norms through the development of the so-called concept of cyber sovereignty with "Chinese characteristics"; the DSR initiative increases dependence on Chinese technologies and investments. The development of the AI industry is one of the most significant areas of development of the Digital Silk Road, as it concentrates many cross-cutting technologies, establishes effective cooperation between the government and corporations in terms of expanding the geography of their own developments, and also concentrates the main contradictions between China and the United States, and for each country, the issue of leadership in the field of AI is a question of international technological leadership in general.

The Chinese "14th Five-Year Plan for the Development of the Digital Economy" defines it as follows: "The digital economy is the main economic structure that historically follows the agricultural economy and industrial economy. Its key factor is data resources, and its main carrier is modern information networks. The digital economy is based on the integration and practical use of information and communication technologies, and its main driver is the digital transformation of all factors of production. It is a new form of economy that promotes a more complete combination of fairness and efficiency" (*Outline of the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China*). The foundation of digital transformation is algorithms, computing power and data. Although China has a huge amount of data, the data infrastructure is still underdeveloped, and there are not enough conditions to fully realize data as a factor of production. Most of the risks in the digital economy related to property rights, transfer, evaluation, registration, transactions, profit distribution and other aspects of data are determined by the virtual nature of data. Digital data have special consumer properties, which makes them a specific commodity.

The advantages of the digital platform economy include: (1) stimulating innovation (use of advanced technologies, development of customized goods and services, emergence of new types of product stratification, consumption of innovative business models, creation of a flexible organizational structure); (2) create a new value for consumers (improvement of competitive advantages, increase in choice, increase in usability, distribution of resources and financial assets; change in marketing policy, ability to choose the best prices and information transparency of the market); (3) opening of new channels (increase in aggregate supply and demand, stimulation of small and medium-sized businesses to enter the market, use of marketing innovations (*Palfreyman, J., & Morton, J.,2022)*, organization of a new distribution system and ability to enter foreign markets (export to any country in the world); (4) reduction of transaction costs (systematic

accumulation of information; comprehensiveness in resolving various situations; rationalization of costs; reduction of information, communication, logistics costs and increased flexibility of production). Instrumental platforms reduce the cost of developing software and hardware-software solutions, and infrastructure and application digital platforms reduce the costs of each additional unit of access, copying and distribution of information, goods or services (*Reznikova, N. V., Bulatova, O. V., Shlapak, A. V., & Ivashchenko, O. A., 2023).*

The Strategy defines six types of platforms according to the different functions and services they provide: (1) an online sales platform "connects" people and goods and provides trading services; (2) a service platform "connects" people and services; (3) a social entertainment platform "connects" people with each other; (4) an information platform "connects" people with information; (5) a financial services platform "connects" people and financial services; (6) a computing service platform "connects" people and computing power. These 6 categories are divided into 31 subcategories (*Zenglein, Max J., & Holzmann, A., 2019).*Traditional consumer markets, being subject to deep structural transformations associated with the growing influence of Internet technologies, have become increasingly related to Internet-dependent markets. In the context of a constantly growing number of Internet users and accelerated development of Internet technologies, the key element in managing e-commerce is the choice of the most suitable Internet platform to attract target consumers. E-commerce can be considered as a basis for creating a new business, the business processes of which are completely or in the overwhelming majority carried out using Internet technologies, or as an additional tool for an existing business in a traditional form, which will allow developing a standard business model through e-commerce. The infrastructure of e-commerce is based on many technological components, including; websites and portals; electronic data interchange; electronic payment systems; electronic reference systems; content management systems (CMS); systems for automating customer service processes (CRM); automatic data collection systems.

We highlight the defining technologies of the digital economy: clouds; distributed computing; big data and the Internet of Things; blockchain; digital twins; augmented reality; additive manufacturing; robots and cognitive technologies. Extended reality is a concept of interaction with virtuality and reality, characterized by various levels of immersion, presence and interactivity of the user with the digital, artificial world. Nowadays, XR is usually divided into virtual (VR), augmented (AR) and mixed (MR) reality. In augmented reality, there is no change in the human vision of the surrounding world and its perception, augmented reality supplements the real world with digital images and new information, and does not completely replace it. Digital technologies are transforming manufacturing in several key areas. In personalization and flexibility digital technologies enable the production of personalized products in mass production, providing high flexibility for production systems. In efficiency and productivity automation and optimization of processes through AI leads to significant productivity gains. The German strategy promises to increase production productivity by up to 50% while halving the required resources. Digital technologies support sustainability as digital technologies contribute to the development of green manufacturing practices by optimizing energy consumption and reducing waste. They also develop new business models as digitalization creates opportunities for new service models, such as "production as a service" and digital ecosystem platforms.

IoT has become a tool for developing technologies such as machine learning and big data analytics. It allows for increasing productivity and reducing costs for many organizations. To fully utilize the potential of IoT, it is necessary to increase the share of data analytics and artificial intelligence, which will significantly improve predictive capabilities and performance in various situations, from industrial production to the household sphere. The Industrial Internet of Things (IIoT) is a technology that connects machines, devices, and systems into a single network, enabling automation of production and business processes. It is a key component of Industry 4.0, the fourth industrial revolution, which represents the integration of digital technologies into production processes. IIoT plays an increasingly important role in the digital economy. IIoT opens up new opportunities to increase efficiency and optimize production, as well as to obtain more information

about the operation of technological systems. Companies that invest in IIoT technologies will gain significant competitive advantages in the market. Industrial Internet of Things technology is an important means of implementing the Industry 4.0 concept. Industry 4.0 is a concept of digital transformation that involves the integration of all production processes into a single digital system. This makes production more efficient and flexible, which in turn leads to increased competitiveness and economic growth ().

Unlike IoT, Industry 4.0 focuses on manufacturing and production process management *(Beier, G., Ullrich, A., Niehoff, S., Reißig, M., & Habich, M., 2020).* In turn, IoT can be applied in any area where data collection and analysis is required. In addition, Industry 4.0 involves the use of new technologies such as artificial intelligence and machine learning, and IoT is the collection and analysis of data from devices. The use of Data Science tools makes it possible to collect, accumulate, and process large amounts of data (Big Data) and, based on them, predict events and model processes occurring in the economy in the context of global economic instability. The use of Data Science tools allows you to search for connections and patterns in data arrays that contribute to the creation of models in the economy that predict the results of economic activity, that is, we can say that Data Science works for the future of the economy. Using software algorithms and mathematical statistics, Data Science tools solve the tasks set, primarily economic ones. The use of Data Science tools in economic activity helps to increase business profitability, increase the profitability of enterprises and its profitability, allows solving a number of urgent problems, such as analyzing the current organizational structure of an enterprise and building a new business model using digital technologies, reducing production costs, marketing costs and logistics costs, as well as reducing business risks and increasing the profitability of investments in the economy.

Digital risk is a term that covers all digital opportunities caused by ICT, automation of data processing, automation of decisions. Digital risks are caused by the use of digital technologies. Digitalization risks are the consequences of their implementation. Digital risk implies the coordinated configuration of processes, data, analytics and information technologies, as well as the overall organizational structure, including human resource development management and organizational culture. Among the digital risks are ensuring data security, forced transformation of business processes and the resilience of digital systems and digital infrastructure. Digital infrastructure is not only traditional information infrastructure — high-speed broadband networks, IP addresses, domains — but also the digitalization of railways and roads, water transport, and electric power.

Conclusions. The main technological drivers that ensure the close interconnection of data and ICT markets are: (1) artificial intelligence and machine learning (AI and machine learning are transforming data analytics by automating complex processes, which significantly stimulates the ICT market); (2) cloud computing (the growing popularity of cloud computing is a significant factor in the growth of the corporate ICT market, as organizations increasingly adopt cloud solutions due to their scalability, cost-effectiveness and flexibility); (3) Internet of Things (the integration of IoT in the ICT sector promotes intelligent interconnection between industries, allowing for real-time data collection, automation and remote monitoring); (4) Big Data (the growing volumes of unstructured and structured information have caused a boom in big data analytics). Among the mechanisms of interconnection between data and ICT markets, we highlight infrastructural interdependence (data centers act as the physical basis for storing and processing large volumes of data, therefore global expansion, hyperscale consumption *(Oliveira-Dias, D., Maqueira-Marín, J. M., & Moyano-Fuentes, J., 2022),* adoption of interconnections and development of edge locations are among the key drivers of growth in this segment) and economic synergy.

The growing demand for cybersecurity solutions is a key driver of the growth of the interdependence between data and ICT markets. The growth of generative AI and the expansion of data collection have pushed data privacy and security to the forefront, making it a critical focus for businesses around the world. The techno-globalism of data-driven companies will burden global competition. Technological innovations will be activated - edge computing (there is currently a significant growth in sensors and network devices, which leads to a massive increase in the amount

of collected data), the development of 5G and 6G (6G networks are revolutionizing telecommunications with ultra-high speeds and low latency). Analysis of the relationship between the data market and the ICT market indicates their deep structural integration and interdependence. The main characteristics of this relationship are: (1) technological convergence; (2) economic synergy (organizations that effectively combine ICT technologies with data analytics demonstrate significantly higher profitability and competitiveness); (3) global growth trends; (4) regional differentiation.

All four strategies (The Advanced Manufacturing Partnership, The German "Industrie 4.0". "The Factories of the Future", Made in China 2025) demonstrate common characteristics: public-private partnership: All initiatives are based on cooperation between government, industry and academic institutions, focus on digitalization (Integration of ICT, artificial intelligence and the Internet of Things is central to all strategies), long-term (all programs are designed for 10-15 years of implementation), innovation networks (creation of specialized research and development centers). The strategies have three key differences: (1) market approaches (US and EU rely more on market forces; Germany uses a balanced approach of state guidance and market mechanisms; China applies strong state support with large-scale subsidies); (2) geographical focus (US and China target domestic market with global ambitions; Germany emphasizes support for small and medium-sized enterprises; EU focuses on pan-European cooperation); (3) technological priorities (US emphasize national security and defense technologies; Germany focuses on industrial automation and efficiency; EU focuses on sustainable development and green technologies; China aims for technological independence and export potential. In all the strategies digital technologies play a central role in the transformation of production. Artificial intelligence and machine learning are used to optimize production processes, predictive maintenance and product quality. All countries see AI as a critical technology for future competitiveness. The Internet of Things (IoT) connects machines, products and systems, creating the basis for smart factories. This technology enables real-time data collection and automated decision-making processes. Cyber-physical systems integrate physical processes with digital control systems, ensuring the autonomy and adaptability of production systems. Cloud computing provides scalable computing resources and platforms for big data analytics, which are critical for modern manufacturing. Digital technologies are central to all strategies, but with different emphases: In the field of artificial intelligence, the US develops military applications, the EU creates AI Factories, Germany integrates into production processes, China seeks leadership (DeepSeek as an alternative to ChatGPT). In IoT and cyber-physical systems, Germany leads in industrial IoT, the US focuses on security, the EU on standardization, China on scalability. In robotics, all strategies include collaborative robotics, but China and Germany lead in industrial implementation. In additive manufacturing, the US develops through America Makes, Germany through Fraunhofer, the EU through joint projects. The strategies have certain differences, in particular, the US uses public-private financing, Germany - balanced public-market financing, the EU - supranational financing through Horizon Europe, China - large-scale state subsidies. The target audience of the strategy for the USA is large corporations and the defense sector, for Germany - SMEs and hidden champions, for the EU - cross-border cooperation, for China - state champions and exporters. The geopolitical goals also differ, in particular, the US wants to achieve technological leadership and security, Germany - industrial excellence, the EU - strategic autonomy, China - global dominance in high technology. All strategies demonstrate that digital technologies do not simply modernize production, but create new paradigms of smart manufacturing, where the convergence of the physical and digital worlds forms the basis for future industrial competitiveness. By 2025, China achieved the highest implementation rates (86% of the goals), including leadership in electric vehicles (50% of the market), high-speed railways and shipbuilding. Germany maintains leadership in industrial equipment and automation. The US has strengthened its position in semiconductors through the CHIPS Act. The EU is developing sustainable manufacturing and an AI ecosystem.

We attribute the following economic effects of digitalization and platformization: changes in the life cycle of economic development strategy; changes in the ratio of strategic and tactical

development goals; changes in business cycles; changes in approaches to competition; changes in approaches to pricing; intensification and automation of existing business processes; optimization of management systems; reduction of transaction costs; creation of a technological basis for the formation of new types of economic interactions; acceleration of economic cycles; efficient use and release of production and logistics capacities.

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