Towards Sustainable Development Through Bridging Digital Penetration Gaps

Evgeniya K. Karpunina[1(✉)], Anna F. Beilina[2], Larisa M. Butova[2], Svetlana A. Trufanova[3], and Alexander S. Astakhin[4]

[1] Tambov State University named after G.R. Derzhavin, Tambov, Russia
egenkak@mail.ru
[2] Voronezh State Pedagogical University, Voronezh, Russia
abejlina@yandex.ru, larbutova@yandex.ru
[3] Moscow University for Industry and Finance «Synergy», Moscow, Russia
st200929@yandex.ru
[4] Belgorod State National Research University, Belgorod, Russia
aastaxin@yandex.ru

Abstract. The aim of the article is to study the impact of the digital environment on the economic conditions of economic entities, as well as to assess the gaps between economic development, changes in social relations and environmental well-being. It is proved that gaps in digital penetration can cause the deepening of existing inequalities and risks: digital inequality, social inequality, inequality in the appropriation of benefits, environmental risks. Approaches to assessing the impact of digital artifacts on the environment (in the context of the concept of "circular economy") and sustainable development of the economic system are investigated. The authors have formed a conceptual matrix of sustainable development in the digital economy, which is differentiated by the subjects of economic activity (individuals, enterprises, the state) and in relation to a specific type of inequality in the digital economy and risks (risks of digital inequality, risks of social inequality, risks of inequality in the appropriation of benefits, environmental risks). The proposed author's approach makes it possible to develop an optimal set of actions for each subject to level emerging risks and ensure sustainable development of the economic system in the digital environment.

Keywords: Digital economy · Sustainable development · Inequality · Risks · Circular economy

JEL Classification Codes:: O11 · O21 · O33 · O44

1 Introduction

The phenomenal "digital economy" has replaced the traditional industrial economy and transformed the entire familiar system of industrial relations in a short period of time. The use of new types of digital technologies, alternative ways of selection of resources and active introduction of innovations in the processes of development and production of products, the use of information tools of interaction between all economic entities,

E. G. Popkova and B. S. Sergi (Eds.): ISC 2019, LNNS 129, pp. 476–485, 2020.
https://doi.org/10.1007/978-3-030-47945-9_53

formal and informal types of business cooperation and other innovations that erase the previous boundaries, has made new sources of economic growth achievable for a number of digital content industries. Today, digital Finance, digital communications, digital entertainment and media, automotive and robotics contribute to the development of the economy – and this, no less, more than one-fifth of global GDP (22%) (Knickrehm et al. 2016).

However, reorientation to new economic conditions can lead to aggravation of existing contradictions of social and economic development. For example, there are problems with access to information systems, especially in the regional context, automation carries significant risks and risks of unemployment (OECD estimates that less than 10% of workers in the OECD region can lose their jobs due to automation, up to 70% of tasks in 25% of workplaces can be automated (OECD 2016), not every individual understands the need for continuous learning and self-development, building digital skills in order to adapt to the digital economy and remain successful.

It is even more difficult to achieve sustainability in the context of digitalization. Sustainable development involves the interaction of socio-economic and natural systems, each of which is complex, nonlinear, dynamic and unpredictable. These qualities mean that sustainable development as an end point or a state of equilibrium can be a worthy and useful goal, but will never be achieved (Jaffe and Gertler 2008).

However, the scientific community, public authorities and the public are continuously searching for sustainable development mechanisms that enable society to minimize its impact on the environment while maintaining or enhancing the capacity to maintain a desirable quality of life for all. An example of this is the adoption by most developed countries of the concept of "circular economy" and its implementation in practice within the framework of the formation of the Industry 4.0 (Iles 2018).

The study of the fundamental vulnerabilities of the digital environment is important for sustainable global economic growth, as well as the balance of its economic, social and environmental components.

2 Methodology

The scientific hypothesis of the study is the assumption that in the conditions of digital transformation, the existing gaps between the development of the economy, changes in social relations and environmental well-being are growing. The asymmetry of the global economic system requires a review of approaches to ensuring its sustainable development in the digital environment and a search of enabling tools based on risk minimization.

To substantiate the hypothesis, the authors studied the works of scientists on the formation and development of the digital economy. First of all, Tapscott D., who pointed out that the driver of progress in the digital environment is the formalized knowledge and implicit knowledge of management and personnel (Tapscott 1995).

Brynjolfsson E. and Kahin B. revealed epochal organizational changes in the system of management, access, market structure and competition in the conditions of digital transformations (Brynjolfsson and Kahin 2000).

Schmidt E. and Cohen J. illustrate the development of the digital age through changes in the individual, society, politics and economy. They call the digital economy "a rapidly evolving interconnectedness besieged by constant technological innovation" (Schmidt and Cohen 2013).

Prahalad C. and Ramaswamy V. in their research focus on changing the relationship between economic and social in the digital environment through the prism of the evolving role of the consumer in the value creation process. Scientists argue that in a world of limitless choice, instant gratification and unlimited opportunities for innovation, manufacturers cannot meet the needs of consumers and maintain the desired growth rate and level of productivity. This can bring the economic system out of balance (Prahalad and Ramaswamy 2010).

Attempts of scientists to justify the possibility of sustainable development of the economic system in the context of "man-society-nature" have been made repeatedly. The approaches proposed by A. Pigou (Pigou 1920), Porter M. and van der Linde (Porter and van der Linde 1999; Dernbach 1998), are interesting. The international adoption of the Concept of sustainable development was the result of the search for a compromise between environmental sustainability and socio-economic development (United Nations General Assembly 1987).

However, the advent of digital technologies to replace the mechanisms of the traditional economy changes the determinants of sustainable development, there are structural and technological changes in the economic system, and, therefore, there are new threats to the balance in the system "man-society-nature". The opinions of scholars differ regarding the evaluation of the impact of digital technology on the stability of the economic system: some say that digitization contributes to sustainability, others argue that it creates additional sources of system vulnerability (Karpunina et al. 2019).

3 Results

The essence of digital transformations of the economic system is revealed in the changes of the expanded value chain under the influence of external influences from information and communication technologies, breakthrough innovations, artificial intelligence systems and other benefits of digital civilization. Value chains in today's world are more complex and dispersed, so external influences are becoming more and more significant.

Thus, Prahalad C. and Ramaswamy V. note that consumers no longer get value just by buying goods or services (Prahalad and Ramaswamy 2010). Consumers interact with a network of firms and consumer communities to meet their unique preferences. As a result, they accumulate total personal experience and realize it in the form of value created.

This situation radically changes the conditions of competition for producers: companies need fundamental changes in the infrastructure for creating value, increasing the openness and accessibility of information and operations for all employees, transforming the nature of relations with consumers towards the establishment of long-term dialogue (Prahalad and Ramaswamy 2010).

Access to information (as a consequence - more informed decision-making by consumers), global reach (gathering information about firms, products, technologies, prices around the world), networking (the ability of consumers to communicate in an open space independent of manufacturers leads to a change in the model of marketing communications), experimental experience (the use of the digital environment for experiments in the development of new products by consumers), consumer activity (consumer involvement in the process of creating value at all stages, process management, stimulation of other participants in the process) create new conditions for the functioning of economic entities of the digital economy.

Through the prism of the real market in this environment, digital penetration gaps are observed, they provoke digital, social inequality and inequality in the appropriation of goods (Sologubova 2017) (Fig. 1).

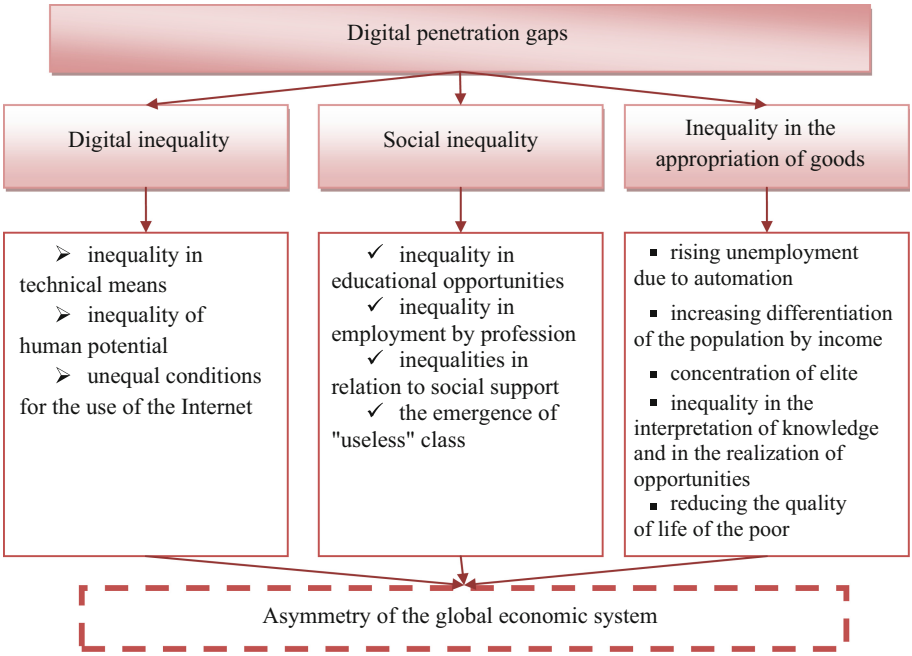

Fig. 1. Types of inequalities as a reflection of digital penetration gaps

At first glance, it seems that lower barriers to entry in a digitalized world are empowering and leading to a more equitable distribution of wealth.

However, this myth dispels the emergence of "digital inequality" in relation to socio-economic inequality within the "online population" (Karpunina et al. 2019).

In this context, the following determinants of digital inequality are distinguished: inequality in terms of technical means (unequal access to Internet content); inequality of human potential (due to different levels of digital literacy, education, skills);

inequality of conditions for the use of the Internet (place of residence, access to web-resources, quality of Internet connection).

The results of the study, which was conducted by a group of European scientists, showed that in the member States of the European Union there are two main aspects of digital inequality - "skills" and "autonomy" of Internet users (Stiakakis et al. 2010).

"Level of formal education" is a representative variable of skill measurement. "The level of population density in different geographical areas" is a representative variable of autonomy measurement. Eurostat data on daily computer use over the past three months and average Internet use at least once a week were used. Scientists have concluded that there is now a problem of digital inequality in the EU at an expanded rate.

The validity of research results is also confirmed by analytical data from a world Bank report in the series "Global development" for 2016: about 15% of the world population can afford broadband access to the Internet; almost 2 billion people have mobile phones and about 60% of the world population does not have access to the Internet, the possibility to use it or funds to pay for it (IBRD and World Bank 2016).

Note that the digital divide within countries can be as deep as the gap between different countries. The largest number of Internet users are registered in China, the United States, India, Japan and Brazil. The gaps between the poorest 40% and the wealthiest 60% of the population, as well as between rural and urban residents, are narrowing in the context of mobile phone use, but are deepening in terms of Internet use (IBRD and World Bank 2016).

Social inequality arises because of differences in education, skill level, professional affiliation. There is a new generation of people instead of classes and estates. According to the researchers, soon there will be a "useless class" of people who will not be able to get an affordable job because of the psychological dependence on digital programs and technologies (Harari 2015). Thus, before the person the problem of lack of employment and emergence of feeling of dissatisfaction from own life is actualized. For example, data from an American study show that 22% of American men without a College degree have not worked a single day in the past 12 months. The U.S. Bureau of labor statistics States: over the past 15 years, the amount of free time low-skilled workers have increased by 4 h a week, and 3 h of this extra time they spend on video games (Sologubova 2017).

Inequality in the appropriation of goods in the digital economy will manifest itself in the growth of unemployment, the concentration of the elite and in an even greater decline in the level and quality of life of the poor.

Indeed, there are concerns about the ability of the digital economy to create enough high-quality jobs and ensure that the benefits of growth are widely shared across and within countries. ILO Estimates that there are about 200 million unemployed in 2017. The global unemployment rate is expected to remain stable. The labor force is expanding in line with increasing digital trends, demographic changes, and participation, so the global unemployment rate could rise even further (ILOSTAT 2017).

Indeed, automation and robotics processes have an impact on employment. The growing trend of increasing robotics is already showing a decrease in production costs, productivity growth and the forced release of significant labor resources. Robotics and automation carry the risk of global restructuring of the labor landscape. So, McKinsey

analysts studied more than 2,000 tasks performed by people of 800 different professions, and concluded that almost half of the work on which employers spent 15 trillion Us dollars can be automated using current technologies. At the same time, only about 5% of these professions can be automated completely with the help of existing technologies, and another 60% of professions can be automated by at least a third. And, according to analysts, the most affected processes that use monotonous physical labor, as well as data collection and processing. McKinsey estimated that 81% of the time that workers spend on physical labor can be transferred to robots; and automation of data processing will give workers 69% of free time, data collection-64% of the time (McKinsey Global Institute 2017).

The existing gap in access to digital technologies is causing a global gap in knowledge and opportunities (Sologubova 2017). It is meant not only about the amount of knowledge mastered, but also their interpretation. The leadership in this case is held by the USA, Canada and some European countries (determined by the share of scientific publications among all scientific journals produced in the world).

Access to information and digital technologies creates enhanced opportunities to harness the benefits of digital civilization for human and societal development. However, not everyone can implement these features. These are probabilistic limitations: unequal access to the e-government system of companies and individuals; the use of online services of public authorities by individuals to obtain information for personal use instead of professional. Studies have shown that individuals with the highest income and highest connectivity are 45 times more likely to use e-services than people with the lowest income and lowest connectivity (IBRD and World Bank 2016).

These inequalities can provoke asymmetry in the development of the global economic system. Thus, in the works of the organization for Economic Cooperation and Development (OECD), the main goal of state regulation in developed countries is to minimize those inequalities that lead to social tensions and conflicts, interfere with the balanced and sustainable development of the economy and social sphere (Skufina 2013).

To ensure sustainable development in the digital economy, it is necessary to assess the impact of digital technologies on the environment.

First of all, it is necessary to assess environmental risks and ensure a balance in the system of relations “man-society-nature”, that is, by integrating and recognizing economic, environmental and social problems throughout the decision-making process (Emas 2015).

Even Pigou A. in his writings pointed to the existence of “random, uncharged services, which are a barrier to achieving equilibrium in the market” (Pigou 1920). He proposed to impose a tax on those activities that cause them negative external effects (externalities), leading to a decrease in the stability of the economic system.

Porter M. and van der Linde C. investigated the occurrence of environmental risks due to human economic activity. They suggested that environmental pollution is a sign of resource inefficiency and concluded that opportunities for the environment and economy can be captured through improvements that reduce pollution in production processes (Porter and van der Linde 1999).

These authors were among the first to draw attention to the relationship between digital and innovation processes and the environmental situation: by stimulating

innovation, strict environmental regulations can actually increase competitiveness. According to Porter, a properly designed environmental policy using market incentives can contribute to the introduction of new technologies and reduce waste, and thus achieve sustainability.

What is the nature of the impact of digital artifacts on the environment?

Historically, for every 1% increase in global GDP, CO_2 emissions have increased by about 0.5% and resource intensity by 0.4%. Current production activity will contribute to a global gap of 8 billion tons between supply and demand for natural resources by 2030, resulting in a loss of economic growth of $ 4.5 trillion by 2030 (Lacy and Rutqvist 2015a).

According to a study by the world economic forum, digital initiatives in industries could provide an estimated 26 billion tons of net CO_2 emissions avoided from 2016 to 2025. This is almost equivalent to the CO_2 emissions of the whole of Europe over this time period. Therefore, the main task is to overcome obstacles to the development of new, cyclical business models, customer acceptance and environmental impact of the digital technology itself (Weforum 2017).

At the same time, scientists Lacy P. and Rutqvist J. prove that the possibilities of digital technologies will allow in the near future to talk about the creation of the so-called "circular economy", the main task of which is to ensure maximum efficiency of each process in the life cycle of a product or service, and the reuse of waste becomes one of its priorities.

The concept of a "circular economy" involves keeping resources in productive use within the economy for as long as possible, sharing economic growth and unsustainable consumption of natural resources. Digital technologies make it possible to transform "waste" into economic opportunities of modern times. According to the authors of the concept, such an economy can provide a potential volume of additional economic production in the amount of $ 4.5 trillion. US by 2030 (Lacy and Rutqvist 2015b).

The proposed concept of "circular economy" was supported by the world community and became a new trend, it is the basis of the concept of "Industry 4.0". The European Commission is in the process of preparing a package of laws to put into practice the concept of "circular economy". The European Investment Bank, in turn, financed projects of the circular economy for 15 billion euros, mainly in Europe. Major companies McKinsey, Ellen MacArthur Foundation, Philips and Accenture support her ideas (Sausheva 2017).

To assess the level of development of the circular economy, special indices reflecting the efficiency of the process of its formation are used: The Material Circularity Indicator (MCI); The Regional Circular Economy Index System; The Circular Economy Performance Index; A Circular Economy Index for the Consumer Goods Sector (Pahomova et al. 2017).

Denmark, Scotland, Finland and China have adopted appropriate development programs and are leaders in the development of the circular economy. Thus, it is unreasonable not to take into account the importance of the environmental component of sustainable development in the context of digitalization. Environmental risks are a threat to the sustainable development of States in the digital environment, despite the attempts of the public and the state to build a new production system, taking into

account their minimization. The analysis of the factors of digitalization and the inequalities and risks provoked by them allows us to form a conceptual matrix of sustainable development in the digital economy (Table 1).

Table 1. Conceptual matrix for sustainable development in the digital economy

Risks	Subject		
	Individuals	Enterprises	State
Risks of digital inequality	• improving information literacy of individuals • improvement of user skills in the field of digital technologies • leveling information security threats	• developing a business environment conducive to the use of the Internet for competition and innovation • introduction of automated enterprise management systems • introduction of electronic document management • creation of enterprise information security systems	• институциональ institutional regulation aimed at creating an open and accessible information environment • implementation of the policy to stimulate digital activity of enterprises • maintaining a healthy competitive environment • ensuring information security of the state
Risks of social inequality	• using the Internet to empower citizens on a collective platform and provide services • training of users of ICT • continuous training and professional development	• advanced development of human capital of the enterprise • implementation of client-oriented strategy of enterprise development • improving the adaptability of staff to the environment • formation of intra-firm system of economic security	• the implementation of the policy of human capital development • ensuring equal access to education for all segments of the population • ensuring equal access to e-government services • development of social protection system
Risks of inequality in the appropriation of goods	• continuous self-development and improvement of professional literacy competence (lifelong learning) • the development of soft-skills	• investing in a timely retraining of the workforce • competent policy of automation and displacement of human labor • development of business social responsibility system • building a system of continuous communication with customers and staff	• creation of a system of continuous training and retraining • stimulating the development of science and innovation • creation of a system of social support for the unemployed due to automation

(*continued*)

Table 1. (*continued*)

Risks	Subject		
	Individuals	Enterprises	State
Environmental risks	• coverage consumers, the waste management system; • involvement of consumers in the activities of the municipal solid waste collection and disposal system • formation of consumer ideology based on the principles of "circular economy"	• investment in the field of waste management • creation of waste management facilities on the basis of public-private partnership • creation of waste disposal facilities that meet the statutory requirements	• formation of a system of recycling efficiency on the basis of regular monitoring, control and operational management of the development of the circular economy as a whole and its individual elements

4 Conclusions/Recommendations

The study of the problems of digital, social inequality, inequality in the appropriation of benefits and risks of environmental security, allowed us to conclude that in the conditions of digital transformation, the existing gaps between the development of the economy, changes in social relations and environmental well-being are growing.

The identified problem areas became a starting point in the process of creating a conceptual matrix for sustainable development in the digital economy. The proposed matrix is differentiated in the context of economic entities (individuals, enterprises, the state) and in relation to a specific type of inequality in the digital economy and risks (risks of digital inequality, risks of social inequality, risks of inequality in the appropriation of goods, environmental risks). According to the authors, this allows us to develop an optimal set of actions for each entity to level emerging risks and ensure sustainable development of the economic system in the digital environment.

References

Brynjolfsson, E., Kahin, B.: Understanding the Digital Economy. The MIT Press, Cambridge (2000)

Dernbach, J.: Sustainable development as a framework for national governance. Case West. Reserve Law Rev. **49**(1), 1–103 (1998)

Emas, R.: Brief for GSDR 2015 the Concept of Sustainable Development: Definition and Defining Principles (2015). https://docviewer.yandex.ru/view/316254058/. Accessed 16 Oct 2019

Harari, Y.: Homo Deus: A Brief History of Tomorrow. Harvill Secker (2015)

Iles, J.: Which country is leading the circular economy shift? (2018). https://medium.com/circulatenews/which-country-is-leading-the-circular-economy-shift-3670467db4bb. Accessed 15 Sept 2019

ILOSTAT: ILO Labour force estimates and projections: 1990–2030 (2017). https://www.ilo.org/ilostat-files/Documents/LFEP.pdf. Accessed 12 Aug 2019

International Bank for Reconstruction and Development (IBRD) and World Bank: Digital dividends. World development report 2016 (2016). https://openknowledge.worldbank.org. Accessed 11 Nov 2018

Jaffe, J., Gertler, M.: Sustainable development in the new economy: risk, vulnerability and eco-social justice. Curr. New Scholarsh. Hum. Serv. **7**(2), 1–20 (2008)

Karpunina, E., Yurina, E., Kuznetsov, I., Dubovitski, A.: Growth potential and economic security threats in terms of digital economy ecosystem. In: Vision 2020: Education Excellence and Management of Innovations through Sustainable Economic Competitive Advantage Proceedings of the 33nd International Business Information Management Association (IBIMA) Conference, Granada, Spain, pp. 2669–2678 (2019)

Knickrehm, M., Berthon, B., Daugherty, P.: Digital Disruption: The Growth Multiplier (2016). https://www.accenture.com/_acnmedia/PDF-4/Accenture-Strategy-Digital-DisruptionGrowth-Multiplier.pdf. Accessed 23 June 2019

Lacy, P., Rutqvist, J.: Waste to Wealth. The Circular Economy Advantage (2015a). https://www.palgrave.com/us/book/9781137530684. Accessed 28 Oct 2019

Lacy, P., Rutqvist, J.: The Circular Economy Advantage. Springer, Heidelberg (2015b)

McKinsey Global Institute: A future that works: automation, employment and productivity (2017). https://docviewer.yandex.ru/view/316254058/. Accessed 13 Aug 2019

OECD: Skills for a Digital World (2016). https://www.oecd.org/els/emp/Skills-for-a-Digital-World.pdf. Accessed 23 July 2019

Pahomova, N.V., Rihter, K.K., Vetrova, M.A.: Perekhod k cirkulyarnoj ekonomike i zamknutym cepyam postavok kak faktor ustojchivogo razvitiya. Vestnik Sankt-Peterburgskogo universiteta. Ekonomika **33**(2), 244–268 (2017)

Pigou, A.: The Economics of Welfare. Macmillan and Company, London (1920)

Porter, M., van der Linde, C.: Green and competitive: ending the stalemate. J. Bus. Adm. Polit. 215–230 (1999)

Prahalad, K., Ramaswamy, V.: The Future of Competition. Creating Unique Value Together with Consumers. Publishing House “Williams”, Moscow (2010)

Sausheva, O.: Monitoring effektivnosti reciklinga: zadachi i organizaciya. Nauchnyj zhurnal NIU ITMO. Seriya Ekonomika i ekologicheskij menedzhment, no. 4, pp. 102–109 (2017)

Schmidt, E., Cohen, J.: The New Digital Age: Reshaping the Future of People, Nations, and Business. Alfred A. Knopf, New York (2013)

Skufina, T.P.: The problem of asymmetry of economic development of space in modern research. Fundam. Res. **10**(3), 650–652 (2013)

Sologubova, G.: The phenomena of the digital economy (2017). https://www.econ.msu.ru/sys/raw.php?o=44108&p=attachmenthttps://www.econ.msu.ru/sys/raw.php?o=44108&p=attachment. Accessed 15 Aug 2019

Stiakakis, E., Kariotellis, P., Vlachopoulou, M.: From the digital divide to digital inequality: a secondary research in the european union: e-democracy. In: LNICST, vol. 26, pp. 43–54 (2010)

Tapscott, D.: The Digital Economy: Promise and Peril in the Age of Networked Intelligence. McGraw-Hill, New York (1995)

United Nations General Assembly: Report of the world commission on environment and development: our common future, Oslo, Norway (1987)

Weforum: Understanding the impact of digitalization on society (2017). http://reports.weforum.org/digital-transformation/understanding-the-impact-of-digitalization-on-society/. Accessed 12 May 2019