Valeriy V. GONCHAROV*

THE FOURTH INDUSTRIAL REVOLUTION: CHALLENGES, RISKS AND OPPORTUNITIES

Abstract: Modern challenges, risks and opportunities of a new technological paradigm of human development — the so-called fourth industrial revolution-are considered. Its social costs and consequences are discussed in detail. The impact of the fourth industrial revolution on business development is analyzed. Development of information platforms of supply and demand is presented as the creation of new business models. When considering the impact of the fourth industrial revolution on the state, it is concluded that the state has increased control over society, while changing the mechanisms of interaction between the state and civil society, the development of competition and decentralization of power. It is pointed out that the ability of state structures and authorities to adapt to the conditions of the fourth industrial revolution will determine their survival in the new conditions. If they are able to face the world of revolutionary change openly, the ability to change their state structures, make them transparent and effective will allow the state to maintain its competitive advantages and withstand the tests of a new technological paradigm of human development. Artificial intelligence is considered in detail as the main driver of the fourth industrial revolution.

Key words: *The fourth industrial revolution, artificial intelligence, technology, state, society, challenges, information, globalization*

The world is at the very precipice of a new technological revolution that will fundamentally change our way of being, way of life, way of work and ways of interaction with each other. In its scale, scope and complexity, the transformation/changes will differ considerably from anything previously experienced by humanity. We still have no idea, how it will evolve, but one thing became apparent: our response should be universal and comprehensive, including all active participants in world politics, from the public-private

* Director, Centre for System Analysis & Strategic Research, National Academy of Sciences of Belarus

sectors to the intellectual and civil society. The founder and Executive Chairman of the World Economic Forum in Davos Klaus Schwab describes these technological transformations/changes as the fourth industrial revolution.

During the first Industrial Revolution water and steam power was used to substitute manual work for machine work and develop industrial production, during the second was used electricity to expand and enhance scale of mass production, during the third was used electronics and information technology to automate production. And right now, the third industrial revolution is being replaced by the fourth, a digital revolution that has emerged and evolved since the middle of the last century. This has been mainly characterized by technology blending, which blurs the traditional borders between the material, digital and biological worlds.

Since 1784, steam power, water, equipment for mechanization of production marked the first industrial revolution. Since 1870, the division of labor, electricity, and mass production have shaped the character of the second. Since 1969, electronics, information technology and automation of production have become the basic features of the third. Can we identify the beginning and main features of the next revolution?

There are three markers, which show that the present changes don't represent a follow-up of the third industrial revolution, but demonstrate us the beginning of the forth one. These are the speed, scale of changes and its effects on the whole system. The speed of the occurring of new discoveries and technological breakthroughs has never been observed before. In contrast to the previous revolutions, the pace of development of the Fourth Revolution is exponential rather than linear. Furthermore, almost all industrial sectors in nearly every country are being reformatted, and the breadth and depth of changes foreshadow transformation of the whole production, administration and management systems.

The possibilities of billions of people, connected by mobile devices with powerful computing capacity, large amounts of information storage and access to knowledge, are endless. And this possibilities will be increased with the discovery of new technologies in various areas, such as artificial intelligence, robotics, autonomous means of transport, the Internet of Things, 3D printing, nano- biotechnology, materials science, energy technology and quantum computing.

1. CHALLENGES AND OPPORTUNITIES

The forth industrial revolution, as the previous third, has the capacity to increase global income and improve quality of life for peoples of the world. Consumers with material possibilities and access to the digital world are

the people, who already enjoy its fruits/benefits; through its technologies, new products and services increase our efficiency and life comfort for everyone. Taxi request, booking of flight tickets, marketing, making of payment, listening to music, film screening or computer game — to all this we have access remotely.

In the future, technological innovations will give rise to significant changes in the industrial procurement, with long-term efficiency gains and productivity in this area. Transport and communication costs will be reduced, logistics and global supply chains will be made more efficient, trade margins will be decreased, all this will lead to the opening of new markets and economic growth.

At the same time, the revolution could bring increasing inequality as a result of changes in the labour market. Either automation, which replaces manual labour, or direct replacement of a worker for a machine, could cause the increase in the gap between the income of capital and the income of employees. However, it is possible, that such replacement of workers will in the future provide net increase in safe and top-paying occupations and jobs.

This shift has never proceeded smoothly, without great social expenses. Moreover, most of them took place in the countries, that made this shift too late. Thus, the first industrial revolution caused deindusghtrialization in India (in XVIII it produced up to 25% of world GDP, by the mid-twentieth century the share fell to 2%), serious lack in technology in Russia and Turkey. The second industrial revolution caused the Great Depression, which resulted in major social shocks not only in the United States, Germany, Argentina, but also mass famine in the colonies (at the expense of which the metropolis was getting out of the crisis).

We haven't yet generalized data on the consequences of the third industrial revolution. However, the most preliminary estimates show, that deindusghtrialization of the postsoviet space, series of crises in Latin America are the consequences of such shift, in which this countries have lagged behind. Alternative examples are China, Korea, which, implying competent industrial policy, have managed to integrate in the third technological revolution and even become one of the world leaders.

The most preliminary estimates show that at least 20% of jobs have been cut. And globalization has led to extremely uneven job cuts in different countries. The imposition of overproduction on the transition of the global crisis did not allow to occupy the released labor force on a global scale through the growth of production. And the economy growth around the world by 3–4% per year doesn't solve any of its problems.

So far, it is difficult to foresee likelihood of developing of one or another scenario, but there are historical prerequisites, demonstrating that the result will be a mixture of both versions. However, it's obvious that exactly talent, rather than capital, will be a crucial factor in the production during the fourth industrial revolution. It will result in the devision of labor market into two mail segments: "low-skilled labour/low salary" and "high-skilled labour/high salary", so that social tension will increase.

Apart from its crucial economic impact, disparity will also have a significant social aspect in the context of the forth industrial revolution. The greatest beneficiaries will be those who will provide intellectual and material — savers and investors –that explains widening gap between groups dependent on capital and wage labour. Therefore, technology is one of the main factors of stagnation, as well as declining incomes, even in countries with high levels of income: the demand for high–skilled labour is growing, but it is dropping for medium-skilled labour. As the result, the labour market will be characterized by high demand for highly skilled and unskilled labor, with the little demand for the middle segment.

Resentment could also be strengthened by spread of digital technologies and the dynamics of the dissemination of information typical of social media. Today more than 30% of world population use social media platforms for communication, education and information dissemination. In an ideal world, these relationships could provide opportunities for building bridges among diverse cultures and, as a result, for unity and cohesion. Nevertheless, these relationships also could create and promote unrealistic and utopian views of the success of an individual or group, as well as suggest and disseminate extreme (extremist) ideas and ideologies.

The invention of the XXI century was the emergence and quick wins of the information space by social media, which in many respects replaced the traditional media. Thus, according to studies of the international marketing management system HootSuite as of January 2018 in Belarus more than 49% of the population (4.67 million) are active users of social media. 3.85 million Belarusians use social platforms on smartphones. But the most curious fact is that Belarus ranks first in the world in terms of the percentage of women on Facebook (58%). It should be acknowledged that only 8.6% of Belarusian business pages on Facebook use advertising tools (this is almost 3 times less than the average).

What can be connected with such changes? Firstly, social media is more mobile way of transmitting and receiving information. Expanding access to the network, and today in Belarus only 3.25 million use the fixed Internet,

with an constantly increasing speed of access to the network, make social networks more competitive.

Thirdly, there is a deepening democratization of the information space. If earlier information could be provided only by centralized news agencies, now we see how social networks allow any registered account to become a kind of center for the transmission and dissemination of information. Therefore, today the media community is faced with an entirely new phenomenon — bloggers. Bloggers, in contrast with journalists, are not bound by mass media legislation, and act as private individuals and are not responsible for the credibility in the transfer of information. The same can be said about social media, which leads to consequences in the area of quality of transmitted and reported information, as well as public security.

Sometimes the anonymity of social media leads to greater risks. Accounts anonymity provide a broad range of instruments to manipulate the information space. Attempts to organize " revolutions through social networks" and as the result distressing consequences effects of the Arab Spring, rumblings of which we still observe in Syria and Yemen, show, that social media require the development of legal framework that could regulate this sphere. In this regard, in the Republic of Belarus in 2010 in the National security concept and in 2016 in the adopted New military doctrine were introduced provisions on the features of the threat of "hybrid wars", namely in the part related to information and psychological methods of destabilization of the situation in the world.

On the one hand, it is necessary to develop legal support for freedom of speech in social media. On the other hand, participants in social networks should feel safe both in terms of access to accurate information and in terms of moral and psychological protection. The latter factors are important. Over recent years, there has been a great number of cases of so-called "hatering", mentally incorrect behavior in social media, which sometimes cause deplorable and tragic consequences. Anonymity and legal undefined of these media creates loopholes, including illegitimate and illegal actions. Many social media, due to their anonymity, in particular the Telegram channel, are used by destructive forces for communication between representatives of criminal and terrorist groups. Therefore, this resource has been recognized as hazard and blocked on the territory of the Russian Federation. Attempts of numerous information junk shot, misinformation and manipulation of interpretations of already existing information are also recorded. All this poses a hybrid threat, which is recognized by experts at the world level.

In the next thirty years, the role of the Internet and social media will only increase. Audience coverage will expand through the generational change,

increasing access to the Internet in new regions and speed of data transmission. Moreover, in some countries social networks are already trying to integrate with e-government, banking systems and Agency resources. There is an integration of information, management and payment systems, the process of digitalization, which expands the functions of social networks and requires more detailed elaboration of security and the establishment of a qualitatively new framework of legal support for the social media functioning.

2. IMPACT ON THE BUSINESS

Nowadays significant challenges remain in thinking or anticipating the speeding up of innovation progress and increasing the pace of change, and these factors are a source of constant surprises even for the most skillful and informed participants. Anyway, there is clearly demonstrated in all sectors of economy, that the technology marking the beginning of the fourth industrial revolution have a decisive impact on business. The fourth industrial revolution is already happening, for now just picks up and is to develop robotics, further digitalize the economy and automate production and services, expand the use of little-used technologies.

In supply and logistics of many industries, we can notice the introduction of new technologies, enabling totally new ways of servicing for existing procurement needs, and, consequently, greatly competing with established production and value chain. A similar effect comes from initiative, innovative competitors, who due to worldwide digital platforms for research, development, marketing, sales and distribution, can quicker than ever displace long and well-standing market participants, through improving quality, speed or cost of providing goods produced for consumption.

In addition, significant changes on demand side are arising, as increasing availability of information, constant involvement of the consumer and new patterns of consumer behavior (mainly as a result of access to mobile networks and information) make companies adapt ways of the development, маркетирования and delivery of products or services.

Development of information platforms is a core trend. Such platforms combine supply and demand and undermine existing production structures, and as examples we can see such new business models as “sharing” economy and “on-demand” economy. These platforms (“Uber”, “Airbnb”, Alibaba etc.), easily used on smartphones, bring people, assets and data together thus creating entirely new ways and means of consuming goods and services. In addition, they make easier for businesses and individuals achieving of “wealth”, changing the personal and professional sphere of employed. These new business models are rapidly spreading as a large number of new

services, from laundry to shopping, from housekeeping to parking, from massage to transportation.

In general, there are four main effects of the fourth industrial revolution on business — the impact on consumer expectations, on product improvements, on collaborative innovation, and on forms of organization. Tangible products and services can be enhanced by means of digital opportunities that make them more valuable. New technologies make assets more sustainable and flexible, while data and analytics are changing the way of its maintaining. The world of individual consumer experience, widely available information services and efficient use of assets requires new forms of cooperation, especially considering the speed with which changes are going on. And the emergence of global platforms and other new business models, as a result, means, that individual capabilities, culture of society and organizational forms should be revalued.

3. IMPACT ON THE STATE

As material, biological and digital worlds continue to merge, new technology and platform will provide expanding opportunities for citizens to interact with government agencies, to express their views, coordinate their efforts, and even to avoid authorities supervision. Concurrently, government agencies will receive new technological options to strengthen control over society, based on more complex and upgraded monitoring systems of digital infrastructure. However, the authorities will be under pressure to reconsider their approaches to interaction with civil society and pursue policies, as their central role in the latter will go down with coming of new sources of competition, redistribution and decentralization of power arising from new technologies.

Ultimately, the adaptability of government structures and authorities will determine their survival. If they are able to accept the world of revolutionary changes, to modify their structures, to make them transparent and efficient enough to maintain their competitive advantages, then they will address new challenges. Otherwise, they may face difficult problems to solve.

This will become especially evident in the field of management. The time of the second industrial revolution coincided with existing public policy and decision-making systems, when decision makers have had time to considerate particular issues and formulate the necessary solutions or appropriate regulatory frameworks. The entire process was linear, mechanical, with strict top-down approach.

Such approach isn't suitable for our time. Given the rapid pace and scale of the impact of the fourth industrial revolution, legislators and regulators

have faced with unprecedented challenges and, mostly, found themselves somewhat helpless.

For example, how could they protect interests of consumers and society in a broad sense while continuing to foster innovation and technological progress? With the introduction of "flexible" public administration, as well as the private sector has implemented appropriate measures to develop software and business models on a larger scale. It means that regulators should adapt to a new, ever-changing environment, evolving to fully understand what they regulate. For that purpose, the authorities and regulatory agencies should work closely with business and civil society.

4. IMPACT ON HUMANITY

The fourth industrial revolution will change not just what we do, but also what we are. It will influence our identity and all related aspects: our perception of privacy, understanding of property, consumer habits, time that we devote to work and leisure, career development, a set of skills and competence, the personal relationships. At the core of this question is the permanent use of smartphones, that may cause losing one of the most important aspects of our existence: to make a pause, to think and to start live meaningful conversation.

Privacy is one of the greatest personal challenges posed by new information technologies. We reflexively realise how important it is for everyone, while tracking and sharing information about ourselves is a crucial aspect of the new information interaction. The fundamental issues of the impact of the loss of control over our information on our private life in the near future will be only discussed more active. As well as breakthroughs in biotechnology and AI that redefine the concept of the human being on the whole and push back the boundaries of life expectancy, cognition and human capabilities will make us review our moral and ethical norms.

5. ARTIFICIAL INTELLIGENCE (AI) AS ONE OF THE MAIN DRIVERS OF THE FOURTH INDUSTRIAL REVOLUTION

Artificial intelligence already exists in our lives, from self-driving cars and drones to virtual assistants who can translate or invest. By virtue of the exponential growth of computing power and the huge amount of accumulated data, the progress in the field of AI has been impressive in recent years. AI is widely used in creating of new types of medicine and developing of algorithms which can predict our future cultural preferences. At the same

time, digital production technologies interact with the biological world. Engineers, designers, architects combine computer-aided design systems, additive manufacturing, materials science, and synthetic biology for breakouts in the discovery of symbiosis between microorganisms, our bodies, the substances we consume, and even the houses we live in.

Artificial intelligence will become the central driver of change according to the polling of 800 leaders of technological companies which was conducted specially for the 46th World Economic Forum in Davos in 2016. 45% of respondents believe that in 2025, artificial intelligence may be present on the boards of directors of large companies.

Artificial intelligence used to exist only in science fiction, but now it's one of the most promising and rapidly developing technologies. Limited, or "weak" AI technologies are already widely used in various spheres: from mobile phones and household electronics to military products. The development of "strong" artificial intelligence, which is able to make informed management decisions is on the agenda today. Experts say that the prospect of creating such a technology questions not only the current system of global labor division, but also the world order and international security system.

Discussions at the conference organized by the China Institute of Contemporary International Relations (CICIR) with the participation of the Stockholm Peace Research Institute (SIPRI) in September 2018 in Beijing showed that AI technologies will be used by nuclear powers in the nearest future to modernize their strategic weapons. The usage of "weak" artificial intelligence (sharpened to solve a specific task) for early warning of the launch of enemy missiles, as well as for estimating the possibility of such a launch, can give the military command of a nuclear power additional time to decide on the backlash and its scale. New technologies can also upgrade the accuracy of nuclear weapons and the effectiveness of missile defense, improve the protection of nuclear facilities, and provide better recon data.

At the same time, the acceleration of the decision-making process of one of the parties will inevitably push its potential enemies to search for opportunities of a faster delivery of nuclear weapons. Such a race between nuclear powers potentially has a serious threat to world stability, since it will leave less and less time to estimate the threat of a missile attack and the expediency of response. Ultimately, it cannot be excluded that the countries will be forced to automatize decisions about a retaliatory strike, which can lead to unpredictable consequences. At the same time, weaker nuclear powers, which feel vulnerable, in the nearest future may implement an automatic nuclear retaliatory strike system (by analogy with the Soviet "Perimeter" system and the American "Operation Looking Glass").

As part of the discussion, it was noted that even machine learning experts do not always fully understand how it works. Despite the rapid development of AI technologies, the "black box" problem, when decision-making algorithms remain hidden from developers, remains relevant. Thus, before trusting artificial intelligence solutions related to the use of lethal weapons, it is necessary to significantly increase its transparency. However, there is inevitably a contradiction arising from the need to combine the transparency of machine learning mechanisms with their protection from the enemy, since the data used by neural networks can be "poisoned" by intentional manipulations (data poisoning). It is also important to note that military forces due to specifics of their work have a fundamentally smaller amount of data for machine learning than civilian companies engaged in AI.

However, it is already obvious that in the medium term, AI will make production, transportation and trade more efficient, improve crop yields, open up many new opportunities for technology development, restructure labor markets and consolidate new approaches to national security and modern military system. One of the tendencies can be particularly shocking: eventually, it is impossible to exclude the possibility that countries will have to automatize decisions about a retaliatory strike, which can lead to unpredictable consequences. Also the situation is complicated by the fact that autonomous weapons and artificial intelligence are still in the "gray zone" of international law.

It means that countries which are able to develop and use innovations in the field of AI will have good prospects for economic growth and for enhancing national security. In contrast, countries that maintain an excessive dependence on outdated infrastructure and economic models will find it difficult to ensure competitiveness.

The United States is a global leader in AI. Such companies as Google, Amazon, Facebook, IBM and hundreds of start-ups conduct extensive research focused on developments in this area. In September 2018, a 2 billion dollar campaign was started in the United States to develop the next wave of AI technologies with the goal of "turning computers from specialized tools into problem-solving partners".

At the same time, China is striving to become a world leader in AI by 2030. In October of this year, China allocated USD 1.6 billion for development in this area, and in 2017 investments amounted to USD 4.9 billion, which was the world's largest investment in this sphere.

Although the USA and China are the largest players, the development of AI is global. In Israel and the UK, the sector is developing at a high level. Earlier this year, the French government announced a major public

investment in this area. The promotion of innovation in the field of AI is also a key focus of governments in Japan, South Korea and Russia.

In September 2017, Vladimir Putin said that "artificial intelligence is the future not only of Russia, it is the future of all mankind. The one who becomes the leader in this sphere will be the ruler of the world. "In Russia, in 2017 the capacity of the AI market was less than USD 12 million, and by 2020 it is expected to grow to USD 460 million. The AI market capacity in the industrial sector by 2021 will be USD 380 million.

Former Google CEO Eric Schmidt believes that both Russian and Chinese leaders realized the importance of this area, not only from the commercial point of view, but also for military developments. ШIn May 2018, at a meeting on military construction Vladimir Putin stated that the production of weapons should focus on the implementation of AI and robotics.

In recent years the AI market in Belarus has grown several times. The High-Tech Park (HTP), which was established in 2005, has about 400 residents now. In 2018, more than 70 companies are engaged in AI, of which the most famous are MSQRD, AIMatter, Viber and EPAM. The number of specialists in the field of AI reaches 1,700 people.

The Decree of the President of the Republic of Belarus Alexander Lukashenko "On the Development of the Digital Economy", signed at the end of 2017, served as an impulse for the active development of technologies by IT companies. The main developments in Belarus on AI are applied in the field of the car industry, health care, agriculture, industrial production, finance, transport and environmental protection. Solutions are being developed for automated vehicles, speech recognition, search technology, computer vision, increasing the effectiveness of the use of acreage, yield forecasting, etc.

Highly automated production, changing the configuration of socio-economic and administrative relationships, do not involve only the automation of physical actions, and repetitive operations, but also the automation of human intellectual activity with its ability to solve non-standard tasks and formulate deep strategic goals. Despite the presence of advanced systems that automate certain aspects of human intellectual activity, it is extremely difficult to realize the ability to solve non-standard tasks and formulate deep strategic goals at a high quality level. At the same time, it is necessary to understand that the technology of machine learning in practice proved the possibility of formalization and subsequent implementation throughout computer technologies of non-algorithmizable processes and subject areas. So we can conclude that high quality in this area is possible.

Now the main thing that is necessary to understand how safe such an impulse will be for humanity, the established system of norms and institutions.

Despite the fact that artificial intelligence, as a scientific area, is the source of a great diversity of principles, paradigms, methods of data processing, semantic methods and technologies are currently the most advanced and promising. In particular, algorithmic methods for creating intelligent systems based on formal-logical models, in a general sense, represent the way to create syntactic structures that do not carry information about the content and meaning of data, and therefore systems based on these models can hardly be called intelligent.

Today, the efforts of all professionals to create intelligent expert systems are aimed at the formal expression of such objects as "inference", "meaning", "knowledge" and, based on the practical awareness of the limitations of classical methods, experts increasingly come to understand that without semantic methods and technologies further progress in the field of artificial intelligence will be impossible. One way or another, it became clear that without these methods, intelligent systems would be just a game of imitation of communication, argumentation, understanding and purposeful action. Moreover, the limits of this imitation have already been achieved. A good example is the "intelligent" chat bot, which for the first time managed to pass the Turing test "at the tests, organized in 2014 by the University of Reading (United Kingdom). At the same time, in order to hide the semantic errors associated with the patterned nature of the system, based on statistical methods of syntactic information processing models, the developers came up with a legend according to which the program is a 13 year old boy from Odessa who does not speak English well.

Despite the fact that the first Eliza bot was written in 1966, we still cannot talk about tremendous progress in this direction. In particular, the bot still works by certain instructions and relies on pre-formed keywords "understood" by the bot. Each command must be written by the programmer separately using regular expressions or other forms of string analysis. If the user does not use keywords, the bot responds with messages like "sorry, I did not understand." At the same time, despite limited functionality, such bots sometimes can be effective. It often concerns electronic legal systems and electronic lawyer systems, since the dialogue between users is served by much greater standardization and formalization.

In addition to bots, search, engineering, economic, medical and military systems with elements of artificial intelligence, intriguing enough, especially for scientists, is the creation of automated systems for identifying and prioritizing research projects in terms of socio-economic development.

In particular, according to the director of the Research Center "Informatics and Management" of the Russian Academy of Sciences, academician Igor Sokolov, separate fragments of this system are already used by the Russian Foundation for Basic Research and some industrial enterprises.

Noting the main benefits of the implementation of AI, it should be noted:

— automation and widespread cost reduction;

— the emergence of autonomous transport and robotization;

— optimization of logistics processes and supply chains;

— optimization of energy and transport networks;

— development of sensor networks and monitoring of agriculture;

— development of information services and a distributed economy;

— development of personal medicine, clinical practices and infrastructure for distributed and secure access to medical data;

— the emergence of personal educational trajectories and the development of social engineering;

— creation of autonomous weapons systems.

Of course, large-scale technological development within these areas and the introduction of relevant results in various aspects of socio-economic practice without proper scientific and economic expertise brings some potential risks.

So, according to many forecasts, AI will already surpass the human intellect by 2035–2050. However, as we noted at the beginning of the speech, the current results, despite the seemingly impressive character, are more likely to be in the area of imitating of intellectual activity or performing easily algorithmic tasks. Therefore, in our opinion, these dates can be significantly postponed.

Recently, there is an opinion in the expert community that AI systems will deprive people of work. In this case, the restructuring of the labor market, the withdrawal of professions related to the same type of processes and standardized physical manipulations, and the reduction of the working day are obvious. But, despite this development of AI systems, undoubtedly, will lead to the creation of new mass, creative and highly skilled professions. Thus, the thesis about increasing of social inequality in connection with the introduction of AI seems to be incorrect, since the emergence of such professions (provided timely and efficiently organized retraining of personnel and equitable distribution of large additional funds raised from productivity growth and cost reduction) will help to overcome the era of alienated, mechanistic labour and to make the work of interacting with AI systems less complicated and more fascinating.

The speed, scale and impact of change on the entire systems of the fourth industrial revolution are unprecedented in human history. Also great are the challenges and risks of the modern technological paradigm of human development, its social costs, consequences and contradictions. Creation of new business models on the basis of information platforms of demand and supply, strengthening of control over society and personality by the state, radical change of mechanisms of interaction of the state with civil society, development of competition and decentralization of power, creation of artificial intelligence — all this can lead to significant progress in the development of society and its degradation. A positive trend in the development of society is possible provided that the state authorities are able to adapt to the new conditions of the information society.

REFERENCES

[1] Braudel F. / Material civilization, economy and capitalism, XV–XVIII centuries. T. Structures of everyday life: the possible and the impossible / 2nd ed.; tr. from fr. L. E. Kubbel; entry art. Yu. N. Afanasyev. -- M.: Publishing House "Ves Mir" (All the World), 2006. — p. 592.
[2] Virginsky V. S../ Essays on the History of Science and Technology of the XVI–XIX Centuries — Moscow: Enlightenment, 1984. — p. 287.
[3] Grammar of Civilizations / Fernand Braudel; Preface M. Emar; tr. from fr. — M.: Publishing House "Ves Mir" (All the World), 2008. — p. 552.
[4] John Bernal/ Science in the History of Society — Moscow: Foreign Literature Publishing House — 1956, p. 738.
[5] Klaus Schwab / Fourth Industrial Revolution / Moscow: Eksmo, 2016, p. 208.
[6] Kurzweil Ray / Evolution of the Mind; Eksmo — M, 2015. — p. 352.
[7] Michi D, Johnston R. / The computer is the creator; World — M, 2011. — p. 255.
[8] Osipov G. S. / Lectures on artificial intelligence; Librokom — M, 2014. — p. 272.