

РАДІОТЕХНІКА, ТЕЛЕКОМУНІКАЦІЯ ТА ЕЛЕКТРОНІКА

UDC 004.8:316.3

THE ICT INTEGRATION AND ARTIFICIAL INTELLIGENCE INFLUENCE AND ITS IMPORTANCE ON SUSTAINABLE SOCIETY DEVELOPMENT

¹Dovgiy S.O., Guliaev K.D., ²Vorobiyenko P.P.

*The National Academy of Sciences of Ukraine,
54 Volodymyrska, Kyiv, 01030.*

dovgyi.s.o@nas.gov.ua, gulyaev@nas.gov.ua

*O.S. Popov Odessa National Academy of Telecommunications,
1 Kuznechna St., Odessa, 65029, Ukraine.*

vorobiyenko@onat.edu.ua

ВПЛИВ ІНТЕГРАЦІЇ ІКТ І ШТУЧНОГО ІНТЕЛЕКТУ ТА ЇЇ ЗНАЧЕННЯ НА СТАБІЛЬНИЙ РОЗВИТОК СУСПІЛЬСТВА

¹Довгий С.О., Гуляєв К.Д., ²Воробієнко П.П.

*Національна академія наук України,
01030, Україна, м. Київ, вул. Володимирська, 54.*

dovgyi.s.o@nas.gov.ua, gulyaev@nas.gov.ua

*Одеська національна академія зв'язку ім. О.С. Попова,
65029, Україна, м. Одеса, вул. Кузнечна, 1.*

vorobiyenko@onat.edu.ua

ВЛИЯЕНИЕ ИНТЕГРАЦИИ ИКТ И ИСКУССТВЕННОГО ИНТЕЛЕКТА И ЕЁ ЗНАЧЕНИЕ НА СТАБИЛЬНОЕ РАЗВИТИЕ ОБЩЕСТВА

¹Довгий С.А., Гуляев К.Д., ²Воробийенко П.П.

*Национальная академия наук Украины,
01030, Украина, г. Киев, ул. Владимирская, 54.*

dovgyi.s.o@nas.gov.ua, gulyaev@nas.gov.ua

*²Одесская национальная академия связи им. А.С. Попова,
65029, Украина, г. Одесса, ул. Кузнечная, 1.*

vorobiyenko@onat.edu.ua

Abstract. The purpose of the study is to determine the role of forecasting, its tasks and components in order to ensure the stable development of society in terms of integration of ICT and artificial intelligence. The study considers the indicators that characterize the results of society development due to scientific and technological progress. It also aims at analyzing the projected changes in society, as well as changes in the structure of infocommunication networks and technologies. It identifies the facts that significantly create instability in the global world in the form of military conflicts, huge military spending, famine and disease.

Scientific novelty is to determine the purpose of forecasting and its active nature in terms of identifying and supporting factors, the introduction of which will stabilize society and improve the quality of

life, which is determined by the happiness index. It is emphasized that the development of education and science can form a socio-political system in which the top of power will coincide with the top of wisdom and morality. Clearly and correctly formulated goals and forecast indicators will avoid many risks. Unemployment is one of the most dangerous.

Key words: artificial intelligence, forecasting, stability, development of society, the goal of the development of society, development indicators, risks.

Анотація. Метою дослідження є визначення ролі прогнозування, його завдань і складових для забезпечення стабільного розвитку суспільства в умовах інтеграції ІКТ і штучного інтелекту. Розглянути показники, якими характеризуються результати розвитку суспільства за рахунок науково-технічного прогресу. Проаналізувати прогнозовані зміни у суспільстві, а також зміни у структурі інфокомунікаційних мереж і технологій. Виявити факти, які суттєво створюють нестабільність у глобальному світі у вигляді військових конфліктів, величезних військових видатків, голоду і хвороб. Наукова новизна полягає у визначенні мети прогнозування і його активний характер з точки зору визначення і підтримки чинників, впровадження яких призведе до стабілізації суспільства і підвищення якості життя людей, яка визначається індексом щастя. Підкреслено, що саме розвиток освіти і науки може дозволити сформувати соціально-політичну систему, за якої вершина влади буде збігатися з вершиною мудрості і моралі. Чітко і вірно сформульовані мета і показники прогнозування дозволять уникнути багатьох ризиків. Одним із самих небезпечних є безробіття.

Ключові слова: штучний інтелект, прогнозування, стабільність, розвиток суспільства, мета розвитку суспільства, показники розвитку, ризики.

Аннотация. Целью исследования является определение роли прогнозирования, его задач и составляющих для обеспечения стабильного развития общества в условиях интеграции ИКТ и искусственного интеллекта. Рассмотрены показатели, которыми характеризуются результаты развития общества за счет научно-технического прогресса. Проанализировать прогнозируемые изменения в обществе, а также изменения в структуре инфокоммуникационных сетей и технологий. Выявить факты, которые существенно создают нестабильность в глобальном мире в виде военных конфликтов, огромных военных расходов, голода и болезней. Научная новизна заключается в определении цели прогнозирования и его активный характер с точки зрения определения и поддержки факторов, внедрение которых приведет к стабилизации общества и повышение качества жизни людей, которая определяется индексом счастья. Подчеркнуто, что именно развитие образования и науки может позволить сформировать социально-политическую систему, при которой вершина власти будет совпадать с вершиной мудрости и морали. Четко и верно сформулированы цель и показатели прогнозирования позволят избежать многих рисков. Одним из самых опасных является безработица.

Ключевые слова: искусственный интеллект, прогнозирование, стабильность, развитие общества, цель развития общества, показатели развития, риски.

"Do not instill in your children the desire to be rich. Educate them so that they strive to be happy. Therefore, when they grow up, they will know the value of things, not the price"

The development of telecommunications and the success of the computer industry has led to the third and fourth industrial revolutions.

It should be recalled that the term "fourth industrial revolution" was introduced in 2011 as a part of the state Hi-Tech strategy of Germany (one of ten projects) [1].

Then in Davos [2] the term became global and included corporate networks, the Internet of Things, renewable energy, composite materials, 3D printers [3], vertical trusses [4], food synthesis, self-managed transport, neural networks, gene modification, biotechnology, and artificial intelligence [5].

The avalanche of digitalization processes of the entire life of each person and society as a whole became possible only because digitalization was planned much earlier in the late fifties when the foundations of the theory of digital communication began to be laid, even though it was unable to be implemented.

Therefore, the success of physicists in microelectronics has fallen on fertile ground. It was clear what equipment was needed and how to produce them. This happened because scientists correctly predicted the further development of telecommunications. In addition, as Klaus Schwab writes, humanity is on the brink of a new technological revolution that will radically change the way we live and work and treat each other. Mankind has never experienced such a scale and complexity of change.

Of course, it is now impossible to predict how it will unfold, but it is already clear that it will affect all groups, strata and substrata of humanity, all professions, etc. [2]. Therefore, forecasting the further development of society, in general and telecommunications in particular, is an urgent task.

The aim of the work is to improve forecasts, determine forecasting goals and dominant factors.

Forecasting and development of proposals for its improvement. Given the high authority of Klaus Schwab, it is necessary to give attention to the excerpt from the above quote about the impossibility of predicting the movement of society in the future.

In principle, it is impossible to agree with this.

There are dozens, if not hundreds of examples where scientific and technological progress has been detrimental. The simplest example is the invention of plasticine and the manufacture of products from it that today pollute land, rivers, and even seas and oceans, creating an ecological catastrophe; or nuclear energy, which was previously used for military purposes and only then for peaceful purposes. Thus, we often observe uncontrolled, virtually chaotic development. What is the way out of this situation?

Society understands the threat of chaotic development of scientific and technological progress through public organizations, primarily the United Nations, which produce goals for sustainable development of society.

Thus, after the global forecast made by the American scientist Jay Forrester in his book [6], the post-war strategy of resource growth will lead to either a lack of resources or catastrophic pollution.

The governments of many countries have begun to seriously address the environment, resource conservation, the use of renewable energy sources, and so on.

The idea was put forward to build an economy on the basis of knowledge [7]. Forrester's ideas were developed by his followers.

The most talented was D. Malous and his group of researchers [7]. The group focused its research on a new model of global dynamics, including the world's population, energy and raw material resources, food security, and pollution.

In response to calculations based on the new model, international research institutions were established [7]. However, the models developed in 1980 did not predict the real development of the economy [7]. There has been some skepticism about computer modeling of the economy.

In [7,8], Nobel Prize winner Herbert Simon is quoted as saying: "Forty years of experience in modeling complex systems on computers, which are becoming bigger and faster every year, have taught us that brute force will not lead us along the royal path to understand such systems. Thus, modeling will require reference to the basic principles that will lead us to solve this paradox of complexity. "

In this context, the question should be answered: what is the purpose of forecasting, what is the most important, and what needs to be changed in order to achieve the set goals?

In [7] we read:

The main objects of socio-economic forecasting are demography, economics, social sphere, ecology and scientific and technological progress. They define the so-called order parameters: those slow variables to the behavior of which the others will adjust. The key parameters of order

throughout world history have been and still remain: population, available resources and the level of technology. Typical indicators of socio-economic macro-forecasting include:

- gross domestic product of the country (as a whole and per capita, production volumes of the most important types of products, goods and services);
- population and labor resources;
- investments in fixed capital, in production and social spheres;
- export and import of goods and services, trade balance;
- labor productivity; and
- human development index.

It definitely lists very important forecasting objects, but not all. First of all, it is important to ensure the stable and peaceful development of society.

To achieve this, it is necessary to create a society where people would live comfortably. By a unanimous decision of the UN General Assembly, at the suggestion of the Kingdom of Bhutan, a celebration of happiness was established in 2012 [9,10]. Happiness ministries have been set up in some countries, such as Bhutan, the United Arab Emirates, Ecuador, and others. The question arises: how effectively ministries work and will work. However, there are already positive examples. Thus, in Bhutan, the GDP indicator "Gross National Happiness" is measured instead of GDP. This indicator takes into account the impact of economic growth on the social sphere, environment, health care, etc. The census questionnaire contains the question: "Are you happy?" In Dubai, "smart" cameras monitor and analyze the facial expressions of visitors at the entrance and exit of the management of roads and transport. If the client's face is not defined by joy, satisfaction, it is a signal to employees of the institution to make adjustments to their work [9].

We need to pay attention once again that, as a rule, development results are estimated by economic indicators such as GDP per capita, created goods and services, improvement of the ecological situation, the percentage of energy produced from renewable sources, and so on.

The following proposes formulating the purpose of forecasting.

Forecasting serves to determine the factors, the introduction of which will lead to the stabilization of society, and, as a consequence, improve the quality of life [11,13].

[14] suggests that all discoveries and inventions should be tested for harm. And to start implementing innovations only after the creation of harm minimization technology. Moreover, simple observations show the imperfection of society. This imperfection is manifested in instability (permanent military conflicts, millions of refugees, inequality between people and countries) and the world community is struggling with it. The United Nations has formulated 17 goals for sustainable development [15]. Undoubtedly, achieving these goals will be beneficial for the world community. But we can predict that the probability of a radical increase in stability is small. In [16], five factors are proposed, through which a significant increase in global stability can be achieved.

To counter instability in the global world, it is necessary to identify the causes of this instability. It is well known that this is inequality, especially in material terms, of people and states. It should be recognized that instability was created by people for the sake of personal wealth and (or) power. Therefore, one of the main tasks of education should be to bring to the consciousness of mankind that wealth and power cannot be the purpose of life. To support this view, we quote billionaire Steve Jobs, who died at the age of 56: "Do not instill in your children the desire to be rich. Educate them so that they strive to be happy. Therefore, when they grow up, they will know the value of things, not the price" [17]. There is also an attempt to theoretically substantiate the groundlessness of the desire for unlimited enrichment. The feeling of satisfaction from this is approaching zero [11]. Power used for personal enrichment and satisfaction of one's ambitions cannot lead to the stable development of the region, the state, and the global society as a whole. This means that citizens will not achieve a happy life.

Of course, the question arises: what is happiness? There are many definitions of this concept (human condition). In the literature [12] there are 20 definitions of happiness of prominent people of the planet. And these are just a few of the definitions that can be found on the Internet. Happiness is considered by philosophers, physiologists, writers and in general everyone has their own idea of happiness. There are similar concepts - the index of life satisfaction in the world [13]. One way or another, the UN measures happiness in many countries [10]. Components of happiness have been developed, namely Estimation of GDP per capita, Social support, Healthy life expectancy, Freedom to make life choices, Generosity, Perception of corruption. These components can and should be discussed, but the beginning has been made and improve these components can be further improved.

Due to its importance, forecasting has become a separate branch of science and practice. First of all, the forecasts are structured. The structuring of forecasts is due to their classification. There are various features of the classification of forecasts. Using sources [18-24], we highlight the following features:

- for the purpose of forecasts (exploratory and normative) [18];
- on the time horizon [18];
- in content (economic, democratic, social (level and quality of life of people), environmental (natural resources), scientific and technical (technological) [18];
- by development methods (based on creative vision and formalized) [18]; and
- by scale [18].

Each of these features, in turn, is structured. The most important is the sign of "content". The structure of this feature should be expanded by adding educational forecasts (change in the education system), consumer (consumer market development), as well as organizational and managerial (forecasting, improving the structure of enterprises and improving management decisions).

Forecasting, regardless of the term (short-, medium- or long-term) and the volume of forecasting (enterprise, region, country, continent, global) should be divided into three stages:

- 1) determining the purpose of forecasting;
- 2) determination of forecasting indicators; and
- 3) ensuring the achievement of the goal of forecasting.

It is recommended to form the goal of forecasting as the achievement of stable development of the forecasting object.

As an indicator of forecasting, it is recommended to take one of the indices: the index of happiness, the index of life satisfaction or another index that relates to human life.

The most voluminous and labor-intensive is the third position of forecasting - ensuring the purpose of forecasting. Therefore, it is necessary to determine the components of ensuring the purpose of forecasting. Science and education are on the first level. The very definition of the directions of development of science and education depends on the fulfillment of the set goals. Socio-economic (including universal values) and natural sciences are recommended to be recognized as the main substantive parts of science and education. That is, to ensure the development of science about the geosphere, biosphere and noosphere [14], as well as their interaction, which can result in stable development of society.

Socio-economic sciences should just explore the purpose and criteria of forecasting, the formation of socio-economic and political systems. The overriding task is to form such a socio-political system in which, figuratively speaking, the peaks of power, wisdom and morality coincided. This requires in-depth studies of human psychology, its personal characteristics and the coordination of these characteristics with the realities of life.

It is very important to study people's ability to learn, cultivate tolerance towards other people, hard work, assimilation of universal human moral values and much more. In addition to

research, synthetic discussion disciplines should be introduced in educational institutions, for example, the conditions for the stable development of global society, which summarize the knowledge already acquired in this regard. Especially since there have been significant changes in these areas [25].

First, teaching and research technologies have changed. Information technology has significantly expanded and accelerated research and provided new learning opportunities. Avalanche-like distance learning is developing.

Second, full-time students are increasingly eager to work, which significantly reduces the time spent directly on studying. To eliminate this contradiction, dual education emerged. To implement this form of education it is necessary to establish relations with business.

Third, the rate of aging of knowledge has accelerated significantly, leading to the introduction of the new term "half-life" to knowledge. It is recognized that the half-life of applied knowledge is five years. It is most likely that this period has decreased today, and this trend will continue. And only thorough knowledge is stable [26].

Fourth, the amount of information needed is constantly growing. To deal with this problem, lifelong learning is introduced, starting in kindergarten, and which lasts a lifetime. The organizational form of such training can be educational and scientific production complexes (NNVK), which will include: industrial enterprises, kindergartens, secondary and higher education institutions, scientific organizations. The work of the Complex will allow educational institutions to fully take into account the requirements of employers for graduates of educational institutions, clarify the areas and specialties of training, determine the content of training and coordinate curricula of different educational and qualification levels, raise the professional level of graduates, improve practical training.

An important trend is the labor market and social development [27-30]. The change in technology has led to a change in the labor market. Demand for intellectual professions is rising, unemployment in others is already projected to increase. This must be avoided. Otherwise, the question arises why stimulate scientific and technological progress. Since the progress of the development of science and technology cannot be stopped, it is necessary to develop other useful areas of activity and create conditions for spiritual development. In addition, it is already necessary to get ready for the preparation of new professions. Dozens of new professions are predicted in the literature. And this is very important. Today the situation is such that as a result of robotization of routine operations in the technological process workers are made redundant, who then have big problems with finding a job. In the near future, the achievement of artificial intelligence will lead to the automation of management and other intellectual activities. It is possible to predict that working professions will need higher education. But if there are new professions, a new organization of work (for example, work not in the office, but at home), the situation is not so negative. Recall that the purpose of development is to increase the happiness index of people, then forecasting future professions is an urgent task. If this information is supplemented by the emergence of completely new practical activities, such as the exploration of the planets of the solar system, a completely new level of the leisure industry and the spiritual development of the individual, then there is a real opportunity to provide employment.

The development of society directly depends on scientific and technological progress (STP), the basis of which is the integration of artificial intelligence (AI) and information and communication technologies in the context of comprehensive digitalization. Therefore, in the future we will consider forecasting scientific and technological progress in the field of telecommunications/ICT and artificial intelligence. Note that the term "Telecommunications/ICT" was introduced by the International Telecommunication Union ITU/ICT. There is another equivalent term - infocommunications, which we will use in the future.

Studies are constantly appearing in the literature to determine the forecast of telecommunications, and these forecasts relate to different areas of activity. For example, Telenor's forecast [31] lists 11 trends. Here are some of them:

1. "Green innovations" will become something real (reducing the impact on the climate).
2. The spread of "Internet of the body" (treatment without a doctor).
3. The creation of new infrastructural connections between companies of different industries (the increase of IT devices will allow to carry out complex works: investigation of emergency situations, logistics, etc.).
4. Distribution of closed networks (secure networks creation).
5. Continuation of the "dirty data" problem (decisions based on artificial intelligence may be erroneous due to inaccurate or falsified data).
6. Confidence in technology companies will become increasingly acute.
7. The development of electric cars and charging stations problem (manufacturers will increase the production of electric cars with increased mileage, there will be a shortage of charging stations).
8. There will be new opportunities for sleep tracking (measurement and control of sleep parameters).
9. Competition between on-line video services will increase (AppleTV +, Disney +, Netflix and others will continue to compete fiercely, which will benefit users).

In [32] five trends in the US telecommunications industry were published. In this study, it is noted that competition is intensifying with the emergence of new players along with the telecommunications giants, who are also active.

The first trend - 5G will be further developed.

The second trend is the main direction: basic communication services. Fiber and 5G transformation.

The third trend is the risk of the Internet of Things market.

The fourth trend is the development of SD-WAN.

In the future we will expand the subject area and consider the development of STP in the field of infocommunications and artificial intelligence. We propose to carry out an analysis, based on the following restructuring of the STP development in content.

1. Influence on society as a whole (including law, expected positive outcomes and risks).
2. Changes in the structure of networks and technologies.
3. New types of production.
4. Penetration of new technologies into traditional sectors of the economy.
5. Changes in company management.
6. Possible Risks.

Let us consider the content of structural units of the forecast step by step.

Impact on society. The greatest impact on society will be the further development of e-democracy, e-government (including the fight against corruption), and e-health, as well as real opportunities for positive change in education and science. E-commerce will make it more convenient to buy goods and services, as well as make online payments. Social networks will unite people and in fact allow unlimited communication between them, regardless of their location. There will be more time for spiritual development, communication with children and rest. A smart home will add home comfort. Being able to work online will eliminate the need to spend time and money commuting to and from a place of work.

The benefits of digitization and the concept of e-health were particularly evident during the COVID-19 pandemic by providing medical and pharmaceutical services during quarantine, as well as to prevent the spread of the disease. The focus is and will be on the health of women and

children. A special concept has been developed in which, in addition to the UN, the International Telecommunication Union takes an active part [33].

Industry 4.0 requires legislative support in the form, first of all, of laws and normative documents in each state, on the basis of which international agreements are created. They regulate one or another type of activity that arises under the influence of infocommunication technologies and artificial intelligence. Naturally, when such a regulatory framework is created, it needs further improvement and development in order to enable the introduction of new technological solutions. It would be expedient to introduce the principle of advanced development of regulatory laws, based on forecasts of technology and production at the international level. The following are some examples.

Today, the development of infocommunications and robotics has led to the active development of technologies and production of unmanned aerial vehicles (UAVs), the use of which requires a strong legal framework. UAVs have become available to amateurs as well as commercial companies. Therefore, it is necessary to legislate their use to ensure flight safety. Undoubtedly, such a base is already being created, in particular for drones. Thus, there is a "Main List of Drone Laws", which is compiled for the United States and most countries [34]. The compiler warns that this list may not be complete and recommends referring to the literature in this list, as well as to study possible changes and additions.

Changing the structure of infocommunication networks and technologies. The benefits of the digital economy and information society will only be felt when broadband Internet access is provided anywhere, anytime, and at an affordable price. Today, 5G technology is used to provide access.

It is expected that the development of 5G will directly affect business processes and technologies (unlike previous standards), as it blurs the line between fixed and mobile Broadband Access (BA). 5G is the first wireless technology capable of supporting performance that is as close as possible to optical technology.

The main advantages of 5G technology over 4G are:

- at least 100 times higher data transfer rate for a short period of time (up to 10 Gbps);
- reduction of delay time (1ms compared to 50 ms);
- ability to connect dozens of times more devices;
- more efficient use of spectrum; and
- tenfold increase in the operating time of devices with low power consumption.

Fixed broadband operators will be able to provide services to mobile operators for 5G networks through their optical networks. In turn, mobile operators with the help of 5G technology will be able to provide wireless broadband services, which in terms of parameters can be considered as a fixed broadband. Thus, access to the Internet will depend on the coverage of the territory, not on the population. Users will benefit from the convergence of services. First of all, it will be possible not to monitor whether you use a mobile or fixed broadband access, and the fee for a mobile broadband access will be formed depending on the speed, not the amount of traffic.

The UN recognized the right to access the Internet as a basic human right in 2011 and noted that the state should be responsible for the availability of the Internet for everyone. As stated in the UN resolution, due to its unique nature, the Internet not only provides an opportunity for human rights to freedom of thought and its dissemination, but also stimulates the development and progress of society as a whole [35].

In 2010 The EU program "Digital Program of Europe" was adopted, which aimed to provide the population with 100% the ability to connect to the broadband access at a speed of at least 30 Mbit/s and 50% of the population at a speed of 100 Mbit/s by 2020 [36].

In 2016, the EU adopted the Competitive Digital Single Market - Towards a European Gigabit Society program, which proposes to improve the telecommunications infrastructure to

provide 1 Gbps Internet connections for schools, transport hubs, community facilities and 100 Mbp/s for households in rural and urban areas [37].

Despite much attention to 5G technology, China has begun to develop 6G technology, which, according to developers, will provide in the future a speed of 8 thousand times higher than 5G technology [38], while expanding the bandwidth to 100 GHz with decreasing distances between base stations [39].

Telecommunication networks built with blockchain technology will be further developed, which will become the main mechanism for uniting various industries and the basis for creating new types of services and complex intelligent systems. Blockchain technology is associated with cryptocurrency, but this is not the case. This is the technology of the future [40,41].

Conclusion. Further research should consider the development of STP and its impact in the following areas: new types of production, the penetration of new technologies in traditional areas of the economy, changes in corporate governance, possible risks.

A complex problem is to be solved - methods to ensure the achievement of the goal of forecasting have to be developed.

REFERENCES:

1. The fourth industrial revolution. Popular about the main technological trend of the XXI century. [Electronic resource] Accessmode: www. URL: [https://www.tadviser.ru/index.php/Статья:Четвертая_промышленная_революция_\(Industry_Индустрия_4.0\)](https://www.tadviser.ru/index.php/Статья:Четвертая_промышленная_революция_(Industry_Индустрия_4.0)).
2. Schwab K. The Fourth Industrial Revolution / K. Schwab. - Eksmo, 2016. – 138 p.
3. Chalenko Y.Yu. The fourth industrial revolution begins with 3D printing // Bulletin of Eurasian Science, 2018, № 3 [Electronic resource] Accessmode: www. URL: <https://esj.today/PDF/51ECVN318.pdf>.
4. Vertical farms 2.0: how they are built "in height" in Ukraine [Electronic resource] Accessmode: www. URL: <https://agroportal.ua/publishing/analitika/vertikalnye-fermy-20-teper-i-v-ukraine/>.
5. 4th industrial revolution in Davos [Electronic resource] Accessmode: www. URL: <https://expert.ru/2016/01/21/chetvertaya-promyishlennaya-revolutsiya/>.
6. Forrester D. World Dynamics: Translated from English. M.: OOO "AST Publishing House": SPb.: Terra Fantastica, 2003. – 379 p.
7. A.A. Akaev, V.A. Sadovnichy On the Forms and Methods of Global Forecasting / Universal and Global History: Evolution of the Universe, Earth, Life, Society. Ed. L. E. Grinina, I. V. Ilyina, A. V. Korotaeva. - Volgograd: Teacher (2012): 560-577.
8. Kapitsa S.P. Essay on the theory of human growth. Demographic revolution and information society. M.: Nikitsky club., № 4, 2008. [Electronic resource] Accessmode: www. URL: <http://spkurdyumov.ru/biology/ocherk-teorii-rosta-chelovechestva-kapica/>.
9. E. Motrenko "Index of Happiness" as a Degree of Life Satisfaction [Electronic resource] Accessmode: www. URL: <https://iz.ru/858177/elena-motrenko/schaste-po-raschetu-dlia-chego-nuzhen-reiting-blagopoluchii-a-stran>.
10. World Happiness Report [Electronic resource] Accessmode: www. URL: https://en.wikipedia.org/wiki/World_Happiness_Report.
11. Hypothesis about the law of material satisfaction and its perception by man / Economic Bulletin of the University, Pereyaslav-Khmelnitsky State Pedagogical University. Hryhoriy Skovoroda, Issue. 45(2020): 114-119.
12. D. Gorchakov 20 definitions of happiness from the best minds on the planet. [Electronic resource] Accessmode: www. URL: <https://lifelifehack.ru/20-opredelenij-schastya-ot-luchshix-umov-planety/>.
13. Ranking of the countries of the world according to the life satisfaction index. [Electronic resource] Accessmode: www. URL: <https://gtmarket.ru/ratings/satisfaction-with-life-index>.
14. Noosphere [Electronic resource] Accessmode: www. URL: https://uk.wikipedia.org/wiki/Ноосфера#Концепція_ноосфери/.
15. Sustainable Development Goals [Electronic resource] Accessmode: www. URL: https://en.wikipedia.org/wiki/Sustainable_Development_Goals.
16. Vorobiyenko P. Industry 4.0 and Information Communication Technologies// 2017 International Conference on Information and Telecommunication Technologies and Radio Electronics (UkrMiCo) September 11-17, 2017, Odessa, Ukraine: 15-18.

17. V. Kozlov The last words of Steve Jobs make us think about the meaning of life. [Electronic resource] Accessmode: www. URL: <https://www.liveinternet.ru/users/3517075/post455384035>.
18. Classification of forecasts. – Режим доступу: www. URL: https://www.uamconsult.com/book_547_chapter_6_1.4._Klassifika%25D1%2581ija_prognozov.html.
19. Forecasting - concept, tasks, functions and principles. Classification of forecasts [Electronic resource] Accessmode: www. URL: <http://www.ekonomika-st.ru/drugie/metodi/metodi-prognoz-1-1.html>.
20. Classification of forecasts [Electronic resource] Accessmode: www. URL: <https://laws.studio/sotsialno-ekonomicheskikh-prognozirovanie/klassifikatsiya-prognozov-34164.html>.
21. Types of forecasts, classification of forecasts [Electronic resource] Accessmode: www. URL: <https://studfile.net/preview/2798320/page:24/>.
22. Review of forecasting methods [Electronic resource] Accessmode: www. URL: <https://ivan-shamaev.ru/overview-forecast-methods/#i-8>.
23. Matvienko V.Ya. Forecasting. Forecasting social and economic processes. Theory. Methodology. Practice. K.: Socis, 2000. 218 p.
24. Novikova N.V., Pozdeeva O.G. Forecasting the National Economy: Teaching Guide. Yekaterinburg: Publishing house of the Ural State Economic University, 2007. 138 p.
25. A. N. Lanskih Foresight as a new methodology for managing the development of higher education. [Electronic resource] Accessmode: www. URL: <https://cyberleninka.ru/article/n/forsayt-kak-novaya-metodologiya-upravleniya-razvitiem-vysshey-shkoly>.
26. Q. Gnap Knowledge Half-Life: How to Replenish Stocks? [Electronic resource] Accessmode: www. URL: <http://chp.com.ua/ua/all-news/item/53646-period-poluraspada-znaniy-kak-popolnyat-zapasy>.
27. A. N. Bodrov Labor market forecasting and employment incentives / Research in education. Series: Economics and Business, 2009:1-6.
28. Akyulov R.I., Skovpen A.A. The Role of Artificial Intelligence in the Transformation of the Modern Labor Market / Labor Economics and Demographic Economics., DISCUSSION, №3(94)(2019):30-40.
29. K. Patrice Influence of artificial intelligence on employment on the example of the transport industry in France / University Bulletin. Development of sectoral and regional management, № 12(2019): 71-77.
30. O. L. Figovsky, L. N. Yasnitsky Artificial intelligence and its impact on technology and society / Proatom, 2020 [Electronic resource] Accessmode: www. URL: <http://www.proatom.ru/modules.php?name=News&file=article&sid=9175>.
31. Telenor: 20 technology trends that will shape 2020. [Electronic resource] Accessmode: www. URL: <https://www.telenor.com/media/press-release/telenor-20-technology-trends-that-will-shape-2020#:~:text=In%202020%2C%20we%20will%20see,and%20building%20new%20revenue%20streams>.
32. Five trends in the US telecom industry this year [Electronic resource] Accessmode: www. URL: <https://www.crn.ru/news/detail.php?ID=142880>.
33. E-Health and innovation in women's and children's health: a baseline review. [Electronic resource] Accessmode: www. URL: https://www.who.int/goe/publications/ehealth_ex_summary_ru.pdf.
34. Master List of Drone Laws (Organized by State & Country) [Electronic resource] Accessmode: www. URL: <https://uavcoach.com/drone-laws/>.
35. United Nations Resolution. [Electronic resource] Accessmode: www. URL: https://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf.
36. EU Digital Agenda for Europe [Electronic resource] Accessmode: www. URL: <https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi>.
37. The EU's Competitive Digital Single Market - Towards a European Gigabit Society program [Electronic resource] Accessmode: www. URL: <https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access>.
38. A. Friedman Chinese agency says 6G could be 8,000 times faster than 5G [Electronic resource] Accessmode: www. URL: https://www.phonearena.com/news/Chinese-agency-says-6g-can-deliver-1TBps-download-speed-vs-5G_id121939.
39. Tikhvinsky V.O. Features and prospects of spectrum use in 5G networks / ITU Regional Training Seminar for CIS countries "Prospects for the development of infocommunications: technologies and issues of sector regulation". - Astana, Republic of Kazakhstan, September 23-24, 2014: 2-15.
40. Blockchain (blockchain, chain of blocks) [Electronic resource] Accessmode: www. URL: <https://alpari.com/ru/beginner/glossary/blockchain/>.
41. What is blockchain technology? [Electronic resource] Accessmode: www. URL: <https://www.ibm.com/ru-ru/blockchain/what-is-blockchain>.

ЛІТЕРАТУРА:

1. Четвертая промышленная революция. Популярно о главном технологическом тренде XXI века. – Режим доступа: [www. URL: https://www.tadviser.ru/index.php/Статья:Четвертая_промышленная_революция_\(Industry_Индустрия_4.0\)](http://www.tadviser.ru/index.php/Статья:Четвертая_промышленная_революция_(Industry_Индустрия_4.0)).
2. Шваб К. Четвертая промышленная революция / К. Шваб. 2016. – 138 с.
3. Чаленко Я.Ю. Четвёртая промышленная революция начинается с 3D-принтинга//Вестник Евразийской науки. – 2018.– № 3. – Режим доступа: [www. URL: https://esj.today/PDF/51ECVN318.pdf](http://www.esj.today/PDF/51ECVN318.pdf).
4. Вертикальные фермы 2.0: как «в высоту» строят в Украине. – Режим доступа: [www. URL: https://agroportal.ua/publishing/analitika/vertikalnye-fermy-20-teper-i-v-ukraine/](http://agroportal.ua/publishing/analitika/vertikalnye-fermy-20-teper-i-v-ukraine/).
5. 4-я промышленная революция в Давосе. – Режим доступа: [www. URL: https://expert.ru/2016/01/21/chetvertaya-promyishlennaya-revolutsiya/](http://expert.ru/2016/01/21/chetvertaya-promyishlennaya-revolutsiya/).
- 6.Форрестер Д. Мировая динамика: пер. с англ. – М.:ООО "Издательство АСТ":СПб.: Terra Fantastic, 2003. – 379 с.
7. Акаев А.А., Садовничий В.А. О формах и методах глобального прогнозирования // Универсальная и глобальная история:Эволюция Вселенной, Земли, жизни, общества: под ред. Л. Е. Гринина, И. В. Ильина, А. В. Коротаева.– Волгоград: Учитель.– 2012. – С.560-577.
8. Капица С. П. Очерк теории роста человечества. Демографическая революция и информационное общество. М.: Никитский клуб. № 4. – 2008. – Режим доступа: [www. URL: http://spkurdyumov.ru/biology/ocherk-teorii-rosta-chelovechestva-kapica/](http://spkurdyumov.ru/biology/ocherk-teorii-rosta-chelovechestva-kapica/).
9. Е. Мотренко "Индекс счастья" как степень удовлетворенности жизнью. – Режим доступа: [www. URL: https://iz.ru/858177/elena-motrenko/schaste-po-raschetu-dlia-chego-nuzhen-reiting-blagopoluchia-stran](http://www.iz.ru/858177/elena-motrenko/schaste-po-raschetu-dlia-chego-nuzhen-reiting-blagopoluchia-stran)
10. World Happiness Report – Режим доступа: [www. URL: https://en.wikipedia.org/wiki/World_Happiness_Report](https://en.wikipedia.org/wiki/World_Happiness_Report).
11. Воробієнко П.П. Гіпотеза про закон матеріальної задоволеності та її сприйняття людиною // Економічний вісник університету, Переяслав-Хмельницький державний педагогічний університет ім. Григорія Сковороди .– 2020. – Вип. 45. – С. 114-119.
12. Д. Горчаков 20 определений счастья от лучших умов планеты. – Режим доступа: [www. URL: https://lifesthacker.ru/20-opredelenij-schastya-ot-luchshix-umov-planety/](https://lifesthacker.ru/20-opredelenij-schastya-ot-luchshix-umov-planety/).
13. Рейтинг стран мира по индексу удовлетворенности жизнью. – Режим доступа: [www. URL: https://gtmarket.ru/ratings/satisfaction-with-life-index](https://gtmarket.ru/ratings/satisfaction-with-life-index).
14. Ноосфера. – Режим доступа: [www. URL: https://uk.wikipedia.org/wiki/Ноосфера#Концепція_ноосфери/](https://uk.wikipedia.org/wiki/Ноосфера#Концепція_ноосфери/).
15. Sustainable Development Goals. – Режим доступа: [www. URL: https://en.wikipedia.org/wiki/Sustainable_Development_Goals](https://en.wikipedia.org/wiki/Sustainable_Development_Goals).
16. Vorobiyenko P. Industry 4.0 and Information Communication Technologies// 2017 International Conference on Information and Telecommunication Technologies and Radio Electronics (UkrMiCo) September 11-17, 2017, Odessa, Ukraine:15-18.
17. В. Козлов Последние слова Стива Джобса заставляют задуматься о смысле жизни. – Режим доступа: [www. URL: https://www.liveinternet.ru/users/3517075/post455384035](https://www.liveinternet.ru/users/3517075/post455384035).
18. Классификация прогнозов. – Режим доступа: [www. URL: https://www.uamconsult.com/book_547_chapter_6_1.4._Klassifika%25D1%2581ija_prognozov.html](https://www.uamconsult.com/book_547_chapter_6_1.4._Klassifika%25D1%2581ija_prognozov.html).
19. Прогнозирование - понятие, задачи, функции и принципы. Классификация прогнозов . – Режим доступа: [www. URL: http://www.ekonomika-st.ru/drugie/metodi/metodi-prognoz-1-1.html](http://www.ekonomika-st.ru/drugie/metodi/metodi-prognoz-1-1.html).
20. Классификация прогнозов. – Режим доступа: [www. URL:https://laws.studio/sotsialno-ekonomicheskikh-prognozirovanie/klassifikatsiya-prognozov-34164.html](https://laws.studio/sotsialno-ekonomicheskikh-prognozirovanie/klassifikatsiya-prognozov-34164.html).
21. Виды прогнозов, классификация прогнозов. – Режим доступа: [www. URL: https://studfile.net/preview/2798320/page:24/](https://studfile.net/preview/2798320/page:24/).
22. Обзор методов прогнозирования. – Режим доступа: [www. URL: https://ivan-shamaev.ru/overview-forecast-methods/#i-8](https://ivan-shamaev.ru/overview-forecast-methods/#i-8).
23. Матвієнко В.Я. Прогностика. Прогнозування соціальних та економічних процесів. Теорія. Методика. Практика. – К.: Социс.– 2000. – 218 с.
24. Новикова Н.В., Поздеева О.Г. Прогнозирование национальной экономики: учеб.-метод. пособ. – Екатеринбург: Изд-во Урал. гос. экон. ун-та, – 2007. – 138 с.
25. Ланских А. Н. Форсайт как новая методология управления развитием высшей школы. – Режим доступа: [www. URL: https://cyberleninka.ru/article/n/forsayt-kak-novaya-metodologiya-upravleniya-razvitiem-vysshey-shkoly](https://cyberleninka.ru/article/n/forsayt-kak-novaya-metodologiya-upravleniya-razvitiem-vysshey-shkoly).

26. В. Гнап Период полураспада знаний: как пополнять запасы?. – Режим доступа: [www. URL:http://chp.com.ua/ua/all-news/item/53646-period-poluraspada-znanij-kak-popolnyat-zapasy](http://chp.com.ua/ua/all-news/item/53646-period-poluraspada-znanij-kak-popolnyat-zapasy).
27. Бодров А.Н. Прогнозирование рынка труда и стимулы занятости // Научные исследования в образовании. Серия: Экономика и бизнес. – 2009. – С. 1-6.
28. Акьюлов Р.И., Сквепень А.А. Роль искусственного интеллекта в трансформации современного рынка труда // «экономика труда и демографическая экономика, DISC USSION. – 2019. – № 3(94).– С. 30-40.
29. К. Патрис Влияние искусственного интеллекта на трудовую занятость на примере транспортной отрасли Франции//Вестник университета. Развитие отраслевого и регионального управления.– 2019.– № 12.– С. 71-77.
30. Фиговский О.Л., Ясницкий Л.Н. Искусственный интеллект и его влияние на технологии и общество // Проатом. – 2020. – Режим доступа: [www. URL: http://www.proatom.ru/modules.php?name=News&file=article&sid=9175](http://www.proatom.ru/modules.php?name=News&file=article&sid=9175).
31. Telenor: 20 technology trends that will shape 2020. – Режим доступа: [www. URL: https://www.telenor.com/media/press-release/telenor-20-technology-trends-that-will-shape-2020#:~:text=In%202020%2C%20we%20will%20see,and%20building%20new%20revenue%20streams](https://www.telenor.com/media/press-release/telenor-20-technology-trends-that-will-shape-2020#:~:text=In%202020%2C%20we%20will%20see,and%20building%20new%20revenue%20streams).
32. Пять трендов в телеком отрасли США в этом году. – Режим доступа: [www. URL:https://www.crn.ru/news/detail.php?ID=142880](http://www.crn.ru/news/detail.php?ID=142880).
33. Электронное здравоохранение (eHealth) и инновации в области охраны здоровья женщин и детей: обзор базовых показателей. – Режим доступа: [www. URL: https://www.who.int/goe/publications/ehealth_ex_summary_ru.pdf](https://www.who.int/goe/publications/ehealth_ex_summary_ru.pdf).
34. Master List of Drone Laws (Organized by State & Country). – Режим доступа: [www. URL: https://uavcoach.com/drone-laws/](https://uavcoach.com/drone-laws/).
35. Резолюция ООН. – Режим доступа: [www. URL: https://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf](https://www2.ohchr.org/english/bodies/hrcouncil/docs/17session/A.HRC.17.27_en.pdf).
36. Програма ЄС «Цифрова програма Європи». – Режим доступа: [www. URL: https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi](https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi).
37. Програма ЄС «Конкурентний цифровий єдиний ринок – до Європейського Гігабітного суспільства». – Режим доступа: [www. URL: https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access](https://ec.europa.eu/digital-single-market/en/policies/improving-connectivity-and-access).
38. A. Friedman Chinese agency says 6G could be 8,000 times faster than 5G . – Режим доступа: [www. URL: https://www.phonearena.com/news/Chinese-agency-says-6g-can-deliver-1TBps-download-speed-vs-5G_id121939](https://www.phonearena.com/news/Chinese-agency-says-6g-can-deliver-1TBps-download-speed-vs-5G_id121939).
39. Тихвинский В.О. Особенности и перспективы использования радиочастотного спектра в сетях 5 G// Региональный обучающий семинар МСЭ для стран СНГ "Перспективы развития инфокоммуникаций: технологии и вопросы регулирования сектора". – Астана, Республика Казахстан, 23-24 сентября 2014 г. – С. 2-15.
40. Блокчейн (blockchain, цепочка блоков). – Режим доступа: [www. URL: https://alpari.com/ru/beginner/glossary/blockchain/](https://alpari.com/ru/beginner/glossary/blockchain/)
41. Что такое технология блокчейна? – Режим доступа: [www. URL: https://www.ibm.com/ru-ru/blockchain/what-is-blockchain](https://www.ibm.com/ru-ru/blockchain/what-is-blockchain).

DOI 10.33243/2518-7139-2020-1-2-5-16