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BREAKTHROUGH TECHNOLOGIES AS A FACTOR OF FORMATION OF INFORMATION ECONOMY IN THE CONDITIONS OF DIGITALIZATION

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Abstract
The relevance of the study of breakthrough technologies objectively determines the need for radical digital changes in society, aimed at the development of robotics, artificial intelligence, the Internet of Things, nanotechnology, synthetic biology, quantum computers, "smart cities". *The purpose of the study* is to conceptualize breakthrough technologies as a factor in the formation of the information economy in the context of digitalization and the conditions for deepening these processes. *Objectives of the study* 1) study of the phenomenon of "smart city" as an information system represented by a complicated social organism, which is an intellectual environment associated with a set of sensors that significantly improve people's lives; 2) identifying the world of cloud technologies and the Internet of Things, which represent a variety of digital services that have a profound impact on the service sector – from transport to medicine and education; 3) clarification of the place, role and functions of robotics in a digitalized society; 4) analysis of neurotechnologies, based on new forms of cognitive computing and improving the design of machine learning algorithms. *Research methodology* – the use of methods of analysis and synthesis, process modeling, synergetic methodology as a methodology of nonlinearity, the method of systems analysis and synthesis, Agile-methodology as a methodology of complex social systems. *The result of the study.* 1. The concept of "smart cities" associated with digital services, which bring together a meaningful whole of information about the work of hospitals, schools and public transport networks. 2. The world of cloud technologies and the Internet of Things is revealed, which is based on the analysis of a huge amount of data generated by the Internet of Things and the search for patterns to provide services to the population to improve their lives. 3. The era of prosperity of robots and their economic potential in a digitalized society, which play an important role in both industrial production and human household, is revealed. 4. The analysis of neurotechnologies based on new forms of cognitive computations and improvement of designing of machine learning algorithms is presented. It is concluded that in the process of unfolding the Fourth Industrial Revolution, new breakthrough technologies will create new advantages in various industries and lead to important social consequences.

Key words: breakthrough technologies, information economy, smart city, Internet of Things, robotics, neurotechnologies, Fourth Industrial Revolution, digitalization.

Statement of the problem in general and its connection with important scientific and practical tasks

The urgency of development and practical implementation of information (digital) economy objectively determines the need for radical digital changes in society, aimed at the development of robotics, artificial intellect, the Internet of Things, nanotechnology, synthetic biology, quantum computers, "smart cities". If we ever build a machine with a brain that intellectually outweighs the human name, then this innovated artificial intellect can become incredibly powerful and the fate of our species will depend on the actions of the super-machine. However, if artificial intellect turns out to be hostile, it will easily stop our efforts to change

it and our preferences. These trials are the most important for humanity in its history. We after all want to create artificial intellect and breakthrough technologies it all so as to protect the humanistic values, based on axiological and anthropological approaches. From today, for the emergence of theories of breakthrough technologies, the theory about the approaching era of technological singularity has become popular, Vernor Vinge mentioned about, and his concept was supported by Ray Kurzweil et al., – as Nick Bostrom notes in his study "Super intellect. Strategies and dangers of development of smart machines" [3, p. 14]. Thus, smart machines are already being introduced today – trains on fire fuel cells operating in France, which has signed a contract to purchase 12 trains from the engineering company Alstom, testing of which will begin in 2023, and from 2025 new express trains will carry passengers. In places where sections of the road are not electrified, the train will run on hydrogen fuel cells, which convert hydrogen energy into electricity. The hydrogen reserves, containing in a special tank on the roof, is designed for 600 km of road, as Alstom notices (European Truth, 2021, April 12).

Analysis of recent research and publications, which initiated the solution of this problem and which the author bases on.

We base on the work of the authors Al-Khalili Jim "What's next? Everything that science knows about our future" (2018. 248 p.), Bostrom Nick "Super intellect. Strategies and dangers of the development of smart machines" (2020, 408 p.), Goodman Mark "Crimes of the future: everything is interconnected, all is vulnerable and what we can do with it" (2019, 592 p.), which describe technological breakthroughs associated with new discoveries of mankind, which posed the problem of human-machine interaction, the latest concepts that reveal many new things to us and lead to the transformation of humanity, because we must learn to manage them. These works show that we are on the threshold of a revolution that radically changes the course of our existence. An important role in our study was played by Schwab Klaus's work "The Fourth Industrial Revolution, Forming the Fourth Industrial Revolution" (2019. 426 p.), which in scale and level of complexity is a completely unknown human experience because it led to new technological discoveries that cover large-scale industries such as artificial intellect, robotics, the control of industrial equipment via the Internet, unmanned aerial vehicles, nanotechnology, biotechnology, materials science, energy accumulation and storage, quantum computers, 3D-printing and manufacturing. At the heart of these discoveries is the driving force of the brain, which led to an increase in cognitive abilities that influenced the discovery. The work of Dean Stanislav "How we learn. Why can the brain learn better than the machine… So far" (2021, 281p.); author's article by Tatiana Teslenko "Scientific and epistemological evolution of the conceptual and categorical apparatus of the philosophy of economics as a new philosophical knowledge" (Humanities Studies, 2020, issue 4 (81). p. 126-144); Kirichenko Mikola "The impact of digital technologies on the development of human and social capital in the conditions of the digitalized society" (Humanities Studies, 2019, issue 1 (78). p. 108-129). Certainly, according to the literature review, based on these technological discoveries – innovations and innovational activity, which were the objects of the studies of such authors as Androsova, O. and Cherep, A. "Transfer of technology as a tool of realization of innovation activity: monograph (2007. 356 pp.); Bugaychuk, O. "Strategies of information and innovation activity development at enterprise in digital conditions" (Humanities Studies. 2019, issue 1 (78). p. 75-85); Venherska, N. and Kalantarova, A. "The export potential of the food industry of Ukraine" (Ekonomika rozvytku – Economics of Development, 2014. p. 72); Venherska, N. "Regional service policy as a necessary condition for the development of services. (Bulletin of Zaporizhia National University. Economic Sciences. 2014, issue 2. p. 142-152); Voronkova, V., Teslenko, T.V. "Formation and development of digital technologies as a factor in the implementation of the Fourth Industrial Revolution (Journal of the Belarusian State University. Philosophy. Psychology, No 2. Minsk. p.4-11); Voronkova, V., Nikitenko, V., Teslenko, T. and Bilohur, V. (Impact of the worldwide trends on the development of the digital economy) (Amazonia Snvestia. 2020. Volume 9, issue 32. p.81-90); Voronkova, V., Punchenko, O., Azhazha, M. "Globalization and global governance in the fourth industrial revolution (industry 4.0) (Humanities Studies. 2020, issue 4 (81). p. 182-200), in which we are talking about that all new changes and technologies have at the bottom a common key feature, as in their progress they effectively use the powerful capabilities of digital and information technologies, owe their existence and increase their influence through digital capacities. The theses conference Voronkova, V. Kyvlyuk, O., Nikitenko, V.I., and Ryzhova I. "Stem-education as a factor in the establishment and development of smart-

society" (Materials of the International Scientific Conference, 23-24 of November, 2017 "Formation and development of the information society as the basis for the competitiveness of Ukraine in the world and the sustainable development of society and the state". Zaporizhia, 2017. p. 23-24) observe that only stem-education being advanced and highly intellectual with the use of informational-communicational technologies can contribute to the emergence of high-tech society with breakthrough technology.

Highlighting previously unsolved parts of the general problem to which this article is devoted.

We can note that cloud technologies and the Internet of Things are important factors of technological progress; they have great potential to improve quality of life, increase productivity, solve global problems and cope with the challenges of society, crisis and uncertainty [4, p. 14]. Maybe someday we will live in a world where all people will monitor their health; various sensors will provide a constant flow of medical data, give commands to refrigerators, order to make heating systems warmer, postpone tomorrow's meetings with customers, improve remote diagnostic tools and will learn to care for the elderly more effectively. The analysis of a huge amount of data generated by the Internet of Things and the search for patterns will be of great importance. Connection to the internet, cable or wireless is an obvious prerequisite for the functioning of the Internet of things. Robotic technologies make it possible to adjust the efficiency of agriculture and at the same time reduce the pressure on the environment. The work will help to determine the level of ripeness of the crop and prevent losses, use less fuel. As we can see, breakthrough creative technologies today have flooded the world and penetrated into all spheres of human life [6, p. 142-152].

The purpose and formation of the article objectives (task statement).

The purpose of the study is to conceptualize the formation of breakthrough technologies as the basis of information (digital) economy in the context of digitalization.

Objectives of the study:

1) the study of the phenomenon of "smart city" as such an information system that is represented by a complicated social organism that is an intellectual environment and the associated set of sensors that significantly improve people's lives;

2) identifying the world of cloud technologies and the Internet of Things, which represent a variety of digital services that have a profound impact on the service sector – from transport to medicine and education;

3) clarification of the place, role and functions of robotics in a digitalized society;

4) analysis of neurotechnologies, based on new forms and capabilities of cognitive computing and improving the design of machine learning algorithms.

Research methodology:

The subject of the study is the development of the Internet of Things, robotics, nanotechnology, artificial intellect, synthetic biology, quantum computers, "smart cities" as factors of human (intellectual) capital and the basis for information (digital) economy, considered mainly in social, economic and anthropological dimensions. *The object of research* is the information economy, which covers the concept of rationality, which sets the model of intellectual capital development, and develops in the context of the interaction of digital economy and management. **Research methodology of** using methods of analysis and synthesis, process modeling, synergetic methodology as a methodology of nonlinearity, method of system analysis and synthesis, Agile-methodology as a methodology of complex social systems [7, p. 4-11].

Presentation of the main material of the research with substantiation of the scientific results obtained.

1. The phenomenon of the "smart city" as such a system that is an intellectual environment that significantly improves people's lives.

"Smart city". As early as 1964, the Canadian philosopher Marshall McLuhan noted that all previous technologies, including cities, would be transformed into information systems by means of telecommunications. This forecast hit the target, as today created "smart cities" that M. McLuhan could have dreamed of. The "Internet of Things" has all the necessary potential "to transform cities into living, breathing ecosystem, which consist of the intellectual environment and related sensors that greatly improve was people's lives", – as Mark Goodman notes [p. 375]. The growing number of "municipal sensor networks" will be able to measure the pollution of individual houses, air quality in a particular neighborhood or the number of pedestrians on a particular street. Improved sensors in street lights will provide the optimal level of lighting, adjusted to the time of day, season and weather conditions, reducing electricity costs by 30% [9, p. 182-200].

We assume that in a couple of decades, most people in the world will live in megacities, and it is clear that the extremely high population density will pose challenges to energy, transport, education, health and many other systems. Urban planners have already begun experimenting with the concept of "smart cities" – digital services that bring together meaningful information about the work of hospitals, schools and public transport networks. Examples of "smart cities" currently exist in the United Kingdom (Glasgow, London, Bristol, Peterborough) and elsewhere. This is so-called network of special lighthouses in San Francisco or at Euston Station in London, which allow people with visual impairments to navigate; or sensors built into the bins to help sort garbage. "Smart urns" are already produced by many companies – Bigbelly (USA), Enevo (Finland), Ecube Labs (South Korea) and they are installed around the world. Sensors not only signal that the urn is already full, but also are able to predict when it will be filled, and to make a rational route for its removal [10, p. 23-24]. "Smart city" manages their energy, material flow, logistics and traffic, introduce a number of new services, ground on the accumulation and processing of data will continuously expand the network of sensor technology and work platforms to collect data that will form the basis of various technological projects and additional services which will be based on analysis results and predictive modeling. "Smart cities" offers the physical space to experiment and test features (such as simple interoperability protocols, network management, device technology) and support services such as personality identification and security support. Thus, the analysis shows that the efficiency of using a large array of data will improve and accelerate decision-making that will simplify the lives of citizens, enable companies and governments to provide real-time services and support in everything from citizen interactions to automated filing of tax declarations and payment documents [13, p. 43-62].

2. The world of cloud and Internet of Things which allow to receive a variety of digital services. Cloud technology and the so-called Internet of Things (IoT) have formed a very strong tandem that is increasingly influencing and will continue to affect our lives. Cloud technologies are remote access to shared computer resources that allow to store and process information and receive a variety of digital services, – Al-Khalili Jim says [1, p. 105]. Today, there are more things connected to the Internet than people, and by 2021 there will be about 50 billion [p.105]. Industry leaders are also beginning to look closely at the Internet of Things, and this is probably where the greatest economic effect and the greatest opportunities for solving national and global problems await us. For example, wind turbines can take sensor data into account to make the most efficient use of wind energy. Factories will begin to combine their informational systems with supplier systems to automatically order raw materials and spare parts at the right time. Another feature of the Interest of Things is the collection of information on an unprecedented scale. Very cheap, unpretentious, networked sensors can be built into many objects in real time to collect information about people, the environment, certain systems, constantly monitor pipes for holes or remove information from mobile phones and track flu outbreaks [15, p. 500-504]. In fact, the Internet of Things poses a difficult task – how to cope with a huge amount of data from different sources? This problem in the English-speaking world acronym is denoted with abbreviation DIKW: 1) information (data); 2) information; 3) knowledge; 4) the top of the pyramid (wisdom), when understanding is already added to knowledge. Therefore, people should get used to them and let them into their lives, because their advantage is that the Internet of Things led people to a new level that makes a profound impact on services – from transport to medicine and education system. We can name five countries that are actively developing the Internet of Things – Estonia, Israel, New Zealand, South Korea and the United Kingdom, – Al-Khalili Jim says [1, p.107]. Cloud technology and the Internet of Things can solve a number of global issues – from health care to environment protection. Medicine will obviously become more personalized and big data will help this person. Medical systems will analyze all information about patients' lives, from lifestyle to genetics, past treatment responses, and the latest data on a disease, such as COVID-19. Technologies will help us to save energy and reduce wastes, increase production efficiency and adapt the medical system to the specific needs of the patient [16, p. 261-270]. However, there are several bottlenecks on the way to solving these problems: 1) security; 2) network coverage; 3) energy consumption; 4) social consequences. However, in this regard, there are problems and contradictions. To unleash the full potential of the Internet of Things, we allow electronic devices to collect any information about us. The more we hide something from them, the less quality of services we become to receive. Thanks to people's

personal data, large technology companies are becoming more powerful and influential, they have direct access to people's lives and financial assets. Thus, in 2015, a group of hackers demonstrated that you can gain control of the car just under the way, hacking it through an infotainment system. After this break, manufacturers began to protect further automotive Internet systems. The risk of cyber-attacks on connected to the Internet cars, homes, businesses and critical infrastructure facilities, such as electricity production plants and water supply points remains an extremely big problem, because if "humanity would be imprudent or unwise to develop breakthrough technologies, they may be an executioner for people", – Mark Goodman says [11, p. 312].

3. The place, role and functions of robotics in a digital society. The robot revolution has been talked about for a long time. The robots have been painting cars, assembling parts and performing various monotonous work since the 1950s. Nowadays, there are more "service" robots than industrial ones: robots work not only in factories, but everywhere – in medical institutions, help take care of children and the elderly, prepare food, serve cocktails, clean houses, sow and harvest, monitor for public safety, fighting in armed conflicts, monitoring climate change, performing surgical operations, protecting endangered species. Robotics is experiencing a period of prosperity, and due to the emergence of a large international market, the state and the corporate world have begun to take seriously the economic potential of robots, and investment in this industry is gradually bringing a radical return. Many companies and startups create new types of robots and come up with new applications for them, the market becomes highly competitive – and this stimulates innovation [17, p. 169-181]. Developments in the field of robotics will depend on the international regulatory framework and the extent to which engineers, designers and manufacturers will practice a socially responsible approach. Much will depend on consumers, and without this investment will not pay off and progress will be slower. As noted by Al-Khalili Jim, according to the International Federation of Robotics (IFR), 4.7 million personal and home robots were sold in 2014; in 2015, the figure rose to 5.4 million (in monetary terms, the market volume was 2.2 billion USD), according to fairly conservative MFF forecasts, in 2016-2019, 42 million devices will be sold [1, p. 192]. In the future, more and more household chores will be assigned to robots, such as cleaning and washing, today there are new developments of robots that can iron, fold towels, take dirty things and put them in the washing machine, and then take out washing; robots for professional cuisine are developing even faster – they prepare burgers, pizza, sushi, can quickly make cocktails [18, p. 148-150]. However, the household needs multifunctional robots, so in smart homes of the future robots will be integrated into home appliances and the structure of everyday life. The number of robots that help care for the elderly and disabled has increased significantly over the last decade. In 2014, the number of such robots increased sixfold compared to the previous year. The robots are equipped with video games and quizzes, they are able to recognize faces and language and more or less arouse interest in preschool children. Such robots monitor images and sounds and signal danger to the child. The Japanese company Secom already sells a feeding robot, produces a bath robot that helps a person wash and water; firm Mitsubishi has designed a robot that monitors the health, doing massage and recalls that it is time to drink medicine, the other robot carries wheelchair and perform simple voice commands; robots are useful for children with special needs. The robots help to interest children in engineering and science and facilitate social interaction with the elderly. Combat operations capable of independently destroying the enemy without operator intervention are actively developed [19, p. 247-258]. China, Russia, the United States, and Israel are developing robotic tanks, fighters, submarines, and ships capable of acting on one front. Police for over decades uses robots for disposal of bombs, the release of hostages, surveillance and information gathering in the shootings. Civilian drones are spreading very fast. Thus, in 2016 a robot eliminated a person suspected in the Dallas shooting, but experience shows that robot must stand up for ordinary citizens. Robots repair the damage from climate change, submarine robots sink into inaccessible ocean depths and provide us with important data on global warming [20, p. 126-144]. "Coral-bot" robots know how to recognize specific species of corals, treat them and allow them to grow again. Fish robots help monitor the ecology of the Great Lakes and constantly broadcast to scientists about water quality. The Scottish Oceanographic Group is working to develop long-range aircraft to help explore the most endangered and inaccessible Arctic regions and determine the causes of melting ice. Robot aircraft are equipped with laser rangefinders and cameras for

shooting and monitoring polar ice. The robots play a key role in detecting chemical pollution that harms people and the ecosystem – oil spills, explosive methane flows from turbo pipelines, toxic chemicals in production. With proper funding and coordinated efforts of the international community, such robots will be the saviors of mankind [8, p. 81-90].

4. Neurotechnology, based on new forms of cognitive computing and improving the design of machine learning algorithms. The revolution in neurotechnology describes a wide range of approaches that give a clear picture of how the human brain works, allowing us to receive information, expand our feelings, change behavior and interact with the world. Neurobiology is gradually moving beyond medical and scientific laboratories, penetrating our daily lives. The field of neurotechnology is rapidly maturing and during the Fourth Industrial Revolution it provides an opportunity to create new value systems, while creating serious risks and management challenges, – Klaus Schwab says [21, p. 316]. These technologies involve deciphering thoughts at fine levels of detail thanks to new chemicals and interventions that can affect our brains to correct mistakes and show functionality. Innovations in this area help to find new ways to communicate and interact with the world, as well as significantly expand the capabilities of the senses. First, the opportunity to correct shortcomings or multiply positive traits will be a huge advantage for those who can afford to buy or sell neurotechnology and related services. At the same time, the ability to access the most secret thoughts and influence thinking is a huge problem in a world driven by algorithms and ubiquitous data collection. Second, neurotechnology is a driver of improvement in other areas of the Fourth Industrial Revolution, providing new forms of cognitive computing and improving the design of machine learning algorithms. The more the neurotechnology tell us how the brain works, the more useful they are in the chain of feedback when forming technology, which interact with the brain and / or mimic its functionality [22, p. 196-209]. Third, and most importantly, our brain is the basis of what makes us human – it allows us to perceive and comprehend the world, learn, imagine, dream and interact with others. By influencing the brain in more precise ways, we can change our self-perception, find a new understanding of what experience is, and radically rebuild the essence of reality. Influencing how we manage ourselves; brain research encourages people to step beyond natural evolution [14, p. 108-129]. In the unprecedented battle between the computer chip and the neuron, between the machine and the brain, the advantage is still on the side of the brain. Theoretically, there are no mechanisms in the brain, just as the machine is not able to simulate. In practice, computers still have a long way to go, they will need a lot of ingredients, such as: "inner speech thinking to create new combinations of concepts; algorithms to reason based on the probability distribution of the curiosity function, the effectiveness of the attention and memory management system, and possibly a sleep algorithm that complements the training array and increases the chances of discovery", – Stanislav Dean says in his work "How We Learn. Why the brain learns better than the machine… So far" [12, p. 233]. The human brain is still holding the palm of supremacy, but for now. Some laboratories, such as the Aldo Faisal Laboratory at Imperial College London, use eye tracking instead of brain waves in combination with machine learning, and this technique surprisingly detects exactly what movements a person intends to perform. Such approaches reduce the cost of expensive interfaces between the brain and the machine and allow paralyzed people to control wheelchairs or robotic limbs by force of thought. The neural modulation (stimulation of nerves) can help restore functionality not only of limbs, but for other vital organs such as the lung, bladder or heart. Neurotechnology can have an even stronger impact on the economy if it improves the capabilities of the human brain and improves productivity. Compared to other industries of the Fourth Industrial Revolution, such as space technology, neurotechnology is entering the mass market rather slowly [23]. The development of neurotechnology requires mathematicians, engineers, sociologists, developers and physicists, as well as neurologists. Neurotechnology will help a person better understand the brain and the mechanisms of its work. The variety of ethical and legal issues related to neurotechnology – such as confidentiality, intellectual property, accessibility – requires a lot of early discussion of the potential impact of truly revolutionary capabilities of neurotechnology [5, p.72].

Conclusions

In the process of deploying the Fourth Industrial Revolution, neurotechnology will create new advantages in various industries and lead to important social consequences.

1. It is necessary to continue to study the objective and subjective processes of breakthrough technologies as factors in the formation of the information economy in the context of digitalization, and here the following

standard of mobile communication -5G can come to the rescue. Its technical specifications provide full coverage of the territory and simultaneous connection in a huge number of devices. The full coverage and wide working range of the new generation of communications will require active cooperation between telecommunications companies and providers of all types of communications – from master to satellite.

2. To promote improve and accelerate decision-making with a view to using the big data (BIG DATA), what leaders must use Mining (data search information) and help create patterns and models of digital society. In recent years, not only technology giants but also other companies have learned to collect data on operations, results of marketing companies and the behavior of their customers, but this requires a better understanding of the principles and algorithms of digital technology to evaluate common digital strategies and data science proposals to improve "smart cities" and the Internet of Things.

7. To study the problems that may arise in connection with the introduction of the Internet of Things. The Internet of Things creates opportunities for a significant improvement not only in the quality of our lives, but also in the global economy as a whole, especially as countless objects become "smart" and learn to interact with each other for human well-being. If we return to the issue of privacy, then together with billions of cars and buildings, coffee makers, mobile phones, elevators, dishwashers and toys that communicate with each other and receive commands from the Internet, a person will provide attackers with many access points to their own lives and many opportunities to influence on him. Today, we cannot protect even a relatively small number of things that are already connected to the Internet, and every day new opportunities and new smart objects will appear in our lives, each of which will carry potential risks and difficulties. We agree with Mark Goodman, who said: we have united the world but failed to address security issues, – and we will have to deal with it more than once.

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ПРОРЫВНЫЕ ТЕХНОЛОГИИ КАК ФАКТОР ФОРМИРОВАНИЯ ИНФОРМАЦИОННОЙ ЭКОНОМИКИ В УСЛОВИЯХ ДИДЖИТАЛИЗАЦИИ

Аннотация

Актуальность исследования прорывных технологий объективно детерминирует необходимость кардинальных цифровых изменений в обществе, направленных на развитие робототехники, искусственного интеллекта, Интернета вещей, нанотехнологий, синтетической биологии, квантовых компьютеров, «умных городов». Цель исследования – концептуализация прорывных технологий как фактора формирования информационной экономики в условиях диджитализации и условия углубления этих процессов. Задачи исследования: 1) исследование феномена «умный город» как информационной системы, которая представлена сложным социальным организмом, является интеллектуальной средой и связанными с ней совокупностью датчиков, которые значительно улучшают жизнь людей; 2) выявление мира облачных технологий и Интернета вещей, представляющих различные цифровые услуги, которые оказывают глубокое влияние на сферу услуг – от транспорта до медицины и системы образования; 3) выяснение места, роли и функций робототехники в диджитализованном обществе; 4) анализ нейротехнологий, в основе которых новые формы когнитивных вычислений и улучшение проектирования алгоритмов машинного обучения. Методология исследования использования методов анализа и синтеза, моделирования процессов, синергетической методологии как методологии нелинейности, метод системного анализа и синтеза, Agile-методологии как методология сложных социальных систем. Результат иследования. 1. Исследована концепция «умных городов», связанных с цифровыми сервисами, которые сводят в осмысленное целое информацию о работе больниц, школ и сети общественного транспорта. 2. Выявлен мир облачных технологий и Интернета

вещей, в основе которого анализ гигантского количества данных, сгенерированных интернетом вещей и поиском паттернов для предоставления услуг населению с целью улучшения их жизни. 3. Раскрыта эпоха расцвета роботов и их экономического потенциала в диджитализованном обществе, которые играют важную роль в промышленном производстве и в домашнем хозяйстве людей. 4. Представлен анализ нейротехнологий, в основе которых новые формы когнитивных исчислений и проектирование алгоритмов машинного обучения. Сделан вывод, что в процессе развертывания Четвертой промышленной революции новые прорывные технологии создают новые преимущества в различных отраслях промышленности и приведут к важным социальным последствиям.

Ключевые слова: прорывные технологии, информационная экономика, «умный город», Интернет вещей, робототехника, нейротехнологии, Четвертая промышленная революция, диджитализация.

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BREAKTHROUGH TECHNOLOGIES AS A FACTOR OF FORMATION OF INFORMATION ECONOMY IN THE CONDITIONS OF DIGITALIZATION

Summary
The relevance of the study of breakthrough technologies objectively determines the need for radical digital changes in society, aimed at the development of robotics, artificial intelligence, the Internet of Things, nanotechnology, synthetic biology, quantum computers, "smart cities". The purpose of the study is to conceptualize breakthrough technologies as a factor in the formation of the information economy in the context of digitalization and the conditions for deepening these processes. Objectives of the study 1) study of the phenomenon of "smart city" as an information system represented by a complicated social organism, which is an intellectual environment associated with a set of sensors that significantly improve people's lives; 2) identifying the world of cloud technologies and the Internet of Things, which represent a variety of digital services that have a profound impact on the service sector – from transport to medicine and education; 3) clarification of the place, role and functions of robotics in a digitalized society; 4) analysis of neurotechnologies, based on new forms of cognitive computing and improving the design of machine learning algorithms. Research methodology – the use of methods of analysis and synthesis, process modeling, synergetic methodology as a methodology of nonlinearity, the method of systems analysis and synthesis, Agile-methodology as a methodology of complex social systems. The result of the study. 1. The concept of "smart cities" associated with digital services, which bring together a meaningful whole of information about the work of hospitals, schools and public transport networks. 2. The world of cloud technologies and the Internet of Things is revealed, which is based on the analysis of a huge amount of data generated by the Internet of Things and the search for patterns to provide services to the population to improve their lives. 3. The era of prosperity of robots and their economic potential in a digitalized society, which play an important role in both industrial production and human household, is revealed. 4. The analysis of neurotechnologies based on new forms of cognitive computations and improvement of designing of machine learning algorithms is presented. It is concluded that in the process of unfolding the Fourth Industrial Revolution, new breakthrough technologies will create new advantages in various industries and lead to important social consequences.

Key words: breakthrough technologies, information economy, smart city, Internet of Things, robotics, neurotechnologies, Fourth Industrial Revolution, digitalization

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