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The great digital future: challenges and perspectives for the 21st century economics

El gran futuro digital: desafíos y perspectivas para la economía del siglo XXI

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ABSTRACT:
This article deals with technological patterns and the digital revolution. Basically, the author considers the sixth technological way of the author's classification, reveals the possibilities and threats to humanity that arise during the transition to this way. At present, the sixth technological paradigm emerges from the embryonic phase of its development, when its expansion was constrained by both the small scale and the inadequacy of the corresponding technologies, as well as by the unpreparedness of the socioeconomic

RESUMEN:
Este artículo trata sobre patrones tecnológicos y la revolución digital. Básicamente, el autor considera la sexta forma tecnológica de la clasificación del autor, revela las posibilidades y amenazas a la humanidad que surgen durante la transición a esta forma. En la actualidad, el sexto paradigma tecnológico surge de la fase embrionaria de su desarrollo, cuando su expansión se vio limitada tanto por la pequeña escala como por la insuficiencia de las tecnologías correspondientes, así como por la falta de preparación del entorno socioeconómico

environment for their wide use.
Keywords: technological paradigm, Kondratieff cycle, digital economy

para su amplio uso.
Palabras clave: paradigma tecnológico, ciclo de Kondratieff, economía digital.

1. Introduction

Presently, universal digitalization is an extremely trendy subject, but it has become prominent, of course, not today and not even yesterday. Humans began operations with numbers as soon as they had learned how to speak and write their first characters. That is, homo sapiens, whose specific distinction from animals is the ability to speak and think, was operating with numbers from the very beginning. For centuries, numbers just like words have been used to create, transmit and accumulate information. A special digital language of mathematics has been gradually formed and became the language of the exact sciences and their applications in technology.

The beginnings of the digital revolution should be put down to the emergence of electronic computers, which perform operations with numbers without human intervention, receiving, transforming and transmitting information. Although a man programs and sets tasks for them, computers independently operate on numbers, generating, accumulating and transmitting new information, including the one that neither man nor humanity as a whole could have obtained without a computer. This is their fundamental difference from the machines with automated controls, which were created and used by people from time immemorial, starting with the toilet cistern and ending with modern machine tools possessing numerical program controls.

With the advent of artificial intelligence systems, computers formulate and solve all major classes of tasks independently, without a human participation. As a child who has mastered literacy and is able to read and write independently, so modern computers can read, generate and transmit digital information, both to a man and to their own “kind”. To communicate with the former, they are able to convert numbers into sounds, words and symbols, both communicating and receiving information from a man. Communication between computers, on the other hand, is performed in a digital language without the participation of a man who has programmed a computer system to perform certain functions or to solve certain tasks. In the Internet of Things or in the "smart home", computers independently perform all the large classes of tasks previously left to a man. Moreover, they perform them more quickly, faultlessly and efficiently.

The first tube computers, which appeared in the middle of the last century, occupied huge areas, consumed a lot of energy and required a large number of people to maintain them. No one could have guessed back then that the scope for their use would soon become infinite, and the number of applications would be unlimited. The most courageous scientific and technical forecasts have limited the use of computers to hundreds of items in areas that required onerous time-consuming calculations — banking and military affairs, scientific research and public administration. Nowadays, the computing power, which used to require a 5-storied building, a dozen employees and an electrical transformer a little more than half a century ago, easily fits into the pocket of a child and is available on the mobile phone of each family. The widespread use of computer systems in the industrial, consumer, social and management areas has given rise to the trendy theme of “the digital revolution”.

2. Methodology

2.1. Digital revolution in the context of structural changes within the economics

To date, the digital revolution has embraced almost all activities and has involved most of humanity within its orbit. Since the appearance of first computers, it has gone through three major stages. During this period, two technological paradigms have supplanted each other in the global technical and economic development.

Technological paradigms are the groups of technological complexes that are distinguished in the technological structure of the economy, which are connected to each other by the same type of technological chains and form a reproducible whole. Each such paradigm is a holistic and sustainable formation, within which a complete macro-production cycle takes place, including the extraction and production of primary resources, all stages of their processing and the production of a set of final products that meet the appropriate type of public consumption.

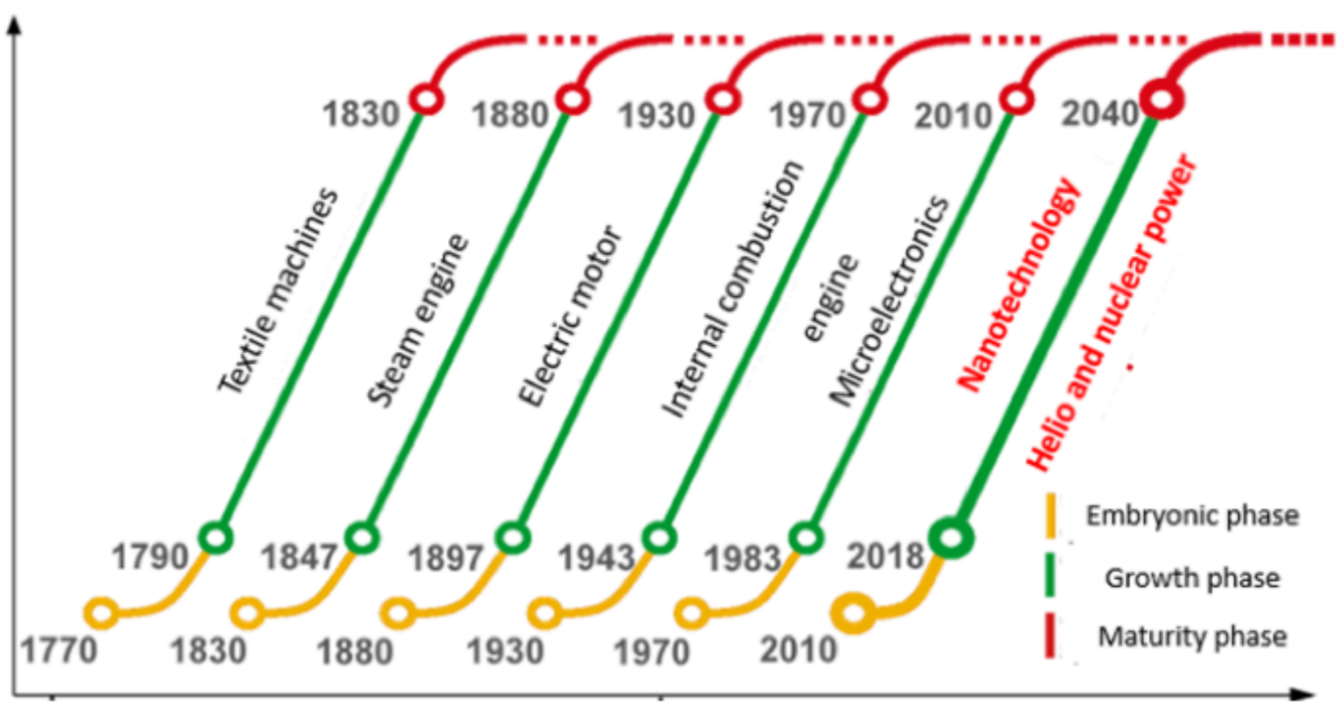
Each new technological paradigm at first uses the existing transport infrastructure and energy carriers in its development, which stimulates their further expansion; meanwhile, the phase of its rapid growth is accompanied by a cyclical increase in production and consumption of GDP, as well as its energy intensity, compared to the long-term trend. As the next technological paradigm develops, a new kind of infrastructure is created, overcoming the limitations of the previous one, and a transition is being made to new types of energy carriers, which lay the resource basis for the development of the next technological paradigm.

In the process of changing technological paradigms, the structure of demand for scientific discoveries and inventions is also undergoing a change. Many of them remain unclaimed for a long time, since they do not fit into the production and technological systems of the dominant technological paradigm. Only with the exhaustion of its growth opportunities, there is a need for fundamentally new technologies, the competitive selection of which forms the basis of new technological trajectories.

Such “discreteness” of the demand for new technologies is an important feature of the regularity of the periodic change in technological structures. The preconditions for their occurrence are created in advance in the form of an appropriate groundwork in research and development, pilot production and basic technologies. By the time when the traditional technological possibilities of capital expansion are exhausted due to the saturation of relevant needs and the achievement of limits in increasing production efficiency, these prerequisites are being realized and turned from potential ways of investing a capital into the real ones.

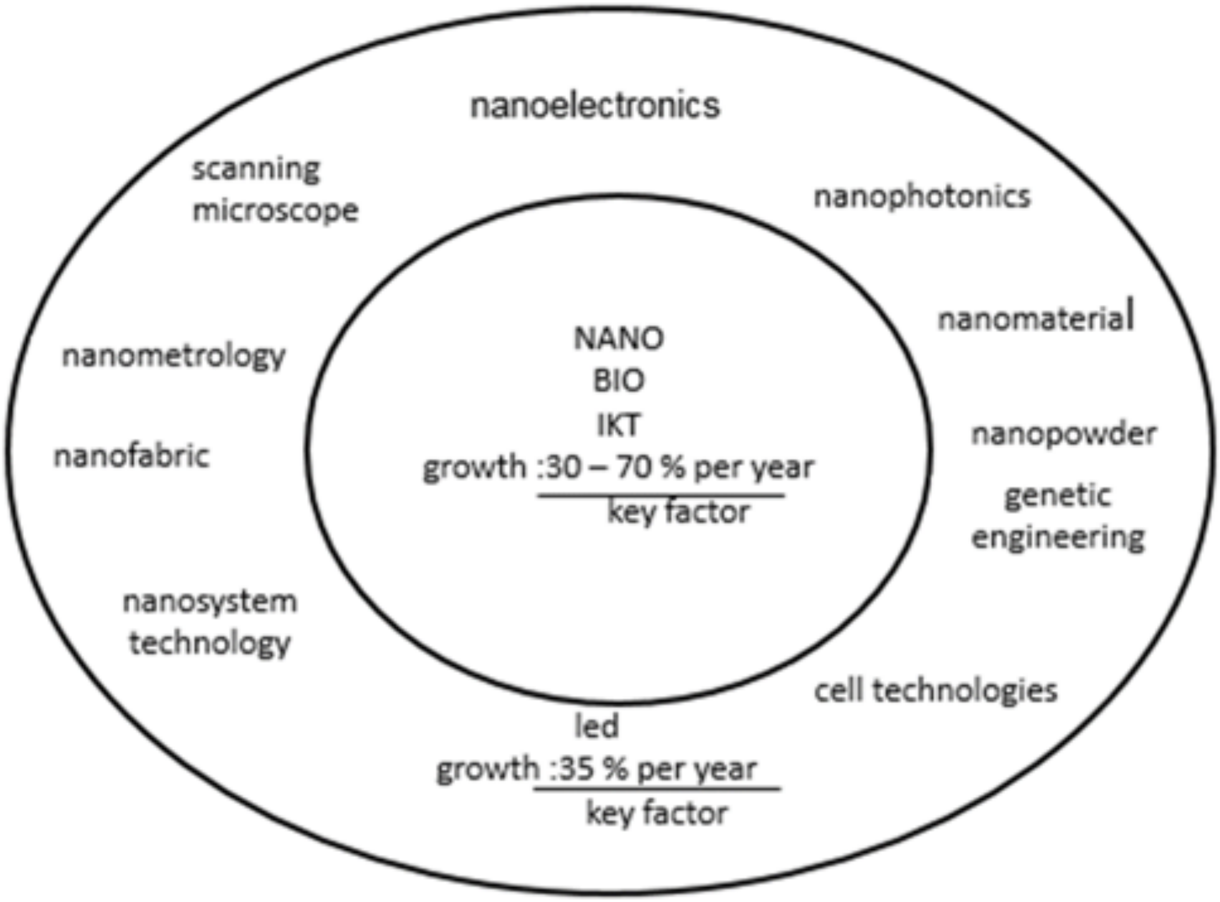
The presentation of long-term technical and economic development as a process of shifting technological paradigms allows for measuring the processes of long-term economic development. The results of these measurements with the use of materials of specific historical and empirical studies of the global and Russian economy have revealed that five technological paradigms have come into prominence and then superseded each other, including the currently dominant information-electronic technological structure (figure 1). It also has foreshadowed the structure of the emerging technological paradigm, the development of which will be determined by economic growth in the next 2-3 decades (figure 2).

Figure 1
Change of the technological paradigms in the course of modern economic development, indicating associated key technologies of energy conversion into work.



Note. Breakthrough in the future: Russia in new technological and world economic structures (p. 55), by Glazyev, S. Yu., 2018, Moscow, Russia: Knizhniy mir.

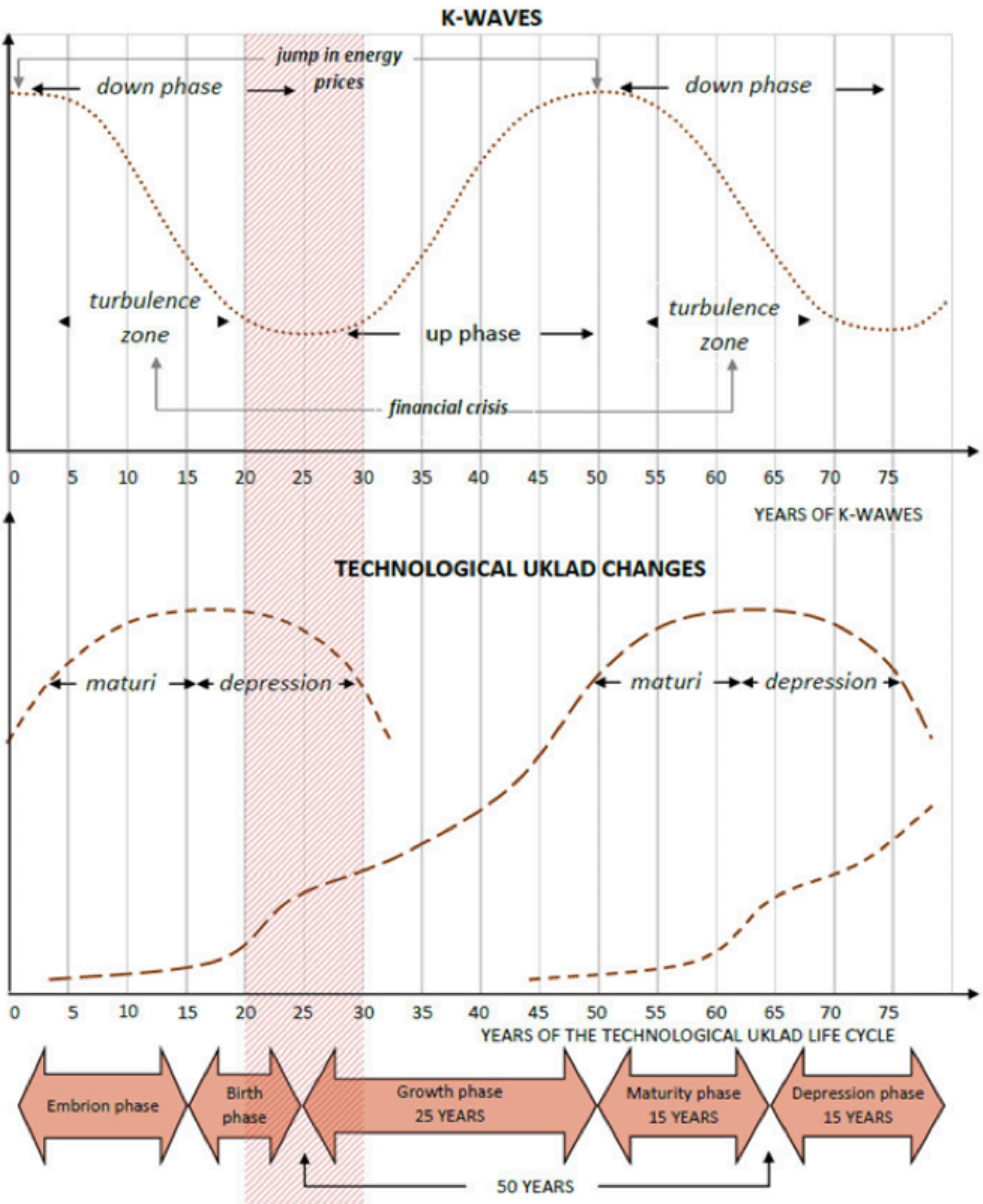
Figure 2
Structure of the emerging (VI) technological paradigm



Note. On the strategy of development of the Russian economy Scientific report, 2011, Moscow, Russia: National Institute.

At present, the transition to the new, sixth technological paradigm, according to the author’s classification, is being completed in full accord with the identified regularities of their shifts. The phases of its embryonic development, the spasmodic increase in energy prices and the macroeconomic depression have already passed, financial bubbles have already been formed and partially deflated, the rapid spread of fundamentally new technologies has begun, energy prices have fallen, and the “new technological paradigm and its transition to the phase of exponential growth” has almost taken shape in the economy of advanced countries (figure 3).

Figure 3
The life cycle of the technological paradigm



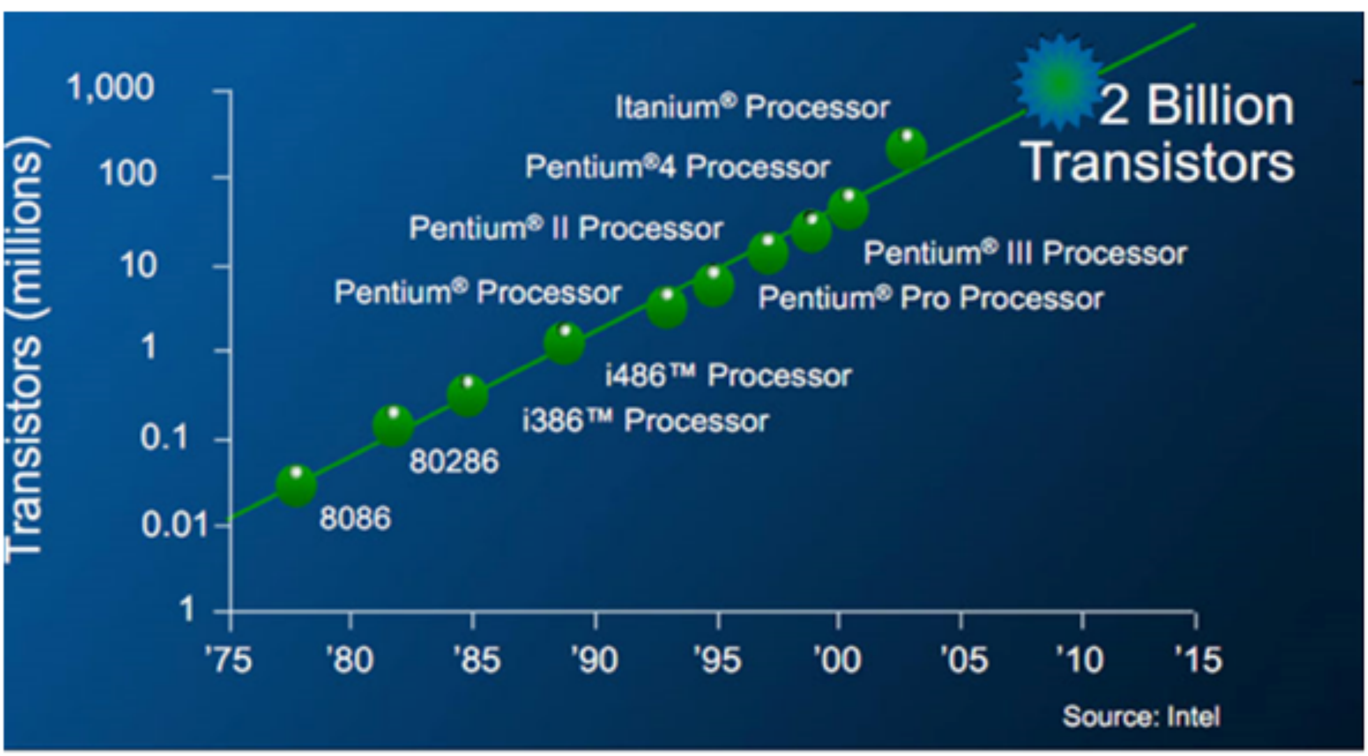
Note. Breakthrough in the future: Russia in new technological and world economic structures (p. 47), by Glazyev, S. Yu., 2018, Moscow, Russia: Knizhniy mir

The appearance and proliferation of tube computers occurred at the final stage of the third technological paradigm, the core of which was the electrotechnical industry. At that time, the rapid development of the fourth technological paradigm was taking place in the economy of advanced countries, the core of which was the automotive industry, the industry of organic synthesis and new construction materials. One of its elements was the production of semiconductors, replacing tubes in the manufacture of computers. This allowed to significantly reduce the costs of their production and operation, which dramatically expanded the scope of use of computers. However, the real breakthrough was the invention of the integrated circuit and microprocessor, which initiated microelectronics in the 60-70s of the last century.

Microelectronics is becoming a key factor in the new technological paradigm, which has entered the growth phase since the early 1980s. The miniaturization of computers and the rapid cost reduction in the production and operation of a unit of computing power ensured the rapid and ubiquitous dissemination of the computing technology. Automation of production processes takes place in the manufacturing industry on the basis of CNC machine tools. Control systems for both technological and administrative processes are being automated. The appearance of personal computers opens the way for the wide proliferation of computers in all spheres of management, in scientific research as well as in the consumer sphere. The emergence of the Internet and fiber optic cables ensured the connection of billions of computers through the global information and communication networks.

The complex of information and communication technologies forming the core of the fifth technological paradigm grew at a rate of about 25% a year until the beginning of the present century. Its rapid spread provided accelerated scientific and technological progress within microelectronics, where the operation of Moore's law (figure 4) allowed to rapidly reduce the cost of a unit of processing power and operation.

Figure 4
Dynamics of growth in the number of transistors per unit surface of the LSI



Note. Nanotechnology as a key factor in the new technological paradigm, by Glazyev, S. Yu., Haritonov V.V., 2009, Moscow, Russia: Trovant.

Computers are revolutionizing the production sphere, where widespread automation of routine operations and the replacement of manual labor by industrial robots is gathering pace. On-board computers are widely used in operating the complex machines and vehicles. Mobile communications are rapidly developing, creating new fast growing sectors in the consumer sphere and providing a significant improvement in the quality of life.

At the beginning of the present century, the growth of the fifth technological paradigm shows signs of already slowing down, and following the year 2008 the world had suffered from the consequences of the financial crisis, after which a transition to a new, sixth, technological paradigm begins. This transition is a structural rebuilding of the economy, which, as usual, is accompanied by a sharp spike and subsequent fall in energy prices, depression in real and turbulence in the financial sector of the economy

(Glazyev, 1993). . At present, the transition process is coming to an end - the new technological paradigm is entering a phase of growth. The complex of information, communication, nano, bioengineering and additive technologies is growing at a rate of about 30% per year, and its individual elements expand at a rate of 20 to 70% per year.

There is a continuity between the fifth and sixth waves of innovation. Their key factor is information technology based on the use of knowledge about the elementary structures of matter, as well as algorithms for the processing and transmittal of information obtained by fundamental science. The boundary between them lies in the depth of the penetration of technology into the structure of matter and the scale of information processing. The fifth technological paradigm is based on the application of microelectronics achievements in the management of physical processes at the micron level. The sixth technological paradigm is based on the use of nanotechnology, operating at a level of one billionth of a meter and capable of changing the structure of matter at the molecular and atomic levels, giving it fundamentally new properties, as well as penetrating into the cellular structure of living organisms to modify them. Along with the qualitatively higher power of computer technology, nanotechnologies allow the creation of new structures of living and inanimate matter, growing them on the basis of self-reproduction algorithms.

The transition to the sixth TP is achieved through another technological revolution, which dramatically increases the efficiency of the main directions of economic development. The cost of production and operation of computer facilities on a nanotechnological basis will decrease by an order of magnitude, the volume of its use will increase due to the miniaturization and adaptation to specific consumer needs. The medicine will have at its disposal the technologies for combating diseases at the cellular level, achieving the exact delivery of medicines in minimum volumes and with the maximum utilization of the organism’s abilities for regeneration. Nanomaterials have unique consumer properties created in a targeted way. Transgenic crops consistently reduce the costs of pharmaceutical and agricultural production. Genetically modified microorganisms can be used to extract metals and refine materials from raw ores, revolutionizing the chemical and metallurgical industry.

No less impressive changes are predicted in mechanical engineering. On the basis of the "nanocomputer-nanomanipulator" system it will be possible to realize assembling automated complexes capable of assembling any macroscopic objects according to the previously scanned or developed three-dimensional grid of atoms' arrangement. With the development of nanomedical robots, methods of targeted delivery of medicines to the affected parts of the body and cellular technologies in medicine, the possibilities for preventive treatment and the prolongation of human life are radically expanded. It becomes possible to address the challenge of restructuring the human body for a qualitative increase in natural abilities.

At present, the sixth technological paradigm emerges from the embryonic phase of its development, when its expansion was constrained by both the small scale and the inadequacy of the corresponding technologies, as well as by the unpreparedness of the socioeconomic environment for their wide use. However, the value of nano-technological applications and the scale of their use are growing exponentially, the total weight of the sixth technological paradigm in the structure of the modern economy is rapidly increasing.

These lines (in italics) were written more than a decade ago, when there was no talk about "Industry 4.0", "Society 5.0", the digital revolution and other newfangled topics. However, all these processes were already in full swing. Which novelties were brought to bear in order to grab the public consciousness so deeply that even the moderators of the World Economic Forum were forced to pay attention to new technologies?

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3. Results

3.1. Social and political components of the digital revolution

Apparently, the ruling elites began to vaguely realize that with the digital technology training of the masses, they may be left without citizens. Indeed, the wide spread of a new technological paradigm radically changes the entire system of management of global socio-economic processes.

On the one hand, there are new opportunities for total control over the behavior of citizens on a global scale. This direction the American special services are not loathe to explore, spying, as it were, on millions of citizens across the planet through wiretapping, monitoring social networks embedded in the computer technology of the American-made gadgets.

On the other hand, it becomes possible for private transboundary systems to be managed by economic, social, and political processes that affect the national interests of states and their associations. The basis for such systems is provided by global social information and trade information networks and cryptocurrencies, the Internet of things and other impersonal information transaction tools that take international trade and finance beyond national jurisdictions. Citizens can opt out of state systems to protect their interests, relying on network structures and using blockchain technologies and smart contracts.

The system of state and legal regulation is clearly lagging behind the challenges of new technological opportunities. Not only in matters of cyber security, electronic commerce and Internet regulation, but also in the use of bioengineering technologies, unmanned vehicles, 3D printers, etc. Public consciousness is stirred up by movies about robots, cyborgs, human-computer monsters, etc. that have run out of control. Advertisers promote smart homes, talking irons and refrigerators. Advanced architects offer governments to build smart cities.

At the same time, the informatization of management systems remains the most corrupt area, absorbing a growing part of the budgets of government bodies without any noticeable return. Let us recall how the governments of many countries were "plowed up" with big money by the pseudo-problem of the year 2000. Similarly, citizens are tricked into getting computer systems in homes, cars, personal computers and telephones that they do not need. Whereas corporations and departments are used as cash cows by sophisticated IT professionals who impose unnecessary updates of information and computing technologies.

Let's try to understand these intricacies of real and fake calls to the spread of digital technology. In the context of the changes connected with them, we will consider the spheres of state, public and personal security, as well as the security of humanity as a whole. Based on this analysis, we will try to formulate recommendations for the system of state and legal regulation in Russia, the Eurasian Union [EAEU] and in the world.

3.2. Threats to Russia's national security in connection with the digital revolution and the possibility of neutralizing them

The state security is jeopardized by the digital revolution in the following areas:

1. Cyberterrorism and cyber espionage conducted against Russia by the United States, its allies, as well as other countries and foreign terrorist and criminal organizations, as well as individuals and their groups.

2. The same threats from domestic criminal groups, terrorist organizations, radical religious, Nazi and other extremist groups and anarchic forces.

3. Avoidance of taxation, illegal export of capital, laundering of criminally

obtained proceeds using a cryptocurrency.

4. Carrying out illegal business activities through the use of the Internet, including electronic commerce and financial services.

The first threat is the most serious and relevant. The United States is actively using cybernetic tools of the hybrid war they are waging against Russia as the main currently offensive weapon. So far it is used for espionage and information gathering, as well as for the disinformation of the Russian leadership and citizens through skillful work in social and special networks. However, its potentially damaging effects could be disastrous. For example, the equipment and software of the NATO countries installed at military and strategic sites may fail at the right time for the enemy, be disabled, or provoke a technogenic disaster. First of all, it concerns control systems, communications, transport, power plants and power grids, as well as a sophisticated military equipment.

It should be noted that the United States is the only country opposing the conclusion of an international treaty on cyber security. They systematically conduct electronic espionage around the world, even against their allies. With advanced information technology and the world's largest fleet of information and computing equipment, an actual global monopoly in operating systems, social networks, a dominant position in the telecommunications services market and complex electronic components, the United States uses its technological advantage for political and economic purposes. Refusing to sign an international treaty on cyber security, they indirectly confirm the intention to use cyber weapons in the future.

Cyber threats coming from the United States pose a serious problem for the security of Russia, China, India, Iran and other countries against which the American authorities are waging a hybrid war. Solving this problem by the forces of Russia alone is extremely difficult due to a limited resources. Due to the degradation of our electronics industry, the growing lag in the field of nano- and information-communication technologies, it is impossible to replace imported equipment with our own production in any wide range. We can talk about this only in relation to the defense industry, special services, and the system of state administration. The latter still works almost exclusively on imported computing platforms and software. Numerous instructions from the leadership of the country in this regard are not carried out. Even the already developed Russian operating systems are not being introduced.

The key solution to this problem is the conclusion of a broad international agreement on cybersecurity, containing a clause on the imposition of collective sanctions by the signatory countries against states that refuse to join the agreement. These sanctions could include:

- designating a country as a cyberagressor should there be revealed facts of systematic activity conducted by the special services of such a country to hack or disable databases, Internet sites, servers, data centers, government control networks of government bodies, objects of defense and strategic importance, public corporations, banks, transport infrastructure facilities, energy, and other life support systems;

- sanctions that should follow against a country recognized through a due process as a cyber-aggressor could include the imposition of an embargo on the import of computers, software, equipment for the needs of the state and public corporations, the disconnection of social networks, the termination of television and radio broadcasting, the termination of bank settlements;

- collective actions to minimize the damage from the introduction of sanctions against the cyberagressor. They could include the development and implementation of an overall plan for import substitution, the joint creation of software tools, common social networks, interbank settlement systems, and information networks.

To start with, such an agreement on collective counteraction of threats to cybersecurity could be offered for ratification to the SCO member states. This would give a powerful impetus to the development of their electronic industry, the production of software products, and control systems for complex technological systems. Perhaps the very statement about the development of such an international treaty without the United States involvement will have a sobering effect on the latter, and we will manage to build a global cyber security system. Otherwise, it will be created in most of Eurasia, which is quite enough for a successful solution of this problem. The creation of such a Eurasian cyber security system would automatically deprive the United States of the leading role in the global information space, the production of computer equipment and software. Soon after, having their main offensive weapon blunted, they would stop waging a world hybrid war, including the aggression against Russia.

If the task of ensuring international cyber security at the state level is solved, the neutralization of threats from certain criminal communities, radical organizations and individuals will become a technical task. To solve it, the national systems of signatory states to the international treaty, their coordination, joint monitoring and programs of common actions should be used. If the United States refuses to sign an international treaty on cyber security, the signatory countries will have to create an international coalition against cyber threats, including those originating from the territories and jurisdictions of third countries.

Neutralization of the second group of threats involves the creation of an identification system for all people using the Internet, including social networks, as well as special certification and testing of equipment purchased from Russian manufacturers for state needs and strategic facilities. The first task will require an appropriate legislative and administrative support. It will be necessary to adopt a law on mandatory voluntary identification of Internet users, starting with social networks. For its implementation, every citizen who wishes to identify himself must be offered a digital signature and keys for work. Networks that refuse to work exclusively with identified citizens will have to be disconnected from the Russian segment of the World Wide Web. The second task is of a technical nature, although it also involves making appropriate amendments to the legislation on public procurement.

When discussing these topics, one involuntarily recalls the typical situation with the "punishment" of a soda machine during the Soviet era. When, after an abandoned coin, the machine did not pour a glass of water, it was often hit in the "face", after which it often gave out water. However, this trick will not work with modern robots. Partially, the problem can be solved with the help of "smart contracts", which stipulate responsibility for violation of the terms of the contract, procedures for its establishment, terms of penalties and their automatic execution by a direct write-off from the account. But, as they say, you cannot predict everything.

Apparently, there is no other way than the introduction of criminal liability of legal entities for the commission of crimes by their robots and computers. Many countries have gained an experience in criminal prosecution of legal entities, which would stand us in good stead in identifying those responsible for accidents and other unintentional crimes committed without people's involvement. For example, it is not clear who is found guilty in case of an accident involving an unmanned vehicle: a programmer, a setup man, or an operator? Not to mention the lack of their intent, but also the very possibility of foreseeing and the authority to prevent all emergency situations on the roads. These functions can also be transferred by the owner of the drone to be outsourced to other legal entities.

3.3. Social issues connected with the digital revolution

A serious threat to public safety is considered to be the rise of unemployment due to workplace robotization, automation of management processes, and the growing use of 3D printers. Although this problem is not new, and since the first industrial revolution nothing has been more painful for society than the movement of luddites who destroyed machinery in England more than two centuries ago, today it is of a particular concern. Indeed, in the first period of mass robotization, one can expect a tangible increase in unemployment among workers and employees in certain professions. However, as the nearly three hundred year experience of modern industrial development shows, this threat is partially neutralized by other factors.

Firstly, along with stagnant unemployment in some industries, there is always a shortage of labor in others. The imbalance in the labor market is sharply exacerbated during the periods of changing technological paradigms. At such a time, the economy is plunging into depression due to the discontinuance of economic expansion in the established areas, slump in production and laxity of investment in industries that have provided the main employment drivers for successive generations. At the same time, the growth of a new technological paradigm provides the demand for labor in other specialties, and those workers who are freed from the outdated technological paradigm and wish to retrain are hired for new jobs. The state can significantly mitigate the build-up of imbalances in the labor market by subsidizing employee retraining programs, and timely restructure the education system to meet the demand for new professions.

Secondly, like the digital revolution as a whole, robotization has long been underway, destroying hundreds of millions of workplaces in various industries. Since the 1980s, with the growth of the information-communication technological mode at that time, the automation of production has covered many branches of the manufacturing industry. Flexible production lines have made the labor of millions of assemblers, packagers and machine operators unnecessary. Tough automation of conveyor production has freed up millions more people engaged in monotonous work to perform simple repetitive operations. Progress in computing has eliminated millions of workplaces of typists, perforators, rate setters, designers, accountants, and other specialties related to routine calculations using established algorithms. Millions of people replaced by automatics found themselves in a difficult situation, but a social disaster similar to the Great Depression, when the previous shift in technological paradigm took place, did not happen. The youth enthusiastically mastered the new professions of programmers, operators, and service engineers. Older people have retired early. Many have found themselves in the service sector, the rapid expansion of which has become the most visible side of the growth of the new technological paradigm, initiating the discourse about the transition to the post-industrial stage of economic development. In fact, industry is still the basis of the modern economy, though its share of the labor market has dropped sharply to an average of 25% in advanced countries.

Thirdly, the consequences of economic policy will be much more significant for the Russian labor market than the digital revolution. Due to the severe degradation of the economy because of reforming by the IMF recipes, entire industries with millions of high-tech jobs were destroyed. At the same time, in spite of global trends, the production under the modern technological paradigm, providing for the expansion of employment worldwide, has undergone the most drastic diminution. Russia was and, in part, remains the only country in the world where, in the 1990s, the number of scientists, engineers, programmers, operators, service engineers, and other highly skilled workers has declined. Most of them were forced to move to low-skilled jobs of traders, carriers, guards. In the transition to a policy of advancing economic development based on the new technological paradigm (Glazyev, 2010), the Russian economy will face an acute shortage of engineering specialists. The economic recovery is already constrained by the lack of highly skilled workers and engineers.

Fourthly, in the foreseeable future, the demand for specialists required to create the infrastructure of the digital economy will be much greater than the destruction of routine jobs associated with its expansion. However, this might happen only if the digital economy will develop on the domestic intellectual and technological basis. If the state policy in the field of information technology does not change and continues to be based on the import of hardware and software, the effect may be very negative. Released mainly from the service sector, the financial sector and trade, white-collar workers may not find themselves a new occupation, either due to the lack of proper qualifications or due to the fact that the growing segments of the Russian market are filled with foreign equipment and foreign specialists.

Thus, the threats of a severe increase in unemployment resulting from the digital revolution are greatly exaggerated. They can easily be neutralized by a well-thought-out state economic policy. Until now, the lackluster policy in this respect was the main reason for the elimination of millions of workplaces and the degradation of human capital, not the digital revolution. With the implementation of advanced development policy proposed by the Izborsk club, the demand for highly qualified specialists will be far ahead of their reduction. The problem is in the presence of a significant number of low-skilled and highly specialized office workers, whose employment will require significant retraining efforts. However, it also depends on a state policy to a great extent.

Real political issue could arise from the use of digital technologies in the field of state control. For example, the use of the blockchain technology will make it impossible to falsify registration documents and permits, and to reissue verification acts. This technology also makes a significant part of expensive notarial certification services unnecessary. The use of "smart contracts" will make bureaucratic arbitrariness in the field of public procurement more difficult. The use of electronic digital signatures and methods for accurately identifying paper and electronic media will eliminate document fraud. The entire system of government will become more transparent and open to public scrutiny. The incidence of corruption will be reduced and the need for regulatory officials will diminish. Perhaps that is why the informatization of public administration systems is so hard - huge money is written off on ineffective and duplicative measures.

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4. Conclusions

Challenges of the digital revolution for the future of humanity

According to our conclusions, they come down to the following threats:

1. The threat of using the genetic engineering technologies to create microorganisms dangerous for humans. It has long existed and is clearly underestimated by the national security agencies. Two decades ago, scientists recognized the possibility of synthesizing viruses of selective action against groups of people with certain biological characteristics. By combining the DNA of viruses that live in symbiosis with humans with pathogenic viruses, it is possible to synthesize viruses that cause

diseases in people of a certain sex, age group and even race. By delivering these viruses through the export of food to a hostile country, it is possible to cause epidemics there and thus get around the double-edged nature of biological weapons. Apparently, such studies are conducted in US laboratories contrary to the prohibition of biological weapons. In any case, the leaders of some African countries sincerely believe that Washington is guilty of creating and spreading Ebola.

2. Human cloning – creating people with certain properties. Scientists started talking about this threat more than a decade ago, when the possibility of cloning mammals was experimentally proven and the practical possibilities of cloning higher primates and humans had opened up. Today, dog cloning has become a commercial enterprise and the emergence of human cloning factories is theoretically possible.

3. Implantation of various cybernetic devices in people. This is a well-established technology in medicine, which widely uses pacemakers, hearing aids, prostheses, and sensors. Theoretically, the emergence of cyborgs is possible - people with instruments built into their bodies in order to endow them with additional computational abilities, improve the functioning of their senses, identify individuals, transfer information to them, manipulate behavior, etc.

4. The built-in of human organs and their models in robotic devices. This is the same fantasy as the head of Professor Dowell in the Belyaev's novel. However, the development of human nervous system models is being intensively conducted and the appearance of androids endowed with the elements of human appearance, as well as robots with artificial intelligence, is quite possible.

5. Getting out of control of the self-organizing autonomous robotic systems. Riot of robots can theoretically turn from fantasy and into a real nightmare in the nearest future. Nowadays, failures of automated power supply systems are throwing large cities down into chaos. If artificial intelligence systems can organize themselves and make independent decisions, the consequences cannot be predicted.

All of the above threats to the existence of humanity are well known and have been discussed many times. However, the real proposals for their neutralization have not yet been developed. It is obvious that the scientific progress cannot be stopped, despite a host of its hazardous consequences for humanity. However, society can limit it to the framework of the law. In order for them to be effective, these restrictions must be international in nature and cover all countries with a significant scientific and technical potential.

The current experience of concluding international treaties to limit the proliferation of missile and nuclear technologies, ban bacteriological and chemical weapons, and conduct tests of atomic weapons is encouraging. Although these treaties do not have mechanisms to enforce obligations, the leading countries of the world usually adhere to them. The range of such agreements will increase with the transition to a new global economic paradigm based on a mutually beneficial and voluntary partnership of states and strict observance of the international law (Glazyev, 2017). This range could also include international treaties necessary to limit the dangerous directions of digital technology developments described above, including:

- prohibition of human cloning;

- ban on the development of pathogenic viruses and other forms of biological weapons;

- the introduction of international standards for implanting devices into the human body;

- monitoring the development of artificial intelligence systems in order to diagnose and neutralize threats to humanity;

- worldwide certification of specialists receiving education in the field of information technology;

- development and adoption of international technical regulations and procedures for certification of android robots.

Russia could also initiate the development and adoption of an international convention on scientific ethics that prohibits research in the fields of modification of human nature, biological weapons, programming aimed at the destruction of people by self-organizing robotic systems, etc.

The digital revolution that amazes emotional people is a long process that has been unfolding for several decades. Digital technologies have already covered almost the entire information and financial spheres, and a significant part of the industrial and social spheres. They penetrate domestic and business areas. They have not yet caused much damage to society, expanding opportunities and improving the quality of people’s life. Numerous examples of the use of digital technologies for anti-human and criminal purposes are related to the actions of people, and not to technologies as such. At the same time, their monopolistic use in anyone's private or national interests greatly enhances the capabilities of these individuals and may pose a threat to the national security of states. Neutralization of these threats emanating from people must occur through legal regulatory methods. The research was supported the Russian Science Foundation, project 18-18-00488

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