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ROLE AND IMPORTANCE OF NEUROTECHNOLOGIES IN DEVELOPMENT OF RUSSIAN ECONOMY

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Abstract

The article is concerned with the notion of neurotechnology, its financial and organizational support by the Government and business communities, and the initiation of such significant projects in the USA, Europe, Asia and Russia (namely, the projects of making neutro-networks and processing big data). The role of neurotechnologies in the age of intelligence, knowledge, and "smart" things is shown to lead to appearance of a more perfect technological platform based on high-tech production, innovative decisions, and artificial cognitive systems. The results of the analysis of neurotechnology application prospects in the whole economy of Russia as well as its separate fields and spheres (including medicine, safety, trade, business, marketing, sales, logistics, recreation, education) are presented. Possible positive effects of neurotechnology application are considered, including improved life quality and prolonged life expectancy, labor productivity growth, more comfortable labor conditions (for disabled persons as well), the reduced negative influence of human factor. Risks, dangers, and obstacles to neurotechnology development in the digital economy are also considered, among them the lack of competent personnel, computer crime growth, the insufficient security of integrity, confidentiality, authentication of transmitted information, the violation of an individual's rights at invasion into his or her personal space. Conclusions and proposals concerning the training of competent specialists, electronic security increase, the promotion of neuro-ideas into society, the development of software products for neurocalculations and big data processing, the improvement of governmental support and regulation methods, the creating of multi-channel financing system are drawn out.

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1. Introduction

In the digital economy, the importance of neurotechnologies is very great, as, alongside with the development of Artificial Intelligence, the intense research of human intelligence capabilities is ongoing, and the results obtained will be applied in various areas of human activities in all countries, including Russia.

Neurotechnology is based on the knowledge of the functioning of human nervous system, and this priority research vector is being developing very actively in many countries in the conditions of large directed financing.

All modern achievements in the sphere of innovative neurotechnologies have been obtained, to a great extent, thanks to financial and organizational support by the state and business communities. Thus, in the USA, despite the general reduction of expenses for research and development for the first time in the last 20 years due to the crisis, the expenses for brain research and new neurotechnologies increased to several billion dollars (for this purpose the megaproject "Human Brain Mapping" or "Brain Initiative" was created).

Similar multi-disciplinary megaprojects with close tasks are being developed in the European Union ("Human Brain Project" with 1.3 billion euro financing for 10 years, "Era-NetNEURON", "Joint Programme – Neurodegenerative Disease Research") and individual European countries. In Asia (China), the priority scientific research program "Functional Connectome Project" whose purpose is to compose the functional atlas of brain neutral networks for perception, memory, emotions, with 300 million yuans financing for 5 years (with possible prolongation for 5-10 years) is being developed. A joint Chinese-Australian project whose purpose is to study brain within the frames of "Brainnetome" was launched in order to make a new generation brain atlas "Brainnetome Atlas".

In Russia, attention is increasingly paid to neurotechnologies, and a number of legal acts concerning the characteristics of perspective development of neurotechnologies in the conditions of the digital economy were adopted (for example, Order of the Government of the Russian Federation of July 28, 2017 No. 1632-p "Digital Economy of the Russian Federation", as well as the Doctrine of Information Security of the Russian Federation, approved by Decree of the President of the Russian Federation of December 5, 2016 N 646 and the Strategy for the Development of the Information Society in the Russian Federation in 2017 - 2030 years).

2. Problem Statement

The main problem is that the Russian economy lags behind the economies of developed countries (the USA, Japan, Germany, Finland, Switzerland, Sweden, Norway and others). It is important to study the extent to which modern and rapidly developing neurotechnologies allow to reduce the current lag thanks to purposeful formation of necessary skills and competencies, making of necessary public policy of regulating and supporting this trend, detecting and neutralizing of threats and obstacles to neurotechnology use.

3. Research Questions

During the study the following questions were posed:

3.1. What will be the role and significance of neurotechnologies in the upcoming era of knowledge, intelligence, "smart" things?

3.2. What spheres and fields of the Russian economy will especially require the use of neurotechnologies, and in what forms?

3.3. What are risks and obstacles to the development of neurotechnologies in the Russian economy?

4. Purpose of the Study

In the given article we analyze the role and significance of neurotechnologies in the development of the whole Russian economy as well as its individual spheres and fields, reveal their expected positive effects and, at the same time, possible risks, dangers, unfavorable results and obstacles to the development of neurotechnologies in the domestic economy.

5. Research Methods

The following research methods were used: a systemic method, and methods of analysis and synthesis which consider the economy of any country as an entity of material and non-material productions including various fields and intersectoral complexes.

Besides, the author used situational, statistic, comparative and expert methods, including the foresight evaluation of neurotechnological impact on the economy in the near and long term.

6. Findings

6.1. Modern situation in the economy of Russia in comparison with other countries

Modern economic development of Russia is characterized by a significant lag in the most significant indicators, including the gross domestic product (table 1).

Table 01. Dynamics of real gross domestic product in percent to the previous period in 2014–2018

Country	2014	2015	2016	2017	quarter II, 2018 to quarter II, 2017
Russia	0.7	-2.5	-0.2	1.5	1.8
Germany	1.9	1.7	1.9	2.2	1.9
Italy	0.1	1.0	0.9	1.5	1.1
Canada	2.9	1.0	1.4	3.0	2.3
China	7.3	6.9	6.7	6.9	6.7
Great Britain	2.9	2.3	1.8	1.7	1.3
USA	2.6	2.9	1.5	2.3	2.8
France	0.9	1.1	1.2	1.8	1.7
South Africa	1.8	1.3	0.6	1.3	1.5
Japan	0.4	1.4	0.9	1.7	1.0

As the analysis has shown, in 2015-2016, in Russia, the dynamics of real gross domestic product (GDP) was negative, and only in 2017-2018 it became positive, but the current growth of GDP in Russia is much more lower than in China, the USA, Canada (Statistics Russia, 2018).

As the statistic data in table 2 show, the dynamics of industrial production in Russia lags behind such countries as Germany, Canada, India and some others (Statistics Russia, 2018).

Table 02. Dynamics of industrial production in percent to the previous period in 2014 – 2018

Country	2014	2015	2016	2017	quarter II, 2018 to quarter II, 2017
Russia	2.5	-0.8	2.2	2.1	3.0
Germany	2.0	1.1	1.5	2.9	3.7
Italy	-0.6	1.0	2.1	3.7	2.8
Canada	4.9	-0.6	0.5	4.3	3.8
India	4.5	2.5	5.2	3.5	5.8
Great Britain	1.5	1.2	1.0	1.1	1.9
USA	3.1	-1.0	-1.9	1.6	3.5
France	-1.1	1.8	0.4	2.0	1.6
Japan	1.9	-1.3	-0.3	4.2	2.5

6.2. Role and significance of neurotechnologies in the whole economy

The author's investigation has shown that in the upcoming and rapidly developing digital information age the role and significance of neurotechnologies in Russia is hard to overestimate, especially taking into account the economic lag of Russia behind other developed countries. In the age of intelligence, knowledge, "smart" things, a more perfect technological platform based on high-tech production, innovative decisions, artificial cognitive system is required, for it will allow to overcome the current lag of the domestic economy and increase its competitiveness.

On the whole, the developing age of digital economy is characterized by medium hybridization (i.e. the difference between physical participation and on-line one, between different types of communications is being erased), the modernization of economic fields and spheres thanks to neuro-network appearance, data processing speed increase, exoskeletal construction use, robot intellectualization, mobile application neutral tuning, obtaining and processing of big neuro-data about individual demand and consumption. As various experts estimate, to 2035 the world market of neurotechnologies will reach 1 trillion dollars. The share of Russia in the global market of neurotechnologies is estimated to be 2-3 % to 2035.

6.3. Role and significance of neurotechnologies in individual spheres and fields

As the research has shown, the use of neurotechnologies is expected to be increasingly intense mainly in the following individual spheres and fields:

- in medicine, various neural chips, new apparatus for diagnostics, expert work, surgery, neural medical techniques and prosthetics, neural prostheses of extremities and sense organs, and treatment with drugs integrated into subcellular structures will appear;

- in the field of security, unique neuro-computers to regulate chemical reactions, and manage civil and military aviation, new apparatus to inspect luggage and prevent terror actions, neural programs to identify faces and emotions in crowded places (airports, railway stations, ports, etc.), personality identification systems, systems to recognize voices and automobile numbers, aerospace image analysis, informational flow monitoring, and other similar things will appear;

- trade, sales, marketing, logistics, and business spheres will increasingly use associative information search, electronic secretaries and agents, filtering of information in info-systems and social nets (e.g.. tracking of relevant product reviews and evaluating of their emotionality), collaborative filtering, news headings, targeted advertisement, targeted marketing for electronic trade, image and associative memory recognition, handwritten check processing, recognition of signature, fingerprints and voice, fake payment system detection, processing of big data about consumers, competitors, and suppliers, situational market evaluation, forming of more precise market development and behavior prognoses, optimizing of goods and money flows, security of transactions with plastic or neural cards, intellectual approach to merchandizing, (Panasenko & Ramazanov, 2018), electronic purchase forecasting (Atsalakis, 2017), forming of nets between enterprises, company segments, and their subcontractors (Quattrociocchi, Calabrese, Hysa, & Wankowicz, 2017), various innovations in retail (Mayorova, Shinkareva, Nikishin, Uryaseva, & Malinin, 2018), new business models based on digital changes (Rambow-Hoeschele et al., 2018), autonomic economic agents, decentralized organizations, crypto-conversions, distributed registers (Zamani & Giaglis, 2018);

- entertainment industry (game models, cybersport, show business) will actively use neurotechnologies to apply neurointerfaces in input and output devices, manage game characters on the base of brain signals of gamers (Lokhman, Karashchuk, & Kornilova, 2018);

- in the educational sphere, it is planned to use neurotechnologies in order to develop memory and intelligence, progressive educating techniques, neuro-compensatory devices for educating disabled persons, neuro-chips implantation, self-educated and self-tuned neuro-nets, unique expert systems.

6.4. Positive results of neurotechnologies in the domestic economy

- the most positive results of neurotechnology application are expected to be the significant improvement of life quality due to improved medical service, successful treatment of diseases, traumas, inherited pathologies, as well as the improved level of education thanks to individual educational trajectories taking into account personal characteristics of trainees, and more comfortable conditions for work, rest and recreation;

- the use of neurotechnologies will lead to prolonged life expectancy with high working performance and mental activities, as well as labor productivity growth;

- of positive significance will also be the transfer of emphasis from energy and resource consuming technologies to high-tech production, gradual change from physical labor to robots, artificial intelligence, manual labor cost reduction, biorobotization, and automation;

- the development of neurocognitive devices and robotic systems managed with a "brain-computer" interface will allow to provide more comfortable living conditions for disabled persons;
- besides, neurointellectualization will allow to make more balanced economic decisions taking into account big data, individual characteristics of persons, and reduce the amount of mistakes associated with a human factor.

6.5. Risks, dangers and obstacles to the development of neurotechnologies in the Russian economy

Among the risks and dangers, the research revealed the risk of possible violation of human rights at invasion into his or her personal space, the dangers of manipulation, promulgation of obtained individual neuro-data, the risk of possible loss of confidence in neurotechnologies in case of a malicious breach, or an information leak.

Among the obstacles to neurotechnologies, the following problems should be paid attention to: the lack of competent personnel, the growth of computer crime, insufficient conditions to provide integrity, confidentiality, authentication, and security of information transmitted and processed, insufficient informative accompaniment and promotion of achievements of domestic scientists, the lack of governmental and other investments in the development of neurotechnologies.

7. Conclusion

On the whole, the analysis of the development of neurotechnologies, their role and significance in the digital economy has shown that it is necessary to make new technological decisions and products, organize neurotechnology-based processes, as well as develop new competencies, train relevant specialists which will be capable to deal with the technologies of this sort. It means the gradual change of educational curricula (including these of economic specialties), the introduction of new or modified curricula, the increased share of practice-oriented tasks and advanced methods of education.

Besides, it is necessary to improve the methods of governmental support and regulation, make the corresponding infrastructure of developing neurotechnologies, take the interrelated measures of increasing electronic security, make the multi-channel system of financing neurotechnologies (at the expense of the Government as well as business communities, and thanks to the development of grant and competition system, the initiation of start-up system). It is necessary to promote such ideas into the society, work much to develop software products of neurocalculating and processing big data.

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