From industry 4.0 to Society 5.0: challenges for sustainable competitiveness of Russian industry

IOP Conf. Series: Materials Science and Engineering **497** (2019) 012090 doi:10.1088/1757-899X/497/1/012090

From industry 4.0 to Society 5.0: challenges for sustainable competitiveness of Russian industry

Tatyana Salimova [1*], **Nadezhda Guskova** [1] **Irina Krakovskaya** [1] **and Efim Sirota** [2]

[1] National research Mordovian State University N. P. Ogaryov, Bolshevistskaya str., 68, Saransk, 430005, Russia
[2] Financial University under the Government of the Russian Federation, Leningradsky ave., 49, Moscow, 125993, Russia

* E-mail: tasalimova@yandex.ru

Abstract. The globalization and digitalization of the world economy keep up to date the problems of attaining sustainable competitiveness for the Russian industrial enterprises. The purpose of investigation is to study the ways of solving these problems on the basis of integrated approach combining the key provisions of concepts of competitiveness of enterprises, sustainable development and information society. The authors have given consideration to interrelation of digitalization objectives and goals of sustainable development reflected in the concepts of Industry 4.0, Society 5.0. The problems of adaptation of the Russian industry to the changes in process and state support to these processes have been revealed. A necessity of shaping a comprehensive methodology under conditions of global digitalization of economy and society on the basis of investigating the genesis of theory and methodology of ensuring competitiveness and sustainable development has been substantiated.

1. Introduction

A rapid growth of new production facilities and branches of industry based on the use of innovative resource-saving and information technologies, problems of increasing competitiveness of industrial enterprises are closely interrelated with the solution of tasks of sustainable development under conditions of transition of the developed countries to the sixth technological paradigm, implementation of national strategies of digitalization of economy and society contemplating even greater toughening of social and environmental standards.

A concept of sustainable competitiveness of social and economic systems — the theoretical and methodological approach orienting researchers and practitioners for using a principle of sustainable development for solving the tasks of increasing competitiveness [1].

A sustainable competitiveness of an enterprise can be viewed as: 1) consistency and sustainability of socio-eco-economic aspects of economic activity of a company in short-time- and long-term perspective [2, 3]; 2) variety of competitive advantages of a firm (positive reputation, innovative potential, efficiency of business processes, etc.) [4, 5]; 3) availability and use of departmental (or cluster-related) advantages, capabilities of building innovations, niche in the international specialization of labor, efficient added-value chains [6, 7].

According to a number of authors a sustainable competitiveness of organization is attained through a concurrent implementation of three conditions (capabilities, abilities): 1) ability to sustain high productivity within durable period of time; 2) capability of innovations (to enhancing productivity in the course of time); 3) following the principles of trinity of socio-eco-economic aspects of efficiency (Triple Bottom Line (TBL) principles), i.e. the development of organization taking into account a sustainability of not only economical but also of social and ecological efficiency indicators [8, 9].

Despite the fact that fairly much time has been paid to different aspects of sustainable development and increasing competitiveness of enterprises in the economical science, practically no works are available, which are devoted to a comprehensive view of the topics of providing sustainable competitiveness of industrial enterprises under conditions of digital economy establishment.

The purpose of investigation is to study the ways of solving these problems on the basis of interdisciplinary approach combining the methodology of information society establishment, sustainable development, provision of competitiveness of enterprises. The investigation tasks include: studying abilities of integrating key provisions of the foregoing concepts; analyzing problems of adaptation of the Russian industry and industrial policy to conditions of global digitalization of economy and society; substantiating a necessity of developing an integrated methodological approach making it possible to provide a long-term competitiveness of enterprises taking into account the principles of socio-eco-economic stability on the basis of using advanced information technologies.

2. Concepts of digitalization of economy and society

The concept Industry 4.0 has been articulated by K. Schwab, the President of World Economic Forum in Davos. The ideas of K. Schwab with respect to the development of Industry 4.0, which were set out in the monograph “Fourth industrial revolution” [10] were used as a conceptual basis for the development of national and interstate initiatives (strategies, programs) for digitalization of economy (and, in particular, industry). For instance, these initiatives are most frequently referred to as Industry 4.0 or Smart Industry in Germany, Austria, Italy, Portugal, Sweden and other EU countries [11].

The Society 5.0 is the development of the Industry 4.0 concept with due account of relevant social and man-induced challenges in the direction of its humanization extending beyond the boundaries of technological and organizational-and-economic transformation of industrial production based on the cutting-edge development projects. The fifth baseline plan of scientific and technological development of Japan was approved by its government in the early 2016 [12] to determine the basic problems restricting a sustainable development of both Japanese and the world economy, negatively influencing the state of the society. First of all, it is a significant reduction of quantity of labor pool and its aging, escalation of international competition, industrial infrastructure demanding renovation, natural calamities and terrorism, environmental problems and scarcity of natural resources. The solution of particularly these problems has been used as the basis of creating the super-smart society, or the Society 5.0 under the auspices of Keydanren, the Japanese big business federation [13].

The Society 5.0 is a social-and-economic and cultural system developing in a sustainable way in the direction, which is optimal for the mankind on the basis of processing the ‘big data’ results, where a physical- and cyber-space are becoming an integral whole for solving the social problems, providing security and eco-friendliness of innovations and sustainable economic growth. The concept of the Society 5.0 is focused on attaining such goals specified by the United Nations Organization in the field of sustainable development up to 2030, as the ‘conscientious consumption and production’, ‘sustainable cities and inhabited localities’, ‘industrialization, innovations and infrastructure, ‘inexpensive and cheap energy’, ‘good health and prosperity’, etc. The leading industrial corporations are determined to actively propagate the ideas of the Society 5.0 globally.

The representatives of political authority (C. Abe, members of the Counsel for Science, Technology and Innovations (CSTI) of Japan), scientific community (in particular, Yu. Kharayama, L. Granrat) [14, 15], Japanese Big Business Federation Keydanren, (N. Uemura, et al.) give consideration to the problems of management of the industrial companies under conditions of emerging Society 5.0 in their publications [16].

3. Russian industry under conditions of global digitalization of economy and society: adaptation problems and measures of governmental support

The domestic industrial enterprises functioning under conditions of globalization and digitalization of the world economy, joining the World Trade Organization by Russia have appeared to be involved into global processes of development of the respective industrial markets. The basic trend determining the world market development is the technological transformation in the direction of transition towards innovative resource-saving smart solutions adapted to the needs of sustainable development. As a result, the manufacture of up-to-date competitive products compliant with the requirements of energy efficiency, safety and eco-friendliness as well as physiological and hygienic requirements becomes the priority direction of activity of industrial enterprises. The provision of stable employment is also by no means unimportant aspect of reaching sustainable competitiveness of industry.

A successful adaptation of the Russian industrial enterprises to the changes taking place is only possible under condition of adequate understanding of organization's goals by its management from the perspective of reaching its sustainable competitiveness, i.e. in the context of ensuring not only current competitive advantages but a continuous improvement of enterprise's activity according to the principles of sustainable development.

A significant part of the domestic industrial companies is unable to independently provide the innovative changes according to the challenges of global market and principles of socio-eco-economic stability due to insufficient financial potential, outdated equipment and infrastructure, durable absence of investments into own promising developments and human capital assets [1, 17].

The Strategy of science and technology development of the RF points out that the 'exhaustion of capabilities of economic growth of Russia based on the extensive exploitation of raw material resources against a background of establishing digital economy and emergence of the limited group of leading countries possessing new production technologies and focused on utilization of the renewable resources', 'growing role of international standards', necessity of implementation of dedicated scenario of sustainable development of Russia on the basis of transition to the next technological paradigms and joining a 'group of countries with high rate of gross domestic product increment' demand accomplishment of a complex of organizational and other measures aimed, in particular, at the development of companies able of becoming the leaders on the new global technological markets [18].

One should agree with the authors of expert-and-analytical report 'New technological revolution: challenges and opportunities for Russia' that the 'Russian economy is to provide labor productivity growth on such a scale, which allows eliminating any lagging behind the leader countries with respect to this indicator within the shortest possible time and be on a par with them in future' [19]. The state programs with the area of focus 'Innovative development and modernization of economy', in particular, the program 'Economic development and innovative economy' and 'Industry development and enhancing its competitiveness' approved in 2014 and intended to last over a period until 2020 are focused particularly on implementation of this task. The measures that will be implemented in the context of this area of focus are concentrated, on the one hand, on assigning positions of the world leader in the power-generating sector, raw material extraction and processing to Russia. On the other hand, they are called upon to shape the 'competitive economy of knowledge and high technologies, conditions for an outbreak of new innovative companies in all economy sectors' [20]. For instance, the expected results of implementing program 'Industry development and enhancing its competitiveness' assume an 'increasing produce manufacture with high added value; decreasing dependence of the economy of Russian Federation on the import of products, equipment and technologies critical for sustainable development; increasing operational excellence and energy-efficiency, providing growth of labor productivity owing to the use of advanced technologies and up-to-date equipment; increasing quantity of high-performance working places by means of building new production facilities; increasing quantity of industrial infrastructure facilities; shaping an efficient system of supporting a demand for produce of the new industries; providing an intensity of expenditures for researches and developments in the civil branches of industry required for sustainable economy development both owing to budget, and non-budget sources; technological renovation of industry and incorporation of

the best available technologies for a considerable reduction of energy intensity of the most power-consuming industries and manufacture of up-to-date eco-friendly produce' [21].

At the same time, the measures in social and environmental areas of focus of the country sustainable development are accumulated in the other block of state programs 'New quality of life'. These are the programs for the development of education, public health service, support of general public employment, environment protection, etc.

The National Technological Initiative of Russia (NTI) is a 'long-term complex program of creating conditions for providing the leadership of the Russian companies on the new hi-tech markets, which will determine the structure of world economy in the nearest 15–20 years' can in some ways contribute to unification of technological and socio-ecological targets of industrial sector development [22]. The NTI distinguishes the following among such markets: market of smart energy system services (EnergyNet); smart market of production and distribution of food and products with individual logistics (FoodNet); market of new personal security systems (SafeNet); market of individualized medical science and medical technologies (HealthNet); market of services based on aerospace and unmanned vehicles (AeroNet); market of globally-distributed smart systems of maritime transport control and technologies of the World ocean development (MariNet); market of unmanned aerial vehicles and solutions based thereupon (AutoNet); markets of decentralized financial systems and man-machine communications based on the advanced developments in neuro-technologies (FinNet and NeuroNet). The NTI also contemplates the development of TechNet — cross-market and cross-departmental area of focus providing a technological support of development of the other markets and hi-tech industries due to establishment of Digital, Smart, Virtual Factories of the Future.

However, the NTI is, first of all, an initiative aimed at the achievement of competitiveness of the Russian companies on the future and not yet established markets, it does not seek ensuring sustainable competitiveness of the existing industrial enterprises. Secondly, a 'distinctive feature of NTI consists in the fact that a substantial part of the list of measures on attaining leadership by Russia on the new markets is articulated by the hi-tech business itself' [22], for which the issues of competitiveness of the existing industrial sector and following the principles of sustainable development may appear to be the secondary ones. Thirdly, the NTI initiatives have been repeatedly criticized for the 'vagueness of assigned objectives, absence of content' and even for the 'diversion of attention and resources from more productive activity' [23, 24].

The technological platforms (self-organizing associations of manufacturing companies, scientific and educational organizations and infrastructure of innovative activity) are called upon to combine the efforts of business, science and state in implementation of the priority areas of focus of modernization and technological development of the Russian economy. Presently 36 technological platforms (RTP), which structure includes more than 3,500 participants have been established in Russia in more than 13 most promising areas of focus of scientific and technological development [25].

The RTP have been established by the example of the European platforms and correspond to an instrument for communication of the parties concerned (business, science, state, civil society) with the aim of activating development and incorporation of the promising commercial technologies, new products (services), engagement of additional resources for financing research-and-development activity, organization of subsequent industrial production, promotion of an innovative product to the external and internal markets [26, 28].

The Government of the Russian Federation approved the program 'Data Economy Russia 2024' in 2017 with the aim of forming conditions of institutional and infrastructure character, cancellation of the available obstacles and restrictions for establishment and development of hi-tech businesses and country's transition to a digital economy [27]. The program includes 5 directions: 1) personnel and education (improving the system of education and transformation of labor market according to the requirements of digital economy); 2) informational infrastructure (development of communication networks, Russian data processing centers, digital platforms); 3) information security; 4) shaping research competences and technological groundwork; 5) regulatory control. The complex of measures

included into this program is intended to provide, in particular, the increase of ‘availability and quality of goods and services produced in digital economy with the use of up-to-date digital technologies’, growth of ‘competitiveness on the global market of individual branches of economy of the Russian Federation, and the economy as a whole’, ‘technological independence with respect to every direction of end-to-end digital technologies competitive at the global level, and national security’. However, the program does not envisage a complex of measures focused on fostering incorporation of the up-to-date digital technologies particularly in the industry. The proposals on incorporating new areas of focus providing for digital transformation of individual branches of economy into the program are just being shaped now [29].

4. Results

Thus, the national initiatives of the Russian Federation on economy modernization (and industrial complex, in particular) according to the requirements of new industrial revolution are fairly diversified (figure 1).

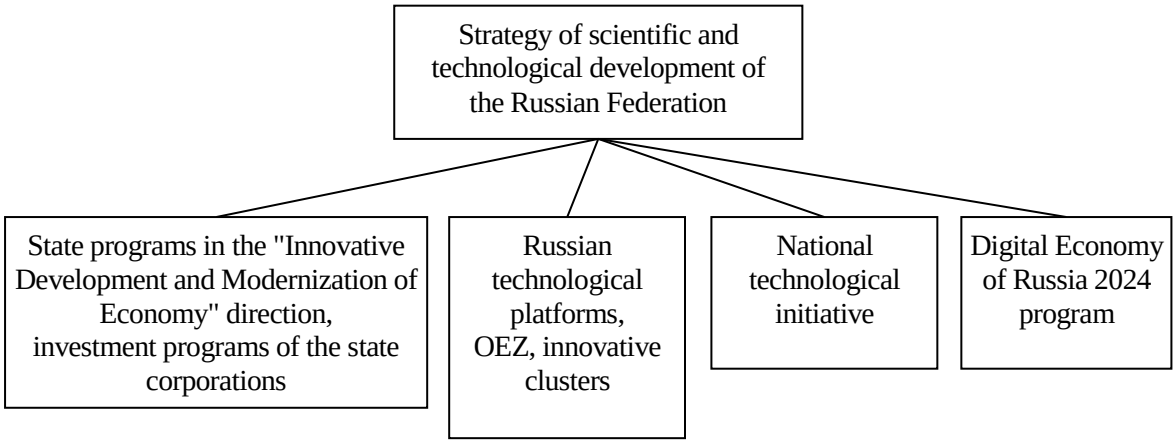

Figure 1. National initiatives of the Russian Federation in the field of the industry 4.0.

Apart from those given consideration above, it also includes development and implementation of the investment programs, establishment of special economic zones (9 zones of industrial and production type and 6 zones of technology and innovation type in 2018), innovative territorial clusters and industrial parks in country regions by the state corporations.

At the same time, the departmental specialization (assignment of individual regulation disciplines to the departments featuring a respective functionality supervising implementation of the state programs and initiatives) is maintained in state regulation of processes of development of national industry under conditions dictated by the present-day trends of transformation of global markets influenced by the new industrial revolution and problems of providing socio-eco-economic stability of national economy. Such an approach, on the one hand, gives an opportunity of deep concentrated study of the existing problems in each area of focus, but, on the other hand, it does not allow for attaining a coordinated solution thereof.

5. Directions for further investigations

In connection with the above matter the task of developing a complex of conceptual managerial solutions making it possible to agree upon the priorities of scientific and technological development of industry with the tools of state support of national companies taking into account the global economic trends with the aim of manufacturing produce required to meet grand challenges facing the country,

providing a technological breakthrough and sustainable competitiveness of the Russian industrial enterprises on the new emerging markets will become actual.

In order to solve this task, it is necessary to develop methodology of providing sustainable competitiveness of industrial enterprises under conditions of the emerging Society 5.0 represented by the nomenclature and system of principles, methods, criteria, indicators of achieving and maintaining sustainable competitiveness of an enterprise established on the basis of investigating genesis of theory and methodology of providing competitiveness and sustainable development. The methodology will be used as a basis for the development of concepts, strategies and programs of competitiveness of the Russian industry at different levels of management.

References

[1] Strategy of Providing Sustainable Competitiveness of Industrial Enterprises of the Region (as exemplified by the Republic of Mordovia), http://www.uecs.ru/index.php?option=com_flexicontent&view=items&id=4692
[2] Barmuta K A 2010 *Bulletin of Dagestan State Technical University* **8** (51) 1274–79
[3] Factors of Sustainable Competitiveness of Enterprises, https://elibrary.ru/download/elibrary_24843631_56767098.pdf
[4] Azoev G L and Chelnokov A P 2000 *Company's Competitive Advantages* 2000 (Moscow: Novosti) 256
[5] Ilienkova N D 2014 *Proc. of Conf. Values and Interests of Contemporary Society. Economics and Management* 172–75
[6] Fatkhutdinov R A 2009 *Management of Competitiveness of Organization* (Moscow: Exmo) 546
[7] Enright M J 1992 *Word Link* **5** 24–25
[8] Cavaco N M and Machado V C 2015 *International Journal of Management Science and Engineering Management* **10** (2) 155–64
[9] Hubbard G 2009 *Business Strategy and the Environment* **18** 177–91
[10] Shwab K 2016 *The Fourth Industrial Revolution (*Moscow: Exmo) 208
[11] Medovnikov D. S., Oganesyan T. K., Styrin E. M., Abdrakhmanova G.I., Rozmirovich S. D., Merkulova D Yu and Bikbulatova Yu S 2017 *Digital Economy: Global Trends and Practice of Russian Business* (Moscow: National Research University Higher School of Economics) 121
[12] Report on the 5th Science and Technology Basic Plan, http://www8.cao.go.jp/cstp/kihonkeikaku/5basicplan_en
[13] Reform of the economy and society by the deepening of Society 5.0, http://www.keidanren.or.jp/en/policy/2016/029_outline.pdf
[14] A. living concept Society 5.0 and the role of universities, http://minedu.fi/documents/1410845/5310220/Harayama+Society5+Finland.pdf/70f24ddc-8ab1-47d7-8583-12934bbbd3eb
[15] Japan's Society 5.0: Going Beyond Industry 4.0, https://www.japanindustrynews.com/2017/08/japans-society-5-0-going-beyond-industry-4-0/
[16] Uemura N 2017 *Economic Strategies* **4** 2–11
[17] Industry is a Synonym of the Future, http://minpromtorg.gov.ru/press-centre/all/#!denis_manturov_vernut_sebe_rynok
[18] Strategy of Scientific and Technological Development of the Russian Federation, http://ivo.garant.ru/#/document/71551998/paragraph/6:1
[19] Idrisov G I, Kuzmina A S, Rozhkova E S and Sultanov D K 2017 *New Technological Revolution: Challenges and Opportunities for Russia: Expert-Analyt. Report (*Moscow) 136
[20] Portal of State Programs of the Russian Federation, https://programs.gov.ru/Portal/
[21] Development of the Industry and Increase of its Competitiveness, http://pravo.garant.ru/SESSION/PILOT/main.htm
[22] National Technology Initiative, http://www.nti2035.ru/nti/

[23] Lobatyuk V V, Nikiforova N V and Byl'eva D S 2017 *Scientific and Technical Statements S-PSTU.* V. 8, No. 1, *Humanities and Social Science* **8** (1) 72–89
[24] National Technology Initiative of Russia or 'Awaiting Hitech Tooth Fairy!', http://blog.disruptive.vc/2017/01/02/национальная-технологическая-инициа/
[25] Russian Technology Platforms: Review, http://economy.gov.ru/wps/wcm/connect/85bc0df1-b174-4e1b-8d4a-a803a158c80b/20181101.pdf?MOD=AJPERES&CACHEID=85bc0df1-b174-4e1b-8d4a-a803a158c80b
[26] Russian Technology Platforms (RTP), Transition from RTP to the Eurasian Technological Platforms: Analyt. Reference, http://www.eurasiancommission.org/ru/act/prom_i_agroprom/dep_prom/SiteAssets/Russian%20technological%20platforms.pdf
[27] Digital Economy of Russia — 2024, https://data-economy.ru/2024
[28] Babkin, A V, Kudryavtseva T J and Utkina S A 2013 *World Applied Sciences Journal* **28** (10) 1408–13
[29] Pshenichnikov V V and Babkin A V 2017 *Quality Management, Transport and Information Security, Information Technologies, IT and QM and IS* 267–73