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Emerging Trends and Opportunities for Industry 4.0 Development in Russia

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Abstract:

The fourth industrial revolution is the blending of technologies of the physical, digital and biological world, which creates new opportunities and affects political, social and economic systems.

The fourth industrial revolution fundamentally transforms modern production, thanks to new technological achievements, including digitalization and robotization, artificial intelligence and the Internet of things (IoT), new materials and biotechnology. Due to these changes, production in developed countries again becomes the main source of prosperity and creation of new jobs.

In this paper, the authors aimed at providing a better understanding for Industry 4.0 concept and its application benefits for Russia. The main problem is how the Russian Federation acts against the economically developed countries, which are the creators of Industry 4.0. This paper mainly focuses on presenting the authors views on how to sustain and increase competitive advantage of the Russian Federation by catching and implementing Industry 4.0. With Industry 4.0, Russian Federation get a bigger share of the world manufacturing value chain.

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Keywords: *Industry 4.0, Manufacturing, Industrialization, Digital Economy*
JEL code: *G21, G29.*

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1. Introduction

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2. Literature Review

By rapid implementation of information and communication technologies in manufacturing, the industrial processes becomes smart and enables mass customization. Many researches today are devoted to the investigation of the technologies and processes concerned with Industry 4.0 and its impact on economic development.

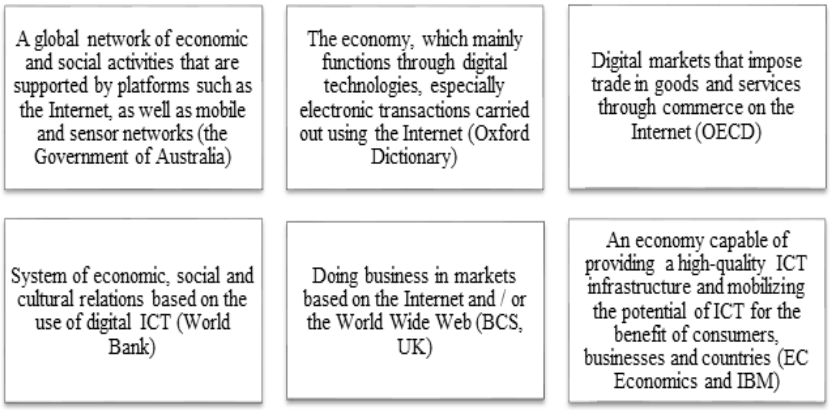
Industry 4.0 supposes the use of network approach that is based on the ability of creating smart products and components (Kohlberg and Zühlke, 2015). According to the authors (Kohlberg and Zühlke, 2015) Industry 4.0 enables new implementation areas through the potential of Industry 4.0 technologies such as powerful, flexible and affordable Cyber Physical Systems applications or extended applicability of Lean Production with various production types.

Bughin and Manyika (2015) assumed that the crucial impact factor in competition is related with the Internet of Things (IoT) which means that senior managers and company's members must act at the system level in order to be able to solve the challenges coming from the technological disruption. Industry 4.0 technologies' application has proved their effectiveness in terms of increasing European firm's competitive advantage not only in manufacturing sectors, but also in service fields such as retail, healthcare, travel and financial services (Piercy and Rich, 2009). Further, we should consider the main approaches to the identification of milestones in the development of industrial systems.

3. Analysis of different views on the concept of "digital economy"

The term "digital economy" was introduced by Tapscott (1996). In 2009, co-authored with Williams he introduced the term "Wikinomics", implying a massive collaboration under it, which is based on such competitive principles as openness, sharing and actions at the global level (Tapscott and Williams, 2009). The system of views on the concept of "digital economy" is presented in Figure 1 below.

Figure 1. *System of views on the concept of "digital economy*"



In fact, in the modern concept of "digital economy" it is a matter of changing the technological base of the economy, which will automate routine operations. Ivanov and Malinetsky believe that it is worth talking about the digital economy, referring to the computer economy (Ivanov and Malinetsky, 2017).

The Government of the Russian Federation has developed and in July 2017 approved a program for the development of the digital economy until 2024, which defines five basic areas: regulation, personnel and education, the formation of research competencies and technical facilities, information infrastructure and information security. This is not about a separate autonomous project, but about creating a fundamentally new way of life, a new basis for the development of the system of public administration, economy, business, the social sphere, the whole society. Obviously, these tasks can not be solved from above, it is necessary to interact with all participants in this process. In accordance with the program "Digital Economy of the Russian Federation", the digital economy is "economic activity, the key factor in the production of which is data in digital form, and contributes to the formation of an information space, taking into account the needs of citizens and society in obtaining quality and reliable information, the development of information infrastructure Russia, the creation and application of Russian ICT, as well as the formation of a new technological basis for social and economic spheres (State program "Digital Economy in the Russian Federation", 2017).

The digital model will increase the competitiveness of the Russian economy in global markets, provide the conditions for a gradual transition to the level of the innovation economy and knowledge economy, and improve the quality and standard of living of the population (for example, by reducing harmful emissions and improving the environmental performance of industrial production).

The digital economy has great potential to promote economic development. The Internet "explodes" the established markets for goods, services and labor, as well as the principles of the functioning of the public sector. Russia needs to take advantage of the current scientific and technological situation in the world economy in order to ensure globally competitive positions in the market (Babkin, 2017). Thus, the problem of managing the development of industrial companies in the context of reindustrialization and digitalization comes to the fore and becomes archival. According to Kurdyumov (2018) under the term “digital transformation” the authors understand:

- a change of the model of economic management from program-target to program-prognostic;
- a change in the economic structure, the change in traditional markets, social relations, public administration associated with the penetration of digital technologies into them;
- a fundamental change in the main source of value added and the structure of the economy through the formation of more efficient economic processes provided by digital infrastructures;
- a transition of the function of the leading mechanism of economic development to institutions based on digital models and processes.

The notion of "digitalization" is closely related to the concept of digital economy. In the broad sense, the process of "digitalization" is usually understood as a socio-economic transformation initiated by the massive introduction and assimilation of digital technologies, i.e. technologies of creation, processing, exchange and transfer of information.

Digitalization is also understood as the introduction of technologies needed to create new business models, processes, systems and software that will increase profits, increase competitiveness and business efficiency. Digitalization is the use of the possibilities of online and innovative digital technologies by all participants in the economic system from individuals to large companies and states.

Digitalization is the most complete disclosure of the potential of digital technologies through their use in all aspects of business - processes, products and services, approaches to decision-making. It is important to emphasize that in order for the digitalization process to be complete, clearly defined business tasks and data.

4. Current problems of digitalization in Russia. The knowledge economy building

The movement along the way of managing the development of industrial companies requires the joint efforts of all participants. It is necessary to overcome a significant number of barriers. Only in this way the industrial complexes and the national economy of Russia as a whole will be able to move to a new stage in the development of the digital economy, to ensure the competitiveness of products of national production, both on the domestic and global markets. Thus, the development environment under digital transformation changes its state to the "digital environment for the development of industrial companies" due to infrastructure and institutional changes.

Under the digital environment, the authors propose to understand a set of interrelated subjects of the production process and a digital infrastructure characterized by the use of information technology, high innovative activity and receptivity, operating in a favorable climate, which allows implementing scientific, technological, innovative and digital potential through proactive behavior. The digital environment for development is the most important prerequisite for scientific, technical and humanitarian progress.

The development of ICT infrastructure was noted by the Government of Russia as one of the priority directions in the construction of the digital economy. Access to high-quality ICT infrastructure positively affects GDP growth and the possibility of developing digital services. Providing broadband Internet access for small settlements, medical and educational institutions, the creation of domestic digital platforms, the deployment of 5G networks is an incomplete list of tasks planned by the Digital Economy of the Russian Federation program.

Thus, the knowledge economy is the goal of the development of the digital economy in Russia. The urgency of the formation of the knowledge economy is confirmed by the state and business. The knowledge economy is an economy in which knowledge is a market product. It is characterized by a high share of services, a high share of investment in innovation, developed information and communication sphere, building partnerships, cooperation of various companies.

The economy of knowledge becomes a factor of innovative development, without which it is impossible to imagine modern society. The key characteristics of the knowledge economy are shown in Figure 2. The index of the economy's digitization is calculated as the weighted average of three subindexes: infrastructure development, online costs, user activity and it is shown in Figure 3.

Figure 2. *Key characteristics of the knowledge economy (Adapted from: Russia 2025: from talent to cadres, 2017)*

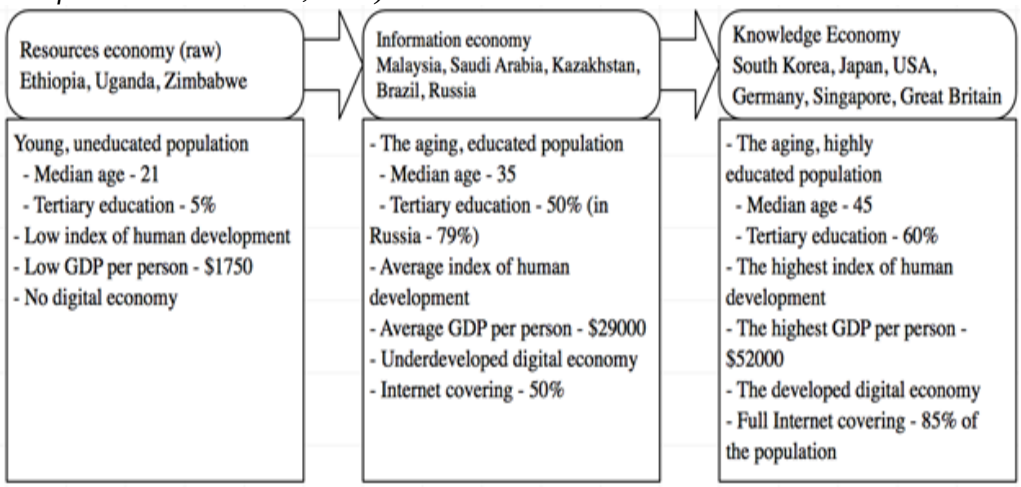
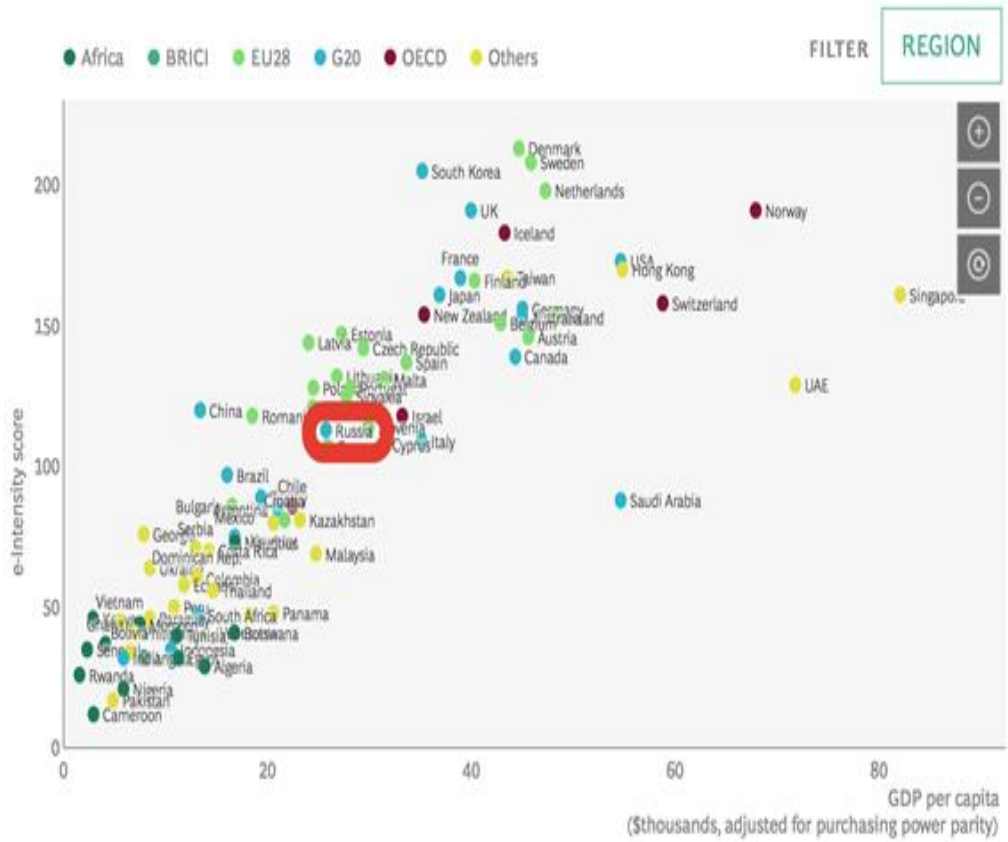


Figure 3. *The index of the development of the digital economy of the countries of the world in 2015 (Boston Consulting Group, 2018)*



The subindex "Infrastructure Development" reflects the degree of infrastructure development and the availability and quality of Internet access (fixed and mobile). The subindex "Online costs" includes the costs of online retail and online advertising. The subindex "User activity" is calculated as a weighted average of subindexes of a lower level: the activity of companies, the activity of consumers and the activity of state institutions. All subindexes are formed from the weighted averages of several parameters underlying them.

Figure 3 shows that Russia's position in the rating of BCG for the past five years has not actually changed, and the country ranks 39th out of 85 in the development of the digital economy. In 2011, it was on the 43rd place, in 2012 - on the 39th, in 2013 - on the 40th line. At the same time, the RF index (e-Intensity) grew at an average annual rate of 24% and in 2015 was 113. The leader of the rating Denmark is characterized by the value of the index of 213. The top 3 also includes Luxembourg and Sweden (212 and 208 respectively). Singapore ranks first in digital competition. However, China's indicators are growing very fast, on average by 33% per year - and by 2025 it can take the first place in the ranking (*URL: https://www.rbc.ru/economics/10/06/2016/5759aed19a79470d3392e05d*).

The advantages that developing countries have so far demonstrated: high growth rates, cheap labor, are no longer a systemic factor that provides economic growth. Russia will need the industrial policy that will promote inclusive and smart economic growth.

5. Lessons from de-industrialization and re-industrialization

The modern condition of the Russian industry provided there was a drop of production volumes in 2015 and a slight growth in 2016 and 2017 with the cumulative deficit of fixed capital expenditures is characterized by a set of attributes (Sukharev, 2014):

– high level of de-industrialization and technological lagging of Russian productions;

– fragmentation of the industrial system: sectoral (branch) breaks, including vertical and horizontal links;

– localization (spatial) of productions by regions with the emerging effect of monopolization and spatial segmentation of industrial markets;

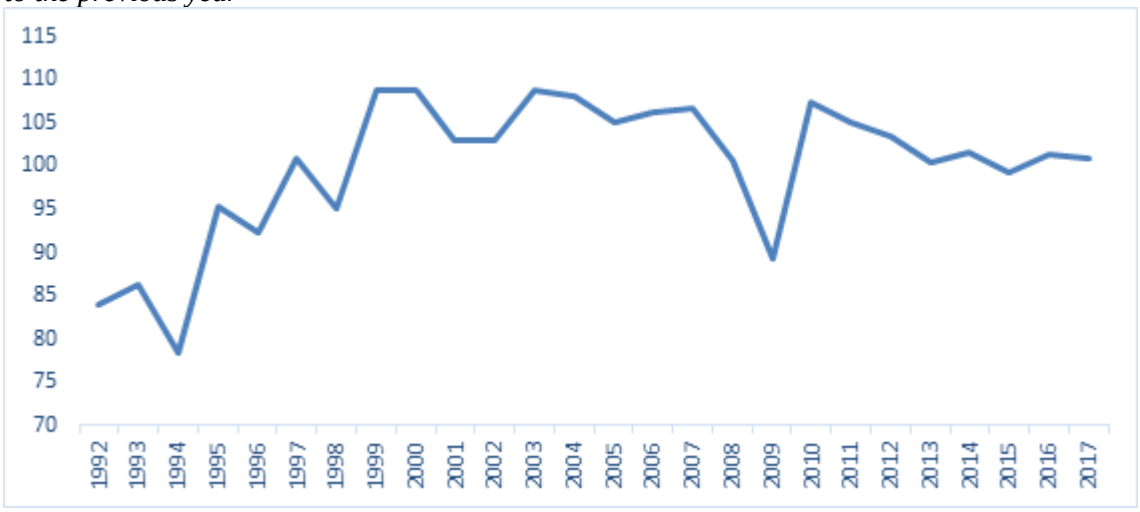
– the effect of scouring for orders, technical solutions, sometimes personnel, as information systems of management fail to find necessary solutions and auxiliary processes (therefore sometimes import is inevitable);

– problems with product competitiveness due to a low technological level of production;

– underdeveloped institutions of industrial development promotion, lack of favorable development environment and organizational forms.

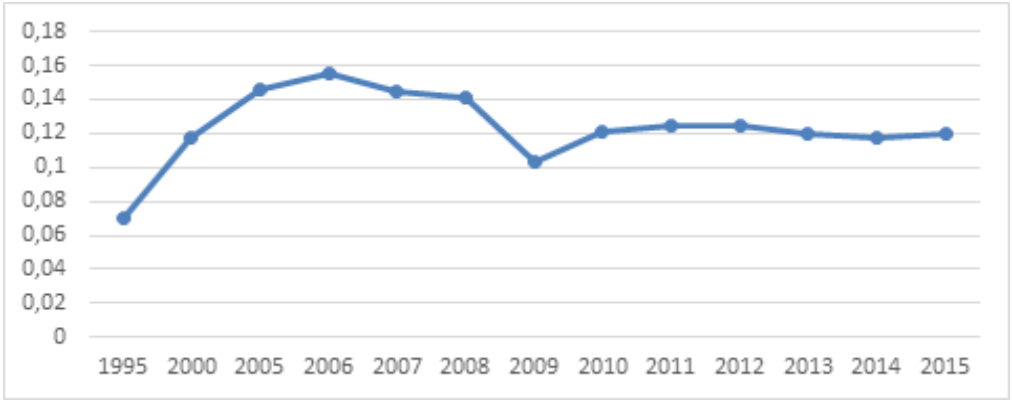
The index of industrial production (Figure 4) shows a drop in the dynamics in 2010-2014, a negative value of the rate in 2015 and a weak growth in 2016-2017.

Figure 4. *The index of industrial production from 1992 till 2017, in % with respect to the previous year*



The general dynamics for the last 7 years may be evaluated as descending (from 107,3 % in 2010 to 101 % in 2017). The yield on capital investments for the last 5 years decreased from 0,125 in 2011 to 0,117 in 2014, in 2015 there was a slight increase to 0,12 (Figure 5).

Figure 5. The yield on capital investments in the industrial production from 1995 till 2015



These alerting figures are the evidence of the necessity to change approaches in the industrial policy.

Let us highlight the main problem to be resolved by the present study. To be

considered the main, a problem should be of system nature for all industrial systems and have such a difficulty that it would be impossible to solve it within the existing managerial models.

We believe that this sort of problems includes deep de-industrialization of the Russia industrial system, which has led to systemic negative socioeconomic consequences. The external factors of the socioeconomic stagnation (sanction in particular) in this case served only as a catalyst of problem aggravation. In this situation the negative effect of de-industrialization is not reduced only to absolute and relative (industrial share in GDP) reduction of industrial production volumes. According to Sukharev (2014), at de-industrialization the share of industrial production doesn't just reduce, it becomes more primitive; the technological level drops down, the production infrastructure collapses/curtails.

De-industrialization is a process of socioeconomic changes caused by decreased or absolutely ceased industrial activities in a region or a country, especially in heavy industry and industrial production (The program of economic re-industrialization of Novosibirsk region).

To describe the above-mentioned negative consequences there was defined the "two Ds effect" (de-industrialization and de-qualification), which has been later transformed into the "three Ds effect" (de-industrialization, de-qualification, dysfunction of management), as well as into the "four Ds effect" (from some analogy with the "four Is effect" (Bodrunov, 2016):

– *disorganization* of production (decreasing organization and management of production);
– *degradation* of technologies applied (falling technological level of production);
– *de-qualification* of labor in production (includes not just a loss of skills and competences, but also simplification of the labor content, destruction of labor motivation etc.);
– *de-complication* (simplification) of products.
–

To our point of view this effect can be supplemented with such components as:

– *disintegration* of production, education and science;
– *deficiency* of investments and sanctions in the economy;
– *de-structuring* of sectors.

At the present time the Russian economy is at the crossroads; to develop following the innovation path and to try and keep pace with the developing economies, or to lose the ability to compete with highly-developed countries forever. Thus, lagging is the main threat for Russia. It is crucial to reverse such situation and to ensure the

development dynamics. The experience of post-soviet development shows that the main problem lies not in ideas, but in their implementation. For the last quarter of the century the country has undergone a series of innovatory and bold initiatives (from creation of Special economic zones to RAS transformation), which, according to the authors' concept, are intended to provide the transition to the innovation path of development, as well as the economic development and life-quality improvement.

However, in practice, such solutions have not always led to the predicted effects. According to some scholars (Ivanov and Malinetsky, 2017), such situation is to a great extent caused by application of the approach known as "innovation without science", as the bulk of such decisions have been made on the basis of common views without sufficient expert examination.

Ivanov and Malinetsky (2017) notice in arguments on development ways the dividing line in the following question: "Human for economy or economy for human?" If "human is for economy", than the greatest achievements are the growth of high-tech export, the number of employees in non-resource-based sectors of industry, the growth labor productivity etc. If "economy is for human", than it is natural to evaluate the quality of life in real indicators important for people: health, education quality, social protection, prosperity, food, energy etc. The authors proceed from the requirements to follow the "economy for human" paradigm. It is necessary to speak about the quality of people's lives, because obviously every next phase of economic development or changes of socioeconomic setups increases the role of the person. Therefore, the creation of high living standards is the key factor for the economy to change and to grow; for the best talents to remain in Russia.

Besides the person's role in the innovation economy, the preservation and restoration of the environment are the objectives of the modern world that require close attention and timely and efficient decisions both in the applied context and in the legal field. The commercial or paid approach to nature management seems to be just, and socially responsible and far-sighted industrial companies are ready to invest considerable funds into environmental events. At the present time the legislation provides for several types of compensation of negative impacts on the environment: payment for negative impacts, as well as indemnification for infliction of damage to environmental components, introduction or improvement of new technologies and holding of nature-conserving events. It is obvious that modernization of production, construction and reconstruction of treatment facilities has a great positive effect in comparison with payment of fees, and the state goal is to stimulate these and similar events. Companies holding nature-preserving events have the right to decrease fees, but the mechanism of funds offsetting has not been properly defined by laws, and in practice the balance is achieved through courts.

Stiglitz (1997), famous American economist and Nobel Prize winner, has come up with the theory of "The Great Divide". He convincingly demonstrated that the American economy had been developing for quite some time in favor of 1% of the

richest US citizens, which could lead to a social catastrophe: „The top 1 percent have the best houses, the best educations, the best doctors, and the best lifestyles, but there is one thing that money doesn't seem to have bought: an understanding that their fate is bound up with how the other 99 percent live. Throughout history, this is something that the top 1 percent eventually do learn. Too late" (Stiglitz, 1997). At the present time the separation between countries and inside them is continuing to grow. Although the inequality has been acknowledged as a great threat to the world stability, nowadays the 1% of the richest control 50% of the world wealth against 43% in 2010 (BCG). We believe that programs and strategies of scientific and technological development, re-industrialization of the Russian industry, the program of digital economy, as well as other state programs of modern Russia must be carried out in the interests of 99 % of its population.

6. Opportunities and threats from digitalization of the Russian economy

Intensive development of the society of digital economy inevitably implies solution of problems in the field of knowledge management. Information and knowledge obtained through experience are becoming the priority resources. And such competences as innovation, competence, creativity and cognitive endeavor are becoming competitive advantages in the market. Therefore, the transition from physical to digital economy requires absolutely new approaches not just in industrial sectors and productions, but in formation of the personnel potential for the digital economy: education, personnel training, development and management of innovative human resources, management of talents.

We shall characterize the depth of digital economy penetration in Russia using the statistics. In 2017 over 62% of business were registered online, 92% of patients were registered before the ambulance arrived to the E.R. due to the access to their personal data, 92% of prescriptions were issued in electronic form, the cost of tutors' services dropped by 30%: 80% of students relied on personal educational paths created on the basis of artificial intelligence. As for the financial sector, over 50% of customers do not attend offices and receive services remotely. It is the average figure in the world. Public satisfaction with the quality of state services today has exceeded 86% (Statistical data of the Gaydar Forum).

Business transformation on the basis of digital models will make it possible to reach an absolutely different level of product and services creation and promotion, to provide the optimal quality of services to clients and the efficiency to companies and enterprises (Kupriyanovsky *et al.*, 2017). However, such transformation necessitates substitution of traditional managerial approaches, principles and values to the models with priority goals and economic system's success criteria being not the profit or short-term efficiency, but client focus, innovation, new project realization rate, cooperation with suppliers and partners.

Thus, describing the digital economy Sukharev (2017) uses the term "irrational

optimism". "Irrational optimism" occurs among agents not only from financial markets, but also from markets on high-tech products. They encounter a similar, but more reserved speculative effect. Such effect may provide high pace of the economic growth, however the quality can be disappointing for most agents. In the course of time it will lead to the occurrence of interconnected bubbles (technological, financial and/or mortgage) provoking an economic crisis. New technologies reproduce irrational optimism regarding the granting of resources for their development and dissemination, including the very resource that is allocated by state funding programs.

The drop of efficiency is becoming inherent into the very plot of speculative human reaction (including the state level of administration as well). Standardization and unification in IT, on the one hand, will decrease development rates, and on the other - they will eliminate the impact of the speculative element in these sectors demonstrating a growing output. Probably, in this case the output growing effect may be ceased or reduced.

7. Conclusion

In this paper, the authors aimed at providing a better understanding for Industry 4.0 concept and its application benefits for Russia. The main problem is how the Russian Federation acts against the economically developed countries, which are the creators of Industry 4.0. This paper mainly focuses on presenting the authors views on how to sustain and increase competitive advantage of the Russian Federation by catching and implementing Industry 4.0. With Industry 4.0, Russian Federation get a bigger share of the world manufacturing value chain.

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