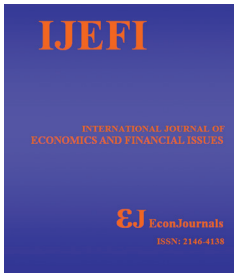

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Transformation of Innovation Infrastructure in the Conditions of Organizational Changes in Russia

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ABSTRACT

The article deals with topical issues of formation of an innovative infrastructure as a priority direction of the state policy in order to achieve a global level in creating competitive engineering production, agricultural technology, development of architecture, science, engineering, economics, improving welfare and culture through the operational development and enhancement of scientific, technical and intellectual potential in the country. Today the focus is on the innovation economy, which is understood as "the economy of society based on knowledge, innovation, benevolent perception of new ideas, machines, systems and technologies, readiness of their implementation in the various areas of human activity. It highlights the special role of knowledge and innovation, especially scientific knowledge."

Keywords: Innovation Infrastructure, Human Capital, Global Innovation Index, Innovation Metrics
JEL Classifications: E22, F01, G10

1. INTRODUCTION

It is not enough to set specific goals and plan to achieve them in order to succeed in the modern world. On the way to achieving the goals of the national economy, the state usually faces a lot of problems to be solved promptly, with the fastest speed, high efficiency and minimum cost. Innovation strategy of the state is often made in the form of scientific, innovative doctrine or strategy containing descriptions of innovative projections, priorities of national innovation policies, scenarios of development of innovation activity and ways of state support and concentration of resources that provide the most rapid development of productive capacities and competitiveness of the country.

In the present study, the goal was to scientifically substantiate the theoretical and methodological approaches to the use of indicators, or as they are called, the innovation metrics that allow to analyze the capacity of the state and organizations for innovative solutions and will serve as a measure of the success of the economy in this area (Giley and Foteyev, 2011). The relevance of the topic of the paper is determined by the fact that the scenario of the national economy requires urgent innovative solutions in terms of organizational changes. It is necessary for modernization and technological development of Russian industry in the transition to import substitution strategy by increasing investment in "human capital," as in the modern economy the innovation activity on the preparation of new means

of production leads to an increase of the effectiveness of labor costs on this basis (Gnezdova, 2015).

2. METHODOLOGY

The study used a review and systematization of the existing domestic and foreign examples, analysis of organizational models and their value in the innovation component of the companies and the economy as a whole.

Individual facts were analyzed, grouped and systematized.

To formalize and summarize the results of the study, theoretical methods were applied: Logic, abstraction, deductive, formalization and general logical.

The methodological basis of the study was a systematic approach, causal analysis, logical-mathematical modeling and theory of innovation. The theoretical basis amounted to works of the leading Russian and foreign researchers and experts in the field of management and economics.

As a result of the systematization and analysis of the materials, it was revealed that the crisis of 2014 revealed the inconsistency of the existing model of the Russian economy, which is focused primarily only on export of natural resources, so that fluctuations in the global energy market have caused the fall of the ruble and fever in domestic markets. The basic argument in support of the implementation and evaluation of innovative solutions in conditions of organizational changes is the practice of successful enterprises, indicating that the reduction of costs is always an inevitable consequence of innovative solutions by concentrating intellectual and organizational effort on the expectations of buyers and quality of the created product (Pogodina et al., 2015). The existing conditions under the influence of foreign economic sanctions and the transition to the active import substitution will stimulate the development of science-intensive and high-tech industries in the consumer sector, the modernization of industry, thereby ensuring a transition from raw material orientation of the Russian economy to the innovative way of development.

The study of literature has given the opportunity to learn the most studied and to identify problem areas in the field of application of the economic and mathematical modeling to optimize the adoption of innovative solutions to improve the efficiency of activities of both a separate organization and the economy as a whole.

3. RESULTS

3.1. Historical Aspect of Development of Innovative Infrastructure as a System of Technological Development of the Country and Investment in "Human Capital"

In the XX century, and especially after 1950, the majority of the capitalist countries and the Soviet Union, relying on scientific and technological progress, began to create their own innovative systems that met specifics of these countries by performance. As a result, innovative systems of two types emerged, one of which is "market" (in capitalist countries) and the other is "administrative." Of course, this division is conditional, since the first system also does not preclude the use of administrative resources, and the other does not deny the need for material incentives and various economic approaches, including market. According to some researchers, the market model of the innovation system in the post-war scientific and technological revolution has been more effective than the administrative, because based on it, the leading capitalist countries have been able to master achievements of modern revolution in science and technology and created a new, post-industrial technological way (Science, Technology and Innovation in Europe, 2008). The administrative innovation system, which provided the known successes of the Soviet Union, mainly in the military-industrial sector, in general failed to solve this problem, and technological basis of the Soviet society developed at a lower level. Scientific advances in the field of information and other new technologies were poorly assimilated into the industry. The existing system has blocked the attempts to make enterprises more responsive to the technological innovations.

However, it is an accepted fact that one-third of the world's inventions and discoveries were made in the Soviet Union, which accounted for <5% of the world population. The economy of the time, according to not only Leontiev and Samuelson, in spite of the ongoing blockade of external forces, was developed with the highest and the most stable rates in the world, and was recovered in 5 years in the postwar period. In 1917, Russia's gross domestic product (GDP) was 3% of the world GDP, in 1990 it was 15%, and today it is about 2% of the world GDP (Gurieva, 2003).

While the leading countries have moved to a post-industrial order, our country has remained at an industrial level. Obviously, the difference between these models is mainly not only in their social and economic infrastructure, but also in the innovation culture (different economic genotype), because the very process chain of the innovation process from science through production to the consumer in general is the same in the systems of both types (Lundvall, 1992).

The infrastructure of the Soviet Union in terms of technology was lagging behind the European countries and the United States, but it has developed rapidly in terms of human capital formation. The results of this hard-line policy of the state are reflected in productivity indicators (Nikolaeva, 2012). The rate of growth of labor productivity of industrial workers in the USSR exceeded the growth rate in the United States, England and France.

Practice shows that mechanisms of analysis, monitoring and evaluation of the capacity to ensure the country's development were present in the organization and management of scientific, educational and technical activities in the Soviet Union. The higher education system has always had a link with sectoral science, a set of certain subjects was specifically selected for each discipline, the study of which, combined with educational and industrial practice, ensures the acquisition of modern scientific knowledge and mastery of the methods of scientific and practical work (Etzkowitz, 2011).

However, the new market organizational structure of scientific and educational activity in modern Russia did not provide the formation of a system conducive to economic growth. Russia is still poorly receptive to innovation due to a continuing negative trend to reduce the number of research organizations that clearly manifested itself in 2012, which became part of the overall long-term downward trend in the number of personnel engaged in science and research, formed in the period from 2000 to 2012. Referring to the Strategy 2020, the transition of the economy to the innovative way of development should, on the contrary, require to strengthen human resources that form innovation in the economy, but in practice these plans so far failed for various reasons. According to Table 1, reduction in the cost of research and development (R&D) is significant.

In the period of market economic reforms, R&D spending in real terms has been significantly reduced - about three times. To a large extent, this was due to the general economic downturn, as the ratio of these expenditures to GDP only halved. Cost reduction has occurred mainly in 1990-1992, i.e. at the time of the most acute crisis and the most radical changes in the economic and fiscal system of Russia. World experience shows that spending on science in the countries is on average 2.7% of GDP (refers to the advanced countries of the West). In Soviet times, the funding of science was about 3-3.5% of the GDP of the Soviet Union, which naturally exceeded the current GDP of Russia. After the Soviet Union collapse in 1991, total spending on science and scientific services fell to 0.5% of GDP per year (1993), and then to 0.3% (in 1996, the same level as Africa), accompanied with a sharp decrease in GDP. In 1992-1996, the costs of basic research in the Russian Academy of Sciences have fallen 10 times (Nikolaeva, 2012). For the period 2000-2014, the backwardness of the material and technical base of scientific research institutes and universities in the field of analytical, laboratory and computer support became apparent, which does not allow Russian scientists to work in a competitive marketplace.

3.2. Investment in Human Capital as an Indicator of a Strong Innovation Infrastructure for Maintaining a High Level of Development of the Country

For effective development of innovative activities and cooperation of the business community with the scientific and educational institutions, business entities must have the economic tools through which they can reach an agreement to satisfy the demand for specialists and innovative products. Human capital is one of the components of the net accumulation of real capital and national wealth of the country. In the context of the newly recorded slowdown in the global R&D, "human factor in the innovation process" was chosen as this year's topic of "global innovation index (GII)," which is published by the Cornell University School of Business INSEAD and the World Intellectual Property Organization. The study examined the role of human capital in the innovation process and underlined the growing interest of companies and governments to identify and encourage activity of creative individuals and groups (The Global Competitiveness Index, 2014-2015).

In order to facilitate the process of discussing issues related to innovation at the international level, the development of economic policies and identification of the best practices, the indicators are required that are able to assess the level of innovation development and the effectiveness of policy in this area. The GII allows you to permanently evaluate factors influencing the innovation; in particular it has the following characteristics:

- Undertakes reviews of 143 countries, country's rankings, their strengths and weaknesses calculated on the basis of 81 indicators.
- Includes 81 tables with data obtained from more than 30 international public and private sources, including 56 tables based on reliable data, 20 tables based on integrated indicators, and 5 tables based on the results of the poll.
- Is based on a transparent and reproducible methods of calculation with the 90% confidence interval for the rankings on each index (GII, sub-indices of costs and benefits), as well as analysis of the factors influencing the annual changes in the rankings.

The GII ranking in 2014 was calculated as the average of the two sub-indices. The sub-index of innovation costs allows to evaluate the elements of the national economy in which the area of innovation activities is embodied, divided into five main groups:

1. Institutions
2. Human capital and research
3. Infrastructure
4. Level of the market development
5. Level of business development.

The sub-index of innovative results reflects the actual results of such activity, broken down to two main groups:

1. Results in the field of knowledge and technology
2. Results in the art.

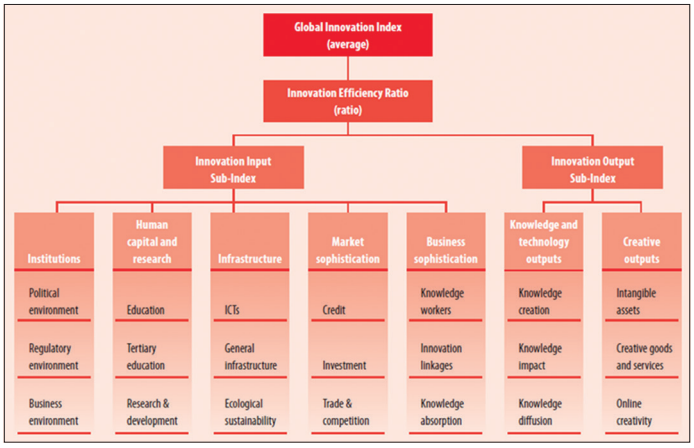
The GII is an indicator of activity in the field of innovation in the countries on the basis of indicators presented in Figure 1.

Table 1: Domestic expenditure on R&D in the Russian economy

Indicator, years	1990	1995	1996	1999	2000	2008	2013
In % to GDP	2.03	0.79	0.90	1.06	1.05	1.04	1.16

GDP: Gross domestic product, R&D: Research and development

Figure 1: Global innovation index 2015 conceptual framework



In particular, the top 25 countries by GII consistently have high rankings by most indicators and also hold strong positions in areas such as innovation infrastructure (including information and communication technology), level of business development (such indicators as knowledge workers, relationship between innovation and the development of knowledge) and the results of innovative activities (such indicators as the goods and services of the creative nature and online art). Russia traditionally has considerable scientific and technical potential, both human and material. Rapid scientific and technological progress is crucial for the sustainable development of Russia (The Global Competitiveness Index, 2014-2015).

This year Russia ranked 49th in the general rankings, between Thailand (48) and Greece (50), moving 13 positions up. According to the report, the strengths of Russia related to the quality of human capital (30th place), business development (43th), development of knowledge and technology (34th). Indicators of infrastructure development remain at an average level (51th place). Innovation is hindered by deficient institutions (88th place), low results of creative activity (72th) and development of the internal market (111th). Among the BRICS, Russia ranks second after China (29th place, while China's ranking is now comparable with the ranking of many countries with high income), ahead of South Africa (57th), Brazil (61th) and India (76th). Among former Soviet countries surveyed, Russia ranks fifth after Estonia (24th), Latvia (34th), Lithuania (39th) and Moldova (43th).

GII 2014 confirms the continuation of global innovation gap between Russia and the leading countries of the world. Rankings of the top 10 and 25 countries have changed, but the lists of countries remain unchanged. The gap that is difficult to bridge remains, which is associated with the fact that it is difficult for countries with less innovative economies to keep up with the pace of progress in the countries with a high ranking, even despite the fact that they have achieved notable success. This can be partly explained by the fact that it is difficult for them to achieve economic growth and preserve human resources needed for sustainable innovation.

The human factor in innovation is one of the reasons why the leaders in innovation remain at the top of the rankings, and for which some of the major emerging market countries have different indicators of innovation. Thus, according to the World Bank, in the national wealth of the United States, the main production assets (buildings and premises, machinery and equipment) account for 19%, natural resources - 5%, human capital - 76%. In Western Europe, the corresponding figures are 23%, 3% and 74%; in Russia they are 10%, 40% and 50%. The priority of Russia is production (export in the future) of knowledge, new technologies and innovation. That is why improving the methodology of human capital management in the interests of innovative development is of particular importance for Russia (Shpak, 2014).

By the indicator of innovation quality, displayed by indicators of achievement of higher education, coverage of academic publications and the international dimension of patent applications, the top spot in the group of countries with high income is taken by the United States of America, followed by Japan, Germany and Switzerland. The leading countries in the group of middle-income countries close the gap on the indicator of innovation quality, and the leading country among them is China, followed by Brazil and India (Brou and Ruta, 2011).

In regard to education as a subcategory of human capital formation, the leaders in the group of countries with high income are the Republic of Korea, Finland and the United Kingdom of Great Britain. The top lines in the group of middle-income countries are taken by China, Argentina and Hungary. All of these countries have made notable efforts to maintain or improve the quality of their human resources through education and training of people throughout their lives (Braun, 2008).

GII shows that better-educated citizens are more successful in countries with a high income, using favorable conditions for the promotion of innovation to their advantage. As the countries are moving towards increasingly complex innovation ecosystems, the value of the quality of their personnel in the fields of science and engineering grows, as well as, for example, in business and management.

Global R&D spending: A strong recovery after the crisis, but then a slowdown.

Falling growth rates of state support for R&D combined with fluctuating rates of increase in spending on R&D firms, especially in countries with high income. The process of fiscal consolidation in many countries with developed economies also appears to negatively affect public expenditure on education since 2010.

Second, despite the fact that in 2009 the governments actually included in the package of measures to stimulate the economy a significant number of projects for future growth under the influence of innovations, the support these efforts seem to be waning in some countries. Certainly, the majority of countries for which data are available continued to increase R&D spending in 2013 and 2014. However, the high growth of R&D expenditure in 2013 and 2014 is expected to take place mainly in Asia, particularly in China, Korea and India.

3.3. Formation of Innovation Metrics for the Analysis of Innovation Infrastructure in Russia in the Conditions of Organizational Changes

Innovation infrastructure development involves the organization of innovation activity based on a refined level of organization of economic activity on the basis of improved knowledge and information that form innovative potential. The issue of evaluating the performance of companies within the innovation infrastructure of the country is relevant. The algorithm for generating the metrics of evaluating innovation of organizations to assess the innovation infrastructure shown in Figure 2 was developed by compiling the global models of the formation of innovation infrastructure adapted to Russian specifics.

Formation of innovation metrics should help to analyze the ability of domestic companies to innovative solutions and serve as a measure of success of the country as a whole in this field in the presence of the quality "human resource." There are a number

of the following arguments in favor of why it should be used (Yakhimovich, 2010).

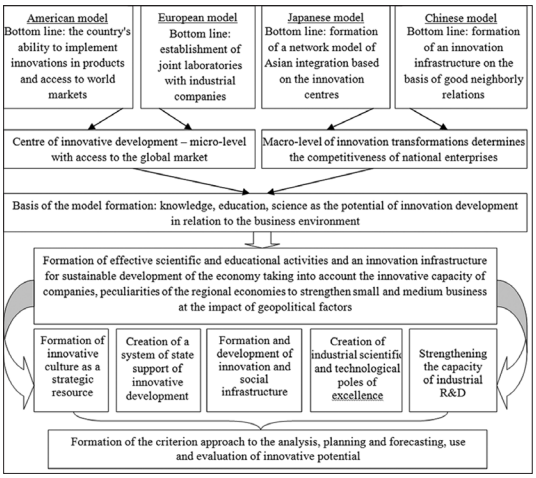
1. The system of indicators creates a formal framework (objective numerical data) for taking managerial decisions.
2. Innovation indicators express the strategic interests of the company, allowing to "build" innovation in business processes and to improve relations between those who generate new ideas and the management team.
3. The indicators help to reasonably allocate resources between the corporate system of managing ideas and innovative initiatives. Planned metrics set expectations for the innovation potential of the company, while a comparison of targets with their values in the reporting periods allows to see "narrow" places - the processes the financing of which does not meet the goals.

The optimum sets of metrics and values for each metric may vary depending on the profile of the organization, but basic metrics that are applicable to any company can be highlighted (Table 2).

4. DISCUSSION

The present study shows that the importance of the innovation component in the activity of the company is growing and will inevitably grow.

Figure 2: Algorithm for generating the metrics of evaluating innovation of organizations to assess the innovation infrastructure



Papers of Romer, Lucas and Howitt show the construction of models of economic growth that provide for the endogenous (internal) account of technical and technological changes. They convincingly demonstrate the importance of the human factor for economic growth. A model of economic growth by Romer had significant influence on the development of the theory of the scientific and technological progress at interaction of sectors of the economy, including the economy of knowledge. One of the conclusions of models of Romer and Lucas was that the economy with the resources of human capital and developed science has in the long run the better chance of growth than the economy deprived of these benefits (Lucas 2002; Romer, 2007). The ban on the export of high-tech products from the United States and the European Union resulted in the blocking of the scenario of the development of the domestic industry on the basis of borrowing foreign technologies, reducing the level of cooperation with foreign manufacturers of innovative products, which should give a boost to ensure the reproduction of the human capital and embody the scientific knowledge into innovation. This is a major factor in shaping the innovative development of the Russian economy. Today's conditions of foreign economic sanctions and the transition to the active import substitution will stimulate the development of science-intensive and high-tech industries in the consumer sector, modernization of industry, thereby ensuring a transition from raw material orientation of the Russian economy to the innovative way of development. The reserves for such types of events in our country are in excess, as the level of capacity utilization of production machinery and components at the moment is only 10-40% depending on the industry.

5. CONCLUSION

The study presented by the authors shows that the innovative paradigm of development sets a strategically important goal for the leadership of many countries, including Russia, - to build an optimal model of cooperation between universities, research institutions and businesses, to develop an algorithm of their integration and partnership.

Conceptually, the study task was to analyze the scenario of the development of the national economy through the implementation of innovative solutions in the conditions of organizational changes at the modernization and technological development of the

Table 2: Basic innovation metrics

Metrics	Description
ROII	ROII can be calculated for both successfully completed projects and projects prepared for implementation
Share of revenue from sales of new products in total income	The indicator characterizing the potential of the company as a whole
Changes in the relative growth of the market value of the company compared to the relative increase in the industrial market	It is advisable to use to compare the results achieved by your company with the values of similar indicators of competitors
Number of innovative ideas implemented by employees, patents, licenses	The indicator characterizing the effectiveness of the corporate system of the ideas management
Time from initiation (filing) a new proposal to the launch of an innovative project	Characterizes the effectiveness of the corporate system of the ideas management
Innovation index is a comprehensive indicator of the overall ability of the organization to innovative activity. The maximum index value equals to 100 units. By setting the initial value, the company used the data collected for the previous period of work, and then the index was calculated on a regular basis to keep track of the current state of innovation competence of the company	

ROII: Return on innovation investment

domestic industry in the transition to import substitution strategy by investing resources in "human capital" (Selivanov et al., 2014).

Romer made a curious remark that ". the graduates of engineering high school a 100 years ago had the same human capital as current, because they studied for about the same period of time and did not have the practical experience. However, the productivity of the modern engineer should be significantly higher, since he or she has access to a much larger store of knowledge. Knowledge is deemed to be a non-competitive production factor that is equally available at the same moment for everyone who can and wants to use it" (Romer, 2007). Negative trends in the domestic economy, especially in recent years: Decline in GDP - for 2014, outflow of capital - $100-120 billion for 2014, reduction in investment in fixed assets - confirm a crisis caused by the mismatch of the existing technological structure and organization of the social and economic requirements and the post-industrial realities, as well as deficiency of quality personnel (Komlev, 2013). The spread of information technology in the world at the beginning of the XXI century is paradoxical, it has a marked tendency to reduction in a narrow handful of technologically advanced countries, meeting much more constraints - not only subjective, but also objective. The main barrier is education and welfare: An uneducated worker will not be able to use the technology, even if they sell it to him or her, and the poor society cannot hold a sufficient number of educated people. This reinforces the objective technological gap between the developed and developing countries, which, perhaps, cannot be overcome today. Therefore, the priorities in the development of the economy should be changed through the use of new mechanisms and the creation of new, more effective ones in terms of innovative development institutions. The most well-known and proven positive development institutions are modern industrial parks, technology transfer centers and special economic zones, which can exist both in a single ecosystem and separately.

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