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Main Strategic Directions of Innovative Development of the Krasnoyarsk Territory (Territorial and Sectoral Aspect)

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The article gives assessment of the level of the innovation and development potential of the Krasnoyarsk Territory. The possible reasons of the region's lagging behind the innovative leaders are considered. SWOT analysis of the strengths and weaknesses of the innovation development was performed with determination of the main possible directions of the future sustainable development. Establishment of an innovation and technology cluster, which can be based at the territory of the closed city of Zheleznogorsk, is considered as a tool to achieve sustainable development.

Keywords: innovative profile, sustainable development, territory, region.

The innovative profile of the Krasnoyarsk Territory formed to the present moment has serious shortcomings. Let us try to identify the main reasons of the region's lagging behind the acknowledged conventional technological (neighbouring Novosibirsk and Tomsk regions) and innovative (Moscow and St. Petersburg) leaders with general positive tendencies towards growth by the key indicators.

The main peculiarity of the human resources potential of the Krasnoyarsk Territory is a relatively low economic activity of the population compared with the innovative regions, which slows down the formation of a proper framework for stimulation and growth of innovations in the region. The current structure of employment is characterized by a low proportion of workers

with higher education understanding innovations, low numbers of human resources involved in science, applied research and development that characterizes the traditional priority of medium- and low-tech industries, which do not require special skills. Working population of the region has the lack of availability of advanced technology. The percent of expenditures on information and communication technologies is very low, and the availability of modern computer hardware, special software, including global networks, has a tendency to decrease. Moreover, in this area, a long-term negative trend is observed, which is associated with a reduced number of students getting higher education, who would be able to form the human resources basis for the innovative development of the region in the future (Gorn, 2012).

Similarly, the structure of the technological potential of the region indicates the commitment and historical specialization in the sectors with the low added value: a satisfactory technological structure of the fixed assets is observed only in the traditional mining and processing industries, construction. Nevertheless, high suitability is ensured not by the rate of renewal of fixed assets, but rather by the prevailing proportion of objects with long life and low level of depreciation (Strategiya sotsial'no-ekonomicheskogo..., 2010).

In general, the technological structure of the region's industries is characterized by a low level of renewal of fixed assets and capital/labour ratio than for the innovative regions. Moreover, the region also has a technologically "failing" industries, which, however, form the basis of its infrastructure. Thus, the transport sector has the lowest ratio of return on assets for the compared regions and the highest proportion of fully depreciated facilities. The positive moment about the technological potential of the Krasnoyarsk Territory is high, (relative to the average value for Russia and compared regions) capital productivity in key sectors of the region, which, however, has no significant effect on the overall unsatisfactory technological intensiveness.

The structure of the scientific potential of the Territory is featured by low prevalence of applied research and technology developments,

as evidenced by low values of the indicators of employment in research and development, staffing with research personnel and innovative activities of organizations.

High personal output of the low-numbered research personnel concentrated in research institutes and universities is not properly demanded in practice and does not give a significant economic breakthrough: the region as a whole has low efficiency of research and development activities (hereinafter R&D), expressed in the absolute value of the research and developments being used, patents obtained, and advanced technologies being introduced. Moreover, the region has a low, even relative to the national average, share of expenditures on R&D in the GRP and the share of implementation of innovative products and services in the structure of the shipped products. This is due to a relatively low investment activity (investments share in the gross regional product (hereinafter GRP) is lower than in the innovative regions) and a relatively low proportion of expenditures on the industrial high-tech investments in the structure of investments spending (Mindeli, 2010).

The carried-out analysis of the components of the innovative profile made it possible to identify the main strengths and weaknesses of the innovation potential of the Krasnoyarsk Territory (Table 1).

Table 1. Strengths and Weaknesses of the Innovation Potential of the Krasnoyarsk Territory

Strengths	Weaknesses
1	2
1. Human Resources Potential	
<ul style="list-style-type: none"> • Stable growth of the population employment. • High level of employment of economically active population. 	<ul style="list-style-type: none"> • Medium level of economic activity of the population and its slowing-down growth. • Unsatisfactory structure of employment by the level of education. • Fall of the amount of the young people getting higher education in the population of the region. • Negative migration flows.

Continuation table 1

2. Technological potential	
<ul style="list-style-type: none"> • Satisfactory rate of fixed assets life, their low level of wear and tear due to the predominance of industries operating on fixed assets with the long-term use (due to the low level of depreciation). • Trend of sustained growth of rates of the fixed capital assets renewal (hereinafter – FCA). • Technological structure of FCA in processing industries (metallurgy) is due to a significant proportion of facilities with long-term use that provides satisfactory performance indicators, the return on assets is above the average for Russia. • Rates of FCA renewal in construction, processing and mining industries is above the average for Russia. • Overall return on assets of FCA in the region exceeds the average return on assets in Russia and the neighbouring regions of the Siberian Federal District. • Higher rates of growth in return on assets over the rates of increase of capital/labour ratio. 	<ul style="list-style-type: none"> • Average rates of renewal of FCA in the whole industry. • Availability of FCA is provided not by renewal and modernization, but due to their technological structure (high percentage of fixed assets with the long-term use). • High extent of wear and the percentage of fully depreciated operating facilities in the transport and communications sectors, with low rates of replacement. • Low indicators of the capital/labour ratio. • Low operating efficiency (outputs) of FCA in the transport and communications sectors, in production and distribution of electricity, gas and water.
3. Research potential	
<ul style="list-style-type: none"> • Sustained growth of innovative activity of organizations in comparison with the average for Russia. • Satisfactory level of applied innovations. • Performance of research staff and the quality of the research (in terms of scientific research results for 1,000 researchers). • Quite steady growth rates of the innovations output (rapid growth of production of innovative products and services over the release of products in the region). 	<ul style="list-style-type: none"> • Reduction of the proportion of research personnel (including those with graduate degrees) in the structure of the employed population. • Reduction of the proportion of the number of enterprises that carry out research and development in their overall number. • Changes in the structure of distribution of trained research personnel (increase of the proportion of scientists not performing research). • Low prevalence (scales) of research and reduction of productivity of the basic science. • Low indicators of the amount of innovative products and services in the scale of regional products and in the structure of innovation production of the state. • Extremely low proportion of expenditures on R&D in the GRP, the tendency towards its decrease. • Poor structure of expenditures on R&D: the tendency to “eating up” the funds, the low proportion of expenditures on equipment as the strategic basis of innovation.
4. Investments potential and information and communication technologies	
<ul style="list-style-type: none"> • The level of using special software for general purposes and software intended for scientific research is higher than the average for Russia. • Relatively high (compared to other regions) proportion of expenditures on information and communication technologies (hereinafter ICTs) in GRP. • Increase of the index of investments actual volume 	<ul style="list-style-type: none"> • Small proportion of expenditures on investments in the GRP. • Low investments indicator per capita. • Lack of the population access to global networks. • Low percentage of personal computers for employees of organizations. • Low level of expenditures on purchase of computers, software, staff training in the structure of expenditures on ICTs

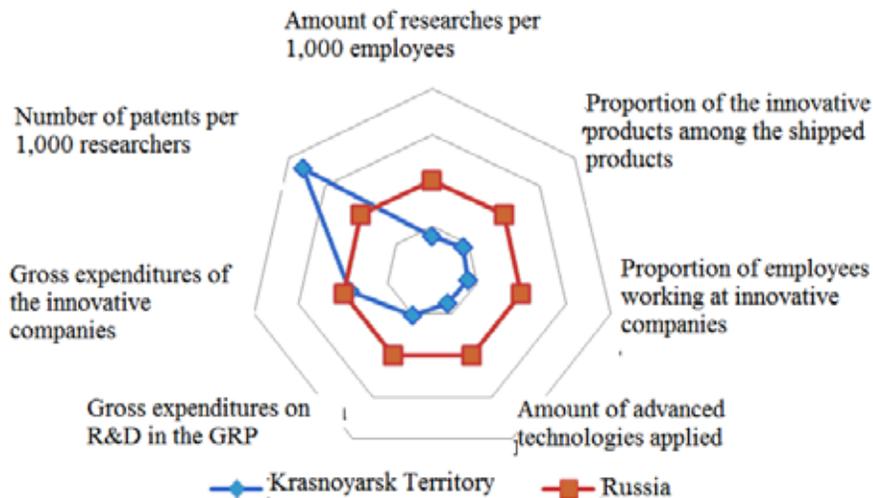


Fig. 1. Place of the Krasnoyarsk Territory in the national innovation performance

Abilities to integrate the innovation potential of the region in the implementation of the strategic vectors of modernization of the Russian economy are presented in Table 2.

Thus, we can identify a number of trends in innovative development of the Krasnoyarsk Territory.

- **Development of the innovation infrastructure, including formation of venture capital funds and other financial institutions to invest in innovative projects.** This is the main priority, while its solution is of particular importance for the achievement of key strategic objectives for the following reasons:

- 1) Bridging the gap in the innovation processes, imbalances of supply and demand at the regional level and the possibility of expanding cooperation (integration) of the participants of the innovation system are determined by the level of development and efficiency of the innovation infrastructure;

- 2) The solution of this problem is to a greater extent within the sphere of authority of the regional government and administration;

- 3) The rate of development of small and medium entrepreneurship in innovation

depends on the development of the innovation infrastructure;

- *Development of creative thinking of the population*, namely, development of rational thinking and creation of quality circles at enterprises; revival of the system of children's and youth scientific and technical creativity, organization of contests, competitions, contests, etc.;

- *Formation and development of innovative high-tech clusters and creation of leading sectors of the regional economy on their basis.* The formation of new high-tech sectors of economy should be considered together with the trend of economic globalization and the inevitable integration of the regional economy into the international division of labour. Experience of the neighbouring regions' development shows that small innovative companies are capable of achieving high growth rates in the shortest possible time to get the niches in the global markets of high-tech products;

- *Strengthening innovation of traditional industries.* Non-ferrous metallurgy can be considered as a "locomotive" capable of revitalizing the regional economy in a short period

Table 2. Main Trends of Innovative Development of the Krasnoyarsk Territory

Strategic development trends	Organizations, events and projects
<p>Obtaining leading positions in the effective production, transportation and use of energy</p>	<ul style="list-style-type: none"> – In order to ensure energy security of Russia, it is planned to build new power generating facilities of federal importance in the Krasnoyarsk Territory: <ul style="list-style-type: none"> ○ completion of construction of the Bogychany hydropower station within the framework of the project “Integrated Development of the Lower Angara Area”; ○ projects of constructing a hydropower stations cascade on the Angara river; ○ new power capacities of coal-fired thermal power plants in the KATEK area. – Large-scale projects of federal importance on hydrocarbons development in the northern areas of the Krasnoyarsk Territory; establishment of Vankorneft OJSC in 2009 to develop oil fields in the Vankor group of fields; investment projects of Gazprom on development of Yurubcheno-Tokhomskoye, Sobinsko- Teterinskoye and other fields. – Development of engineering and transport infrastructure in the framework of the project “Integrated Development of the Lower Angara Area”, Taimyr and Evenkia. – Establishment of industrial park for the development and implementation of energy-saving technologies (Krasnoyarsk Machine-Building Plant, Siberian Federal University, Siberian Aerospace University). – Formation of a regional technology platform “Energy, energy efficiency and energy saving” (Siberian Federal University).
<p>Development of new nuclear technologies</p>	<ul style="list-style-type: none"> – Production centers in Zheleznogorsk and Zelenogorsk. – Improvement of technologies of storage and extraction of valuable components from spent nuclear fuel.
<p>Development of information technologies on the basis of using super computers, global open-access information networks in particular.</p>	<ul style="list-style-type: none"> – Implementation of joint projects of the Institute of Computational Modeling, Institute of Biophysics of SB RAS and Siberian Federal University in the field of geographic information technologies on the basis of SibFU supercomputer. – Formation of a regional technology platform, “Information and Telecommunications, and Space Technology for Innovative Development of Siberia” (Siberian Aerospace University).
<p>Development of ground and space infrastructure to transmit any kinds of information</p>	<ul style="list-style-type: none"> – Manufacture of communication satellites of Information Satellite Systems named after Academician M.F. Reshetnev, OJSC. – Development and implementation of GLONASS system modules (JSC “Academician M.F.Reshetnev “Information Satellite Systems”, Siberian Federal University, Siberian Aerospace University, Radio Engineering Plant, OJSC). – Formation of a regional technology platform, “Information and Telecommunications, and Space Technology for Innovative Development of Siberia” (Siberian Aerospace University).
<p>Development and manufacture of special types of medical equipment, besides up-to- date means of diagnostics and medical products</p>	<ul style="list-style-type: none"> – Production of new drugs within the framework of Kraspharma OJSC modernization. – Research performed by the Institute of Biophysics SB RAS, Siberian Federal University, Krasnoyarsk State Medical University named after Voyno-Yasenetsky.

of time with a synergistic effect of development of new processes, new materials, composites and consumer goods.

Thus, **determination of the strategic objective of the region's innovative development** can be defined as achievement of long-term international competitiveness of the region through development and dissemination of technical, technological and social innovations aimed at improving the level and quality of life.

It is possible to achieve this objective through establishment of an effective regional innovation system, which is defined by the presence of the following components:

the ability to generate knowledge and technologies, including the sale of the scientific, educational and innovation potential;

developed channels and institutions of technology transfer and commercialization integrating the activities of various participants of innovation processes;

high innovative activity of enterprises and organizations in the region;

system support of innovative activities by regional and federal authorities.

Strategic directions of the formation of the effective regional innovation system should include interrelated target settings for all of its subsystems:

1. *The system of scientific and technical education:* development of human potential through continuous educational process that combines both the needs of the individual development and the demands of the labour market to the presence of professional skills.

2. *The system of knowledge generation:* improving the competitiveness of the research and education complex of Siberia and the region, creating the conditions for its reproduction on the basis of integration of research and education activities, use of achievements in fundamental research of the research centers of SB RAS and

SB RAMS to provide a high level of education in the universities of the region corresponding to the world-class science and technology.

3. *The system of technology generation:* support of the sectors of the new economy, in which the potential of knowledge is transformed into commercial products with the high added value, development of small and medium-sized businesses in the innovation sector.

4. *System of technological upgrading of enterprises:* the formation of regional programmes on creation and development of high-performance, environmentally friendly and resource-saving technologies at the enterprises of the region.

5. *Innovative infrastructure:* development of favourable conditions to carry out research and development, technology transfer and commercialization of innovations by increasing the number and diversity of the infrastructure facilities, developing the network of interactions between the participants and expanding international cooperation of innovative companies.

Today the Krasnoyarsk Territory as a whole has a formalized and structured innovative environment. The regional innovation infrastructure, including the centers of equipment joint use and resource centers at universities, a network of innovation and technology centers at industrial enterprises and academic institutions, the regional business incubator, the regional fund of scientific and technological activities support, is developing rapidly (Shendrik). The cluster of nuclear and space technologies at Zheleznogorsk is being actively developed; it received the support of the federal government. To coordinate all those involved in innovation in the region, the Ministry of Investments and Innovations was established in the Krasnoyarsk Territory.

Everything mentioned above, provides the region with real prerequisites for development

of the **innovation and technological enclave/cluster**, in which two starting points may be outlined:

- development of a high-tech subcluster, including military, space engineering, communications and nuclear energy sectors (the centers are the cities of Zheleznogorsk and Zelenogorsk, Krasnoyarsk);

- formation of a subcluster of innovative services based on ICTs. This subcluster is related to services supply as it should cover all areas of the regional economy. It should include a system of scientific and technical education, a system of knowledge generation and a system of modernization. An important role is played here by development of the institute of engineering centers, establishment of a science park and creation of special economic zones. These specific areas may include, for example, the Angara- Yenisei area of high technologies of subsoil use.

The Krasnoyarsk Territory has already got Siberian Federal University, which is a mediator of knowledge and technology between the Russian Academy of Sciences and production companies, being at the same time a key player at the market of practice-oriented personnel with the necessary competencies, the list of which is determined in the process of interaction of the university and potential employers.

SibFU is the object and the subject of innovation development programmes of large financial-industrial groups and enterprises operating in the Krasnoyarsk Territory and influencing the development of the global economy. Thus, it is a clear competitive advantage of the region.

The formation of this cluster in our opinion should have a step-by-step nature of development:

- accumulation of knowledge and innovative developments in various fields;

- the effective introductory stage and appropriate decision at the legislative level, which will qualitatively change the real course of the economy of the Krasnoyarsk Territory.

- orientation of the leading research and education center of the region (SibFU at the maximum involvement in solving the tasks and implementation of projects of national importance;

- integration of research and development, and design and development departments of SibFU and KSC RAS with technology modules of corporations within the framework of the science park;

- practical focus of research performed in the region.

The main project line that determines the development of the cluster in the nearest future will be the creation of the Krasnoyarsk science park at Siberian Federal University. The proposed practice is based on the experience of world leaders: the main prerequisite for the efficient development and operation of science parks is close links with major universities – the Silicon Valley was formed on the basis of Stanford University, Science Park Highway 128 – on the basis of Massachusetts Institute of Technology, the largest science parks in the UK, Germany, France, etc. The transfer of this right (the leading role) to the University provides significant strategic benefits for the region as a whole, primarily due to the system of mandatory elements of the innovative infrastructure already established at SibFU, such as: the center of scientific and technical information, research department, research and education centers, centers of equipment joint use, the center of standardization, metrology and quality management, the center of innovation consulting, the prototyping center and the technology transfer center.

However, the transition to a qualitatively new level requires an infrastructure of

specialized engineering centers, which is being actively developed by the University on its own. In particular, the projects of applied research centers has been developed in such priority areas for the region as: development of remote sensing technologies for determination of mineral deposits and monitoring of their mining using UAV complexes; mining and processing, processing of natural and technogenic mineral resources; information technology; oil refining catalyst technology; radio engineering; metallurgical industry; power engineering; energy efficiency and energy saving; innovative building technologies. These findings may provide the basis for the formation of the future concept and specialization of the project of the science park in Krasnoyarsk.

Creation of the science park at SibFU will give a significant impetus to the development

of these centers and at the same time, will lead to the expansion of integration links within and outside the regional economy, the launch of new lines of production, which fits the logic of the execution of the order of the Russian Federation President, Vladimir Putin, from 2006 on innovative development of the regions through the established system of leading universities (Innovatsionnoe razvitie obrazovaniya..., 2006).

Therefore, the Krasnoyarsk Territory has the potential for development of the innovative technological enclave or cluster. One of the centers of the cluster may be Zheleznogorsk due to the accumulated scientific and technological potential. The individual elements of the innovative structure already developed in Krasnoyarsk (for example, SibFU) may become additional catalysts for the development of the cluster.

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**Основные стратегические направления
инновационного развития
Красноярского края
(пространственно-отраслевой аспект)**

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В статье оценивается инновационный уровень и потенциал развития Красноярского края. Рассмотрены возможные причины отставания региона от инновационных лидеров, проведен SWOT-анализ сильных и слабых сторон инновационного развития, определены возможные основные направления дальнейшего устойчивого развития. Предложено создание инновационно-технологического кластера, который может базироваться на территории ЗАТО город Железногорск как инструмента достижения устойчивого развития.

Ключевые слова: инновационный профиль, устойчивое развитие, территория, регион.
