DOI: 10.15838/esc.2016.4.46.10
UDC 338.242.001.76, LBC 65.012.2, 72.5

Institutional Capacity of Innovation Activity Development in the Region

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Abstract. The article presents the results of the study under the theme of development of institutions of innovation sphere, transfer of scientific results to the real sector of the economy. The purpose of the study is to reveal institutional capacities of strengthening the implementation of research findings, drawing on the functional properties of institutions with regard to innovation activities. The methodology is to apply well-known methodological principles to the solution of emerging challenges (software-based method for fundamental scientific result implementation, sectoral research organizations in the new management environment and statistical records of process innovations by analogy with product innovations). The article puts forward and justifies the proposal for strategic innovation as the institution of communicating the results of fundamental research to social practice by integrating into a single process the results of oriented fundamental research, applied research, engineering development, development and other works, which are realized in the form of a material object or service of a high technology level. The distinguishing feature of strategic innovation is a future-oriented outlook and the solution of long-term objectives. Russian scientific achievements can become the basis for strategic innovation development. The article gives examples of possible research field where strategic innovation can be developed and demonstrates an innovative implementation mechanism in the format of specialized

For citation: Rumyantsev A.A. Institutional capacity of innovation activity development in the region. *Economic and Social Changes: Facts, Trends, Forecast*, 2016, no. 4, pp. 184-198. DOI: 10.15838/esc/2016.4.46.10

research-and-production program which combines government and business participation. The paper gives arguments and development ways of the institution of sectoral research organizations as providers of state technological policy in sectors and regions; coordination of import substitution; centers of communication establishment with engineering companies; analytical and predictive research. The study justifies the expediency of developing an institution for statistical innovation records by introducing the indicator of weight of innovative production technologies which are of particular importance to the measurement and management of innovation processes in extractive industries and regions. We have worked out a proposal for the development of the institution of scientific and technical programming by making an annual operational program implementation plan. The results of the study can be applied to fundamental research results programming and may also be used by federal and regional authorities in the system of measures for the development of national and regional innovation systems. The study can be pursued in line with the proposed institutions in terms of clarifying state financing and the provision of a preference for businesses units within strategic innovation, the introduction of pilot projects on the measurement of process innovation, the development of a short-term scientific and technical program implementation plan.

Key words: institution, strategic innovation, sectoral applied research organization, process innovations, operational plan.

The state of innovation activity in the context of economic challenges cannot be considered satisfactory. According to the statistics, the share of innovative products in the Russian Federation in 2005–2014 ranged between 5–9%.

In the context of the underdeveloped innovation market and the changing external environment (the declining hydrocarbon prices, production imports limitation), the role of the state in the regulation of innovation activity is gaining significance – finding and implementing the ways of overcoming innovation obstacles that hamper its strengthening, including through the development of institutional conditions, i.e. the organizational and managerial rules to streamline and stimulate innovation activity.

The economic literature attaches much importance to the institutions in the economic and social development. Thus "productivity growth" is believed to be "the result of both technological and institutional changes" [7, p. 78]. Amid the technological expansion the same important role is assigned to the institutions, as well as to economic and financial factors [15].

One of the most fundamental purposes of institutions is to reduce uncertainty in human relations, to ensure their certainty which can be achieved through the rules and regulations [7, p. 79]. Uncertainty is an inherent feature of innovation activity. "Uncertainty is the main characteristic of the innovation process... These problems can be partially resolved only through

the institutions"[1]. The development of innovation activity institutions implies the reduction of uncertainty in the relations between the participants of the sector of knowledge generation (fundamental, applied, corporate science), the sector of innovation and production (innovative companies, innovation manufacturers and consumers), investors and building of confidence between them.

The institutions may be established at both the federal and regional level. The institutions established at the federal level (venture and seed financing, strategic innovation planning, etc.) are manifested in relevant regional institutions. They are usually associated with the implementation of federal regulations, regulations of a higher level[2]. In addition, additional local institutions of innovative business support may function at the regional level based on the regional budget capacity and the appropriateness of a particular institution in the region, such as patenting subsidies, tax benefits, tax holiday, security for loans, partial recovery of expense on interest rates, etc. They are acceptable and valuable in the regional setting. "The regions should develop their own institutional mechanisms which would meet the needs of innovative activity for a given period of time"[3].

The institutions established in the innovation sector play a positive role. However, the level of innovative activity relative to other countries remains low. And its improvement may be associated with the evolution of the institutional environment. "In order to radically alter the situation and increase the susceptibility of the manufacturing sector to the innovations, it is necessary to intensify efforts to create necessary institutional conditions" [6, p. 200].

The article is prepared on the materials of the research conducted at the Institute of Problems of Regional Economics in order to identify the ways which have proven to be successful in the process of scientific results transformation into products which ensure people's vital activity and, possessing institutional features, are consolidated in the form of rules and regulations.

The research targets are the urgent problems of the introduction of scientific results: the use of fundamental research achievements, the development of sectoral research organizations, the measurement of process innovations as conditions for their management, scientific and technical programs management planning. The research was carried out on the basis of statistical records, official documents, publications, past and present experience. The content of the article may be attributed to institutional design [2, p. 39], i.e. it is aimed at the justification of possible institutions of innovation activity organization and support.

[1] Pilyasov A.N. *Sinergiya prostranstva: regional'nye innovatsionnye sistemy, klastery i peretoki znanii* [Synergy in space: regional innovation systems, clusters, and knowledge spillovers]. Smolensk: Oikumena, 2012, p. 449.

[2] *Ibidem*, p. 77.

[3] *Ibidem*, p. 630.

Strategic innovation on the basis of fundamental research

The results of fundamental research are the starting point, the beginning of the innovation cycle. However, the innovative process of bringing them to the finished product and placing on the market is complicated and difficult to implement. Its peculiarities are attributable largely to the differences between the nature of scientific research, aimed at learning the world around, and the real sector of the economy aimed at the production of material product. They also involve uncertainty in achieving the goals, investment risks and a relatively long payback period. The existing difficulties may be partially overcome by the established institutions mentioned above. However, the problem of the implementation of fundamental research still remains. "Modern Russia demonstrates a fundamental disparity and the gap between different links of the chain connecting fundamental research with technologies introduced into the economic environment" [6, p. 199]. "The problem of the Russian innovation system was and still remains slow adaptation of innovative ideas and creation of new products, technologies and techno-technological industries on the basis of these ideas" [13, p. 284].

In practice, there are two forms of fundamental research application. The first is when the solution of global issues such as nuclear power, space, rocket and missile engineering and defence is directly related to setting fundamental science objectives, the achievements of which are then used in specific projects. The second form implies low-level technology production which may embrace only the selected results of fundamental science. Therefore only a thin layer of fundamental research is commercialized. The extension of their practical importance may be associated with the development of a special type of innovations, taking into account the nature of fundamental research, which lies in the opening of new scientific horizons and future development paths. Therefore, innovations based on fundamental research may represent strategic focus, a vector of fundamental changes. They are aimed at finding the way out of the existing technology structure which has exhausted the productivity growth potential, in order to update the design model with high initial capacities of value creation. Such technologies mark a new stage of economic development of companies, industries and regions. This article deals with strategic innovations based on fundamental research and possessing the features of both final results and innovation process organization.

Strategic innovation is the result of re-conducted oriented fundamental research (the continuation, if necessary, of the existing framework), applied research and engineering development embodied in a material object or service as an element of a new technological pattern or the conditions in reaching it.

The term "strategic innovation" is not new, it is used as a means of achieving the strategic goals of the corporation [14; 20], in the countries' technological race [16]. Together with "strategic innovation" the term "radical innovation" is used, which is close in meaning [17; 18; 19]. The common feature of the two terms and the term "strategic innovation" used in article is a future-oriented outlook and the solution of long-term objectives. The difference is that the term "strategic innovation" used in the article is the result of a fundamental research. The term is "attached" to the fundamental study and reflects its innovation.

The purpose of strategic innovation as an institution is to streamline the innovation process, to create an instrument of bringing the results of fundamental research to practical application. Strategic innovations are included in the system of strategic planning, development and implementation of the innovation policy. The relevance of strategic planning reflects the fact that, according to expert estimates, Russian science reaches the world level in most critical technologies or exceeds it in some areas *(Tab. 1*).

Strategic innovation as a tool for innovation activity may be of particular importance to the regions with a developed scientific and educational sphere with academic institutes and universities, which are the sources of fundamental scientific results.

When conducting a fundamental research, strategic innovation may represent a major project which includes the full cycle of works: fundamental and applied research, experimental work, development in production, product promotion; i.e. it is aimed at restoring long process chains from science to industrial development [3].

The following proposals of the Institute of Electrophysics and Power Engineering of the Russian Academy of Sciences (Saint Petersburg) on the implementation of fundamental research are a good example of potential strategic innovation.

1. The creation of new types of powerful plasma generators for power engineering, plasma chemistry and the creation of new materials. Project realization term – 2020, the volume of financing – 4.5 billion rubles. Project Participants: Institute of Electrophysics and Power Engineering of the Russian Academy of Sciences, Scientific and Development Association "Iskra" JSC, Power Machines OJSC, Soyuzteplostroy CJSC.

2. The creation of industrial organic substance reprocessing facilities (wood, municipal solid waste, agricultural waste) for synthetic gas generation in order to produce electric and thermal energy and liquid fuels. Project realization term is 2025, the volume of financing – 7.5 billion rubles. Project participants: Institute of Electrophysics and Power Engineering of the Russian Academy of Sciences,

Table 1. Status of research and development in the field of critical technologies of the Russian Federation [5, p. 220]

Level of research corresponds to the international level and in some spheres – higher	
Communication and innovation systems	*Environmental management*
Software production technology	Monitoring and atmosphere and hydrosphere state forecast technology Resource assessment and lithosphere and biosphere state forecast technology
Nanosystem industry and materials	
Bio-conductive material technology Membrane and catalyst system technology	
Living systems	*Power engineering and energy conservation*
Bioengineering technology Biocatalytic, biosynthetic and biosensoric technology	Nuclear power and nuclear fuel cycle technology, safe management of radioactive waste and spent nuclear fuel
Russian research correspond to the international level in general	
Communication and innovation systems	*Environmental management*
Bioinformatic technology	Natural and technological disasters risk reduction and mitigation technology Technogenic formations and waste recycling and disposal technology Eco-friendly exploitation and mineral resource extraction technology
Nanosystem industry and materials	
Polymer and elastomer production and processing technology Crystal materials production and processing technology Composite and ceramic materials production and processing technology	
Living systems	*Power engineering and energy conservation*
Biomedical and veterinary technology of human and animal life support and protection Genomic and post-genomic pharmaceutical manufacturing technology Eco-friendly resource-efficient agricultural raw materials and food production and processing technology	Hydrogen energetics technology Energy saving transportation, heat and energy distribution and consumption systems technology
	Transport and airspace technology
	Technology of creating a new generation of rocket and space aircraft and marine facilities
The level of Russian research is generally below the international level, the level is comparable to international only in selected spheres	
Communication and innovation systems	*Nanosystem industry and materials*
Intelligent navigation and management system technology Information processing, storage, transfer and security technology Distributed computing and systems technology Electronic component database technology	Nanotechnology and nanomaterials Mechatronics and microsystems engineering technology
	Living systems
	Cell technology
Power engineering and energy conservation	*Transport and airspace technology*
New renewable energy sources technology Organic fuel and energy processing technology	New transportation systems creation and management technology Energy efficient transportation systems engine production technology

Scientific-Production Association "Iskra" JSC, Scientific and Development Association I.I. Polzunov Scientific and Development Association on Research and Design of Power Equipment, Power Machines OJSC 4.

Strategic innovation may be a tool for the implementation of critical technologies. It is important to single out from the structure of scientific groundwork on critical technologies those technologies, which are of primary importance for the rebuilding of the economy, and those which could be specified in terms of content in the form of strategic innovation, based on the criteria of relevance criteria in the world and the needs for the development of the domestic economy.

The content of strategic innovation based on fundamental research may possess the properties typical of a formal institution, which is focused on the reduction of uncertainty of scientific results, risk sharing between the state and the private investor, the coordination of project participants' activity.

Strategic innovation as an institution combines the following mechanisms:

– government funding of the initial high-risk stages of work (continuation, if necessary, of fundamental and applied research, development works);

– organization of the relations between the participants of the project, their unification with a common goal and a set of technological works and stages;

– coordination of the activity of organizations and enterprises of different industries and competencies in the solution of problems of scientific results transfer;

– non-opportunistic behavior of project participants caused by mutual interest of achieving a common goal – the merchandising of new production and technology.

Initially, strategic innovation may act as an informal institution and only its gradual strengthening can bring it to regulations (at the regional or federal level). The development and implementation mechanism of specialized research-and-production target program may serve as the technology of its creation. The initiator and the subject for such a program may be a scientific organization, a university in cooperation with partners from applied science, business entities with organizational and financial support of the government. If the organization has scientific results that may be the core of a large-scale project with a perspective in the domestic and foreign markets, as well as the probable demand forecast agreed and adopted by the business, they may become a target for the development of a scientific and production program. The special-program method of solving complex scientific and production problems is justified by the need to organize

[4] *Prioritety nauchno-tekhnicheskogo razvitiya Severo-Zapada Rossii* [Scientific and technological development priorities of the North-West of Russia]. Saint Petersburg, 2011, pp. 210-211.

interdisciplinary and inter-firm cooperation of many enterprises and to attract funds from different sources.

An interdependent non-linear innovation process can be implemented in the form of a target program. This process is characterized by more stable, trust-based relations with a possibility of implicit knowledge spillover lying in professionals, workforce, skills, and abilities or in organizational practice, which can be obtained through common activities[5].

The internal feature of the institution of strategic innovation could be the creation of favorable business environment which stimulates the involvement of business structures, when the state assumes costs and risks of the initial stages of the innovation process with a high degree of uncertainty, and the investment of private capital, secured by the participation of the state can be considered as a reserve with a possibility of obtaining considerable profits due to the emergence of new markets and the presence of intellectual rent in the price of new products. When developing the program hard work is required in order to limit budgetary funds, mobilize private resources and create various incentives from percent bonification to state guarantees and risk insurance [4].

Being a tool for promotion of fundamental research results in public practice, strategic innovation can solve the problem of reducing the "big lag between the emergence of evidence-based scientific and expert proposals and decision-making by government authorities" [1], which is especially important in the technological race and import substitution at the global level.

Institute of sectoral research organizations in new management conditions

The development of fundamental research implies the involvement of applied science organizations of various scopes. The introduction in practice of fundamental research is possible with a developed applied science in the country. In Russia this process is constrained by a limited composition of applied research organizations. During the reforms of the 1990s, as a result of slumping public investment in scientific research 80% of sectoral research organizations changed their scope of activity and ceased to exist [3]. Previously, "there were 132 sectoral ministries, each having their own academic institutions. Now there are no ministries left and the ministerial applied science is virtually destroyed. It was mostly privatized and new owners did not develop their institutions and used their property for commercial purposes"[6]. Sectoral research still exists in the public sector – in defense,

[5] Pilyasov A.N. *Sinergiya prostranstva: regional'nye innovatsionnye sistemy, klastery i peretoki znanii* [Synergy in space: regional innovation systems, clusters, and knowledge spillovers]. Smolensk: Oikumena, 2012, p. 449.

[6] Mekhanik A. Zadacha upravlentsa – ne meshat' khoroshim lyudyam rabotat': interv'yu s prezidentom Rossiiskoi akademii nauk V. Fortovym [The manager's task is to not interrupt good people's work: an interview with the President of the Russian Academy of Sciences V. Fortov]. *Ekspert* [The Expert], 2015, no. 41, pp. 49-55.

aerospace, shipbuilding and nuclear industry and in some regions (federal subjects of the Russian Federation).

The declining applied science, the extended interruption in equipment and machinery design led to the break of succession of engineering[7], the decrease in the domestic production base of modern technological equipment and bulk purchase of foreign machinery. In 2011, Russian companies invested 358.9 billion rubles in innovation, primarily in the purchase of imported technology (only 16% of them are of domestic production) [10, 20]. According to the data of Chamber of Commerce and Industry of the Russian Federation, only 13% of the purchased equipment is modern, the rest is rather cheap, but outdated [8].

The country has all the necessary prerequisites for the development of the institution of sectoral science. Firstly, it is the experience of the institution of sectoral research organizations operation. It is believed that "the present and the future are connected with past social institutions and, in relation to the economic system – with the memory, experience and technological opportunities and benefits recorded in them" [11, p. 27]. Secondly, there are powerful social forces interested in the establishment of the institutions of sectoral research institutions: the government is interested in intensifying the innovation activity in the economy, solving strategic long-term objectives – to maintain and develop the competitive sector of the economy; the sectors are interested in strengthening technological innovations and the implementation of the sectoral technological policy; the region is interested in the socio-economic development of the territory; business entities – in purchasing first-class domestic equipment and providing operational stability and profitability. Academic community is emphasizing the government's need for maintaining applied science at the appropriate level. Specialization exclusively on fundamental research is unjustified from the economic point of view [6, p. 199]. Applied science is developing, albeit slowly, in civilian sectors in the form of joint-stock companies. Thus public corporation "Rusnanotech" created by the government in 2007, during its development and strengthening on the market was in 2010 transformed into a joint-stock company "RUSNANO". About 70 applied research institutions exist in the Sverdlovsk Oblast. They have strong science and engineering schools, vast experience in scientific project support [12]. The number of engineering companies which provide design, project support and other services is increasing.

Formed under the aegis of the ministry, sectoral applied research organization, being located in the region and integrated in the socio-economic system with a

[7] *Sankt-Peterburgskie vedomosti* [Saint Petersburg gazette], 2015, November 27th, p. 8.

developed production and development base, being able to offer a brand new proven technology and produce small series of equipment amid the expansion if its scope of activity and consolidation in the market, may then change its status and become a joint-stock company. The need for sectoral research organizations is understood in leading industrial circles. According to Deputy Minister of Industry and Trade of the Russian Federation, the lack of sectoral institutions is a major challenge for ministries and agencies in terms of their implementation of the sectoral policy[8].

Sectoral research organizations could become a state technological policy conductor in sectors, regions, including in the implementation of priority directions and critical technologies, a coordination center of the import-substituting policy of production technologies and equipment, and could build communication with engineering and other production and technological companies, conduct forecast-and-analysis research of the cross-sectoral, sectoral and regional character. A major impact on the development of innovative economy is possible only under a strong applied science in a sector, led by a major sectoral research organization with the functions of a research production enterprise and a strategic element.

[8] Medovnikov D., Mekhanik A. Proizvoditel'nye sily, pod"em! [Productive forces, rise!]. *Ekspert* [The Expert], 2014, no. 27, pp. 44-50.

Statistic records of process innovations

The use of scientific research results in the extractive industries is of particular importance for Russia. However, the observation of innovative activity performance with the use of the specific weight indicator of innovative production, which is currently considered as the principal indicator for its evaluation, does not fully reflect the technological progress in extractive industries. In the regions with a significant share of mineral resource extraction and processing the figure is very low. For example, in the Republic of Karelia, in the Arkhangelsk and Murmansk oblasts it ranges between 0.1% and 3.6% (2006–2014). It can be assumed that the structure of productive sectors in the region may influence the low value of the specific weight indicator of innovative production. The innovation process in the aforementioned regions is largely related to raw material extraction and processing technologies, i.e. to the development and application of process innovations. Extractive sectors are becoming more and more technically advanced, and process innovations which play a central role in their technological development should not be excluded from measurement and control area.

Table 2 shows the correlation between product and process innovations by type of economic activity on the specific weight indicators of organizations and the specific weight of costs of the organizations engaged in innovation activities.

Table 2. Correlation between product and process innovations in 2012

Types of economic activity and technological innovations	Specific weight of organizations engaged in innovation activity, %	Costs of innovation activity
1	2	3
Mineral extraction:		
- product innovations	29.4	16.5
- process innovations	82.6	83.2
Manufacturing:		
- product innovations	67.6	54.3
- process innovations	53.1	44.4
High-quality production:		
- product innovations	79.9	66.7
- process innovations	48.5	32.4
Source: *Indicators of innovation activity, 2014: statistical book*. Moscow: Vysshaya shkola ekonomiki. 472 p.		

According to the table, process innovations in the mineral extraction sector prevail over product innovations, their proportions in manufacturing is approximately equal and in high-tech industries a high proportion of product innovations is accompanied by a significant proportion of process innovations. Attention should be drawn to the fact that some organizations implement product and process innovation (column 2). The data from the table confirm the appropriateness of the introduction of statistical monitoring of innovation performance in the sphere of both product and process innovations. By analogy with the specific weight statistical indicator of innovative products, the indicator of process innovation measurement can be offered – the share of innovative production technologies as the ratio of production volume produced with the use of newly developed recently modified technologies (during the past three years) to the total production volume in percentage [9].

The number of developed and used advanced production technologies recorded by national statistics includes only technological processes managed by a computer or based on microelectronics and does not cover the whole complex of innovative technology. It is also important to have an indicator for measuring the total amount of process innovations.

The need to measure process innovations raises the issue of the development of the institution of innovation activity statistical record. The measurement of process innovations could extend target orientation and program management of innovative development of both extractive and manufacturing sectors in line with the concept of innovation activity as a heterogeneous complex process in need of statistical monitoring improvement. The appropriate

reflection of the real situation in innovation activity is a necessary condition for making right management decisions.

Planning of regional programs implementation

Scientific and technological programs developed at the regional level are not always fully implemented. There are several reasons: their insufficient elaboration, particularly of sources of financing, and the impact of the changing economic environment resulting in inaptitude to the realia adopted in the program of indicators. Lack of personal responsibility for the implementation of the program and its units, along with the program's "vague" character, leads to the failure of implementation. According to the results of the monitoring, the implementation of the "Comprehensive scientific and technological program of the Northwestern Federal District of the Russian Federation for 2010–2030" in 2011 (the second year of program implementation) was suspended due to lack of funding of 99 projects, 20 projects were removed from the program and 22 of them required cost adjustments amounting to 22% of the sum of money planned up to 2030.

Along with the development of the national programming institution, the methods of organizing program implementation need to develop. Their reduction to program monitoring and adjustment does not provide full implementation of its updated parameters. That is why the improvement of program management effectiveness, including through "accession" the institution of program implementation to the programming process is appropriate. In this case the general scheme of the program management method may be represented in the form of three successive development stages: strategies of scientific and innovative development (of the federation, regions), research and innovative programs at the appropriate level and a short-term plan of their implementation.

The third stage of this three-part research and innovation activity management plan ("strategy – program – plan") will be different in the content and functions compared to the indicative planning which, reflecting future indicators, generates a forecast development plan. In contrast, the scientific and innovative program implementation plan can be devised for the upcoming year as an operational tool for program's implementation. This function implies the specification of parameters of program projects of for the planning period according to expected changes in market conditions, investment amounts and their sources, the composition and functions of counterparts, risk analysis, their possible compensation, etc. The possibility of the plan implementation can be based on making economic contracts of the executives and on confirming the budget expense obligations by public authorities, which determines the responsibility of each participant for the implementation of target objectives. The indicative plan is a forecast

plan, but the program implementation plan is a realization plan of agreed actions for the coming period. An important step towards increasing the practical relevance of the programs is the "Guidelines for the development and implementation of state programs of the Russian Federation" (approved in December 2012 by the Ministry of Economic Development)[9], which provide for the annual arrangement of the program implementation plan and a detailed (network) scheduled plan with the names of the officials responsible for scheduled milestones of the program (those which have a significant effect on the results). It is important that this regulation is applied not only at the federal but also at the regional level.

Conclusion

The development of institutional conditions for the implementation of the achievements of fundamental research, strengthening the sectoral scientific organizations, the measurement of process innovations and planning the implementation of regional innovative programs will depend on efforts to promote the practical use of these ideas and on the actions of decision-makers, primarily of federal and regional authorities.

The institutional development will require additional financial costs. Their lack in the period of stagnation of the economy may become a deterrent to the institutional development. At the same time decisive action is necessary in order to change the situation in the innovative sphere and create a real basis for economic growth. The available opportunities for the development of institutional conditions of innovative activity are an additional tool for the transfer of scientific results into the real sector of the economy and for the increase in innovative activity in the region.

The results of the study may be used in programming, planning, coordination of bringing scientific achievements to innovations, especially the results of fundamental research of academic institutes and universities. They may also be used by federal and regional authorities in the system of measures to develop national and regional innovation systems.

The research may be pursued in the direction of the development of the obtained results – the justification of methods of innovation activity implementation: determining the appropriateness of state financing and providing preferences for business units within strategic innovation, the analysis of the state of applied science in sectors and regions and the determination of the appropriateness of sectoral research organizations, the introduction of a pilot project of process innovation measurement, the development of a short-term operational plan of regional scientific and technological programs implementation.

[9] *Rossiyskaya Gazeta* [The Russian gazette], 2013, February 22nd.

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Received June 01, 2016