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Interdisciplinary Project Management of Structure Transformations in Staff Training in Nuclear Industry

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In the article the topical questions concerning increase in the competence level of experts, carrying out the activity in the sphere of nuclear branch are raised. The role and place of innovations in social development of the nuclear industry, the purpose and the problem of innovative activity are revealed. The priority directions in the sphere of modernization and technological development of Russia are stated, basic stages of staff training are presented. The information and procedural model of the management mechanism is shown by interdisciplinary projects of structural transformations of nuclear branch.

Key words: nuclear branch, personnel potential, interdisciplinary projects, structural transformations, innovative economy.

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1. INTRODUCTION.

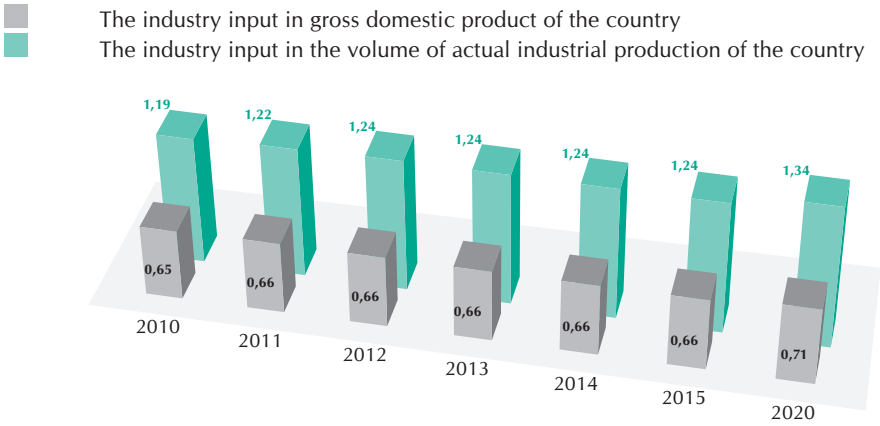
Staff training in nuclear industry is one of the most complex problems at the contemporary development stage of nuclear engineering. The predicted rate and scale of nuclear industry development require outrunning growth in staff competence of all structures of the nuclear energy complex, which implies the design of new interdisciplinary projects of structural transformations, with special attention being paid to establishing and developing the relevant programs within universities.

In theses conditions Russia sets the global, these achievable goals for the long-term development – provision of high rate of population wellbeing, consolidation of the country's role as one of the key leaders determining the world policy. The only possible way to achieve these goals is to transit the economy into innovative socially-oriented development model – innovation-based economy.

2. STRUCTURAL TRANSFORMATION IN STAFF TRAINING IN NUCLEAR INDUSTRY

Innovative trends in economy are the most important condition for nuclear industry development in modern conditions that involve the need for leadership and innovation economy, development of interdisciplinary projects [1]. Quantitative indicators of such economy can make a significant share in the market of hi-tech and knowledge services by 2020. To provide the double increase in the share of hi-tech sector in gross domestic product (GDP), 5-6 times increase in the share of innovative pro-

Fig. 1. Development of Nuclear Engineering - Role of Innovations



duction in industry output and 4-5 times increase in the share of innovation-active enterprises (Fig. 1).

Moreover, transition to the economy of innovative type is possible only under the condition of efficient and dynamic development of industrial branches determining scientific engineering progress. The experience of economically developed countries shows that in modern conditions the main competitive branches are those of hi-tech sector, the basic aims of which are:

- powerful, innovatively active potential, including scientific engineering, scientific experimental and experimental and production bases, innovation projects, highly-qualified staff;
- government participation in support and development of current scientific engineering, production and staff potentials.

The world economic crisis of 2008-2009 hindered the achievement of the goals, since it had stipulated innovation spending cuts in private business and aggravated the structural weaknesses of the Russian innovation system. Nevertheless, such an economic situation in short-term perspective does not imply the necessity of long-term development goal review, rather the rate and quality of economic development can increase in 2013-2020.

The solution of post-crisis recovery problems and transition to innovation development route is made under the influence of internal and external challenges on Russia, on the one hand, complicating the set goal achievement, on the other hand, dictating the necessity of even more intensification in efforts to solve the problems existing in Russian economy and innovation system [2].

One of the key challenges for our country is global development of competitive struggle for the factors shaping the competitiveness of innovation systems, first of all, for highly-qualified work power and «intelligent» money (investments injecting new knowledge, technologies, competencies into projects), sharp increase in mobility of these factors. In the condition of low efficiency of national innovation system in Russia it means accelerated decrease in remaining competitive potential – personnel, techniques, ideas, projects, and capital [3, 4].

Hence, these challenges determine the necessity of priority development in the definite spheres of research and engineering developments («pure» engineering, genomic medicine etc.), in most of which there is no sufficient capacity in Russia. To be up to the challenges it is necessary for Russia to integrate drastically into the world innovation system overcoming the isolation that still exists.

The failure of Russia to meet the challenges means reduction of «possibil-

ity window» for transition to innovative economic, loss of existing scientific potential, weakening of geopolitical positions, inclusion of Russia into the group of countries with imitation innovation system, unable to production of new knowledge and achievement of global leadership in the key engineering spheres.

Started in the beginning of the 1990's transformations had a negative effect on both the situation in hi-tech industries that resulted in decrease of production rate, reduction of its quality and competitiveness. Among the main causes for existing crisis situation the analysts have stated: changes in the sphere of economic governmental management such as shrinking the governmental investments and state-guaranteed orders, disintegration of intrasectoral and intersectoral relations, replacement of domestic products by import ones and others. At the level of enterprises the situation is influenced by inefficient restructuring, equipment depreciation and obsolescence, absence of funds for new technologies, lack of qualified staff and disintegration of their training system, particularly, in engineering specialties.

Obviously, in current situation the task of structural transformations in hi-tech spheres is to be considered a priority, as it would allow developing of the base (projects) for all other types of organizational changes.

By structural transformations the intended enhancement, improvements, modernization of separate parts in branch (company) structure is the result of changes in enterprise's specialization, size and other important parameters.

Peculiarities of structural transformations in hi-tech spheres comprise, first of all, enhancement of science role and integration of research departments into developed structures, since it is science that is the base of engineering achievements and innovations [5]. On the course of transition to market economy the integrated relations between science and industry were destroyed. Restitution of hi-tech branches of fundamental and applied sciences in the structure would permit to produce the goods of higher research-engineering level and contribute to:

- strengthening of industrial and scientific relations between separate enterprises enabling achievements of synergetic effect;
- optimal combination of modern production capacities and advanced research and development base;
- improvements in existing projects;
- increase in diversity and achievements of optimal length of processing chains;
- large-scale application of engineering, production, and management innovations.

Structural transformations are labour-consuming, time-consuming systematic process which is to be controlled. In managements of hi-tech plants there appear many methodological problems including:

- determination of strategic goals of transformations;
- choice of transformation direction and mechanism taking into account production and engineering peculiarities as well as character of inner and outer industrial bonds;
- selection of enterprises for development of structures relevant for the market environment in accordance with the reforming goals and tasks.

Setting the goals is the starting point in the management process. Taking into account the significance of hi-tech spheres, the goals of structural transformations are determined not only by owners' and managers' interests but also by government's interest for which the development of hi-tech branches determines the rate of high technologies and is connected with the issues of national security.

According to the goal, structural transformations can be implemented by means of either integrative or disintegrative processes (see Table 1).

The Table demonstrated that the strategy suggested is a continuation of stimulation policy for innovation activity performed within the last decade. In 2005 program "The Basic Trends in the Development of Innovation System in the RF by 2010" was adopted, in 2006 – "The Strategy of Science Development in the Russian Federation up to 2015". In the course of the program and strategies implementation the bases for the current national innovation system are laid, the essential efforts in the development of research and development sector, formation of developed innovative infrastructure based on technological innovations are made [1].

First and foremost, over the recent years financing both fundamental and applied sciences by the government funds has increased through the Federal Target Programs and state funds of scientific investments. The modern system of development institutions in the sphere of innovations including institutions of pre-sowing and showing investments and venture capital funds with government participation was established (through OJSC «Russian Venture Company»), Bank of Development and Foreign Economic Affairs (Vnesheconombank), State Corporation «Rosnanotech» supporting the projects in the sphere of nanotechnologies.

3. SIMULATION OF SCIENCE AND EDUCATION INTEGRATION.

Significant efforts were made for stimulation of researches and innovative developments in higher education. Financial support of innovative programs in 57 universities was performed, nearly thirty universities were given the status of National Research Universities on the competitive base and were granted money for development program implementation including introduction of innovation infrastructure, development of research activity. Measures on involvement of internationally recognized scholars into research of Russian universities, support of cooperation of universities and industry, further development of university innovation infrastructure are taken.

The work on arrangement of national research centers has started (such a center was established on the basis of

Table 1. Comparative Characteristic of Integrative and Disintegrative Structures

Indicator	Integration	Disintegration
Mobility	Low, due to need for coordination of actions at all stages of production and marketing	High, due to small volume of production and clear intra-structural relations
Demand for different resources (financial, staff, production etc.)	High, due to constantly increasing production volume	Depending on the specificity of goods produced, but, as a rule, lower than at integration
Management and intracorporate relations	Multi-level management structure; challenges in building vertical and horizontal communications	Usually simple management structure and clearly structured communicative bonds that makes it possible to take decisions quickly
Investment attractiveness	High, including the factor of large company share quotation in the market	Average except the cases when output product is of high innovation potential

Kurchatov's Institute). The infrastructure of innovation activity support is formed – technology development special economic zones providing sufficient benefits for innovation companies, technoparks, business incubators in universities, centers of technology transfer, centers of core facilities etc. A special place is occupied by the support for establishment and development of innovation clusters on a competitive base.

The foundation was laid for creation of new Russian «innovation territory» in Skolkovo near Moscow where an unprecedented legal framework minimizing administrative and taxation burden is developed for the resident companies.

The system of government co-funding is developed for innovation projects support of private corporations – through management organization of Skolkovo project as well as, in future, through the Russian Fund of Technological Development after its reorganization. As for companies with government participation the system of support for development and implementation of innovation development programs is formed (Fig. 2).

Significant work has been done to improve the legal regulation of innovation activity – the necessary legal bonuses have been and are still being introduced. The law permitting budget-financed educational and research organizations to establish small innovation enterprises was adopted, during the first year of its application about 600 small innovation enterprises have been established in universities and research institutions [6, 7].

It should be noted that the key problem is low demand for innovations in the Russian economy as well as its inefficient structure – redundant excess in the sphere of buying off-the-shelf equipment aboard to the detriment of our new facilities.

Simultaneously, there is a new unfavorable tendency of retardation in achieving the indicators set by the Basic Trends of the RF Government for the period up to 2012 in the sphere of science and innovations.

Those trends determine the necessity to realign the policy in the sphere of innovations performed up to now, shift the focus from buildup of general volume of support in all constituents of the national innovation system to radical increase in efficiency, concentration of governmental efforts for solution of problems urgent for innovative development [1, 2].

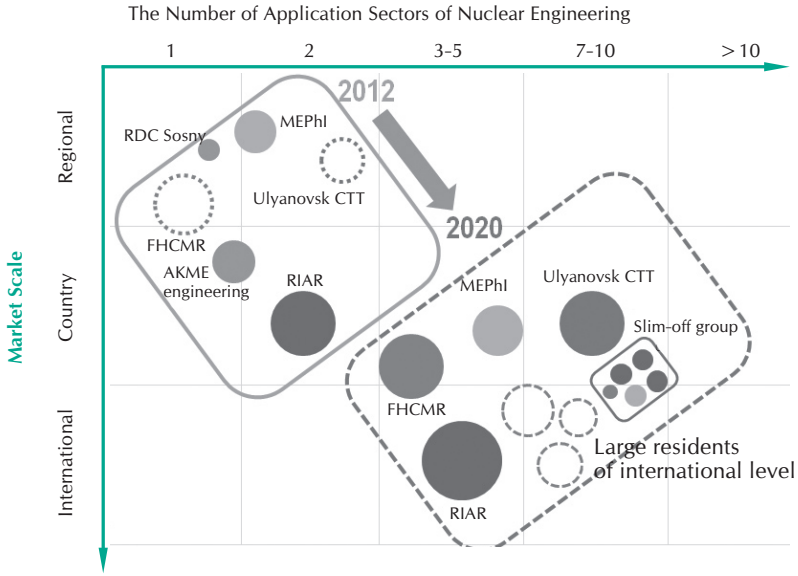
One of the most important competitive advantages remaining in Russia from the point of view of innovative development is human capital assets. Involvement of all population in the basic education, one of the first places in the world in the share of population with higher education (23,4 % of the number involved in economy that corresponds to the rate of some leading foreign countries, such as Great Britain, Sweden, Japan, and it outstrips the rate of such countries as Germany, Italy, France), high level of higher education in natural-science and engineering specialties – all these creates the foundation for efficient innovation system. At the same time, the conditions in this sphere are characterized by a number of negative tendencies that, in fact, can devaluate the competitive advantages in future.

Firstly, the quality of education tends to decrease at all levels – from basic, elementary and secondary vocational education to higher one, as well as PhD program.

Secondly, apart from quality of education significant role for the future innovative development is also played by life goals, behavior models developed in a man that either contribute to innovation extension in economy and society or prevent from it.

Within the 2000's the internal cost for research and development in the Russian Federation mounts constantly in absolute values. As a result Russia is inside the top ten of the world leading countries in general volume of such costs, though it goes sufficiently behind the leaders in such an indicator as the cost share for research and development of GDP (1,24 % as compared to 2,77 % in USA, 2,64 % in Germany and 4,86 % in Israel). The investments in all types of

Fig. 2. General scheme of nuclear-innovation cluster development (2012-2020.) as a potential concentration of unique research infrastructures and competencies



research are increasing. For instance, cost for research and developments in universities from 2002 to 2009 has increased from 5,4 to 30,8 bln rub. Thus, if in such indicator as cost of research and development per capita Russia went behind all developed countries of East Europe at the beginning of the 2000's, the gap was if not closed, but reduced significantly by the end of decade.

In terms of absolute scale of its research sector Russia is still in one of the leading positions in the world, giving place only to China, USA and Japan. However, in terms of the researchers' number per 1000 of involved in the economy Russia cedes to more than 20 countries including Finland, France, Germany, USA, Japan etc. The growth of general volume of investments, on the one hand, and reduction in the number of researchers, on the other, enable the significant increase in domestic costs for research and development per one researcher in Russia.

There is still complex situation with reduction of the generation gap appeared in Russian science as soon as the 1990's. Though in 2000's the share of researchers at the age of up to 29 in the whole number of researchers grew, but simultaneously to 2006 there was no growth in the next age category (30-39), that meant failure of many research institutions to draw young specialists. At the same time the share of researchers at the age of 60 and older has grown within 8 years from 20,8 to 25,2 %.

Nevertheless, in spite of remarkable achievements of definite Russian scientists, Russia is presented in the world science by rather low indicators. For instance, for Russia there was only 2,48 % of articles (published in scientific journals indexed in Web of Science database), whereas for France – 5,5 %, Germany – 7,5 %, China – 9,7 %. For its specific weight in the entire volume of scientific publications Russia is between Brazil (2,59 %) and Netherlands (2,46 %). There are still low indicators of research results. In fact, in Singapore per one article in internationally recognized editions there is 3,6 active researchers, in Germany and France - 3,5 researchers, in Argentina - 5,8, in Japan – 9,2. In Russia this indicator is as high as 16,4 (in China, for example, - 13,2).

There is still low rate of citation of Russian scholars that demonstrates their low relevance to international scientific

community. If the share of Russia in the world number of scientific publications amounted to 2,48 %, its share in the world number of citation in scientific journals made only 0,93 % within 2004-2008. In this case the «cost» of one Russian publication (relationship of domestic cost for research and development and the whole number of scientific publications) was growing in the 2000's with advanced pace and amounted to 848 thou. US dollars in 2008 as compared, for example, to 221 thou. US dollars in Poland [2-4].

The infrastructure of innovation activity in Russia is in general comparatively developed. Within the last 10 years in all the country there were established hundreds of innovation infrastructure units with the support of government – technoparks, business-incubators, technology transfer centers, common use centers etc.

For instance, the whole number of common use centers reached 75 by the end of 2008, where nearly 2500 items of equipment are concentrated the general cost of which amounts more than 11 bln. rub. In 2005-2007 with the governmental support of the general sum 239 mln. rub. More than 100 technology transfer centers were founded. In the course of state support program for small and medium enterprises 34 innovative business-incubators were established, in this case the general cost of federal budget amounted to 863 mln. rub. Besides, more than 140 innovative-engineering centers and technoparks operate, in the framework of the state technopark program in the sphere of high technology the money was given for 9 technoparks (Fig. 3).

Technology development special economic zones have been set. Innovation infrastructure was formed nearly in every university. At the same time, efficiency of infrastructure still remains at insufficient level, first of all, it is limited by stagnation in demands for innovation on the part of the Russian companies.

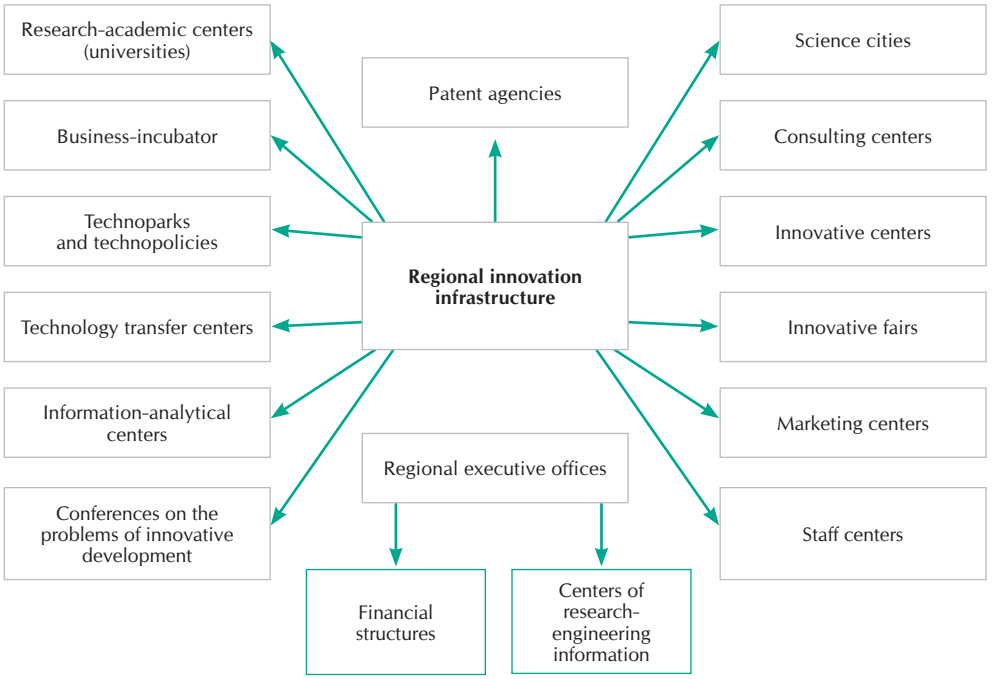
4. CONCLUSION

The analysis of modern conditions of Russian innovative system has shown that the current challenges are connected with long-term perspectives of international competition aggravation, hence the following conclusion can be made: the main goal of innovative economy is to create efficient mechanisms for stimulating engineering modernization in all industries and services as well as to develop and introduce new interdisciplinary projects including staff training of nuclear industry. In addition, as practice shows, the process is to be moderated by definite branches of industry among which nuclear industry occupies a leading place [6, 7].

Unfortunately, in any country one can observe low interest of business in performance of complete innovative cycle – from the stage of research and developments to positioning of new products and technologies within the market. At present Russian businessmen invest in research activity and technology developments and projects significantly less than their competitors in the developed and many developing countries. Efficient innovative economy should contribute to reconcile this contradiction.

Inflow of young staff into nuclear industry is a principle task in implementation of innovative development scenario. The key issue is connected with provision of the industry with the specialists of high level. In this aspect the basic version of development strategy for nuclear industry of Russia has been developed and approved for the period up to 2050 that permit for estimation of perspectives in selection of strategic trends in development of the given industry. It should be noted that the basic statements of the innovative economy are focused on performance of its main tasks with the help of State Corporation «Rosatom», under the supervision of which there is the complete operation cycle of nuclear power-industrial complex, that makes it possible to minimize engineering and economic risks in realization of development strategy of nuclear industry as a whole [7].

Fig. 3. Elements of Regional Innovation Infrastructure



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