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From high technologies to the technological superiority

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The basis of modern economic growth is intellectualization of traditional and new factors of production. Common form of support for such activities is the creation of centers of excellence. The experience of creation of such centers of excellence in the form of one of the divisions of Tomsk Polytechnic University is described in this article. Basic problems which must be solved for the formation of the center of excellence at the University as well as basic principles of operation of the centre are given in the article. The main idea of existence of such center should be a continuity principle of scientific and educational process. It is accomplished through the implementation of the information of the latest achievements of world science in training courses.

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1. Introduction

Currently, the development and even more breakthrough in modern science and technology are inconceivable without the formation of interdisciplinary approaches to the implementation of innovative projects based on the groups' interaction of adjacent or completely different fields of knowledge. A significant role is played by the formation of the optimal integrated structure combining vertical infrastructure of interactions with project management. It requires a new look at the control system adopted in the high school division (Institute). This system is necessary to create an active development of scientific and educational activities. Here the project is important which provides the flexibility and mobility in the formation of temporary creative teams from different departments and levels of subordination. It shortens the way from an idea to a principally new product or technology.

2. Basis for the formation of University Center of Excellence

The creation of centers of excellence is a common form of support of innovation activity in the United States and Europe. These organizations conduct research and development in breakthrough areas and they have unique logistical, intellectual

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and human resources. There is no generally accepted definition of centers of excellence in international practice. It is so-called national laboratories of the USA, advanced research institutes in Germany, specialized research centers with a special status. Scientific research and innovation centers of excellence are distinguished by the highest quality and efficiency. As a rule, they are national (some worldwide) leaders in one or more areas of science and technology. They are a transfer of new knowledge from the world-class to the national one and serve as orienting point for other institutions of a similar structure (Yu, 2014).

The institute of High Technology Physics has the task aimed at concentration and effective use of existing and acquired resources. The efforts of leading research team are focused on preservation and growth of our country's competitiveness in the market of high-tech products. The main objective of the centre of excellence is to increase competitiveness and the quality of Research and Advanced Development and train highly-qualified personnel on the basis of interdisciplinary and co-operation with the world's leading centers. However, its creation is intended to ensure the development of transnational cooperation between Russian and foreign research centers, universities and companies which determine the quality and level of research and development, as well as distribution and use of their results in the world.

In 2010, seven scientific and educational institutions - the "centers of excellence" were established in TPU in accordance with the program of development of TPU. Each institution is an interdisciplinary network structure which includes departments of different faculties of TPU, as well as laboratories of Research Institute (Nuclear Physics, High Voltage and Introscopy)and external ones as structures of the Academy of Sciences, business structures and other institutions of higher education of our country and abroad. These centers bring together specialists from different areas and carry out the "triune task". They train masters of international level, upgrade skills of business partners' staff and perform research and design work (Khan, 2014).

The Institute of High Technology Physics (IHTP) is based on the laboratories of High Voltage Research. It includes 12 departments of the faculty of Sciences and Mathematics as well as electrophysical, mechanical-engineering and chemical engineering departments combining the best achievements and experience in the scientific and educational activities for more than a century (Morimura, 2010).

The main directions of scientific and educational activities of the centre are conducted in the following areas:

• Electric-and beam-plasma technologies;
• Technology nanomaterials and materials of new generation;
• Laser and Optical Technology;
• Chemical Technology and Biotechnology.

The center should ensure the competitiveness of TPU due to the presence of world-class technological base (including unique installations) and highly qualified staff which will provide scientific and educational priority of the Russian Federation on the above-referred research areas. Establishment of the Centre should achieve the following effects:

• Implementation of a "critical mass" of ideas, human, infrastructural, financial and other resources in order to improve the research and development of the Russian Federation;
• Increasing the attractiveness of Russian and Tomsk scientific and educational area for domestic and foreign scientists as well as students and large industrial companies;
• Competitiveness and demand for university graduates in the global job market;
• The extension of influence of the centre of excellence on innovative system of Russia;
• It must be a backbone unit of the national innovation system and provides retooling, steady growth and competitiveness of the national economy.

It is necessary to solve the following tasks for the formation of an efficient and competitive Center of Excellence:

• Hiring scientists and world-class specialists and creation of appropriate conditions for their work;
• Creating an effective structure interaction within departments and laboratories of the Centre;
• Creation of its own research program with external accountants – global specialists;
• Moving from the narrow scientific tasks to the integrated interdisciplinary research;
• Personnel development for adapting the best experience in the field of scientific research, design and development work and process development work and the organization of research and educational activities. Introducing into practice the presence of mandatory work experience of employees in industrial enterprises in their activity profile;
• Creating conditions for mobility of staff in order to participate in international conferences and seminars;
• Developing and promoting innovation activity, including through the creation of Small Innovative Enterprise in accordance with 217-Federal Law with participation of interested investors (Vesper, 1997);

• Developing the effective mechanisms of transfer of knowledge and technologies that meet modern requirements of the Centre of excellence in Russia and abroad, with the involvement of practitioners;
• Formation of the international image of the Center by participating in exhibitions and competitions;
• Increased interaction with leading scientific and educational centers, including centers of excellence, manufacturing industry, Russian Academy of Sciences, Academy of Medical Sciences, technology platforms, Skolkovo, etc.
• diversification of funding sources, scientific and educational products due to active innovation activity and discovery of new, marketable educational programs (including the Double Degree) in order to create conditions for stable development of the Center regardless of fluctuations and volume of state subsidies.
• Participation in global research projects and initiatives that meet the research areas of the Centre;
• Increasing the publication activity of employees, with refocusing on the top-rated publications, including with high impact factor;
• Patenting developments in Russia and abroad.

The Center of excellence should be a consortium of departments of the Institute aimed at fundamental and applied research and laboratories with great experience in the implementation and realization of design and development work and process development work. The formation of thematic clusters based on the laboratories and departments which are combined to solve similar problems will be appropriate. The work of the Center is to be built on the principle of continuity of scientific and educational process, thanks to the introduction of the information on the latest achievements of world science, including the achievements of the Centre in the training courses. The educational process which is built on this principle should be a "supplier" of the elite highly-qualified personnel for the research and innovation activities of the Centre of excellence.

3. Conclusion

The formation of a network structure of the Centre with the creation of integrated structures based on enterprises and research institutions will be positive for implementation of goals and objectives. In this area IHTP has sufficient experience, having three joint departments with SB RAS. Such departments as: department of high-tech engineering and department of Materials Engineering joint with Institute of Strength Physics and Materials Science SB RAS and department of High Current Electronics with Institute of High Current Electronics SB RAS.

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