

International Conference on Research Paradigms Transformation in Social Sciences 2014

## Creation of Technical University Center of Excellence

Yakovlev Aleksey N. \*, Kostikov Kirill S., Kozyreva Irina N., Martyushev Nikita V.

*Tomsk Polytechnic University, Lenin Avenue, 30, Tomsk 634050, Russia*

---

### Abstract

Foundation of contemporary economic growth lies in the process of traditional and new production factors intellectualization. The most common support form of such activity is creation of Centers of Excellence. The paper outlines the experience of organizing a Center of Excellence at Tomsk Polytechnic University, goals to achieve in order to create a Center and its work principles. The key idea for Centers of Excellence is a deep connection between scientific and educational processes. This idea is put into practice by integrating the information on state-of-the-art achievements in different fields of science in curriculum.

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

Peer-review under responsibility of Tomsk Polytechnic University.

*Keywords:* centers of excellence, economic growth, Tomsk Polytechnic University, innovations, innovation activity.

---

### 1. Introduction

The USA, European and other countries are moving from “a consumer society” towards “an intellectual society”. Contemporary economic growth is determined by intellectualization of traditional and new production factors. Nowadays, innovations turned out to be a major factor in market competition. New inventions and ideas applied in production of different mechanisms and equipment take about 80-95% of gross domestic product in developed countries. Abroad experience of innovation activities shows that foreign countries pay special attention to innovation development which is characterized by rapid increase of expenditure on researches; investments of business sector to research and technological developments; stimulation of education, science and business cooperation (Wong, 2005, Vesper, 1997). The most common support form of innovation activity in the USA and Europe is creation of Centers of Excellence – organizations that conduct researches in major science fields. Centers are fully equipped and have unique intellectual and human resources. At the moment there is no accepted definition for “a center of excellence”.

---

\* Yakovlev Aleksey N. Tel.: +7-3822-70-56-98  
E-mail address: [yakovlev\\_an@tpu.ru](mailto:yakovlev_an@tpu.ru)

## 2. Creation of a University Center of Excellence

The key factor for success of research and technological developments is productive cooperation of Center of Excellence, scientific and educational institutions and industrial enterprises. The first step towards Center of Excellence creation was made in 2012. Joined efforts of Institute of High Technology Physics (TPU) and JSC “Scientific Research Institute of Semiconductor Devices” resulted in creation of Scientific and educational laboratory of laser technologies. Such consortiums may serve as a platform for creation cooperative R&D centers that will contribute to development of scientific ideas and projects of Center of Excellence.

Center of Excellence is supposed to become a virtual platform for cooperative work development of not only Tomsk and Russian but international research groups. An important condition of Center creation is its activity internationalization including its interaction with leading scientific and educational world centers and creating virtual and real integrated structures (international laboratories, centers, research teams).

Center development strategy includes development program symbiosis of certain institutes of TPU. It is aimed at gaining synergetic effect and fulfilling potential in optimum conditions and productive cooperation.

Effective work of Center of Excellence will be provided by selective support of the most prospective fundamental and applied researches conducted by departments of Institute of High Technology Physics or in cooperation with foreign experts in order to make a list of relevant projects and evaluate potential project results. It should be taken in consideration that in 2012 Institute of High Technology Physics organized Scientific and technical council for scientific activity coordination, effective support of scientific and technological developments and innovation projects of research groups and departments of the institute and also for integration of research groups and laboratories of High Technology Physics Institute for conducting cooperative scientific projects (Vidayev, 2014). Council members worked out a plan for regular meetings and organized seminars for research groups, departments and laboratories of the institute.

Further development of Scientific and technical council includes getting allied trade, humanities and economics external experts to take part in enlarged meetings that will serve as a foresight group for a long-term strategy and development plan for Center of excellence and its research fields. Choice of strategy development will be made due to thorough expert work, it will contribute to revealing possible difficulties and problems. Cooperative work of internal and external experts will result in development of business and informal connections, formation of common way of collaboration. It will lead to discussion meetings where representatives of science world, business world and authorities will face the challenges and solve problems (Morimura, 2010).

As a first step toward creation of Center of Excellence, Institute of High Technology Physics organized two scientific and educational centers within Innovation educational program “National Research Universities” with the assistance of Federal purpose-oriented program:

- Innovation scientific and educational center “Electric-discharge and beam-plasma technologies”.  
Project objective: Training of highly qualified specialists and teams of world level professionals in electric-discharge, beam and plasma technologies, highly accurate electronics, research and production in designing advanced technologies and equipment in this field.
- Scientific and educational innovation center “Nanomaterials and nanotechnologies” (“Nanocenter of TPU”)  
Center goals: Interdisciplinary training of highly qualified specialists and teams of professionals in the field of material science, nanomaterials and nanotechnologies; research development and commercialization of TPU projects; professional development of specialists; multiple access center of unique equipment.

The work of the centers proved the efficiency of cooperative efforts of different research teams in implementation of scientific, technical and educational projects. The following results are worth mentioning: quantity and quality increase of scientific papers (in 2011 Institute of High technology Physics published a paper

in journal “Nature”, impact factor – 36,1), increase of economic contracts for scientific and technological developments, gained project “Federal purpose oriented program”, increase of research and development works in total amount of raised finance. The annual amount of presented dissertations is 20. Innovation scientific and educational centers are equipped with research and technological unique equipment unparalleled anywhere in the world. Moreover, Institute of High Technology Physics takes leading positions at TPU in aspects of total working-out, in basic scientific efforts and students research papers in 2011.

### **3. Scientific and Innovation Activity**

Taking into consideration state concentration of efforts and resources in priority fields of science and technology, modernization and innovation technological middle-term and long-term developments of Russian economy, the main factor is concentration of High technology center on these priorities and achievements in certain scientific fields.

The institute has positive experience in commercialization of conducted research results. The importance of the mentioned factor lies in necessity of technological modernization and competitiveness of Russian economy but low innovation activity of Russian industry prevents the institute and the country from rapid development in this direction. That is why Centers of Excellence need complex and long-term state funding, including technological modernization support and production diversification.

A good example that proved its efficiency is Russian Federation government decree №218 “State support of cooperation development of Russian higher education institutions and organizations implementing complex highly technological industrial projects”. As a part of the decree the institute implemented two essential projects: “Development of highly efficient and durable light sources and lighting devices and their large-scale production” (consortium of TPU, TUSUR, TSU and JSC “Scientific Research Institute of Semiconductor Devices”) and “Industrial development of functional, constructional nanostructured ceramics for highly technological industries” (TPU, CJSC NEVZ-CERAMICS). Participation in the third competition resulted in a supported project of TPU, Institute of Physics and Material Science (Russian Academy of Science), and OJSC Rocket and space corporation “Energia”.

The Institute has stable, long-term relations with foreign companies, scientific and educational institutions. Three programs are implemented within Federal purpose-oriented program 1.9 “Researches in priority areas of science and technology in Russia 2007-2013”. These programs are implemented in cooperation with BIZIMET IMPEX (India), Karlsruhe Institute of Technology and Institute for Scintillation Materials, National Academy of Science of Ukraine.

### **4. Educational Activity**

Training of highly qualified specialists demands meeting certain conditions: not less than half year internship at an enterprise of a real sector of economic activity. During an internship students have opportunities to be practically trained and as a result they improve and expand their professional competence.

In October 2011 Tomsk Polytechnic University joined international project CDIO Initiative (Conceive Design Implement Operate). Institute of High Technology Physics takes part in two Bachelor programs (among 7 of them implemented at the Institute of High Technology Physics): “Chemical technology” and “Technological machines and equipment”.

CDIO suggests intensifying practical training courses and integrating problem and project studies. When studying, students will solve different project-oriented problems including difficulties during internships. It is important to point out that at the beginning of an educational process students choose the field of research they would like to conduct during the period of studies including writing and presentation of their final graduation

works. It will give an opportunity to take the studies as a process of development of a certain research. Successful completion of the two pilot programs will allow to use the same educational model for all Bachelor programs.

For increasing the prestige and quality of Excellence center education and specialist training, it is planned to get accreditations of Russian Association for Engineering Education for all educational programs in the field of technology.

Another way of increasing the quality of Center of Excellence education is Double Degree program that allows students to get two diplomas – TPU diploma and a diploma of a partner-institute. Institute of High Technology Physics implements two Double Degree Master programs:

- High technology physics in mechanical engineering (Mechanical Engineering) and Berlin Technical University (Germany);
- High voltage engineering and electrophysics (Electrical engineering and power industry), Institute of Applied Sciences (Aachen, Germany) and Karaganda State Technical University (Karaganda, Kazakhstan).

For increasing prestige of specialties and quality of trained specialists at the Center of High Technologies, DD-system will include maximum amount of available programs. It will contribute to borrowing positive experience from leading foreign scientific and educational centers, and supersede out of date training methods.

New educational program development is supposed to be oriented on industrial enterprises demands. That is why the program will be developed in close cooperation of the educational institutions and industrial enterprises. One of the ways for cooperation development is purpose-oriented training based on special educational modules determining a set of competences for specialists. This type of cooperation is being developed at the Institute of High Technology Physics.

Competitiveness of specialists will be provided by getting second qualification by all students during their studies. More than that it is important to get student understand the idea of long life learning (LLL). Center of High Technologies in its turn will render a wide range of educational services such as professional training for specialists and supervising careers of graduate students.

Creation of TPU Center for International Certification of Technical Education and Engineering Qualifications may serve as an additional incentive for long life learning. Graduate students who annually take the course of professional training will have an opportunity to become an APEC engineer.

At present Institute of High Technology Physics has developed 19 programs for professional training of specialist of pharmaceutical industry, metal heat treatment, nanomaterial science, technologies of bulk nanomaterials and devices, laser and optical technologies, electric discharge and beam-plasma technologies, two programs for professional personnel retraining in oil and gas industry, and specialists of luminous architecture and design. Center activities will include current programs modernization and development of new programs including employer demands and tendencies of world economy.

Development of programs for middle and top managers including not only technical courses but courses of economics, management and law are intended to raise extra-budgetary funds and become prospective platform for educational development of center. Positive side effect of the programs mentioned will lead to cooperation of institutions and enterprises and further industrial implementations of Center projects.

## 5. Conclusion

Process of technical specialists training is supposed to include not only major subjects but a wide range of liberal arts subjects (philosophy, psychology, ethics, sociology, culture history, ecology and rhetoric) that will serve as an essential tool in the work of engineers or managers and will contribute to developing creative thinking, logic, verbal literacy, skillful presentations, communication art and qualified personnel management.

## References

- Wong, E.O.W. (2005) Operationalization of strategic change in continuing education *Source of the Document International Journal of Educational Management*. 19 (5), 383-395
- Vesper, K.H., Gartner, W.B. (1997) Measuring progress in entrepreneurship education *Journal of Business Venturing*. *Journal of Business Venturing* 12 (5), pp. 403-421
- Vidayev, I.G., Martyushev, N.V., Ivashutenko, A.S., & Bogdan, A.M. (2014). The resource efficiency assessment technique for the foundry production. *Advanced Materials Research*, 880, 141-145.
- Khan, W., Iqbal, M., Khan, P. (2014) Sarah university of science and information technology, Peshawar, Khyber Pakhtoonkhwa, Pakistan, *Middle - East Journal of Scientific Research*, 20 (2), 162-166
- Morimura, K., Osabe, K., Karpelowitz, D. (2010) Cultivating a sense of global leadership and global experience among graduate students using the internal education system of a global enterprise *Source of the Document IEEE International Professional Communication Conference 5530007*, 195-198
- Martyushev, N.V., & Egorov, Y.P. (2003). Determination of the signal strength with the computer analysis of the material structure. (pp. 192-194). *Proceedings of the 9th International Scientific and Practical Conference of Students, Post-graduates and Young Scientists - Modern Techniques and Technologies, MTT' 2003*, art. no. 1438190.