Project-focused innovative entrepreneurship training at the University. Experience of BSTU named after V G Shukhov

Nasser Safaie1*, M A Romanovich1,2, O V Domozhirova3 and L G Romanovich3

1Faculty of Industrial Engineering Department in K. N. Toosi University of Technology, Iran
2Department of Hoist transport and road machines, Belgorod State Technological University named after V G Shukhov, Kostyukov St., 46, Belgorod, 308012, Russia
3Department of Economics and organization of production, Belgorod State Technological University named after V G Shukhov, Kostyukov St., 46, Belgorod, 308012, Russia

E-mail: romanovich.ma@bstu.ru

Abstract. The paper deals with current issues of implementing a project-focused model of innovative entrepreneurship teaching for students at Russian higher educational institutions. We present the dynamics of students enrolled in innovative entrepreneurship programs, projects recommended for implementation, as well as the main scientific activities of small businesses. The mechanism for training and infrastructure support of this innovative entrepreneurship training for undergraduates and postgraduates is proposed. The article analyzes the infrastructure support of innovation activities, as well as the positive experience of Belgorod State Technological University named after V G Shukhov that successfully implemented a model of educational scientific innovation complex and makes it aim to support and encourage innovative activities of young scientists and students and commercialize intellectual property of the University. The results obtained in the analysis of the process of organizing innovative activities for young scientists may be of interest to both Russian and foreign companies, scientific and research centers.

1. Introduction

At the modern stage of the global economic system development, the transition to the knowledge economy is becoming one of the crucial elements of the national strategy for improving the country's competitive ability in the international scene. Since the modern global economy in a greater degree bases itself on scientific, technological, and innovative factors in its development, this is what determines the dynamics of production of goods and services, trade, investment, as well as the socio-economic system. Innovations have become an effective means of increasing the competitive ability of market entities including countries, as they lead to the influx of new investments, the creation of new products and markets and new jobs. It is worth noting that innovations form the foundation of socio-economic processes, affect the pace and scale of the reproduction system, and the innovative activity of companies determines their future and, therefore, the future of the entire state.

For this reason, the tandem of universities – business – state in the knowledge economy plays a decisive role. The creation, dissemination and preservation of new knowledge, research and development in the interests of business, as well as the transfer of new technologies, training of specialists who best...
meet the needs of a dynamic new economy – this is an incomplete representation of universities as key factors in the development of the smart economy.

Infrastructure support facilities for innovation activities: University science parks and business-incubators are designed to encourage the creation of start-up companies engaged in scientific research and commercialization of intellectual activity results in various areas of the economy. Research conducted by western scientists in recent years [1-4, 10-17] has shown that infrastructure facilities created on the basis of higher education institutions are considered as the major elements of stimulating the growth of the regional economy. It is discovered that science parks stimulate the University's publication and patent activity and consequently contribute to the employment of graduates and invite successful scientists to work. In the article dedicated to science parks and the development of new technology firms, Richard Ferguson and Christer Olofsson showed that companies that were located in infrastructure support facilities had a higher survival capacity than those that were located outside of it, which is clearly important for the region.

Both universities and public authorities are interested in implementing regional programs and actively support them and act as initiators of projects for the development of regional innovation systems. Universities also receive an effective mechanism for transferring technologies from science into industry and business. Infrastructure support facilities are a place for implementing ideas of scientists, teachers, students, engineers, and entrepreneurs. In turn, the training process for engineers who meet the needs of a dynamic new economy is also being improved [13].

2. Materials and Methods

2.1. Materials

The fields of activity of small innovative enterprises based at BSTU named after V. G. Shukhov correspond to the University's promising research areas (aimed at new markets) and the needs of all regional clusters: construction, machine-building, agro-industrial, mining and smelting, IT-technologies, transport-logistic, biopharmaceutical, tourism and recreation. Also these fields of activity focus on new markets within the framework of the national technological initiative.

Scientific activities of small enterprises are related to the development of machinery and equipment for industry and agriculture, electrical equipment, process control instruments, industrial processes, software; innovative technologies introduction for processing man-made and agricultural waste, quality management and production management systems; design of mechanical equipment, engineering and hydraulic structures.

Currently, thanks to the University system 110 small innovative enterprises have been created, 88 license agreements have been signed and the output volume of products and services of university small innovative enterprises amounted to more than a billion rubles in 2019. At the enterprises, more
than 300 jobs were created from among the University's youth. The number of students enrolled in innovative entrepreneurship programs and projects recommended for implementation is shown in figure 2.

One of these small businesses is LLC "Kompozit". The subject of the enterprise activity is research and development, as well as practical application (implementation) of the intellectual activity results in the field of creating new materials and energy-saving technologies. The company's leading project is the production of energy-efficient composite binder. The production technology of composite binder in this enterprise is protected by security documents. The technology is resource-saving due to the use of energy-efficient equipment and technological waste of metallurgical production as raw materials and obtaining a synergistic effect during dispergation. LLC “Kompozit” is working on a number of projects. Thus, the project for the production of composite binders was presented as part of the Presidential program in Germany, where it received a high expert assessment and partner information and technical support for implementation in the Russian Federation.

Figure 2. Dynamics of students enrolled in innovative entrepreneurship programs and projects recommended for implementation.

In 2017, experimental developments and industrial tests of the new technology "White composite cement production" were successfully completed, and in 2018, the development of industrial production began. These products are now marketed in the Moscow, Voronezh, Tula, Vladimir, Kursk, Nizhny Novgorod, Ryazan, Sverdlovsk and Rostov regions and the Krasnodar territory. Enterprises of the Belgorod region are also consumers of the manufactured products. For example, white cement is used for the production of small architectural shapes, decorative hyper-pressed bricks and paving slab. Composite binder for 3D construction has prospects in the field of alternative construction. It is very important that these products are import-substituting. Also, LLC "Kompozit" implements the intellectual activity results of the departments of lifting transport and road machines, cement and composite materials technology, glass and ceramics technology and others.

Small innovative enterprises that were created with the participation of BSTU named after V. G. Shukhov implement such projects from the section "Smart energy-efficient city" as "Energy-efficient automated system for dispatch control of distributed power supply and essential services of buildings". Their development is implemented in BSTU named after V. G. Shukhov, Belgorod National Research University, Joint Stock Company "Kmaproektzhilstroy ", Close Corporation " Stroycenter", distributed housing facilities in Stary Oskol, etc.

Thus, thanks to the University system, young scientists and SIE employees receive property support in the university business-incubator, research and consulting support in the business centre and
they improve their skills at the school of training in innovative entrepreneurship based on the innovative-technological center and the international technology park of BSTU named after V. G. Shukhov and this in turn helps optimize the costs of enterprises and manage them.

2.2. Methods

One of the main lines of the Belgorod region development is the innovative environment development. For Belgorod State Technological University named after V. G. Shukhov (hereinafter referred to as BSTU named after V. G. Shukhov) this means creating a single educational scientific and innovation space. This very concept is currently being implemented at the University [5,6]. Thus, in recent years, the University has significantly increased the scientific and innovative activities of students and postgraduates. This is evidenced by the dynamics of indicators for the student science and postgraduate studies development. In addition, the Executive authorities of the Belgorod region carry out outstanding work to encourage young people to create and develop businesses, as evidenced by the adopted programs that provide entrepreneurs with access to financial and other resources (subsidies to compensate for the expenses of existing innovative companies related to the innovative products production, guarantees for lending and credit, etc.).

However, students, postgraduates and young scientists involved in research and development can not profit from existing programs due to the lack of necessary knowledge and experience in the field of organization, business and the innovative project management in the high-tech sphere. It is worth noting that even when a small enterprise receives initial capital and places it in a business incubator, it usually has little chance of success [8,9] because of the lack of necessary knowledge and management experience in its field.

This article discusses the development and implementation of a project-focused approach to the field of innovative entrepreneurship. Getting really effective learning outcomes in this field is possible only with a fundamental change in the ratio of practice and theory and their creative combination in the educational process. Since 2012, as an effective measure in solving this problem, the author's training program for 4-5 year students of all specialties under the program "Innovative entrepreneurship" has been first introduced [9].

The first unit is the studying the basics of technological entrepreneurship as part of the General course on innovative entrepreneurship programs for all students of 1-5 courses (bachelors and specialists), master’s students and postgraduates. It is worth mentioning that the course programs were developed with the participation of the Belgorod Chamber of Commerce and industry specialists, the Belgorod regional supporting fund of small and medium-sized entrepreneurship, regional representatives of the innovation promotion Fund, and successful entrepreneurs – innovators.

Here it’s important to emphasize the students who need assistance in self-determination of occupational outlook in the career guidance work carried out by University specialists in 1-3 courses of studying. Students who want to become entrepreneurs in the production and innovation field are trained in various technology entrepreneurship programs for two semesters in their senior years. Such students are provided with "mentors" from the department staff who supervise student projects. Project defense involves creating a business plan for a small innovative enterprise.

The second unit is related to teaching commercialization and technology transfer to master’s students who have identified themselves as enterprise organizers in the high-tech sphere. As part of this training, each master's student takes on their own startup project, which can become an active SIE at the end of training [9].

The third unit is aimed at working with graduate students on the organization of the thesis defense with a possible presentation of the business model. In this case, the respondent is assisted either in protecting intellectual property and entering into a license agreement with a functioning enterprise or they are helped in organizing their own small business.

Based on the selection response of projects for implementation, the leaders (or teams) of the best projects can apply for scientific and consulting, infrastructure and financial support from the University at the organization of innovative enterprises involving students and postgraduates. The University
contributes the rights in the authorized capital of such enterprises, to use intellectual property: inventions, utility models, computer programs and other objects. Thus, during the implementation period of the University's strategic development program, 4,461 people were trained, 1,712 projects were recommended for implementation and 110 small innovative enterprises were organized, where 147 projects were realized. These projects received financial and scientific consulting support from the University, support from the programs of MEDT of Russia and the innovation promotion Fund for the organization and development of youth innovative enterprises.

3. Results
So, as a result of the research, analysis and data systematization of economic literature on the issue of innovative potential of enterprises and specific features of the small enterprise activity in innovation at universities we have developed a model of cumulative innovation potential of small enterprises that were organized on the basis of the University (Figure 3).

![Figure 3. Project-focused model of teaching students and postgraduates innovative entrepreneurship at the University.](http://www.bstu.ru/research/innovations/mip)

The Science and Technology Department of the Ministry of Education and Science noted the positive experience of the research and innovation departments activity at the University complex of BSTU named after V. G. Shukhov. As a result of this activity more than 110 small innovative enterprises were created. With our assistance and joint-authorship with other scientists of the BSTU named after V. G. Shukhov and with the support of the Ministry of Education and Science of Russia we developed an instructional guidelines tutorial called "Small innovative enterprise step by step", which is recommended by the Department of Education for use by all Russian universities. What needs to be done at the R&D stage and the formation of an innovative project? Where is the required amount of finance? How to create a successful innovative enterprise? What is necessary for its development? The sequence of necessary actions is shown as a chain of steps that scientists need to implement in order to successfully commercialize an idea.

Guidelines tutorial is available on the website of BSTU named after V G Shukhov in the public domain [http://www.bstu.ru/research/innovations/mip](http://www.bstu.ru/research/innovations/mip)

It makes sense to provide all categories of students with conditions for practical work on their projects on the basis of an infrastructure support facility (for example, a studied university, a business incubator). Actually, the presence of an incubator helped to implement a pure model of project-focused learning.
Conclusion. The project-focused model of training in the studied universities for technological (innovative) entrepreneurship programs will help implement a comprehensive strategy of participation in the programs for students of all categories: bachelors, specialists, masters and postgraduates. Thus, programs for the target group of masters and postgraduates will involve young scientists in innovative processes and ensure the implementation of their innovative projects in higher education institutions in a shorter time. Programs for bachelors and specialists are also very important, since they will help to select innovative and active students focused on scientific and innovative activities (future masters and postgraduates) as well as prepare innovative and motivated specialists for industrial enterprises and businesses.

4. Discussion
As a result of the analysis of research and materials of scientists and researchers, we found that various studies conducted in this area in recent years by Russian and foreign scientists have shown that infrastructure facilities created on the basis of universities are considered as the most important elements of stimulating the growth of the regional economy.

In our opinion, in the knowledge economy, creating the most profitable University – business – state tandem will play a decisive role in creating, distributing and preserving new knowledge, research and development in the interests of business, which will be key factors in the development of a "smart" economy.

5. Summary
Thus, the implementation of a project-focused model of teaching students innovative entrepreneurship allowed for solutions to a whole range of tasks: from the students’ knowledge and skills acquisition for the entrepreneurial innovative activity to their employment and commercialization of university intellectual activity. This project can be described as a pilot one in terms of its integrity, set of goals, active tasks and effectiveness. Each target group has its own programs taking into account the goals and objectives set. At the same time, it is worth noting the stated positive international experience, which testifies dozens of programs based on one University. In our opinion, the experience of BSTU named after V. G. Shukhov may be of interest to both Russian and foreign organizations and partners. As well as the developed mechanism of the project-focused model and its implementation experience can be used for all Russian universities as a good practise.

6. References
[1] Yang J, Jiao H, Jiang P 2018 Construction of engineering graduate education system based on cultivation of innovation and entrepreneurial ability Social-Informatics and Telecommunications Engineering, LNICST 243 257-265
[2] Wu T 2018 Exploration and practice of talent training mode of mechanical and electrical specialty under the background of engineering education Quarterly Journal of Indian Pulp and Paper Technical Association 30(4) 444-450
[3] Pardo-Garcia C, Barac M 2020 Promoting employability in higher education: A case study on boosting entrepreneurship skills Sustainability (Switzerland) 12(10) 1-23
[4] Winarnowinarno A, Rahayu W, Wijijayanti T 2019 The failure of entrepreneurship education of vocational high school students and college students: Perspective of evaluation instrument of learning results Journal of Entrepreneurship Education 22(1) 5-7
[5] Romanovich L G, Evtushenko E I, Romanovich M A, Yarmolenko I V 2016 Stimulation activities in the area of innovation on the basis of russian universities The Turkish Online Journal of Design Art and Communication 6 2977-2984
[6] Romanovich L G, Romanovich M A, Deryabina S A, Mamatova V V 2018 Engineering activities in russian universities Proceedings of the 4th Annual International Conference on Management, Economics and Social Development (ICMESD 2018) 61 139-143
[7] Domozhirova O V, Slabinskyay I A 2017 Assessment of Costs for Utilization of Amorphous
Magnesite By-Products in Complex Production International Conference "Actual Issues of Mechanical Engineering" 186-191

[8] Romanovich L G, Romanovich M A, Yarmolenko I V, Kuznetsova I A 2018 Technopark based on higher educational institutions of Russia Proceedings of the International conference "Economy in the modern world" (ICEMW 2018) 61 128-132

[9] Romanovich L G, Evtushenko E I, Romanovich M A 2015 Small business of innovation sphere in the conditions of globalization Bulletin of BSTU named after V G Shukhov 6 287-290

[10] Dzisi S, Odoom F 2017 Entrepreneurship Education and Training in Higher Educational Institutions in Ghana Journal of International Entrepreneurship 15(4) 436-452

[11] Cohen D, Hsu D, Shinnar R 2020 Identifying innovative opportunities in the entrepreneurship classroom: a new approach and empirical test Small Business Economics 1-7

[12] European Commission 2008 Entrepreneurship in higher education, especially within non-business studies Final Report of the Expert Group 1-68

[13] Elenurm T 2012 Entrepreneurial orientations of business students and entrepreneurs Baltic Journal of Management 7(2) 217-231

[14] Burylina G, Sanger P, Ziyatdinova J 2016 Approaches to entrepreneurship and leadership development at an Engineering University ASEE Annual Conference and Exposition, Conference Proceedings 2016-June

[15] Hampden T 2009 Teaching Innovation and Entrepreneurship Cambridge 18

[16] Hisashi Y 2010 Entrepreneurship and education Journal of Regional Policy Studies 3-8

[17] Sheregi F, Ridiger A 2016 Small innovative enterprises of universities American Journal of Applied Sciences 13(3) 307-320

Acknowledgments
This work was realized under the support of the President Scholarship; in the framework of the Program of flagship university development on the base of the Belgorod State Technological University named after V. G. Shukhov, using equipment of High Technology Center at BSTU named after V.G. Shukhov.