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Organization of research activity of the university in the transition to innovation economy

The formation of the economy in Kazakhstan based on knowledge is impossible without reviewing the role and functions of classical universities according to modern ideas about their role in the innovation process. World practice shows that key role in the innovative development of the country now belongs to the research (innovation), universities, that embody the best scientific potential, prepare a new generation of professionals able to bring new knowledge and ideas into the final competitive innovative products. The article examines the views of domestic and foreign researchers on the role and functions of universities in the innovation economy. The basic indicators characterizing innovation activity and innovation environment of university, compliance with which can attribute university to research (innovative) type are determined. The complex of measures at the macro, meso and micro level to transform the classical higher education establishment into the research one within the «triple helix» concept is determined.

Key words: innovative university, R&D activity, innovative economy, the «triple helix» concept.

The concept of Research (innovation, entrepreneurial) University emerged as a response to the new needs of a society that expects the contribution of universities to the social and economic development in conditions of high knowledge-intensive production. Research University is a scientific and educational complex with the development of innovation infrastructure (training facilities, laboratories, research institutes, design offices, business incubators, technology parks, R&D organizations), carrying out a full cycle of innovation, allowing to get a profit and is able to implement the training of specialists with skills of innovative entrepreneurship. The aim of a Research University is organizing the relationship and co-existence in one physical space and interactive regime of the processes of education, scientific research and the commercialization of its results.

The model of Research University is built on the interaction of three components: education, research and innovation. The previous model combines two functions of the University — the development of fundamental science and fundamental education. The modern model of the University gets the third function — «flow» of information transmission in the community or «transfer of knowledge» [1].

Considering the evolution of the role and mission of the university in social and economic life, Youtie&Shapira describe 3 models: traditional, present and evolving (Figure 1).

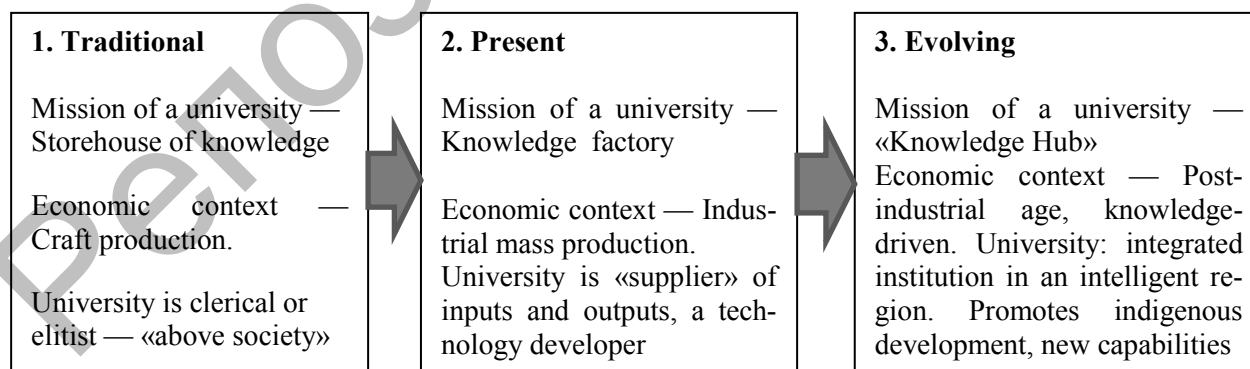


Figure 1. Evolution of the models and the mission of a university (Source [2])

The third model of universities appeared in recent decades. In this model universities function as «knowledge hub», which aim to develop new opportunities and innovation, particularly at the regional level. In this model universities are deeply embedded in the innovation system, actively tend to develop synergies and spillovers to link research with the implementation and commercialization, and act as catalysts and acti-

vators of economic and social development. Universities, of course, have always been institutions of knowledge, but in the third mode, the institute aims to use knowledge actively to contribute to the development and creation of new opportunities in the region and beyond.

The traditional functions of a university including training and basic research are complemented by its activity on the transfer of new technological developments in the industry and business sector. There are many universities that attract in the orbit of its operations the industrial, research, trade and other businesses. Interaction with business is allowed to many universities become the largest educational research and innovation centers. An example is the University of Oxford, which interacts with more than 300 high-tech companies [3].

The professor of Stanford University G. Etzkowitz with L. Leydesdorf developed a new model of organization of the innovation process, which was called by them as «triple helix». In the model a university is recognized as a core of innovation activity. It becomes the main center of focus of the state efforts on the development of innovation, organizes the cooperation with industry, business, largely by taking the functions of their research units. Classical university turns into an entrepreneurial (innovation) University, which focuses on the development of business principles in students along with academic knowledge.

The development of the national innovation system is represented in the model through the evolution of University-Industry-Government (UIG) relationship. In first, called «static» model, state encompasses academia and industry and directs the relations between them.

The second model (called «laissez-faire» model (model of non-intervention) of UIG relationships is a model where institutional scope clearly defined and divided between the players. The relationship between the state, business and university are based on an independent basis.

Finally, Figure 2 shows a model of the «triple helix» that generates a knowledge infrastructure in terms of overlapping institutional spheres, and the players in this intersection, sets conditions of a truly productive relationship.

The goal is to develop an environment conducive to innovation, with the participation of academic spin-off companies, tripartite economic and social development initiatives, strategic alliances between companies, academic and government research laboratories, etc. The role of government is no longer in control of the relationship, but in formulating and promoting these partnerships. Trilateral communication and hybrid organizations are emerged between the three players in the space of the relationship.

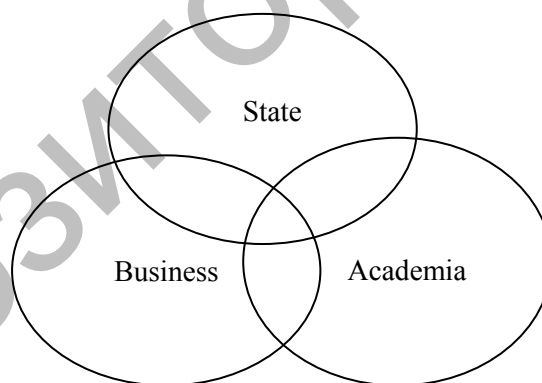


Figure 2. The Triple Helix Model of University-Industry-Government Relations (Source [4; 111])

The basic idea of the triple helix model is to increase the role of the university in the economy and society based on knowledge. In industrial society, the university trains highly qualified professionals engaged in fundamental and applied scientific research, but not involved actively in transfer of technology to industry. In this model the universities become centers capable for creating technology and new forms of enterprise, along with maintaining focus on research and development.

The model of Research (Innovation) University for the first time in Kazakhstan was implemented on the basis of the East Kazakhstan State Technical University named after D. Serikbayev. EKSTU combines technology business incubator, student technology engineering and design bureau. The university placed on its territory a regional scientific and technological park «Altai», which has been prepared 63 investment projects

to date that worth over 10 bln. tenge. Moreover, 58 projects are innovative [5]. This positive experience suggests the possibility of transformation of classical universities in research ones also in other regions of the country.

Effective integration of universities in the innovation system of the country directly depends on scientific and technological capacity, which has each individual university. Currently, at the initial stage of formation of the knowledge economy only small number of universities with appropriate technical base and accumulated experience in fundamental and applied research can active involve in the innovation process. These universities generally are public universities, which have a great experience in educational and scientific activities, represent all levels of training (bachelor-master-doctor PhD) as well as highly qualified teaching staff.

Researchers [6] identify a number of features, compliance with which can attribute the university to innovative (research) type:

- a wide range of areas of specializations including natural science;
- orientation of the faculty on research and development, particularly for fundamental research;
- focus on perspective areas of science and innovation;
- developed system of training of masters and PhD doctors;
- highly qualified teaching staff;
- invitation of leading foreign specialists for reading lectures on topical research areas;
- susceptibility to global experience and flexibility in terms of introduction of new areas of research and teaching methodologies;
- competitive approach in the enrollment of students;
- the development of the university innovative infrastructure facilities, specific technical, scientific and economic space, relations with other educational and research institutions;
- developed corporate ethics, academic freedom in offering of educational programs.

It is important for the university to develop the scientific areas in which researchers and scientists of Kazakhstan have scientific results. Analysis of the publications of local scientists on specific areas of knowledge shows that the greatest number of articles in leading international journals with impact factor in 2009-2013 years was published in such areas as chemistry, physics and astronomy. They comprise over 50% of all published scientific articles [7].

Thus, at the current stage of development of innovative activity in the country it is desirable the active involvement of universities in the innovation system. Especially it concerns ones with significant potential in the educational and research activities, conducting research on natural science areas, in particular in the field of chemistry and physics.

Involvement of the university in the region's innovation activity involves two tasks.

First, it is the development of intellectual potential of university-based training of experts on modern technologies and the involvement of the most capable ones in research activity;

Second, it is the generation and transfer of knowledge in order to accelerate the implementation of innovative technologies in various fields.

The major characteristics of innovation activity and the innovative environment of the University shall be the following indicators:

1) participation of innovative structures of the University, as well as research teams and individual scientists in innovation projects and developments (the number of ongoing studies, the number of applications for patenting, patents obtained, the number of projects and developments in cooperation with the enterprises of the region, the volume of revenues);

2) the creation of innovative infrastructure in universities, providing effective commercialization of high-tech products and technologies (the amount of research, innovation and implementation structures, including industrial parks, business incubators, etc.);

3) support of innovative activity with material, technical and information base (laboratory equipment, the number of personal computers in high school; terminals with Internet access, access to the information resources of the world largest universities, the total number of storage units of the university library collection);

4) the development of intellectual potential of the university (the total number of the teaching staff, staff with a PhD degree, the availability of training programs for masters and PhD students);

5) active participation of doctoral students and young scientists in the development and implementation of innovative projects and development (number of students and doctoral students, participated on paid basis in research in the framework of the research, innovation and implementation structures);

6) cooperation with universities in the educational, scientific and research activities (student exchanges, joint training of PhD students, staff mobility, the holding of international scientific and practical conferences [8].

Thus, the first block of indicators (1–2) describes the innovative activity of the university in the creation and implementation of its own scientific R&D, whereas the other indicators (3–6) characterize the innovative potential of the university and its possibilities in the educational activities that promote innovation.

Despite the fact that the university is the source of innovation, it is difficult enough for researchers to provide industrial implementation of their own R&D. The step of commercialization of R&D requires the establishment of partnerships and interactions with financial and innovative infrastructure of the region, in particular technology parks and regional venture funds, which model is being implemented now in Kazakhstan.

In our view, the provision by the technology parks of laboratory and test services does not solve the problem of commercialization of scientific research and requires increased cooperation in the following areas:

- the evaluation of commercial value and investment attraction of patented R&D;
- access to technopark technological base for manufacturing of experimental samples and pilot lots of high-tech products;
- the search for customers and assist to researcher in obtaining venture financing.

Getting the experimental samples largely determines the capabilities of scientists in obtaining funding from the venture capital funds that could invest in the project up to 100% of the required funds.

An important aspect of commercialization of scientific developments should be the development of practice of intellectual property evaluation by technology park with the aim of making the patent to the share capital of the project and the use of patents as collateral in obtaining loans from commercial banks. The implementation of this measure will allow scientists along with venture funds and technology parks to become a full partner in the project.

Another important aspect for the development of the university is highly qualified teaching staff. The indicator of the high scientific results of the university staff is a high publication activity in international journals with impact factor. According to the analytical Scopus database during the period from 1991 to 2015 the scientists from Kazakhstan published 11,872 articles in journals with high impact factor [9]. The largest number of articles published in the fields of physics and astronomy (20.9%), engineering (14.3%), materials science (13.6%), chemistry (13.0%), which confirms the high scientific potential of the RK scientists on natural science areas (Figure 3).

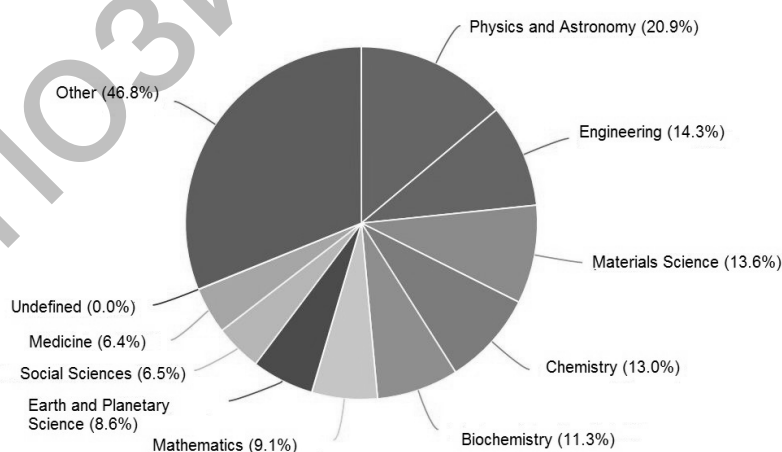


Figure 3. Areas of publications of scientists of Kazakhstan in 1991–2015 years in journals with impact factor, indexed in the Scopus database (Source [9])

In our opinion the implementation of the following measures will contribute to raising of the intellectual potential of the university:

- trainings of teaching staff of a university, incl. scientific internships at leading world universities, participation in scientific internships through the Government program «Bolashak»;
- receiving the state educational order for training PhD students on new specialties within physics and chemistry, also increasing the number of students on available programs with further employment at university;
- attract foreign scientists to conduct joint research projects, guest lectures, the creation of platforms for the exchange of experiences within the framework of international conferences.

At present, the Ministry of Education and Science provides a variety of grant schemes to support scientists and scientific organizations in the framework of Regulations of the grant, program-oriented financing of scientific and technical activity. However, the size of grants for research and development remains small. For example, in 2014 the size of innovative grants for technological innovations in the country reached 1 485,9 bln. tenge, which amounted to only 0.3% of the total cost for this type of innovation (or 4% of the national budget expenditures). In our opinion, it is necessary to increase the amount of grant if the progress of the project has already achieved some results:

- if the application for grant is prepared in cooperation of scientist and entrepreneur. In this case, an increase in grant funding will be appropriate, because there is a guarantee of implementation of project on the production facilities of entrepreneur.
- if the application for grant is prepared by local scientists in collaboration with a foreign laboratory, when the part of the work carried out on foreign equipment and with the participation of foreign experts.
- if the application for grant is prepared by consortium of universities that will jointly implement the project in the fields of specialization of the region, developing production of value-added goods and services.

Thus, at present, the transformation of the classical academia into Research (Innovation) one requires the joint efforts of the actors of national innovation system within the «triple helix» framework at macro, meso and micro level.

On the macro level, the government represented by the relevant ministries, National Agency for technological development creates the necessary conditions for coordinating the work of all elements of the innovation system at the national level, including universities. Government orders scientific and technological research, allocated funds to upgrade material and technical base and innovation infrastructure of a university. The most important recommendations of the support the transformation of the university at this level, in our view, is the introduction of schemes of grant funding for joint projects of research teams and businesses that allows them to implement R&D to production, increase the demand for domestic R&D by the business sector.

On the meso-level the technological parks and regional venture capital funds are active participants of innovation activity. They help to the university to implement projects in priority sectors of the region. In our view, at this stage of support it is important the provision by the technopark a technological base for experimental samples and pilot lots of high-tech products, as well as search for customers and assist in obtaining venture financing of the research projects from the regional venture fund.

At the micro-level, in our view, priority task of a university is to develop a system of material and social incentives for academics and young scientists. Development of the system for the promotion of young scientists will increase the prestige of the scientist, to attract in research the talented young people, to ensure the continuity of teaching staff.

In the long-term period it is important for a university, in our opinion, the creation of endowment fund, which is formed by attracting funds from individual and corporate donors (alumni, charities, patrons). If at the initial stages of the development of fund the funding is not great, then after 10–15 years, these funds can be a significant part of the budget of the university.

The transition from the classical model of university to innovation, research model based on the mechanism of interaction between science, education and production can not be accomplished in a short period of time. The realization of the goal require the implement project-oriented approach to the management of a university, which is based on the promotion and support of initiatives of university staff, efficient operation of institutional mechanism to ensure full using of considerable intellectual potential of a university [10].

The organizational structure of innovative university is constructed as a combination of a vertical hierarchy of educational and scientific departments and the horizontal subsystem, where units are project teams

and creative teams. The composition of project teams of «horizontal university» can be formed from units of «vertical university».

The realization of these measures, in our opinion, will contribute to the active implementation of R&D at the enterprises of Kazakhstan, strengthen links in the chain of education-science-production through the development of innovative function. The innovation activity of universities potentially allows to create the centers to generate innovative activity in the region and institutional framework of regional innovation system, and, on its basis, the national innovation system.

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Д. Диманте, Д.А. Ситенко

Инновациялық экономикаға өтудегі университеттің зерттеушілік қызметін ұйымдастыру

Қазақстанда білімге негізделген экономиканы қалыптастыру классикалық университеттердің инновациялық үрдістегі ролі мен қызметтерін заманауи көзқарастарға сай қайта қарастырмай мүмкін болмайды. Әлемдік тәжірибе көрсеткендей, бүгінгі таңда елдің инновациялық дамуындағы басты рөл зерттеу (инновациялық) университеттерге беріледі. Олар үздік ғылыми әлеуетті қолданып, жаңаша білімдер мен идеяларды бәсекеге қабілетті инновациялық соңғы өнімге айналдыра алатын жаңа буынды мамандар дайындауды жүзеге асырады. Мақалада инновациялық экономика жағдайындағы зерттеу (инновациялық) университетінің ролі мен қызметі қарастырылды. Университеттерді зерттеу (инновациялық) түріне жатқызуға мүмкіндік беретін, университеттердің инновациялық қызметі мен инновациялық ортасын сипаттайтын негізгі көрсеткіштері анықталды. «Үштік орам» концепциясының аясында классикалық жоғары оқу орнын зерттеу университетіне айналдыру бойынша макро-, мезо- және микродеңгейде шаралар кешені анықталды.

Д.Диманте, Д.А.Ситенко

Организация исследовательской деятельности университета при переходе к инновационной экономике

Формирование в Казахстане экономики, основанной на знаниях, невозможно без пересмотра роли и функций классических университетов согласно современным представлениям об их роли в инновационном процессе. Мировая практика свидетельствует о том, что ключевая роль в инновационном развитии страны сегодня принадлежит исследовательским (инновационным) университетам, которые воплощают в себе передовой научный потенциал, ведут подготовку нового поколения специалистов, способных воплотить новые знания и идеи в конечную конкурентоспособную инновационную продукцию. В статье рассматриваются взгляды отечественных и зарубежных исследователей на роль и функции университетов в инновационной экономике. Выявлены основные показатели, характеризующие инновационную деятельность и инновационную среду университета, соответствие которым позволяет отнести университет к исследовательскому (инновационному). Определен комплекс мер на макро-, мезо- и микроуровне по трансформации классического вуза в исследовательский в рамках концепции «тройной спирали».

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