

KEYS TO CREATING AN EFFECTIVE REGIONAL INNOVATION INFRASTRUCTURE

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Abstract. Integration processes in science, education and production are driven by the acceleration of scientific and technological progress, the introduction of innovative scientific developments into mass production and the informatisation of the economy. The development of knowledge-intensive industries places new demands on the training and retraining of innovation-sensitive personnel, as well as on science, education and the economy as a whole, which are currently unable to develop effectively independently and adapt to changes in technology and engineering. The *purpose* of the article is to find promising areas for the development of education and science based on their integration with business entities not only within the limited space of regions, but also on the basis of spatial integration of territories with a special geographical location. *Methodology.* The necessary and socially significant conditions for the integration of science, education and business are the achievement of knowledge and skills, goals and values related to the acceleration of the reproduction of innovation potential in society, awareness of the role of science, education and business in solving problems of innovation development, and also their integration interaction in this area. *Practical implications.* Three main levels of economic systems are allocated: individual, organisation, and region. It has been determined that the degree of influence of innovation processes on them is determined by the presence and condition of three factors necessary for the formation of innovation susceptibility (stabilising, activating and structural). *Value/Originality.* Based on the concepts of the main innovation systems and the necessary conditions for innovative economic growth, the authors have clarified the content of the category "innovation receptivity of the region". The paper also reveals the basic principles of building a model of innovation receptivity and determines the degree of interdependence and interdependence between its constituent elements based on a systematic approach.

Keywords: region, innovative infrastructure, higher education institution, innovative form, efficiency.

JEL Classification: O18, O32, I29, O31, G14

1. Introduction

One of the main areas of innovation development is the creation of an infrastructure that integrates the resources of science, large enterprises and small and medium-sized enterprises. The innovation infrastructure includes scientific, technical, educational and industrial organisations and their associations, technology incubators, technopoles, technology parks, training and business centres, innovation and venture funds, other specialised organisations, as well as innovation and technology centres and technology commercialisation offices. The regional innovation infrastructure includes

a number of economic entities that facilitate innovation activities, including the provision of services for the creation and sale of innovative products. The infrastructure of the innovation system includes technology transfer centres, innovation and technology centres, technology parks, business incubators, venture capital funds, etc. The main task of the regional innovation infrastructure is to help solve the problems of using the resources necessary for the innovation process.

The practice of foreign countries shows that the status and importance of small and medium-sized enterprises is maintained despite the dominant

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position of large businesses in innovation processes. This is primarily due to the development of specialisation and the separation of functions of large, medium and small production with the convergence of their technical level; as well as the development and implementation of new technologies that do not require large capital investments, production lines and machine complexes and are effective at relatively small production volumes.

A business incubator is an innovative small business support infrastructure facility that facilitates the creation of the necessary conditions and supports entrepreneurs at an early stage of their business, provides them with non-residential premises free of charge for a certain period or for rent, and provides consulting, legal and other services.

Ukrainian business incubators are mostly funded by international donor organisations and provided with premises by employment services at city and district state administrations. The sources of their funding are most often international funds and grant programmes, and only to a small extent local administrations and sponsors. To promote the development of business incubators in Ukraine, the Ukrainian Association of Business Incubators and Innovation Centres was established.

2. Sequence of Creation of Regional Innovation Infrastructure

As is well known, the process of creating a new (innovative) product goes through several stages, from the emergence of an idea through basic research and development of a product prototype to mass production and sale to the consumer. This entire path, called the innovation corridor, is based on the use of a whole range of resources by enterprises in the course of their activities: production and technological, financial, human, information and other resources (Rohatina, 2018). The innovation infrastructure provides access to these resources, the availability and condition of which, as well as the ability of enterprises to use them, determine the effectiveness of innovation activities.

Innovation infrastructure is divided into the following types (subsystems):

- Production and technology (technology parks, innovation, innovation and technology centres, business incubators, etc.);

- financial and economic (various funds and financial institutions);

- consulting (technology transfer centres, organisations that provide consulting services to innovation entities on the use of intellectual property, standardisation and certification, and so on);

- human resources (educational institutions, innovation centres, business incubators, technology parks, and so forth);

- information (databases and knowledge, analytical, statistical and other centres providing access to information);

- marketing (organisations that promote innovative products on the market).

Consider the role of individual infrastructure elements and the problems of their development in accordance with the described subsystems.

In the process of transforming a higher education institution into an innovative one, an appropriate infrastructure should be formed to create conditions for small enterprises to access production resources. To ensure access of researchers, postgraduates, students, inventors and innovators to production facilities and necessary equipment, either innovation centres, technology parks or innovation and technology centres are created (Korytko, 2012).

The advantages of setting up technology parks, and also innovation centres and small innovative enterprises at higher education institutions, are obvious: if they exist, researchers do not need to leave their laboratories or departments, as they can work part-time in companies that implement their ideas, and the technology park or innovation centre provides qualified management. The main feature of the innovation centre is that it is essentially a support structure for already established small innovative enterprises, providing them with advisory assistance as well as at the stages of their creation and formation. This is the main difference between an innovation centre or innovation and technology centre and a technology park. Therefore, in an ideal world, technology parks should be established at universities and serve as incubators for small firms, while innovation and technology centres are designed to provide more sustainable links between small businesses and large specialised enterprises, and thus should be established at large enterprises or research and production complexes. However, almost half of the innovation and technology centres were created at universities, often on the basis of existing technology parks, so these two types of innovation infrastructure components largely perform identical functions and even overlap to some extent.

The list of business incubator services includes (Zhavoronkova, 2010):

- Lease of non-residential premises to small businesses, depending on the time the business stays in the incubator (the first year the rent is 40% of the established rent, the second year – 60%, and the third and last year no benefit is provided);

- telephone connection (except long-distance), 100 MB of Internet traffic per month, access to the business incubator's information databases;

- tax, legal advice, business plan development, market research, management consulting.

In connection with market transformations in higher education, the system "higher education institution" by the nature of its relations with the external environment is increasingly acquiring the characteristics of an open production system. Underestimation or ignoring the properties of the open system "higher education institution" in the practical activities of managing the training of innovation-oriented specialists may be one of the main reasons for the development of shortcomings inherent in the current state of higher education.

The degree of openness of a system is determined by the nature of its relations with the external environment.

In relation to the university, which carries out educational, scientific and innovative activities, the external environment as its infrastructure with which it interacts includes all levels of legislative and executive power, regional education authorities, sectoral ministries, departments and their regional structures; employers and business communities (legal entities of all forms of ownership); associations and unions (communities); non-governmental organisations (movements, societies, foundations); scientific institutions, subdivisions of academies of sciences, regional scientific societies; social environment institutions; educational institutions of other levels; contractors related to the university's scientific and innovative activities; consumers of the products of the university's scientific and innovative activities. At the same time, it is necessary to consider the mechanism of functioning of the system "higher education institution" as an innovative one in relation to the external environment, which is, first of all, the innovative economy.

The system of "higher education institution" is constantly under the influence of the external environment, primarily the development of the labour market and higher education services, which force it to take actions aimed at creating its sustainability and survival as a structural unit, especially in the competitive struggle.

The current situation requires a different approach to managing the training of specialists through the organisation of the university as an open system that functions under the influence of a stochastically changing external environment, interacts with it, and is able to respond adequately to these changes, i.e., solves the second task.

Development management through the second feedback loop belongs to the category of strategic management. An innovative higher education institution as a producer of higher education services of a new, innovative direction, which in a market economy is considered as an open system, can successfully function and perform its main production function – the formation of a personality

and a competitive specialist in the labour market – only if it is able to adapt to the influences of the external environment.

The implementation of the principle of necessary diversity and external complementation is determined by the need and possibility of solving innovative and educational tasks, depends on the real conditions of the university and can take various organisational forms:

The university complex as a single legal entity is an autonomous university;

the university complex as a single legal entity with a developed external infrastructure that ensures the implementation of the full cycle of the innovation process from research to the transfer of finished products and technologies to the economy and social sphere on the basis of cooperation agreements in the field of training, research, and joint production with enterprises and business structures in the region;

an association of educational institutions, research, design and other commercial organisations created to implement innovative projects and developments of the university.

3. Efficiency of New Forms of Innovation Infrastructure in the Region

The effectiveness of the new form of university as an innovative one depends on the level of adequacy of the regulatory framework for its activities. Thus, the current regulations in the field of education orientate universities to provide the minimum quality of educational services guaranteed by the state.

It is advisable to consider incentives for employers and businesses through preferential taxation, up to full tax exemption, for funds and resources invested in the development of universities, and in the case of training, to allow them to include the costs of targeted training in the cost of production.

The effectiveness of an innovative university depends on the degree of adequacy of the regulatory framework for its activities and requires appropriate amendments to existing laws and regulations.

The focus of an innovative university on meeting and developing the needs of consumers requires a legitimate opportunity for consumers (employers, business structures, etc.) to participate in assessing the quality of graduates, curricula, developing recommendations for the development of new areas of professional training, assessing the quality of research and innovation, providing their material and technical base and human resources for the organisation of scientific, innovative and industrial practice of students (Putsenteilo, 2017).

At the same time, it should be borne in mind that the term "entrepreneurship" in relation to education and science meets with mixed reactions in the wider

academic and teaching community. Clark also noted that the term "entrepreneurial university" has a negative connotation in the eyes of many members of the academic community. It evokes associations with individual entrepreneurs, people who are aggressive and business-oriented, looking for maximum profit. This public perception was one of the reasons why, when the universities participating in the Clark's study came together as an association in 1997, they used a different, more neutral and generic term for their universities – the innovation university. The association was named the European Consortium of Innovative Universities. However, these universities essentially recognise themselves as business organisations.

An interesting definition of an innovative university is given by the European Consortium of Innovative Universities (Chandler, 1990): "The founding universities (meaning the founders of the consortium, i.e., the innovative universities) have several characteristics in common. All of them have a high level of teaching in engineering and social sciences; all of them are relatively young, entrepreneurial and progressive; all of them have close links with industry

and the regions where they are located. They are committed to developing and implementing new forms of teaching, learning and research; to fostering an innovative culture within their walls; to experimenting with new forms of management and administration; and to supporting and nurturing staff with an international mindset."

Thus, a "research" university is an innovative university at an early stage of its development, while "entrepreneurial" and "innovative" universities are, in principle, synonymous with the same name.

Innovative development of the university is a complex, multi-level process of integrated implementation of innovative technologies and research and innovation activities in all structural units and areas of the university.

At the same time, the transformation of universities into innovative ones requires the development of an appropriate methodological framework. Figure 1 shows the relationship between the main concepts of transforming technical universities into innovative ones.

Integration processes in the fields of science, education and production are driven by the

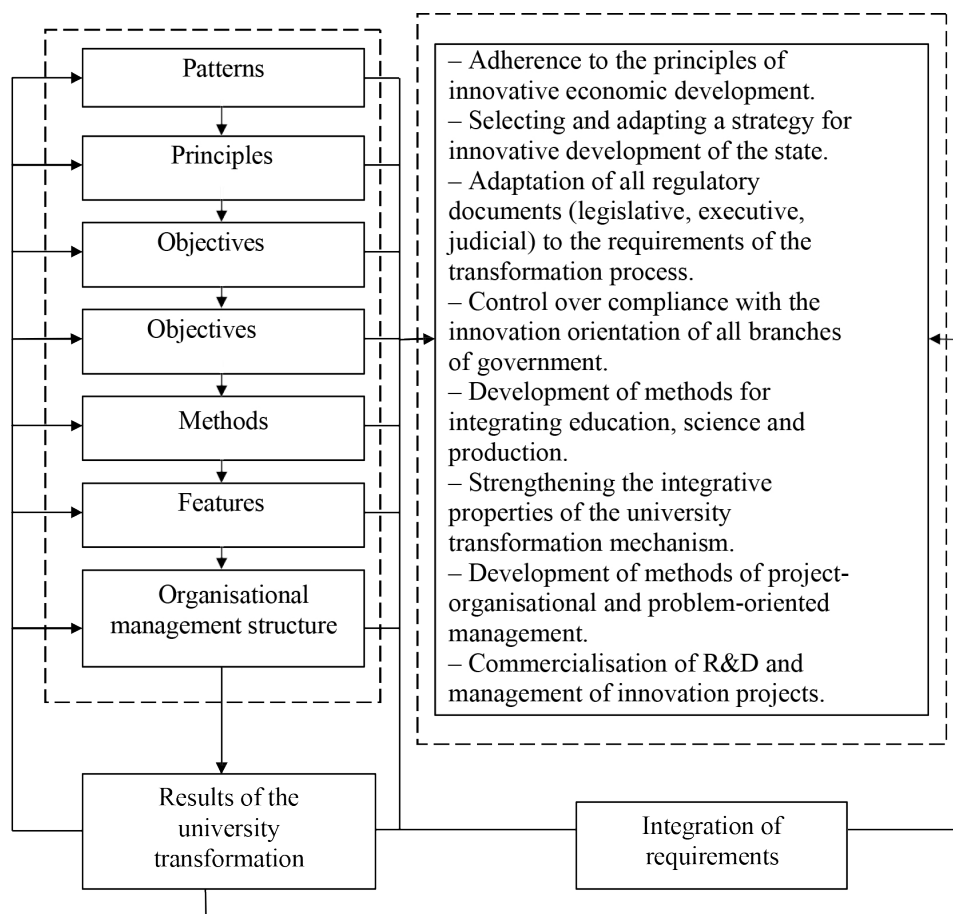


Figure 1. Interrelation of the main concepts of university transformation

Source: developed by the authors

acceleration of scientific and technological progress, the introduction of innovative scientific developments into mass production, and the informatisation of the economy. The development of knowledge-intensive industries places new demands on the training and retraining of innovation-sensitive personnel, as well as on science, education and business as a whole, which cannot develop effectively independently of each other and adapt to changes in technology.

4. Patterns of Transformation of Universities to Innovative Status

Consider these groups of patterns in more detail, mainly by grouping them.

1. Group of renewal and development patterns:

Renewal of education based on qualitative changes under the influence of new scientific, innovative technical and technological changes, socio-economic and political factors;

renewal of education by resolving contradictions between its form and content, innovation and conservatism, supply and demand for types and quality of educational services;

cyclical updating of education through educational reforms, strengthening the factor of continuity in educational innovations;

increase the knowledge intensity and innovation of modern education;

adjustment of innovation and educational cycles due to the obsolescence of new knowledge and scientific and technological progress.

2. Group of pedagogical regularities:

Growth of the innovative component in curricula and programmes, teaching methods in line with the global processes of integration of education with science and practice, and increased competition in the educational services market;

acceleration of knowledge obsolescence and the related increase in the fundamental nature of education, the pace and scale of its renewal;

certain temporary destabilisation of the pedagogical process when introducing scientific and pedagogical innovations;

reorientation of pedagogical innovations towards a rational combination of teaching methods, processes and ways of learning knowledge with the processes of developing innovative abilities;

increasing the role of interdisciplinary and multidisciplinary scientific and pedagogical innovations in connection with the development of these processes in science and the real growth of practice needs for multidisciplinary specialists at the intersection of different types of professional activities, multidisciplinary specialists-systems and polyprofessionals;

transition from predominantly specialised pedagogical innovations to integrated cluster innovations due to the development of new educational information technologies and interdisciplinary approach to training courses;

the emergence, growth and strengthening of the role of scientific and pedagogical transfer in the transfer of knowledge to the educational process and, accordingly, the strengthening of transfer links between science and pedagogical practice.

3. Group of economic regularities:

Cyclical changes in economic activity in the field of education in accordance with the dynamics of general cycles of economic development, scientific and innovative activity of society;

temporary destabilisation of economic attributes and parameters of educational systems depending on the degree of their renewal (decline in economic indicators, inconsistency of subsystems, disruption of economic rhythms in them);

increase in the integrated efficiency of spending on innovative programmes compared to the efficiency of spending on traditional educational systems, programmes and activities;

change of the negative dynamics of indicators of economic efficiency of educational systems during their development to positive trends and again to negative ones in the overall dynamics of the life cycle of educational innovations;

obsolescence of educational innovations due to the emergence of more advanced and effective specialised innovations in the relevant field of education;

increasing economic risks of educational systems depending on the degree of novelty of the innovative changes implemented in them;

increasing the role and scale of special innovation resources (financial, material, human) in the overall resources of the education system and individual universities, depending on the growth of innovation in the economy and society;

improvement of the innovative receptivity of educational systems depending on the growth of their competitive market advantages;

rising prices for training specialists in innovative universities in terms of the cost of purchasing new equipment, machinery, and devices, while reducing the specific cost of training these specialists.

4. Group of organisational and management patterns:

Strengthening specialisation and cooperation in design and development, technology, research and experimentation, direct implementation and marketing of scientific, educational and innovation activities with the growth of innovations in education;

the emergence and growing role of innovative structures, forms and methods of management in the system of organisation and management of

educational institutions in the context of increasing innovation in society, economy and education;

transition from predominantly spontaneous and spontaneous forms to predominantly managed forms of educational innovation;

the emergence and growth of the role of scientific, innovative educational management, which uses the reserves of effective education based on traditional management;

differentiation of management in education into a triad of organically interrelated forms: reproductive, innovative and general, combining the first two depending on the state and objective needs of the educational system;

reducing the role of administrative and increasing the role of economic methods of managing educational innovations in the context of the development of the educational services market and strengthening the economic interest of educators in the results of work on updating the educational process.

5. Group of social regularities:

Intensification of the innovation movement in the scientific and pedagogical environment in the context of objective educational reforms, and vice versa, the pattern of decreasing activity of this movement in case of delayed reforms, their inhibition and deformation;

increasing the importance of the innovation component in the structure of motives for scientific and pedagogical activity in the context of growing innovation in the economy and society, and the competitiveness of education;

social adaptation of science and education workers to new conditions, forms, methods, norms and values of the educational process in higher education institutions based on innovations;

social differentiation of educators in their attitude to educational innovations;

individual and group resistance to educational innovations, in particular, the pattern of reducing this resistance as their duration rationally increases;

the pattern of increasing resistance with the growth of their depth and scale, the pattern of increasing resistance with the growth of the stability of the position of teachers and pedagogical teams, the pattern of decreasing resistance to innovations as the crisis state of educational teams and structures manifests itself;

emergence of social conflicts between different categories, individuals and groups of teachers, depending on the degree of depth and scale of the educational process renewal and distribution of results (effects) of educational innovations;

increased complexity, riskiness and remuneration of teachers-innovators, as well as an increase in the overall complexity of teachers' work during the period of educational innovation;

strengthening the social differentiation of educators by income level in the context of market innovations and education sector reform;

renewal of elites in the educational sphere in the context of fundamental and large-scale reforms; this pattern is closely related to another, which determines the dependence of the quality of new elites on the real goals and methods of educational reforms that are actually implemented (not declared);

increasing the role of innovative qualities and actions of educational leaders and staff in shaping and ensuring their social image and authority in line with the growing innovativeness of society, economy and education;

a decrease, *ceteris paribus*, in the innovative activity of teaching and management staff of educational institutions with an increase in their average age.

6. Group of political regularities:

Increasing the priority of the innovation component in educational policy during the period of educational reforms, in the context of the growing innovativeness of the economy and society, as well as with the growth of crisis phenomena in education, has led to a pattern of increasing the political status of managers responsible for innovation in education;

consistent globalisation of educational innovations with the development of the globalisation of the innovation economy;

the growth of political consciousness and movement of the pedagogical community in the context of the formation, development and improvement of the political structure of society, the need to restore the mechanisms of relations between politics and education, especially in the context of educational reforms;

cyclical forms of relations between the authorities and leaders-innovators of the educational sphere;

the emergence and functioning of the educational lobby in the state authorities;

the emergence and growth of political significance of the problems of development and renewal of education in the programmes and organisational structures of political parties and socio-political movements;

the appearance and consistent growth of political resources and the effect of reforms in education in line with the growing innovativeness of the state's general policy and the formation of a knowledge economy.

These patterns lead to the emergence of appropriate principles for transforming a university into an innovative one. In our opinion, unlike most post-Soviet countries, the Ukrainian education system is more flexible for innovative transformations.

In line with the above measures, a number of measures should be taken at both the national and regional levels to facilitate university-enterprise cooperation.

5. Conclusions

Thus, the transformation of technical universities into innovative ones is inextricably linked to the business environment, in particular, cooperation with regional enterprises. That is, successful development strategies for both universities and enterprises are largely dependent on legislation, financial support and government incentives.

The result of such cooperation is the development of regional infrastructure, the creation of science and technology parks, business incubators, educational, research and production, innovation and production complexes and other elements of innovation infrastructure on the basis of the technical university. The level of technological development of production and the degree of receptivity, i.e., the demand for products and results obtained in the innovation sphere by society as a whole and specific consumers in particular, is considered an important factor in the effectiveness of scientific, technical and innovation activities in the region.

The formation of innovation receptivity of business entities involves a group of measures related to the regulatory and legal support of innovation activities, the creation of typical elements of the mechanism and regulation of innovation policy, and public

awareness through propaganda, scientific disciplines, conferences, etc. The most important role belongs to the human factor, which has the main potential and, at the same time, the main danger in shaping innovation receptivity. In this regard, there are growing demands on the quality of education, its scientific nature and adequacy to the requirements of practice. The constraints to restoring these systems and bringing them into a single field of social partnership are the weak development of forms of self-organisation and self-regulation of business, low corporate culture of employees, weak interconnection between education, science and enterprises, and insufficient regulatory support. The solution to these and other problems of integrating science, education and production largely determines the development of innovation activity in the territory and its competitive immunity.

The sphere of innovation activity in one way or another forms the knowledge capital that forms the basis of the innovation economy, which ensures the competitiveness of business entities. The local nature of competition is transforming to a global level. These changes are accompanied by liberalisation of markets, which intensifies the highly competitive global economic environment.

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