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UNIVERSITY INNOVATION INFRASTRUCTURE MODEL AS A KEY PART OF A TERRITORIAL CLUSTER

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Abstract

Over the recent decades there have been increasing efforts by developing countries to reduce the economic gap between developed and developing countries. Asian and Northern European countries demonstrate good progress in these areas. Sweden, Denmark, China show stable high economic indicators that have been achieved by targeted government programs. These programs were aimed at creating a new type of economy based on knowledge and new technologies. Given the success of these countries, a number of developing countries, whose economies are dependent on resources, today, are looking to repeat their way; those countries are Russia, Indonesia, Brazil and Chile. The modernization of the economy and the formation of innovative economy are key objectives of the state policies of these countries. The research by leading economists and scientists led to the conclusion that the regional level of national economy plays a key role in formation of knowledgebase economy, which indicates the need to differentiate the innovation policy of the state depending on the economy parameters of each region.

This paper presents a model of the first stage of the formation of the entrepreneurial university - University innovation infrastructure model, which is a key part of a territorial cluster. The article consists of five parts. The first part covers the analysis of the two main models of regional development: clustering theory and Triple Helix. This section describes a positive result, which is achieved by using these models simultaneously. The second part of the article shows the importance and the role of the entrepreneurial university in the formation of innovative clusters. It will be explained how and under what conditions this formation is achieved.

The third part of this paper will present University innovation infrastructure model. The fourth part will examine the practical first steps to create a cluster "Vorob'evi Gori" on the basis of the Moscow State University. The fifth, final part contains the main conclusions of the article and the next steps in the investigation of this subject.

Keywords: clusters, infrastructure, integration, entrepreneurial university, university-industry links (UIL).

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Regional development concept

Currently, there can be distinguished two dominant concepts of regional development:

- The cluster concept, based on the relationship of a number of organizations;
- Triple Helix Model.

1. The cluster concept

Clusters are becoming one of the key tools of innovative ecosystems. They are aimed at strengthening the links between the main participants: business, science, education, business associations, etc., which in turn leads to the strengthening of the position of participants in the market. As a result, the finished product is competitive and leads to the development of the region and the country as a whole.

Cluster policy is gaining popularity both abroad and in Russian regions. The most striking examples in Europe are: Austria (Styria), Germany (North Rhine-Westphalia (BioRegio InnoRegio), Italy (Veneto), France (Competitiveness Clusters), in Asia: Singapore, Indonesia.

A. Marshall and M. Porter are considered to be the ancestors of the cluster theory. At the end of XIX century, Alfred Marshall described in his work "Principles of economic science" relationship between efficiency and geographical localization of production, having urban agglomerations and industrial districts as an object of his study. Michael Porter introduced the theory of competitiveness and a diamond model of its assessment ("diamond model"), in his book "Competitive advantages of nations" (Porter, 1990.)

Over time, the interest in the study of clusters increased. There are several classifications of the clusters. This article will provide an analysis of formation of innovative and territorial clusters only. They are mainly defined as follows: "Innovation clusters means groupings of independent undertakings – innovative start-ups, small, medium and large undertakings as well as research organisations – operating in a particular sector and region and designed to stimulate innovative activity by promoting intensive interactions, sharing of facilities and exchange of knowledge and expertise and by contributing effectively to technology transfer, networking and information dissemination among the undertakings in the cluster. Preferably, the Member State should intend to create a proper balance of SMEs and large undertakings in the cluster, to achieve a certain critical mass, notably through specialisation in a certain area of R&D&I and taking into account existing clusters in the Member State and at Community-level¹."

2. Triple Helix Model

In recent years, the unique Triple Helix theory uniting the state with universities and business communities is winning more and more supporters. The main idea of TH theory is the presentation of the university which in future becomes the main institution of a knowledgebase society. Industrial corporations as the basis of society, capitalistic or socialistic, are looked upon as the dominant force of community organizations during production of goods and services. As a result, each stage of innovative product development features cooperations between certain institutions. At the initial level of generation of knowledge it is the government and the university which cooperate, then, during technology transfer, the university cooperates with business, and finally, it is the business together with

the government who bring the product to the market. Thus, the product is developed and promoted spirally. Integration among institutional spheres of universities, companies and government while fulfilling each other's functions along with their own, suggests a creative approach to organizational process development, which in turn becomes the reason of the appearance of various organizational innovations.

In the scientific world, there is criticism of Triple Helix (TH) theory, aimed at the lack of theoretical background of the model, such as:

1. Inability to do quality measurement of results when applying TH (Drobot 2009).
2. Failure to account for the specifics of the countries where TH is to be used.
3. Vague mechanisms of achieving cooperation among science, business and government.

Some of the answers to these questions can be found in the combination of two models of regional innovation development: clusters and TH; they do not contradict, but rather complement each other. Clusters can be created and used as a hybrid organizational format of interaction of universities, business and government, and the TH model can be a tool of regulation among cluster members.

Role of an entrepreneurial university in the formation of innovative clusters

The cluster includes research organizations, universities and colleges, which supply specialists, as well as new knowledge, ideas and technologies that underpin the competitiveness of cluster members. Universities are key players in TH theory according to which it is important to maintain communication with students after graduation, as they are intermediaries between university science and business.

Building of high-tech clusters and creation of business environment can best be achieved by the development and support of strong universities, which attract talented students, and higher educational programs, as well as the presence of highly qualified faculty. [Botot S., Satincky D. 2011]

Market conditions lead to the fact that in recent years the university begins to act as an entrepreneurial organization. Universities cooperate with industry organizations, do joint research [Bokov L.A., 2011]. Researchers receive budgetary funds on the condition of having an agreement with industry partners, interested in the research results. In this chain there is a positive factor that the studies are more likely to be in demand as they interest business.

¹ [<http://www.innoviscop.com/en/definitions/innovation-clusters>]

This trend is becoming increasingly popular; the confirmation is the creation of knowledge-based companies at universities within clusters. These include the spin-in, spin-out, spin-offs.

entrepreneurial universities shows that the first major step in forming innovative universities is building infrastructure.

Table 1

Classification of high-technology (innovative) enterprises based on Triple Helix of Innovations Model

Organizational forms of high-tech enterprises	Name of a hi-tech enterprise in hi-tech business	Sphere of business (startups) of high-tech enterprises
Small innovation business	Spin-in, spin-out, spin-off	University (scientific) field
Medium and big innovation business	Hi-tech, making foreign direct investments (active and passive) of high-tech level	Government
	High-tech enterprises of military-industrial, defence complex of the country	Business

Source: composed by the author T. Pospelova

Thus, universities are involved in the process of cluster formation, so theoretical study and practical implementation of present day forms of knowledge-based companies formed in university environment becomes possible [Shaimieva E.SH, 2011]. As a result, there is a change inside universities: traditional universities are transformed into entrepreneurial [Pospelova 2012].

The entrepreneurial university is the next step after the implementation of a model of a research university, which will create a new balance between science, education and innovation in business. This in turn requires the creation of a strategic plan for the development of the necessary mechanisms and processes of modernization of university management. When forming an entrepreneurial university, the strongest field or program of the university needs to be chosen.

H. Etzkowitz identified the following features of the entrepreneurial university:

- Increase the volume and provide a world-class basic and applied research
- Ensure integration of entrepreneurial activity in the daily academic work of the university and participate in the development of the region
- Demonstrate commitment to the formation of hybrid organizational formats in interaction with business and government.

Formation of an entrepreneurial university is a unique process; there is no single universal phased model that guarantees results. The experience of existing

Further, the analysis of university innovation infrastructure as a fundamental element in the formation and development of the entrepreneurial university cluster will be presented.

University innovation infrastructure model

The key purpose of university innovation infrastructure model formation and development is to modernize the university in the direction of effective use of the results of intellectual activity (RIA) established in the university, in accordance with the model of entrepreneurial university. It seems that a harmonious university innovation infrastructure model incorporates all

five elements required for the transformation towards an entrepreneurial university proposed by B.Clark, namely: strengthened steering core, enhanced development periphery, discretionary funding base, stimulated academic heartland, integrated entrepreneurial culture¹.

The general university infrastructure model of the entrepreneurial university, which is part of the innovation cluster, consists of following elements (Fig. 1).

A. Foresight center in priority spheres of science-technical and socio-economic development

Research, scientific and technological development of the University is the basis for further innovation and entrepreneurship, the development of new technological solutions, products and services - assumes the constant foresight as a part of university everyday functioning. Under foresight we shall identify the technic of critical thinking in the direction of long-run development, which enables to develop the long-run trends in the priority fields of science and technology, that can be formed into tasks for researchers and developers.

Obviously, the implementation of foresight, forecasting activity in the University can not be performed at the same high quality level in all universities interested in the development of innovation and entrepreneurship. Thus, there are three basic approaches to implement this task in the University:

1. University as an industry forecasting center for the scientific, technological and socio-economic development.

¹ Clark, B.R., 1998; Clark, B.R., 2004.

Table 2

Main features of entrepreneurial universities

Capitalization	Knowledge is created and spread to be implemented into practice and disciplinary development. Capitalization of knowledge becomes the base of economic and social development, and as a result, increases the role of a university in society.
Interdependence	An entrepreneurial university actively cooperates with business and government.
Independence	An entrepreneurial university is a relatively independent enterprise; it is not a structure established by other institutions, neither it is dependent on them.
Intermixture of forms	Conflict resolution between independence and interdependence principles led to the occurrence of hybrid organizational forms, which are able to reach both goals at the same time.
Reflexivity	Due to continuous renovation of internal structures of the university and its relationship with business and government, there is a constant redevelopment of their relationship with the university.
Commercial interest	Universities should aim at commercial interests and use market experience.

Source: composed by the author T. Pospelova

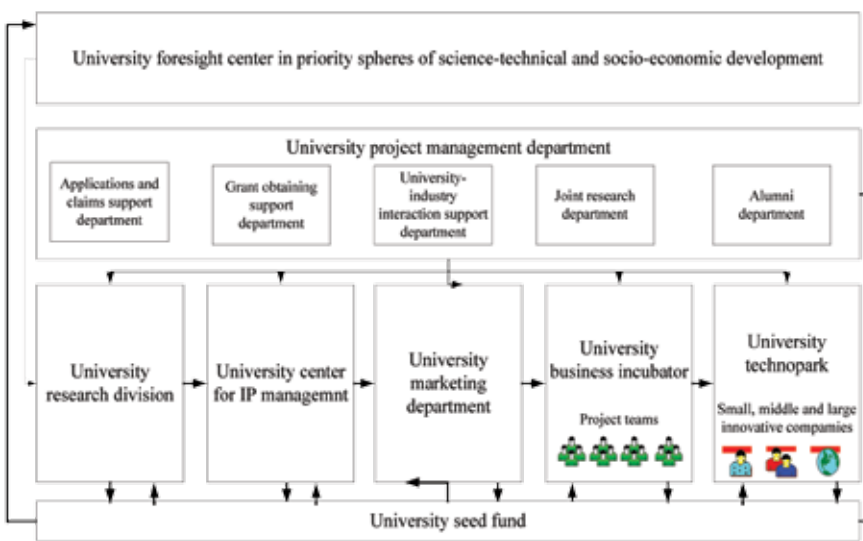


Fig. 1. University infrastructure model of the entrepreneurial university

Source: "Russian universities innovation infrastructure model organization", PhD, A. Engovatova, 2013

laboratories and research institutes. Proposed is the allocation of three levels of responsibility for the harmonious and efficient development of project activities within the University. A central coordination of project activities, as in the interests of the University as a whole and for individual structural units initiating different projects, is allocated at the first and highest level. Leadership at this level is exercised directly by the rector, as well as by vice-vector and deans. In the second, average level

2. University as a performer within the trend set by the industry forecasting center.
3. University as a developer of products and services within selected areas of science-technical and socio-economic development.

B. University project management departments

The modern post-classic university, which is characterized by the parallel development of education, research and entrepreneurial functions, is a successful participant of regional and national economic development. The efficiency of the post-classic university largely depends on project activity management, fulfilled by different university departments.

The strengthened steering core must include both representatives of University administration (rectors, vice-rectors, deans, heads of central units) and the major scientific, educational and research departments: departments, faculties,

of responsibility the key approaches and projects regulations are developed, the general conditions for their successful implementation are being carried out, the monitoring and reporting on all areas of project activities is being fulfilled. This is carried out by the heads of the departments directly involved in the project. Finally, on the third level of responsibility the working group of the project is located, which includes representatives of the scientific and educational departments of the University, project managers, possibly representatives of other organizations cooperating within the current project.

University project management assumes development of the following departments within the university:

1. application and claims support department (technical and information aid for the university employees);
2. grant obtaining support department. In addition, the department provides information and methodological support the University staff,

asa well as students and postpraguates on opportunities to participate in domestic and international projects and grant programs;

3. university-industry interaction support department. The department also initiates various forms of joint activities with the domestic business sector, major customers within the business community;
4. joint research department;
5. alumni department.

C. University center for IP management

The University center for IP management supports innovators within the University in terms of licensing their inventions and selling the licenses to companies. The Centre also generates the knowledge base of support re: patents, technical knowledge, exclusive/non-exclusive license, etc.

Key goals for the University center for IP management are:

1. development of the university policy in the field of IP management, with special inner standarts and regulations;
2. detection of the eligible and potentially appropriable university R&D results at the earliest stages;
3. development of the IP management strategies for the RIA, created within the University;
4. procedures of the legal protection of the RIA;
5. help with the formation of University spin-offs, with intangible assets based on University patents;
6. license development, to be granted to external companies, based on University patents;
7. organization of mentor programs, roundtables, workshops devoted to the problems of IP protection, special training programs.

D. University marketing department

Change of the University role in the society, research and innovation activity development within the University, high level of 'university – business community' interaction, increasing competition among universities – all of these changes lead to the development of a comprehensive system of marketing activities in the Universities.

This activity aims to embellish the image of the University, both locally and internationally (like PR activity); inform the general public about the achievements of the University, its scientists, students, alumni; if possible, position the University as an innovation hub. All these would improve the University's position in different university rankings (THE, QS, ARWU), attract more attention from high

school graduates, companies, and potential clients for the research projects, and joint ventures.

Key goals for the University marketing department are:

1. awareness formation among the faculty staff, postgraduates, students, business partners of the University about the most promising areas of research through direct interaction with the Foresight center in priority spheres of science-technical and socio-economic development;
2. marketing support of the University R&D (with formed IP management strategy only). Marketing support includes following strategies:
 - to identify a potential market; market research (volume, growth potential, key competitors and their shares); pricing analysis; sales forecasting, identification of market share; product/service promotion; assistance in making a presentation for investors.
3. informing the business community about the new University R&D developments, University new research fields, to ensure university-industry cooperation based on grant finance or other forms of contracts, e.g. Industry Sponsored Research. This task is carried out by organizing regular events in the form of roundtables, workshops and so on., to which representatives of industry companies, seed and venture capital funds, companies are invited (e.g. cooperation based on kaggle.com ideology);
4. the organization of the university Innovation Cup, where University start-ups compete. The jury is formed of experts from the business community, marketers, VCs. The Cup winning team is given the opportunity to become a student business incubator resident; other teams may receive funding from seed fund (University or external), and attract the attention of the venture community.
5. development of various training programs for students, university staff, in order to increase their knowledge and skills in the field of market analysis, product positioning and promotion and so on. The task is carried out by organizing lectures, workshops, seminars and roundtables with presentations of success stories, masterclasses from the business community experts etc.

E. University business incubator

The Incubator serves to facilitate entrepreneurial activities within the University. It connects young entrepreneurs, experts and potential investors in efforts to fulfill innovative ideas by providing resources and support at the initial stage of business (seed and start-up).

The essence of the University business incubator development is in formation of a specific area where talented students, entrepreneurs, experts and potential investors can interact most efficiently.

Business Incubator provides various services to the future companies, existing now in a form of University team with a viable idea on seed or start-up development stage, for them to be able to overcome the so-called "death valley" before receiving their first income. The time period for the companies to be incubator residents must not exceed 1,5 years.

Key goals for the University business incubator are:

1. 'resupply' of the project teams with all the necessary specialists (e.g., from the number of students / postgraduates / University staff / database of professionals interested in cooperation with the University);
2. formation of favorable conditions for the development of innovative ideas that involves donation of a certain package of services (legal, accounting, financial, marketing, accounting); accommodation for the teams, and provision of all the necessary equipment (from tables to printers to landlines to wireless access to the meeting room); implementation of the direct interaction with an engineering center in which, if necessary, the prototype of the future product innovation will be developed.
3. complex projects administration, project approach trainings, the development of business models and business plans for University start-ups;
4. the organization of the contest for the graduates (former residents) of the business incubator. The jury is formed of experts from the business community, marketers, VCs. The contest winning teams are given the opportunity to become residents of the University technopark;
5. establishment of communication with potential investors (representatives of venture capital funds, business angels), potential partners for the development of projects and future customers of the innovation products;
6. providing project financing (by obtaining investment from University seed fund, grants and subsidies under various programs, federal-regional-local programs, private funds, venture and equity finance etc.);
7. involvement of students, postgraduates of the university and its partners in the design and creation of high-tech products as part of a business incubator project, which requires the maintenance of a database.

F. University research division

The university research division serves to provide collective use of equipment and prototyping in research activities, and thus to intensify and advance experiments using a modern technological basis. Another advantage of this structure is that it allows a concentration of high professionals and scholars in one unit.

Key goals for the University research division are:

1. the collective use of research multifunctional complexes, which leads to a cumulative increase in the efficiency of its use;
2. growth in the efficiency of the implementation of research project by University teams (consisting of students, postgraduates and University professors), small innovative companies;
3. liaison with different laboratories, research and educational centers, business incubator, technopark and other objects of the innovation infrastructure of the University;
4. creating conditions to keep talented young people (postgraduates/students) in research and science spheres, creating conditions for the development of their skills.

G. University technopark

The technopark serves to form the territorial innovative environment. It creates the image growth point due to diversification and deindustrialization of the local economy, facilitation of high-tech business and the development of small and medium business, all of which contribute to the profit growth in local and regional budgets. Regional and federal governments support the development of technoparks. The University can be a sole founder or it can develop a technopark in conjunction with the local administration and/or big business, venture capital fund, or a bank/ financial institution.

Technopark provides the residents with certain infrastructure:

1. office space with all the necessary equipment for work, internet, telecommunications, meeting and conference rooms;
2. overall capacity in form of laboratories equipped with the necessary equipment for research and computing;
3. significant total area space (like Idea Lab), where residents can communicate in free form with each other, learn about each other developments, offer some solutions over a cup of tea (not the format of the dining room). The presence of such areas is to maximize synergies from joint ventures of innovative companies that, in fact, is one of the main tasks of the Technopark. To confirm the need

for such Idea Lab serves the study "Managing the flow of technology" by Tom Allen, in which the probability of interaction between two people is a function of the distance separating them: at a distance greater than 50 feet (15.2 m), the probability does not exceed 7%¹;

4. exhibition areas;
5. printing center;
6. social infrastructure: parking, dining areas, cafe, fitness center, ATM.

Key goals for the University technopark are:

1. the development of high-tech business, creating conditions for the development of interaction with the medium and large businesses on the industrial profile of the University, the involvement of faculty staff into innovative entrepreneurship;
2. providing resident companies with the entire spectrum of services needed (legal, marketing, accounting, finance, engineering) - both on its own and through established contacts with various innovation infrastructure objects of the University and the region (University research division, marketing department, University IP management center, venture funds and other institutional investors);
3. the establishment and development of cooperation with local, state and federal authorities, joint implementation of investment, innovation programs, creating an image of region growth point;
4. the establishment and maintenance of information resources to help inform the Technopark residents;
5. assistance in the development of international cooperation of the University with foreign partners (together with other objects of University innovation infrastructure), assistance in the organization of conferences, roundtables, public seminars, trade shows and so on.;
6. development of effective social infrastructure, including parking, dining, cafe, fitness center, ATM's – as well as the convenient geographical location of the Technopark.

H. University Seed Fund

The fund serves to provide initial investments for promising University projects and small companies at initial (seeding) stages. In order to receive funds, a project or a company should pass the selection process and be legally registered. The companies also should have teams of qualified employees, business plans and prototypes.

University seed fund is filled, first and foremost, with the help of additional revenue generated from innovation, entrepreneurship activity of the University, secondly, from funds transferred by alumni (on a charitable basis), and thirdly, by the University-business collaboration. In particular, the funding sources are generated from the University project activities (grants, externally financed research, alumni donations), earnings from the University center for IP management operations (royalties, sale of patents, paid research for the external users), earnings from the University research division operations (paid research for the external users), earnings from the University marketing department (paid market research for the external users), earnings from the University business-incubator (paid services for the external project teams), earnings from the University technopark (paid services for the external project teams).

Key goals for the University seed fund are:

1. the organization of innovation competitions of the University with relevant expertise within which projects and teams will be selected for further cofinancing;
2. implementation of co-financing of selected University start-ups;
3. evaluation of financial resources spent by the University project teams and start-ups.

The innovation policy of Lomonosov Moscow State University and the increase of innovative activity. The practical part

In the articles The process of formation of entrepreneurial university in Russia [Ivashchenko N.P., Pospelova T.], Building the Entrepreneurial University Lomonosov Moscow State University was used as an example to present a detailed analysis of innovative initiatives at MSU since 1990. Currently, MSU operates the following infrastructural facilities that contribute to innovative activity and involvement of the university in cooperation with the business community:

- Department of Economics of Innovation (2007);
- Business Club of the Department of Economics of Innovation of Moscow State University (2009);
- MSU Business Incubator with the support of the Department of Economics of Innovation (2010);
- Laboratory of business innovation and entrepreneurship InnovationStudio (2010);
- PRE.incubator for school children, with the support of the Department of Economics of Innovation (2011);
- Creation of Center for Innovation consulting of MSU (2011);

¹Morris L., 2009

- Establishment of the Centre of National Intellectual Reserve and Fund "National Intellectual Development" (CNIR / FNIR) (2012);
- Establishment of the center of the bioeconomy and eco-innovation (2013).

Being in close proximity, the centers form a system. The results of the work and cooperation of these centers have proven their effectiveness, which led to the launch of the ambitious and expensive project of the establishment of scientific technological cluster "Vorob'evi Gori" on MSU territories¹. In December 2013 at a meeting of the Board of Trustees of MSU the Dean of MSU Viktor Sadovnichii revealed the content of their plans for this project: "In the territory of about 100 hectares, we plan to combine various facilities into a single multidisciplinary cluster; this will include the laboratories conducting fundamental research and experiments and implementing innovative products and experimental production in priority areas of scientific and technological development of our country. All this is placed in a specially constructed and equipped buildings, pavilions and laboratories. This is the first project of such kind in the history of Russian university education."

Among the planned objects of scientific innovation infrastructure are:

- A biomedical cluster with a certified vivarium;
- A laboratory of prototyping and tests for medicine and pharmacy;
- A cluster of nanotechnology and new materials with a separate clean room unit;
- A laboratory for creation of nanomachines;
- A cluster of information technology, mathematical modeling of high-performance computing;
- A cluster of robotics technology and special purpose machine engineering;
- A cluster of space research with a center of operative space monitoring, monitoring the asteroid hazard;
- A cluster of Earth Sciences, study of the use of land resources and environmental projects.

Thus, in the near future an unprecedented for Russia project on the development of university innovation environment will be fulfilled; it will promote the involvement of university science in particular, into the work of the scientific and technological clusters. This project will be partially based on theoretical models of clusters, entrepreneurial universities and innovation infrastructure. The experience of leading countries will be implemented. The scientific and technological cluster "Vorob'evi Gori" will present a systematic approach to the construction of clusters and will promote an acquisition of a new role by the university in this case.

The main conclusions of this study are that the use of such models of regional development as the cluster theory and triple helix model in combination with each other gives an additional effect. Clusters can be created and used as a hybrid organizational format of cooperation between universities, business and government, and the TH model can be a tool of regulation among cluster members.

The study identified new functions of the universities, if they are involved in the formation of the cluster. In this context, universities are transformed into entrepreneurial ones.

Following conclusions were made in the article regarding the implementation of the first stage of entrepreneurial universities creation - the formation of innovation infrastructure. Formation and development of the University innovation infrastructure model is a basic assumption for effective integration of universities within the framework of the cluster and its sustainable functioning as a full and largely key member of the cluster. In our opinion the general University innovation infrastructure model, acting in accordance with the principles of the entrepreneurial university, formed by B.Clark, and developed within the framework of the cluster and Triple Helix concepts will include the following divisions:

1. University foresight center in priority spheres of science-technical and socio-economic development
2. University project management departments
3. University center for IP management
4. University marketing department
5. University business incubator
6. University research division
7. University technopark
8. University seed fund

For all the divisions the key goals were provided.

The further research assumes the application of the University innovation infrastructure model, proposed in this article, in the process of Science and Technology Cluster "Vorob'evi Gori" development.

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ИННОВАЦИИ

МОДЕЛЬ ОРГАНИЗАЦИИ ИННОВАЦИОННОЙ ИНФРАСТРУКТУРЫ ВУЗОВ КАК КЛЮЧЕВОЙ ЭЛЕМЕНТ РАЗВИТИЯ НАУЧНО-ТЕХНОЛОГИЧЕСКИХ КЛАСТЕРОВ В РОССИИ

Н. П. Иващенко, Т. В. Поспелова, А. А. Энговатова

Аннотация

В статье проанализирована роль инновационной инфраструктуры отечественных вузов в развитии научно-технологических кластеров. На основе анализа двух моделей регионального развития: теории кластеров и теории “Тройной спирали” – доказана необходимость развития предпринимательской функции в университетах. Представлены первые инфраструктурные практические шаги по развитию научно-технологической долины на базе МГУ имени М.В. Ломоносова.

Ключевые слова: кластер, инфраструктура, предпринимательский университет, научно-производственная интеграция.

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