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The process of innovation infrastructure creation in Russia: an exploratory study of St. Petersburg

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Abstract. *This article discusses the issues with creating an innovation infrastructure for efficient knowledge transfer in Russia and, in particular, in the St. Petersburg region. Despite many infrastructural organizations already existing, the innovative activity in the country is comparatively low. The aim of this research is to analyze institutional interconnections and interactions of the educational, scientific, production and technological components of Russia's (St. Petersburg region) innovation infrastructure and to reveal the barriers preventing efficient knowledge transfer. The region situated in the northwest of Russia includes the second largest metropolis of the country, a city with rich traditions of higher education, research and a long industrial history. Firstly, the key elements of its infrastructure and main characteristics are described. Furthermore, the major problems are revealed including the problems of financing and intellectual property protection, searching the right personnel, etc. This research is based on the results of an expert poll in 2010-2011 among the managers of St. Petersburg infrastructural organizations.*

Key words: Knowledge transfer, Innovation infrastructure, Regional development

1. Introduction

Within the last 20 years, interest in the relationship between knowledge production and economic competitiveness of a region has significantly grown. There have been remarkable changes in the external and internal regional economic conditions which include increasing globalization, demands for new and intensive knowledge, and innovation. For example, in many countries higher education and research institutions have come through the evolutionary process, shifting from pure educational and research towards entrepreneurial activities and active participation in regional innovation systems [1].

In the context of Russia, additional factors driving the need for changes involve: a) shifts in the companies' needs for specialists and general lack of qualified personnel on the labor market; b) decline in federal government research funding; c) competitive situations when universities strive to higher their status and fight for the best students under conditions of severe demographic problems; and, last but not least d) Russia's addition to the World Trade Organization, which may increase inflow of investment and competition in the domestic markets [2].

In the "Concept of Social-Economic Development of Russia until 2020" the particular role of increasing the country's level of development and, therefore, people's standards of living is attributed to infrastructural development of regions, especially the development of infrastructure needed to push innovative activities [3].

In practice, after the 1990s sharp social-economic and political reorganizations of the country lack of state governance and management of the regional infrastructure had a strong impact on every region in Russia. The majority of industrial,

economic and financial interconnections were ruined not only inside regions, but also within the relationships with outside customers and suppliers. At the moment, existing obsolete infrastructure does not correspond to the contemporary tasks of innovative development. Figure 1 illustrates the main parameters of Russia's economy and the economies of other countries that fall into the category of "transition from efficiency-driven to innovation-driven" (for example, Brazil, Chile, Mexico, Estonia) according to the calculations of the Global Competitiveness Report 2011-2012.

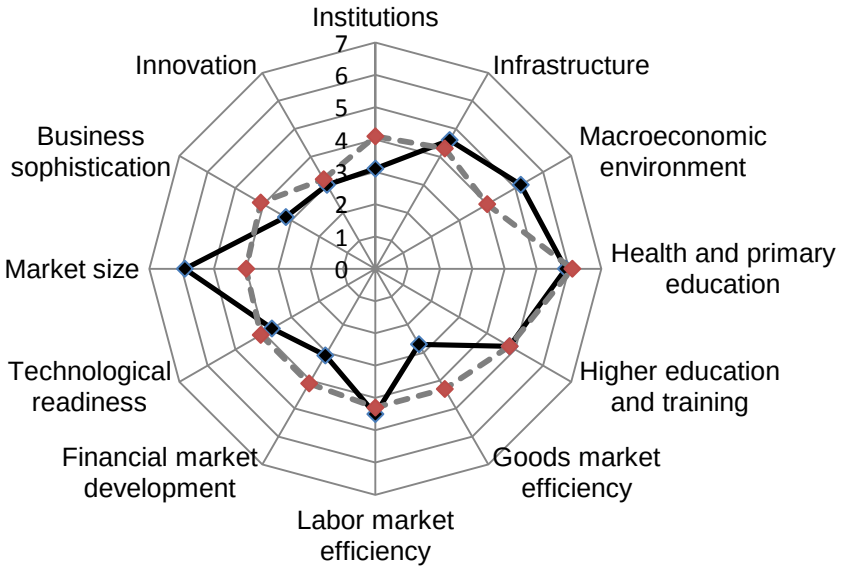

Figure 1: Competitiveness of Russia's economy (solid black line) comparing to other countries in transition (dashed line) [4]

It is worth mentioning that the old Soviet system of innovative development functioned rather well: invention or new scientific idea worth being patented or published could come from any actor and on every stage of the innovation process – in a research institute, Academy of Sciences, on a production spot – and be put into practice within a certain frame of time. Scientific development was mainly focused on military complex, but, as Nelson concludes, most countries whose innovation systems he studied in [5], developed new technologies mainly in military complex and higher education systems. One of the main weaknesses of the Soviet system was its inability to adjust to the new market conditions and find new approaches to stimulating researchers' motivation under new economic circumstances.

By now it is recognized that Russia did not manage either to keep the positive elements of the old innovation system or create new systems of scientific knowledge and innovative product creation despite the internal expenditures on R&D have increased from 1.05% GDP in 2000 to 1.16% GDP in 2010; the economy was growing, on average, by 4.4% per year in this period, but the number of researchers continued to decrease. According to [6], the number of researchers per million of population decreased from 7266 people in 1991, 2912 people in 2000

to 2598 people in 2010. A remarkable “brain drain” exists: about 30% of the middle class population between 25 and 39 would prefer to emigrate from the country [7].
The business sector does not willingly invest in risky projects in the territory of the Russian Federation. In developed countries, internal expenditures of companies on R&D reach 50% while Russian companies spent 18.7% of internal expenditures on R&D in 2000 and 18.3% in 2010. In 2010 all extracting and processing companies in Russia invested €0.54 billion in innovative activities, and only 27% of this amount was spent exactly on R&D [6]. As a comparison, only Toyota invested €6.67 billion in R&D in the same year.
The share of Russia in the world high-tech export remains considerably low: 0.09% in 2010 comparing to 9% of the USA, 6% of EU and 27% of China [6]. Russia’s export portfolio continues to be export-oriented: in 2011 68% of export consisted of energy resources and only 5,7% of machinery [8].
Innovation policy in Russia is to some extent an “imported” policy concept caused by the need to push the economy towards modernization. At times the policies are constructed from international experiences and reflect the opinions of invited experts and organizations. For example, in 2011 OECD together with Russia’s Ministry of Education and Science prepared “The Review of Innovation Policy in Russia” [9] in which the authors criticized the overwhelming power of the state and top-down policy conditions. They proposed shifting the responsibility for producing innovations towards the private business sector, without taking into account the absolutely different business environment in Russia and somewhat unique relationships among business, society and power under the conditions of uncertainty and unacceptably high risks. Furthermore, the size of the country and inequality of living standards as well as the demand for innovations are overlooked in such documents. Indeed, when a regional dimension is introduced, it is important to stress that in Russia often the national and somewhat positive quantitative trends disappear in most of the regions of the country, with the exception of several major metropolitan areas including Moscow, St. Petersburg, and Novosibirsk.
The goal of this research is to analyze the key elements of Russia’s innovation infrastructure, reveal the main barriers to knowledge transfer processes based on the results of a survey conducted in 2010-2011 among the managers of St. Petersburg infrastructural organizations.

2. Innovation infrastructure in Russia

There are many definitions of innovation infrastructure (II) depending on the context: II inside of an organization, II as promoter of individual creativity, regional and global II. Porter and Stern describe II as an element of a framework for determining national innovative capacity (along with such elements as cluster-specific conditions and quality of linkages). II itself is defined as a set of cross-cutting investments and policies supporting innovation throughout the entire economy [10].
In the policy documents of the Russian state, only one definition of II exists [11]: II is a set of innovation system participants which contribute into innovation activities, in particular by offering services on creating and commercializing innovative products. II includes technology centers, knowledge transfer centers, incubators, venture funds, centers of developing personnel, etc.
According to the definition given in [12], II is a set of subsystems which give access to various resources (assets) and (or) provide service to the participants of innovation activity**.** The main elements of innovation infrastructure are represented by:

a) Subsystem of personnel training (universities, research organizations);
b) Industrial and technological subsystem (technological parks, incubators, etc);
c) Consulting subsystem (commercialization, marketing, standardization and more);
d) Information subsystem (databases, information centers);
e) Financial subsystem (funds).

We are putting universities and research institutions in the center of II for several reasons. Firstly, in Russia the majority of specialists in marketing, innovation management, and technology audits are shaped in universities. Secondly, many elements of II (technological, consulting) are being built now exactly in universities and research institutes--turning them into key actors of II.

The 5 subsystems of II in Russia are considered in more detail below.

a) Fundamental changes are observed in the systems of knowledge production and personnel training – universities and research bodies. Higher education systems in the majority of countries go through the process of transition from the traditional Humboldt model of science-based universities (that appeared in the beginning of 19th century) to the so-called third generation model. These changes happen for several reasons: it is, again, globalization, increased costs of breakthrough research which universities cannot cover without external investment, increased multidisciplinary research, the need to search for new approaches to management and governance, etc. [13]. All these changes push universities to become more entrepreneurial and establish links with business [14]. So, Western universities are trying to currently embrace the three roles of educators, knowledge producers and entrepreneurs (the last is quite criticized by a number of experts) [15]. Universities in Russia traditionally played only the role of educators while the role of knowledge producers was attributed to scientific research institutes (SRI). Therefore, in order to catch up with the global trends, Russian universities should make two big steps forward, becoming research and entrepreneurial in a very short time.

Let us look closely at the basic function of a university as a part of II – preparing personnel for innovative activities. In Russia hundreds of universities prepare innovation managers, specialists on marketing, etc. However their efficiency is not high: in many universities lectures are given by people who do not have any practical experience in the sphere of innovation; during teaching foreign manuals which do not have much connection with Russia's realities are often used.

In recent years, the Russian government has put into practice a number of initiatives aimed at supporting innovative and research activities in universities by dividing them into categories (elite, federal, national research, state, budget, autonomous) and giving them financial support according to them. Furthermore, in 2009 the new Federal law №217 allowed universities and SRS to create small and medium enterprises. The critic of this law is given in [16]. According to experts' opinions, the main obstacles to putting this law into practice were imperfect intellectual property right protection and tax legislation. For example, according to this law, if universities or SRI receive a patent for an invention, they immediately have to start paying taxation for it which is certainly impossible when the invention costs tens of millions dollar and the market of innovative products is very uncertain [17]. This is one of the reasons why (and practically all case studies proved it) innovators in universities do not see any sense in commercializing their research results inside of Russia: it is more reliable and easier to transfer ideas via well-built informal connections to Western companies and sponsoring funds.

Since law №217 was passed, universities created 325 small and medium sized enterprises [18], but 50% of them have the charter capital of approximately €250, which makes us conclude that these enterprises do not actually perform innovations, but only exist on paper [16].
In SRI, as the President of Russian Academy of Sciences Y.Osipov mentioned in his interview [19], only 30 SMEs were created in 2009-2011.
b) The next element – industrial and technological subsystems of innovation infrastructure – embraces scientific and technological parks, business-incubators, clusters. The first technoparks were created in universities of Russia in the beginning of 1990s (in Tomsk, Moscow and Zelenograd). In the mid-1990s technoparks appeared in State Scientific Centers. The next step included creating regional technoparks for science-intensive production. Such technoparks have their own facilities and funding from the State and municipal governments; they successfully developed their own small innovative start-ups.
From the end of the 1990s to the beginning of the 2000s, a network of innovative-technological centers (ITC) was created. Their tasks are similar to the ones of technoparks, but the support is given to more mature small innovative enterprises which have already come through the stage of a start-up. In order to build up sustainable connections with industry, ITCs were created within industrial enterprises, not in universities. The first university ITC in Russia was created at St. Petersburg State Electrotechnical University, which specializes in IT, radio electronics and medicine.
Since 2003 the network of technology transfer centers (CTT) has been developing with the aim of accelerating commercialization of scientific achievements.
At the moment the total number of technoparks, ITCs and CTTs numbers over 200 [20]. In St. Petersburg, the technopark at the State Electrotechnical University is considered to be one of the most active. It was built in 1991 when 70 SMEs were created and served as an interface between university science and enterprises as well as an instrument of conversion of the university's intellectual potential from military to civil needs. Later, this technopark managed to create 300 workplaces for academic personnel and therefore keep people involved in university science.
c) Consulting infrastructure includes centers of shared equipment, centers of new technologies' commercialization and knowledge transfer, centers of independent expertise of scientific developments, foresight-centers creating forecasts and roadmaps aimed to decrease risks of new ideas' commercialization.
In Russia there are successful examples of shared equipment centers. One of those is represented by the Moscow Institute of Steel and Alloys with its Institute of Rare Metals. Shared laboratories are equipped with the latest generation of machinery and serviced by high-qualified personnel. Since 2006, over 500 local and foreign organizations, universities, companies have used the services [21].
Several shared equipment centers were opened in St. Petersburg State University: "Dinamika", "Interdisciplinary Center of Nanotechnologies", "Optical and Spectral Technologies," etc. At St. Petersburg's National Mineral Resource University there is a network shared center which aims at enhancing opportunities for R&D, increasing labor productivity, and product quality at SME based on the efficient application of unique scientific and production equipment.
CTTs are supposed to provide available professional consulting services to SME concerning the particularities of innovation activities. Statistical data proves that the viability of innovative SME is very low partly because they are managed by unprofessional managers. At the moment in Russia CTTs are being created at universities, academic research institutes and, to a much smaller extent, in industrial re-

search institutes and state scientific centers. The CTT in St. Petersburg's Physical-Technical Institute is one of the more successful examples. The main problem in Russia's CTT is the lack of qualified personnel who can actually provide professional consulting services in marketing, sales, export operations, etc.

d) Information infrastructure is constructed with the aim of making available the information about innovative activities support. In 2005 within the framework federal program "Research and development into the priority branches of science and technology 2002-2206" 10 national information and analytical centers were created.

e) The financial component of innovation infrastructure is one of the most discussed at the moment. Many financial instruments have been created, but enterprise own funds remain the main source of funding innovation activity: bank loans are expensive, federal budget money are available mostly for big corporations, and the amount on average does not exceed 5% of enterprise's expenditures on innovation (for example, processing industries in 2009 received 3.4% of money for innovation from federal budget [8]).

The history of venture financing in Russia is quite short. The Russian Association of Venture Investment was created in 1997. In 2006, the role of the state in venture financing was increased by creating the Russian State Venture Company (RVC) with the budget comparable with all private venture capital in the country (now about $1 billion [22]. The overall objective of RVC is to invest into "seeds" that provide expertise and market innovations. Between 2007 and 2009 seven new venture funds were created in the form of state-private partnerships. However only 20% of money was invested into innovative companies: the supply of investment is bigger than demand [23]. This can be explained by the imperfect investment instrument – the limited liability share fund, which is by now the only non-taxed instrument. The peculiarity of the instrument is that all the money should be invested into the fund at the moment of creation, not at the moment when a promising investment project appears--which is of course a barrier for potential investors. The level of trust to venture funds is low: only 23% of innovative companies trust them. This can be partly explained by the lack of experience in venture businesses.

As shown above, currently in Russia the key elements of the innovation infrastructure have been already built, however the results of innovative activity are quite insufficient: the number of companies engaged into innovation activities is decreasing (Figure 2).

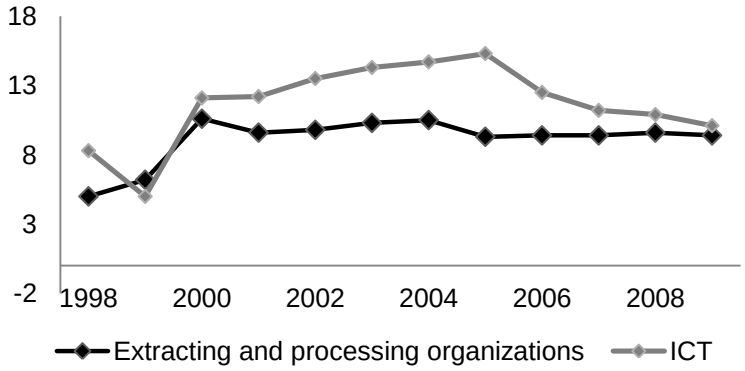

Figure 2: The share of organizations producing technological innovations in Russia 1998-2010, % [6]

3. Survey

In order to reveal the real state of the art of II in St. Petersburg, a group of scientists headed by A. Mischenko (of the Sociological Institute of the Russian Academy of Sciences) conducted applied sociological research. An expert poll was used, in which heads of II organizations acted as respondents. At the time of the research in the beginning of December, 2010 there were 29 such organizations in St. Petersburg. The sample was created to include all types of the innovation infrastructure organizations: the "science city" of Peterhof; St. Petersburg's special economic zone (SEZ); four science and technology parks; four ITCs; two business incubators; innovative and technological cluster of mechanical engineering and metal working; scientific and production corporations and others. Altogether 18 II were involved in this research project, seven of which were created by St. Petersburg universities.

These surveyed technoparks and ITCs can be divided into three groups: a) organizations engaged in the "incubation" of innovative small enterprises (SE) and in the creation of innovative products; b) organizations engaged only in "incubation" of innovative projects; c) organizations which place small innovative production lines in their territory and render them infrastructure services.

According to the respondents' statements, the innovative SE, working in the ITCs, seeks to involve technology development zones and technopark, which have shared equipment opportunities. It is worth mentioning that about 50% of the surveyed organizations have shared equipment funds or shared laboratories. At the same time, their residents have to use those of the third-party organizations quite often, which leads to cooperation between the II organizations.

Technoparks and ITCs, created by universities, are characterized by rather intensive cooperation among each other: sharing experience, information, transfer ring initiative innovative projects to each other in case their scientific and technical profiles are not perfectly suited. University and non-university organizations of II also interact: innovative projects go through the "incubation" stage, and then they are transferred to technoparks and ITCs which are focused on the placement of small and medium innovative production lines. At the same time representatives of some industrial technoparks note that universities do not willingly cooperate with them.

The majority of the surveyed II organizations created special production clusters around themselves, in which enterprises performed R&D and develop manufacturing in the area or closely-related areas; often they are connected to each other technologically. Many of the organizations are going to continue such "clustering" policies.

Representatives of II organizations belonging to universities point out that ideas for future innovative projects as a rule are born at the leading departments of universities. Other surveyed organizations experience difficulties in attracting carriers of such ideas. They look for ideas in the Russian Academy of Sciences organizations, as well as in higher education institutions and in the industrial enterprises of the city. Often, ideas are brought to private technoparks and innovative centers by higher education or research institutions personnel, who did not find support at their initial workplaces.

This expert poll reveals notions about the exhaustion of innovative ideas in recent years: ideas born at Soviet times have already been exploited, while new ones have not appeared, in particular due to the hardships that Russian science has witnessed.

University technoparks and ITCs have actively used the opportunities given by new federal legal acts in the sphere of innovative activity (the law №217) and created SE with their own shares, which had been prohibited before. Experts mention that the creation of innovative SE brings additional money to universities, income to participants of innovative projects, workplaces for graduates and, at the same time, generates certain problems. For example, SEs demand certain resources from universities, they need facilities, equipment, etc. Furthermore, there are problems connected with educational and teaching activities. As payment at SEs exceeds the payment for teaching and scientific work, part of scientific and teaching staff (generally of younger age) flows into these enterprises and reduces the volume of lecturing; so, university starts to lose personnel.

4. Results of the survey: the barriers to knowledge transfer process

During the expert poll the following five groups of problems of II organizations are revealed:

a) Problems of II and technology transfer financing. Banks, venture organizations and private investors have their own requirements for projects. For example, banks connect their requirements with property pledges--which is time-consuming and involves corruption schemes initiated by state administration bodies. Venture organizations only finance projects that are ready to be put into practice or are close to this stage and have high profit potential. They claim for a controlling block of shares in the enterprises created to produce the developed innovative product. Private investors – “business angels” – aim at projects that have a quick payoff, with very high investment profitability, and as a rule look towards projects in the IT sphere.

A large number of projects uses federal state or regional grants for financing innovative projects: Bortnik's fund, “Umnik” programs (supporting young scientists), "Speed", "Start-up". However with these grants many innovative projects get stuck at the stage of “prototype” or “laboratory model,” unable to create a ready-made product. And large industrial enterprises would willingly buy the finished products, but they cannot afford expanding their production because of limited working capital.

University science and technology parks and innovative centers widely use such international financing programs as TEMPUS, BRICS, and the FP7 programs of European Union.

Foreign investors strictly require complete alienation of the developed product, a practice considered undesirable by local developers. In spite of this, practically all surveyed organizations (90%), to a greater or smaller extent, direct their attention towards foreign investors and customers. Sometimes it even becomes an attitude of principle for II organizations’ heads.

While discussing innovative projects’ financing, practically all experts mention corruption problems that arise during the process of distributing investments, orders, and city budget funds.

b) Problems connected with imperfect legislative base regulating innovative activity. As the existing taxation system is the same for mass producers and for innovative enterprises, innovative activity risks are significantly higher since enterprises have to pay taxes even prior to the developed product realization. 30% of interrogated experts note that because of the imperfect patenting mechanisms, they have to use the mode of know-how for their product in order to protect the copyright on their technological development. This mode definitely hinders further commercialization. In universities this problem is less sharp because there are patent services

responsible for intellectual property rights protection. Another important issue is how to reward direct participants of the innovative product developments patented by universities. This problem is explained by old traditions originating in Soviet times when all property rights belonged to the state, and the developers could not access them. The majority of experts emphasize the urgent need for a new law on innovative activity containing the main concepts defining innovative activity and removing the contradictions in the normative documents.

c) Personnel problems arising during innovative projects implementation. The aging of the scientific and pedagogical staff is one of the main problems of university science and technology parks and innovative centers. The distribution of a teaching workload does not leave enough space for science--especially for young teachers who want to forge scientific careers (defend their theses, etc.). Experts mention that university representatives stand up for the inclusion of scientific work within a paid teaching workload.

Another problem emphasized by both university leaders and non-university technoparks and ITCs heads is the decreasing qualifications of scientific, pedagogical and engineering personnel. The reasons are: lack of modern equipment for research, long time absence of state procurement for research, isolation of Russian universities and research organizations from international environment. Problems with the engineering staff are connected with a general decrease in the level of engineering education, and also with the lowered prestige of engineering work.

Last but not the least, the problem in this subgroup is a “brain drain”. Highly qualified specialists working in foreign companies in Russia often receive job offers abroad. As a result they leave the country not only because of high salary prospects, but to greater extent because of more favorable conditions for research.

d) Problems connected with innovative products and technologies transfer. According to the experts’ opinions, key difficulties of innovative developments introduction at the industrial enterprises are explained by technical backwardness of the domestic enterprises (the outdated and worn-out equipment); absence of trust in business relations rooted in the times of “wild capitalism” of the 1990s; low production culture and culture of work with contractors at the enterprises. For example, one technopark refused to work with domestic enterprises at all and began to work only with foreign partners.

Today domestic enterprises introduce innovative developments and new technologies quite reluctantly. The compromise is reached as follows: technoparks and the universities’ ITCs agree to sell their innovative developments on a turnkey basis – only together with professional service and personnel. That actually suits to both: enterprises finally get new technologies, and universities provide employment to the graduates and increase prestige of the institution.

e) Problems of office and floor space availability. Both university and non-university II organizations’ heads point out the lack of facilities for potential residents in their territory. At the same time the rent considerably increased which creates difficulties for placement “incubator” projects and innovative manufacturing.

The heads of some of the surveyed organizations are ready to repair emergency city buildings by their own efforts under the condition of the subsequent preferential rent, but the city government does not yet respond to such offers. As a result innovative manufacturing is often built up outside the city, for example, in Gatchina and Kirishi, for the following reasons: lower rent, empty production facilities, and also available engineering and working personnel.

The results of the aforementioned expert poll confirm that the regional innovation system in St. Petersburg and Leningrad region is at the inception of a full for-

mation. In the future, the city will take the role of the “idea man”, and the ideas themselves will be implemented in hi-tech and knowledge-intensive productions in satellite towns within a radius of 200 km from the city.

5. Conclusions

In this article the attention is drawn to the development of innovation infrastructure (II) in Russia and in particular in St. Petersburg and its region with an emphasis on the issue of ideas and knowledge transfer from universities to industries.
Firstly, the overall trends of innovative development of the country are discussed. It is revealed that despite rather stable macroeconomic figures, the number of innovative companies is decreasing, the demand for innovations is low, and Russian state corporations are investing in R&D insufficiently.
Secondly, the key elements of II are analyzed, i.e. subsystem of personnel training (universities, research organizations); industrial and technological subsystem (technological parks, incubators, etc); consulting subsystem (commercialization, marketing, standardization and more); information subsystem (databases, information centers); financial subsystem (funds). It is observed that at the moment Russian universities are in severe transition phase trying to currently embrace the three roles of educators, knowledge producers and entrepreneurs. According to the state policies, they are placed at the center of the country’s II. Most infrastructural objects (i.e. technoparks, innovative-technological centers, centers of technology transfer, etc) are built at universities.
Furthermore, based on the results of an expert poll among the managers of St. Petersburg infrastructural organizations, five groups of problems hindering knowledge transfer are revealed:

- Problems of II and technology transfer financing;
- Problems connected with imperfect legislative base regulating innovative activity;
- Personnel problems arising during innovative projects implementation;
- Problems connected with innovative products and technologies transfer;
- Problems of office and floor space availability.

The results of the research confirm that despite many infrastructural elements already exist in Russia’s National Innovation System, they are still loosely connected to each other. Vaguely defined institutional norms, i.e., ineffective intellectual property protection, underdeveloped intellectual property market, etc., represent other barriers to knowledge transfer.
Based on foreign success stories, some experts in Russia propose shifting the responsibility for producing innovations towards the private business sector, without taking into account different business environment in Russia and unique relationships among business, society and power under the conditions of uncertainty and high risks. The participants of the expert poll discussed in this article agree that the government has to play a crucial role in building strategic research relationships between universities, research institutes and industry by paying particular attention to the subsystems of II and interactions between them during the process of ideas and knowledge transfer.

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