Assessment of resources and development factors of the scientific and educational subsystem

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Abstract. This paper touches upon the scientific and educational subsystem, since the formation and development of this particular subsystem are demanded by the conditions of post-industrial transformations, the process of increased spatial competition. This need applied to the economy of a megalopolis is reinforced by a contradictory combination of relatively high investment attractiveness, the presence of several modern growth points, on the one hand, and the “obsolescence” of competencies that the human factor has, on the other hand. Significant problems in the development of the scientific and educational subsystem of St. Petersburg are considered in the paper. The individual components of the desired subsystem with the identification of strengths and weaknesses are analyzed. An approach to the analysis of the development factors of a promising subsystem of a scientific and educational profile is proposed: representing the integral result of this subsystem in the space-time continuum of the regional economy as a production function. The authors see the direction of further research in the allocation of groups of factors-arguments of the production function.

Keywords: Scientific and educational subsystem, innovative economy, advanced technologies, SWOT analysis, competencies

1 Introduction

There are unique organizations of higher education aimed at graduating specialists with modern key competencies for the leading sectors of the modern economy in St. Petersburg. The modern scientific complex of St. Petersburg, unlike other regions, has strong traditions and is focused on the needs of modernization and development of innovative reproduction.

There are about 40 research institutes and their branches in St. Petersburg. The share of the employed persons in research and development grows.

The volume of research and development costs concerning the regional gross product in the North-West Federal District is 1.4 times higher than the average for Russia. As of January 1, 2017, in St. Petersburg, there are 4164 organizations with the type of activity “Research and Development”.

The productivity of using the existing scientific potential can be demonstrated by the issuance of patents, citation indices, and the presence of international publications (Tables 1 and 2).

Table 1. Creating and using advanced technologies in the economy of St. Petersburg

| Indicator                        | 2007 | 2009 | 2011 | 2013 | 2015 |
|----------------------------------|------|------|------|------|------|
| Number of created advanced       | 85   | 155  | 190  | 218  | 160  |
| manufacturing technologies       |      |      |      |      |      |
| Number of used advanced          | 2985 | 3790 | 5122 | 7128 | 8099 |
manufacturing technologies
Patent applications for inventions, utility models, industrial designs and the issuance of security documents

| applications for issuance | 2920 | 2744 | 3192 | 2944 | 3014 |
|---------------------------|------|------|------|------|------|
| granted patents           | 2513 | 2926 | 2323 | 2500 | 2518 |

The data in table 1 indicate that the scientific potential that is present and growing in the region is in demand by the development of territorial reproduction. About 3,000 patent applications are filed annually in St. Petersburg, and many applications have a positive response from the Federal Service for Intellectual Property, Patents, and Trademarks. The negative impact is exerted by a very large gap from the moment of applying for the grant of a patent: the minimum term is one year.

The results of the index evaluation of scientific publications of workers in the field of education and science of St. Petersburg are given in Table 2.

Table 2. Indicators of the Russian science citation index

| Indicators                                              | Russian Federation | St. Petersburg |
|---------------------------------------------------------|--------------------|----------------|
| Total authors on elibrary.ru                           | 777756             | 77829          |
| The largest number of publications                      | 23841              | 1262           |
| The largest number of citations                        | 78121              | 22844          |
| The largest H-index                                     | 87                 | 67             |
| The largest number of publications in foreign journals  | 6079               | 1039           |

Summarizing the results of the analysis presented in Table 2, we conclude that almost 10% of the entire Science Index information-analytical system is provided by the authors of scientific publications in the region. The scientific potential of the region is also characterized by a high H-index (67).

In St. Petersburg, there is a developed network of training scientific personnel; scientific councils have been created at research institutes, universities, which have provided relevant results in the field of certification of the scientific potential of the city (Fig. 1).

Figure 1. Defense candidate and doctoral dissertations in St. Petersburg, units

It is necessary to mention the low commercialization of scientific projects and defended dissertations in comparison with developed economies, at the same time, high - compared with the average Russian data. There is a significant gap between the available resources (mainly scientific and technical potential) and the effect of their use is production and export of high-tech products and technologies. Commercialization of scientific projects is carried out through innovative activities related to the transformation of ideas into technologically new or improved products or services introduced on the market, also into new or improved technological processes or methods of production (transfer) of services used in practice. The highest rate of innovation activity (the proportion of organizations implementing innovations in the total number of surveyed) compared to other regions is 18.9% in St. Petersburg, twice the average (9.9%) for Russia. According to the analysis of the organization’s
innovative activity, it can be concluded that only 10% of scientific developments find their application, besides, the most active users of scientific developments are the production of electric equipment, electronic and optical equipment, the production of coke and petroleum products, and chemical production.

Thus, the basis for the development of high-performance sectors of the new economy may be the unity of the processes of market consolidation, systemic organization and systemic development of the research and educational potentials available in the region with the support of the state.

2. Problem statement
It is legitimate to conclude that in the economy of a megalopolis there are complexes of industry and academic science, educational institutions, research centers that are just beginning to move towards synthesis into an integrated scientific and educational subsystem [1-3]. Let us single out the gaps that prevent this synthesis:
- between fundamental and applied science;
- demanded and the actual structure of personnel training;
- the theme of scientific development and the structure of production requirements.

To accelerate this synthesis, support is needed for competition between organizations in the relevant field, as well as support for the forces of specification and the process of forming clusters that combine scientific centers and manufacturing enterprises.

The development of the analyzed prospective subsystem is demanded by the functionality of informative tools:
- estimates of the prospective results of the formation in the internal environment of a promising subsystem of capital combinations, including forecast estimates of their synergistic effect; these predictive estimates would allow the scientific and educational subsystem to integrate into the process of strategic development of the innovative economy of the region;
- a comprehensive assessment of the adequacy of promising subsystems to the imperatives of post-industrial transformations and the relevant goals established in the process of strategic development of the innovative economy of the region; this assessment is necessary to ensure the competitive interaction of several promising subsystems and the distribution of territorial reproduction development resources between them.

3. Research methodology
We focus on the scientific and educational subsystem of St. Petersburg, since the formation and development of such a subsystem are demanded by the conditions of post-industrial transformations, the process of intensification of spatial competition [4]. As applied to the economy of St. Petersburg, such a need is reinforced by a contradictory combination of relatively high investment attractiveness, the presence of some modern growth points, on the one hand, and the “obsolescence” of competencies that the human factor has, on the other hand.

A conceptual idea of the scientific and educational subsystem is formed. In the first approximation, this is a scientific and educational localization that has formed in the space of the regional economy. [5] However, such a definition is not enough, because it does not take into account the effects of market forces in the economic space, the possibility of specification, as well as the priority of scientific and educational activities that create the key assets of the new economy: intellectual capital; intangible assets.

Based on the above provisions, it is legitimate to define the scientific and educational subsystem of the regional economy as the result of the specification of assets, contracts and behaviors of participants in the local market of scientific and educational services, integrated into the region’s innovative economic system and providing its needs for the formation of key competencies of the human factor and intangible assets adequate to accelerate post-industrial transformation.

Based on the fact that in the scientific and educational subsystem there are scientific and educational branches, four interrelated components in its structural organization are distinguished: general cultural, vocational training, research, and implementation [6-7]. The first two components are related to the educational branch and the next - to the scientific.
The necessary explanations are given. The general cultural component lays the necessary foundation for subsequent training. At the same time, taking into account the stated scientific problem, the focus of our research is the structural component of professional training, which includes educational institutions of the highest and middle levels. At the same time, this component presents not only educational activities, but also scientific activities (the provision of scientific services under the state order, the implementation of contracts with market participants, etc.).

Having determined the scientific and educational subsystem and having highlighted its main structural components, we proceed to the analysis of the scientific and educational subsystem of St. Petersburg, starting with the assessment of the dynamics of the main parameters of the component of vocational training (Table 3).

Table 3. Dynamics of the main parameters of the professional training component of the scientific and educational subsystem of St. Petersburg (higher education)

|                          | 2007 | 2009 | 2011 | 2013 | 2015 |
|--------------------------|------|------|------|------|------|
| Number of institutions of higher professional education (HPE), units. | 101  | 101  | 97   | 95   | 82   |
| Non-state educational institutions HPE | 45   | 45   | 41   | 41   | 41   |
| The number that performed research and development, units | 47   | 44   | 44   | 39   | 45   |
| Number of graduates      | 84 333 | 90 132 | 91 441 | 90 345 | 75 391 |
| The number of professorial teaching staff | 30339 | 30078 | 28592 | 26 947 | 24 345 |
| Doctor of Sciences       | 4923 | 4789 | 4628 | 4607 | 4479 |
| Candidate of Sciences    | 15403 | 15473 | 14947 | 14 336 | 13 365 |

Analysis of table 3 allows to draw the following conclusions:

- The number of higher education institutions is declining. St. Petersburg corresponds to this trend, which is typical for all Russia. At the same time, the process of unification of educational institutions is expanding [8]. It is legitimate to assume that foreign experience is being copied here. Thus, in Germany, the initiative to unite 15 universities has shown itself positively. But there it came from the organizations themselves, with clearly defined and tangible positive consequences for each of the parties [9]. In our country, the process of merging universities does not come from the universities themselves, that is, it takes place outside of contracts, along the administrative vertical, which affect its results;

- The initial decrease in the number of universities occurred due to washing out of the market of a part of non-governmental higher education institutions. In 2012, the reduction began within the public sector of this sector, which is associated with increased competition and the emergence of budgetary restrictions;

- The number of universities actively conducting research and development remains at the same level. The activation of the sphere’s organizations in this regard was not affected by the implementation of the federal target program “Scientific and scientific-pedagogical personnel of innovative Russia 2009-2013”, adopted to improve the quality level and professionalism of domestic specialists, creating a clear system to stimulate the flow and consolidate young promising scientists [10]. The target indicators of this program were: the wage fund of young scientists, co-financing not less than 20% of the total funding, as well as the publication activity of participants in scientific projects and the creation of a scientific and technical product. Under budgetary constraints associated with the unfavorable situation in the economy, expenditures on education and science should be a priority, and their share in the total expenditures of the budget system should be increased.

This program is aimed at solving the tasks set by the Strategy for Innovative Development of the Russian Federation until 2020 to develop human resources in the field of science, education, technology, and innovation, as well as to create a balanced and sustainable developing research and development sector. At the same time, the Program aims to provide conditions for the modernization of the personnel policy of the Russian sector of research and development, including by creating mechanisms to attract young specialists in science and innovative activities.
As the historical experience of Germany (1930s) shows, strict centralization of management had a detrimental effect on the state of science and education. Due to the administrative pressure that has arisen, a significant part of scientists emigrated. A similar threat exists in Russia in the case of tightening administration in science and education [11-12].

One of the main reasons for the merger of universities is the inefficiency of many of them, as evidenced by international ratings of the best hundred universities in the world. But administrative mergers and market connections are two fundamentally different processes. Positive international experience has been accumulated with regard to the market connection, for example, merging two well-known universities in the UK - Victoria University of Manchester and UMIST - into a single University of Manchester, which has become the largest one in this country, the experience of the National University of Singapore, formed in 1980, as a result of the merger of the University of Singapore and Nanyang.

To enter leading universities in international ratings, the Ministry of Education and Science of the Russian Federation held a competition for the right to obtain special subsidies for the implementation of activities that will promote universities in international ratings. 15 Russian universities won the competitive selection of universities. There are three St. Petersburg’s universities among them: St. Petersburg State Polytechnic University, St. Petersburg Electrotechnical University “LETI”, St. Petersburg National Research University of Information Technologies, Mechanics and Optics. Let us make the criteria for competitive selection:
- level of development of scientific activity;
- attractiveness of educational programs for applicants;
- involvement in the international academic market;
- positions in international university ratings.

The decrease in the number of universities results in the reduction of scientific and educational personnel. There is a normative ratio of the number of faculty to the student population - 1:12 for state institutions of higher education. Based on this ratio, the planning of the volume of the study load at the university takes place, except universities having the status of a national research university (NRU) and the status of a federal university.

But in a real situation, these institutions move to a more enslaving relationship to "survive". This process is influenced by two factors:
- universities have reduced funding in connection with the introduction of regulatory funding for the provision of public services in the areas of training (specialties), on the one hand;
- an increase of the average salary of teachers of educational institutions of higher professional education and scientific staff to 200% of the average salary in the corresponding region in 2018, on the other hand.

The structural component of the professional training of the analyzed subsystem from the angle of spatial competition is evaluated. Table 4 shows the most powerful components in this respect.

Table 4. Comparative characteristics of the structural components of professional training in the scientific and educational subsystem of some Russian regions, 2015

| Indicator                             | Moscow | Saint Petersburg | Sverdlovsk Region | Republic of Tatarstan | Samara Region | Rostov Region | Novosibirsk Region |
|---------------------------------------|--------|------------------|-------------------|-----------------------|---------------|---------------|-------------------|
| Number of HPE institutions, units     | 256    | 82               | 32                | 29                    | 28            | 25            | 24                |
| Non-governmental educational institutions of HPE | 150    | 41               | 14                | 10                    | 11            | 11            | 9                 |
| The number of students                | 1028,4 | 381,7            | 175,2             | 190,7                 | 141,7         | 141,512       | 141,3             |
The following conclusions can be drawn after analyzing Table 4:
- Moscow and St. Petersburg are natural leaders in the number of universities in Russia's regions; there is a tendency to develop large educational centers here;
- the separation of Moscow and St. Petersburg from the next region in the ranked series - the Sverdlovsk region - is very significant.

Let us try to evaluate the quality of higher education. Today, there are many university rankings compiled by the Expert RA Rating Agency, the Higher School of Economics National Research University in conjunction with RIA Novosti, the All-Russian public organization “Business Russia”, the Federal Agency for Education (FAO), and the publishing house “Kommersant”, an independent agency "Reitor". We note their weak comparability - some ratings are built on the basis of statistical indicators, others - on the basis of exam scores of received, others - on the basis of assessing the demand for graduates in the labor market, etc.

It seems that three criteria can be used as the basis for a rating assessment of the quality of educational activity [13]:

a) the quality of staff, which is determined by the degree of qualification, the competencies of teachers and researchers. The quality of personnel through the quality of educational programs in the combination of teaching and research, subject to the conditions of their compliance with public demand, determines the quality of the content of training;

b) the quality of preliminary training of students, which is determined by the gap between general secondary and vocational education, as well as the mechanisms of educational and vocational guidance and motivation of students;

c) the quality of the infrastructure and the “physical educational environment” of educational institutions, covering the entire set of conditions for their functioning, including computer networks and modern libraries, which can be ensured by adequate infrastructure investment.

Given the above criteria, universities in cities are in a privileged position under clustering and the creation of scientific and educational centers. Therefore, stably the first places according to different ratings are occupied by M.V. Lomonosov Moscow State University (Lomonosov MSU), Bauman Moscow State Technical University (BMSTU), St. Petersburg State University (SPbSU), St. Petersburg Polytechnic University (SPbPU), etc.

International ratings also confirm the leading position of universities in cities and metropolitan areas [14]. What is the reason for the loss of leadership positions as a professional education? Here are a few factors. The first of them is an ill-conceived, alienated from socio-cultural roots education reform, a blow to all its components, and above all, to high school [15-16].

The second factor is the nationalization of education and science. The share of the private sector of vocational education in the regions in 2012 was in the range of 35-45% (St. Petersburg was at the upper limit of this interval - 43%). Over the past three years, this indicator has changed downward, going into the interval of 30-40%, which indicates a weakening of the competitive conditions for the interaction of scientific and educational organizations. The ratio of the private and public sectors in the

| Educational Institutions of Higher Education, Thousands of People | 174,1 | 89,5 | 40,6 | 32,8 | 31,0 | 40,3 | 29,1 |
|---|---|---|---|---|---|---|---|
| Accepted Students in Educational Institutions of Higher Education, Thousands of People | 262,1 | 75,4 | 41,4 | 31,4 | 33,2 | 41,2 | 30,0 |
| Specialists Graduated from Educational Institutions of Higher Professional Education, Thousands of People | 805 | 759 | 409 | 499 | 440 | 473 | 525 |

| Students per 10,000 People of the Population |
|---|---|---|---|---|---|---|
| 805 | 759 | 409 | 499 | 440 | 473 | 525 |
research and implementation structural components of the emerging scientific and educational subsystem is even worse. The private sector share is about 20% in the scientific field.

Taking into account the meso-level, we also single out the factor of regional representativeness of students per 10,000 people, which characterizes the promising possibility of replenishment of personnel of territorial organizations by qualified specialists. The average indicator in Russia is 454. Its highest values are in the Yamal-Nenets autonomous district. Analyzing this indicator, we note that most regions are close to the average value for Russia, except Moscow and St. Petersburg, where this indicator is 805 and 759, respectively.

Focusing on higher education, let us highlight the characteristic “problem factors” of the quality of education:
- gap between full-time and part-time forms affecting competencies;
- separation of training from the real demand of the labor market (inertial continuation of graduation of specialists in legal, managerial and economic profiles);
- imbalance of general and special training components;
- corruption destruction of the education process;
- bureaucratization of the educational and scientific processes in higher education, leading to a decrease in the quality and crowding out of the content components of the activity by purely formal ones [17-19].

**Results**

A SWOT-analysis is conducted to determine ways to increase the competitiveness and efficiency of higher education organizations and their strengths and weaknesses are identified (Table 5).

**Table 5. SWOT-analysis of a typical organization of higher education in St. Petersburg**

| Evaluation Options | Internal factors | Weaknesses |
|--------------------|------------------|------------|
| University management | Systematized organizational structure | Low interest of employees in the development of the university |
|                     | Clear distribution of authority | |
|                     | Democratic management style | |
| Finance             | Government subsidies | Reduction of financing according to the standards for performance of the state task |
|                     | Income-generating activities | Lack of free current assets |
| Personnel           | Timely payment of wages | Weak career growth |
|                     | Social Security | Staff turnover |
|                     | Highly qualified personnel | Very high age of teaching staff |
|                     | Performance evaluation motivation | |
|                     | Ranked wage system | |
| Educational process | Development of a system of continuing professional education | Distance learning is not adjusted |
|                     | Expanding the range of training areas | The difficulty of introducing innovations |
| International cooperation | Participation in international events | No educational tours for students |
| Research activities | Academic mobility of students | A small share of financial income from applied and basic research |
|                     | The implementation of research work, the organization and conduct of international and national conferences, round tables, the development of research activities of students | |

Summary of the analysis results presented in table 5 allows to identify the main opportunities and threats of the scientific and educational subsystem of St. Petersburg. Let us present them in accordance
with the selected areas of assessment: organizational mechanisms, competition, obtaining impulses of market demand, government regulation, investment, technology (Table 6).

**Table 6.** The main opportunities and threats of the scientific and educational subsystem of St. Petersburg

| Assessment directions | External factors | Threats |
|-----------------------|------------------|---------|
| **Organizational arrangements** | Training of highly specialized personnel | Changing the preferences of applicants |
| **Competition** | Cooperation with the business environment | Strengthening the position of universities of a similar profile |
| **Impulses of market demand** | Cooperation with employers | An overabundance of humanitarian specialists, lack of experience in the specialty |
| **State regulation** | State interest in developing narrowly specialized universities and raising the global rating of national higher education | Administrative merger of universities |
| **Investment** | Financial autonomy of universities | Reduction in government funding |
| **Technology** | Application of modern technologies, equipment and programs | Applying new technologies by competitors |

In recent years, some innovations have appeared in Russian higher education, which has led to structural and functional transformations. These innovations, in most cases, were initiated not by educational organizations, but by the relevant federal ministry. Moreover, regional features of the development of scientific and educational activities were not taken into account.

The change in the status of organizations in the field of higher education is evaluated. On January 1, 2011, Law 83 –FZ “On Amending Certain Legislative Acts of the Russian Federation in Connection with the Improvement of the Legal Status of State (Municipal) Institutions” entered into force. With the entry into force of Law 83 –FZ, educational institutions are allowed to follow the path of commercialization. At the same time, motivating factors for ensuring the quality and accessibility of educational services should be:
- formation of tasks for each institution with indicators of the volume and quality of its implementation;
- control over task performance;
- the establishment of a direct relationship between the volume of financing of the assignment and the results of the institution;
- great economic independence of institutions and the responsibility of their leaders for the financial performance of the institution;
- unambiguous determination of the list of services financed from the corresponding budget;
- clear requirements to the procedure of providing paid services to institutions and determining their value for the consumer.

The implementation of this law has led to the emergence of three new organizational forms of educational institutions:
- government institutions;
- budgetary institutions;
- autonomous institutions.

The financing of the activities of public institutions at the expense of budgetary funds is carried out on the basis of budget estimates. Budgetary and autonomous institutions - in the form of subsidies for the fulfillment of state tasks provided on the basis of a plan of financial and economic activity. Budgetary and autonomous institutions received the direction of commercialization, independence in deciding on
the spending of funds from income-generating activities and partially subsidies for the state (municipal) assignment, at the disposal of movable property, except especially valuable movable property. But this is a declared picture; in fact, the independence of budgetary organizations is very conditional, as the competition between sectors of the sphere. The necessary arguments are given. The Ministry of Education and Science conducts open public competitions among educational institutions of higher education that have state accreditation, with the distribution according to the results of the competition, control figures for admitting citizens to areas (specialties) for training at the expense of the federal budget are set. But at the same time, the number of private organizations participating in such a distribution is limited; the share of budgetary reception falling on them, and the competition is conducted by an interested party - the state body, which is in charge of most of the participants. Further, the standard costs for the implementation of the basic professional educational programs of higher education are determined, established by specialties (areas of training) and differentiated by levels - bachelor degree, specialist training, and magistracy. Besides, funding standards vary by specialty (area of preparation), depending on whether they require laboratory equipment or not. Standards for specialties with a special ratio of the number of teachers and students (1: 4, 1: 5, 1: 6) are separately established, as well as for priority specialties. However, it is unclear how these standards take into account significant differences in the property complexes of universities. Let us evaluate the ways of stimulating the choice of the analyzed organizational forms. The state is interested in choosing a form of autonomous organization and pushes state universities to switch to this particular form. For example, participants have to go into the status of autonomous organizations to participate in the program of inclusion in international rankings. The process of redistributing financial resources in favor of strong organizations is complicated, burdened with social consequences. Economic methods alone (“money follows the student”) cannot be promoted. Weak universities, the funding of which is decreased, have to finish up the students who have already arrived, maintain state property, which creates a threat to their insolvency. Besides, the preferences of applicants may not coincide with the priorities of the state educational policy and the predicted structure of the labor market; therefore, some organizations in the sphere have to be maintained, despite low demand. That targeted funds are required to allocate to weak organizations that need restructuring and a change of management to carry out the necessary transformations, which casts doubt on the financing mechanisms of the type of state registered financial obligations that would ensure the priority of strong universities in obtaining budget funds. The principle of “money follows the student” is effective where several universities are competing with each other and can increase supply and improve the quality of educational services, following increased funding [8]. The dominant vector in the direction of the development of higher education — the restructuring of the network of universities with the aim of liquidating inefficient institutions, the introduction of a financing mechanism based on the principle of “money follows the student” — predetermines the investigated subsystem to long-term administrative quasi-establishment, while the incapable business entities of the subsystem have to go through bankruptcy mechanisms and joining. The next component of the scientific and educational subsystem is research. Let us evaluate the dynamics of the main parameters of the scientific component (Table 7).

Table 7. Dynamics of the main parameters of the research component of the scientific and educational subsystem of St. Petersburg

| Indicator | 2013 | 2014 | 2015 |
|-----------|------|------|------|
| Number of organizations performing research and development, units | 302 | 299 | 299 |
| Including | 85 | 84 | 87 |
| public sector | 174 | 173 | 164 |
| business sector | 39 | 40 | 45 |
According to Table 7, the following conclusions can be drawn:
- the number of organizations performing research and development declines. This is due to the restructuring of the scientific and educational subsystem as a whole both in St. Petersburg and in Russia. Moreover, the decrease is insignificant if the whole subsystem is analyzed;
- infrastructural change is taking place in the public sector. This is due to one of the criteria for the effectiveness of both state organizations and higher education is the attraction of funds and it is precisely through a scientific line;
- it is characteristic that the number of workers performing research and development remains at the same level. But the total number of researchers - doctors and candidates of sciences decreases; the number of attendants grows. This means that among our scientists, the number and proportion of those with a scientific degree rapidly fall. Modern scientific trends follow the post-Soviet trend.

The implementation component is a dynamically developing system link in the scientific and educational subsystem. The introduction component of Peter the Great St. Petersburg Polytechnic University is characteristic in this work. Technopark Polytechnic created at the university. The main activities are the creation and implementation of innovative programs in the scientific and technological field; the development of innovative infrastructure at the university, the development of the implementation component of scientific research, the promotion of the spread of modern technologies for innovative products, etc. The technopark has been successfully operating for 20 years and is actively developing and helping residents of the technopark of commercialization and technology transfer. The Polytechnic business incubator promotes the development of business ideas for scientific youth. As part of the business incubator, Fablab Polytech works, which works not only with students, but also with schoolchildren.

Conclusions
The scientific and educational subsystem is generally recognized to function in a crisis economy. The implementation component of the three components actively develops, this is correct. Any scientific research should be implemented. However, the implementation component is not possible without the educational and research components. Since they are now relegated to the background, there will be a tendency to slow down in a few years.
Under accelerating post-industrial transformations, the needs for training specialists dynamically change. In the near future, specialists will be in demand, which no one is taught today, because the corresponding specialties have not yet appeared. In such a situation, the most effective way to develop a vocational education system is to work closely with innovative businesses. The mechanism of public-private partnership (PPP) provides increased efficiency in spending budget funds and improves the quality of public services.
The main mechanisms of public-private partnerships are implemented in continuing education. High-tech companies create laboratories of the future; provide full equipment for teaching children, not only
in schools, but also in higher education institutions. In some universities of St. Petersburg, basic departments have been created, which is a mechanism of public-private partnership.

Further research areas

The scientific and educational subsystem is inscribed in increasingly complex socio-economic transformations, feeling economic instability, increasing uncertainty and social risks. At the same time, the requirements of society to the level of education, the competence of the individual in various areas of social practice are increasing. In these conditions, ensuring its effectiveness plays an important role, for which relevant indicators are in demand. [9].

Further research needs to determine the approach to such an assessment. We proceed from the urgent need to study competition in the scientific and educational subsystem and to develop clear competitive strategies adapted to the Russian conditions of the new system. Many regional economies are not sufficiently prepared for open competition. Therefore, the central moment is the formation by their scientific and educational subsystems of qualitatively new competitive advantages.

This problem can be solved, basing on the formation of key competencies. G. Hamela and K. Prahalada can be distinguished among the scientists who made a significant contribution to the development of this problem. They have developed a concept of key competencies and the corresponding strategy: “To take advantage of foresight and gain leadership in key competencies, the company has to take over important global markets before competitors. The goal is not to get into the market as quickly as possible, but to create a global lead in the market" [10].

The scientific and educational subsystem is designed to form key competencies. The more such competencies are created for it, the higher its contribution to the increase in the competitiveness of the regional economic system is.

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