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Article

Development of the Knowledge Economy and Regional Innovation Policy in the context of sustainable development: Russian Practice

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Abstract: The paper explores different models of innovation management at the regional level and reasons for the best model considering the specific features of St. Petersburg as the innovative region of Russia. The authors, on the base of their long-time experience in studies of innovative enterprises and elaborating the regional innovation policy in St. Petersburg, propose the tool of creation and measuring the results of the regional innovation policy that promotes the life quality improvement and regional sustainable development. The balanced scorecard is used as a method, based on the methodology of knowledge economy development and adjusted to the specific needs of St. Petersburg innovation ecosystem. The authors pay special attention to the implementation of principles of green economy into the realization of the regional innovation policy and the proposed balanced scorecard.

Keywords: sustainable regional development; knowledge economy; regional innovation policy

1. Introduction

This article represents generalization of 20 years of the authors' experience in the sphere of regional innovation policy. Since 1994, at the start of economic reforms in Russia, attempts were made in St. Petersburg to switch the city economy to innovation-based development. During this period, the city government adopted several programmes aimed at increasing innovative activity, encouraging innovative ventures, and identifying the actual innovative capacity of enterprises in St. Petersburg. Moreover, the concept of post-industrial economic development of the city was put forward. The adoption of this concept almost led to the failure of the city economy. St. Petersburg is a major industrial centre, the contribution of which into industrial production of the Russian Federation may be compared to the contribution of the Chicago agglomeration into the industrial production of the USA. The displacement of major industries from the city resulted in a contraction in such areas as scientific services, research and innovation organizations. Only in 2010, after the 2008-2009 financial crisis, the city government come to understand the role of industry in the development of the city economy; consequently, the resolution to implement the strategic programme "Science. Industry. Innovation." (in the years 2011-2015) was adopted. This programme is designed to compensate for losses, which the city economy suffered due to cuts in scientific research and development and reduction of industrial innovative capacity. Currently St. Petersburg is facing the task of developing the knowledge economy, for this purpose the latest programme of

the knowledge economy was developed by the government, and the authors of this article were involved in the development of this programme as well.

The aim of this study is to identify the best model of innovative management for the region. To achieve this, authors analyze knowledge-based economy development in St. Petersburg, set out approaches to innovation economy administration, identify challenges of knowledge-based economy design, and explain advantages of strategic management in innovation development administration.

The paper is constructed as follows. First, we describe the methodology of the research and its linkages with the areas of economic growth theory, innovation development, and management. The theoretic backgrounds of the study are summarized in the following section. After this, authors analyse the regional innovation policy implementation in St. Petersburg in the context of its sustainable development. The authors' approach to balance scorecard as a tool of measurement the knowledge-based economy development is presented further. The adjustment of the balance scorecard approach to the sustainable development of St. Petersburg is subject of the following section. Finally, the conclusions are presented.

2. Research Methodology

The study was performed by using the general research techniques – a systemic approach, analysis and synthesis, social and economic research techniques, statistical analysis methods.

In order to obtain the maximum objectivity of the research results, methods of involving the stakeholders were used in the research (interviews, expert evaluations and opinions, workshops and colloquiums), field research was also conducted, including work with executive authorities, as well as with research and manufacturing companies. To classify the models and approaches to knowledge-based development (further – KBD), we analysed the websites of regional administrations in the EU, Asian and North American countries and collected data from regional authorities of five regions of Russia. For the purposes of identifying and classifying models, we relied on the papers published by Casey (2003) and Mankiw (2006), who provided a profound analysis of existing concepts, which we developed according to our vision of regional development theories' evolution.

Five research areas underline regional development concepts: 1) *neoclassic theories* based on a production function; 2) *cumulative expansion theories*, a composition of neo-Keynesian, institutional and economic-and-geographic models; 3) *new regional development theories* based on increasing returns to scale and imperfect competition; 4) *new forms of territorial organization* of production based on industrial and regional clusters, value-added chain, learning economy, and national and regional systems of innovations; and 5) *other theories* explaining local or individual issues of regional development. Table 1 presents various theoretic backgrounds for regional development.

Table 1. Classification of theoretical approaches to regional development

Theoretic background	Main proponents	Specific characteristics
Neoclassical regional development concept	Menger (1871), Wieser (1884), Pigou (1933)	The neoclassical school studies the behaviour of the so-called economical man (a consumer, an entrepreneur or a salaried employee) who strives to maximize his/her income and minimize expenses. Limiting values constitutethe basic analysis criteria.

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New neoclassical school	Lucas and Sargent (1991), Sargent and Wallace (1975), Barro (1977), Samuelson (1948), Friedman (1957)	The proponents of this theory analyze the reactions of the economic system acting under the conditions that its agents not only have adequate information about the future development of the economy, including the activities of government policies, but also are able to act rationally, expecting certain changes in the economic environment. They believe that macroeconomic policies are usually based on the models, which summarize the nature of economic reactions in the past, that is, the past economic behaviour of the agents. They do not take into consideration the future behaviour of those agents, which will be changing depending on their expectations and due to the very activities of the government.

Table 1.*Cont.*

Coincidence, or convergence models	Solow (1980), Barro and Sala-i-Martin (2003)	Convergence models divide the factors of capital into physical (material) and human (with the exception of Solow and Swan's model), which enables them to determine the degree of interchangeability of labour and capital as well as the rate of convergence of the growth rate of regional economies. Moreover, regional economic growth, according to the models, just as in the first model, is determined not by the flow of production agents but by to what extent they are accumulated.
Innovative economic growth theory	Kuznets (1973) and others	A higher rate of innovation is considered an important factor. In accordance with the new growth theory, the generation of knowledge is viewed as an endogenous process, which responds to market stimuli, such as expansion of possibilities for profit generation, development of production agents, e.g., better education for the employees. Information technologies accelerate the process of innovation by making information processing easier and cheaper and shortening the innovation development periods. The evolution of the innovation economy is a progressively accelerating process.
Cumulative expansion theories	Boudeville (1966), Lasuen (1971) and others	These are theories of the emergence of growth centres and channels of their propagation in the spatial economy, development of agglomerations and central places, diffusion of innovations, development of peripheral territories, constant returns to scale and uneven growth under the conditions of free competition. Based on the above principles, these approaches include growth factors of spatial economy specialization or territorial labour division, transportation expenses, mobility of production agents, the central place and the factors of its evolution, agglomeration of production and the factors of its development, innovation and other novelties and the channels of their expansion, localization related to the immobility of production agents, as well as individual regional peculiarities.
"Growth pole" concept	Higgins (1983), McKee (1987), Kuehn and Bender	A growth pole may be: 1) a regional complex of enterprises involved in regional exports (not just

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	(1969), Lasuen (1971), House (1978), Doloreux and Dionne (2008), and others	related to the leading industry); 2) a system of poles, where each of the poles grows by means of pulses generated by national demand, which are conveyed through the export sector of the region; or 3) a growth pulse, which is conveyed to secondary industries through the market links among enterprises and among geographic peripheries.
Agglomeration theory	Richardson (1973), Rosenthal and Strange (2004), Mori, Koji, and Smith (2008) and others	The accumulation of production activities in the cities as large industrial centres, a particular kind of growth pole, is the major factor of growth.
Sustainable regional development	Gore(1992) Odum (1969) Cobb, and Cobb, et al. (1994) Solow (1974) Victor(1991) Georgescu-Roegen (1975) and others	Sustainable development is such development which allows present generations to satisfy own requirements, without creating threat for future generations to satisfy their requirements The essence of sustainable development consists in settlement of environmental problems, but not to the detriment of economic development.

The methodology of knowledge economy development governance must focus on the problem of ensuring strategic stability of a region's social and economic system. What is controlled is the social, economic and natural environment of a region, and the management entity is comprised of government agencies, social organizations, legal entities and physical persons, being the stakeholders of regional development.

The balanced development of the region consists of implementation of a set of activities:

1). Setting the goals for balanced development. The problem of setting goals is conditioned by the multiplicity of the goals of regional development, while the limited resource potential makes it necessary to build a hierarchy of goals. Methods of hierarchical analysis will be considered in the following sections of the research. 2). Analysis of the balanced development potential. It must necessarily include institutional analysis, along with resource potentialanalysis aimed at identifying resource limitations. Balanced development in the Russian regions, as international experience of regional management shows, will primarily depend on the quality and level of development of the basic institutions. Therefore, institutional prerequisites for balanced development play a key role in identifying existing imbalances and assessing the region's overall potential.3). Development forecasting for a region should reveal the main problems of ensuring the balance of the region's socio-economic system.4.) The mechanism of implementation of the balanced development strategy should include a set of management methods and tools that would help ensure the required regulatory control of the relevant subsystems of the region's social and economic environment. The indicative-regulatory planning using the system of social charters, becomes the main tool functionally for the implementation of targeted programmes that represent the strategy of balanced development of the region, taking into account the comprehensive stimulation of market adaptation of the principles of the green economy.5.) Monitoring of the balanced development strategy implementation is necessary to carry out control actions that ensure timely adjustment of plans, programmes, and budgets. The monitoring system provides the necessary information to assess the effectiveness of the implementation of projects and programmes, thus creating the conditions for making adequate decisions on their resource support. Thus, strategic monitoring provides feedback to the balanced development management system, while real-time monitoring forms an information space for current managerial decisions.

In addition, authors developed the methodological aspects of Balanced Scorecard implementation in the public administration.

3. Theoretical Basis of the Study

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Following the changes in society in the 1980s and early 1990s, the dominant role of new knowledge and information in the process of economic development was widely acknowledged. Toffler (1983) pointed out that in the past land, labour and capital were the key production elements. In the future, information will become the key element".

The shift in the role of information and knowledge in modern economic development, particularly, in the information theory of value, developed by Bell (1981) and his followers. Bell pointed out that in the course of social development knowledge, innovation, and methods of their practical application act as a source of profit. That is why the old paradigm of the labour theory of value, which ignores the fundamental role of information and knowledge in an economy, should be changed.

Turning the new "intellectual" technology into an essential tool for system analysis and theory of decision-making.

Thus, information and knowledge become the "fundamental social fact" that forms the basis of economic development. Modification of conditions of economic activity is reflected in the fact, that many researchers identify the new type of economic development, which is called "knowledge economy".

Machlup (1962) is considered as the founder of "knowledge economy" theory, he identified it as a type of economy, where the knowledge sector plays the crucial role and the production of knowledge is the source of economic growth.

This refers not only to the "new economy", but also to the new type of society that was suggested by Drucker (1969) to be called a "knowledge society".

In recognition of the increasing role of innovations, researchers tend to call the modern economy "knowledge-based economy", "learning", information or innovation economy (Foray, 1999).

Taking into account the importance of the regional aspect in the implementation of economic policy, the world's leading development institutions carried out research in the field of creating economic policy that boosts the development of the knowledge economy (Powell and Snellman (2004); Castells. (2000–2004); Fischer et al. (2010); Dang, Umemoto (2009) Armstrong (2006). Olsen, Osmundsen (2003); Leydesdorff (2000, 2004); Melnikas (2011)).

Sustainable development demands the balanced approach to development of economy of the region. As Garbie (2017) notes "Sustainability/sustainable development (S/SD) is considered as one of the major drivers of next industrial revolution as so called "Industry 4.0"

4. Effects of the implementation of the regional innovative policy in St. Petersburg (2016) in the context of sustainable development

There was a constant fall in prestige of research activities during the period of economic conversion, which also contributed to build up of crisis phenomena. This resulted in reducing the number of applicants to higher educational establishments, most notably technical, postgraduate students, as well as closing of postgraduate education at a number of industrial Scientific-Research Institutes, a decline in the proportion of students enrolled in postgraduate school and those who defended a thesis.

The structural crisis of St. Petersburg's industry exerted negative influence on St. Petersburg's scientific sphere. A shift towards the increase of share of material-intensive industries with simultaneous reduction of science-intensive and high technology products has taken place.

Selection of priority areas of research and technology development, as well as closing of unpromising research and technology organizations cannot come about purely by market forces, since many quite promising and internationally acclaimed research and technology teams in St. Petersburg faced financial hardships (due to the non-payment crisis, and from the state with the intolerable burden of taxes and customs duties on imported equipment etc.). The privatization process in many cases was implemented ignoring the interests of scientific enterprises.

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The package of measures, that, in addition to overcoming the crisis in research and production, should have contributed to its conversion to the innovative type of development in 1996-2000, included:

Successive modernization of major industrial enterprises through conversion, access to foreign markets, attracting of strategic investors etc.;

Priority development of knowledge-intensive production and the professional services sector (design, information, consulting etc.);

Attracting private foreign investments to the spheres in Russia that are non-conventional for institutional investors, primarily in industry, by providing investors with tax and customs privileges;

Banking sector development in order to ensure better availability of long-term credits for investment purposes;

Improvement of education, creating conditions that enable treatment of highly qualified staff training as one of the priority areas;

Restructuring of fundamental and applied science. We can expect that fundamental science, while reducing the scope of secondary activities, will maintain its positions in those areas, where it has advantages on both domestic and international level. Applied science should focus on research and development, ensuring accelerated commercial success both on the domestic and on the global market;

Activisation of entrepreneurship by providing support to small and medium-sized businesses. Since the market's self-regulatory mechanism at this stage does not provide the formation of the optimal small business sectoral structure, active governmental support is required for small businesses: operating in the sphere of production, engaged in innovative activities, working in asset-intensive industries, providing the full cycle of "design - manufacture – sales", involved in market support. Primarily, we should encourage enterprises engaged in innovative activities covering the full cycle of "design - prototyping – sales of products", since this area of small businesses' activities is of particular importance for the further development of the city and currently is the least profitable. Given the significant (compared to the other subjects of the Russian Federation) potential of the scientific sphere, the established complex of fundamental science, underutilized potential of academic and industrial science, concentration of knowledge-intensive industries in the city, the industry innovative development should be considered as the main direction of development for the city's economy.

Dynamics of the number of contracts for technology export and import is a factor of extreme importance that characterizes processes of technology transfer. (Figure 1).

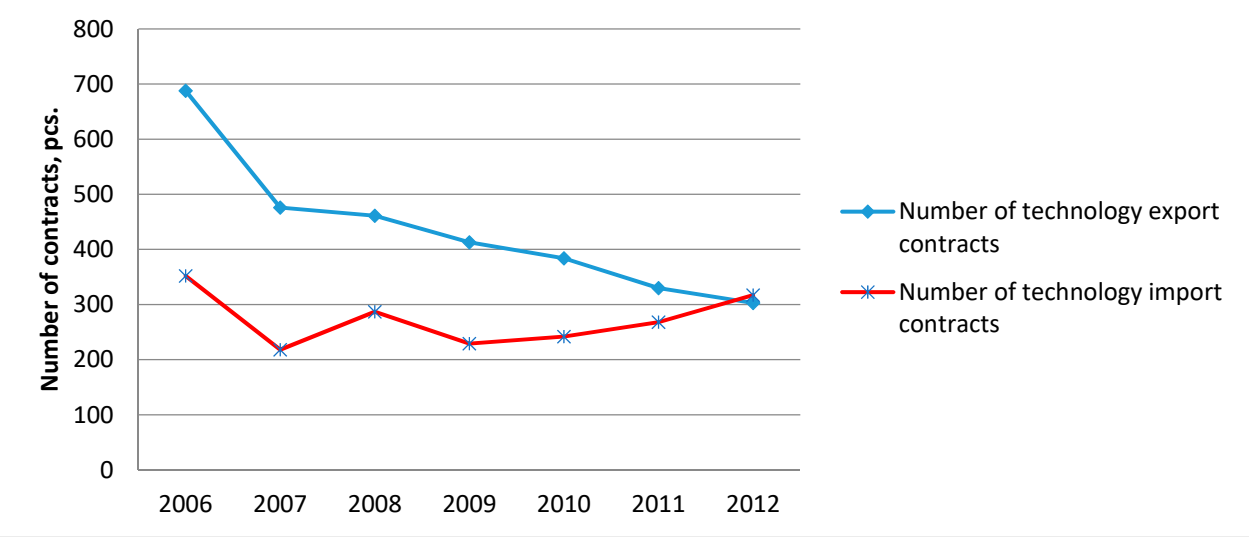

Figure 1. Dynamics of the number of contracts for technology export and import in St. Petersburg in 2006-2012.Source: Unified Interdepartmental Statistical Information System, authors' calculations.

It is obvious that under WTO conditions St. Petersburg continues to lose the role of technology donor, gradually turning into recipient. Under these circumstances, the only solution is to work seriously for the protection of intellectual property of St. Petersburg enterprises and organizations, to assess the commercialization potential, and to promote actively in the international technology markets, which requires revision of the regional innovative and industrial policy.

At the same time environmental problems of the city economy have become aggravated. In Saint Petersburg, atmospheric air monitoring in various parts of the city is conducted at the stationary posts of the Federal State Unitary Enterprise "North-West Department on Hydrometeorology and Environmental Monitoring" and the Automated System for Atmospheric Air Monitoring in Saint Petersburg (AMS) established by the Committee for Nature Management, Environmental Protection and Environmental Safety.

The table below shows gross emissions into the atmosphere from automotive transport and stationary sources in Saint Petersburg according to the yearbooks "Environmental Protection, Nature Management and Environmental Security in Saint Petersburg" published by the Committee for Nature Management, Environmental Protection and Environmental Safety, and annual reports on the environmental situation in Saint Petersburg. According to the table, the main source of carbon monoxide emissions into the atmosphere in Saint Petersburg is motor transport. Motor vehicle emissions made up 94% of the total emissions in 2016 (86% in 2012, 94% in 2013). Emissions of stationary sources in Saint Petersburg are insignificant, both by gross mass and by the number of sources. About 78% of emissions from stationary sources are directly related to the city's utilities.

Table 2. Total emissions of pollutants in atmospheric air from stationary and mobile sources in 2013-2016, thousand tons

	Total	Solid	SO_2	CO	NOx	CH_4	volatile organic compounds
2013	536,6	2,7	5,4	396,8	66,5	10,6	53,4
2014	5,13	3,0	4,7	377,4	62,3	16,9	47,9
2015	521,0	3,1	4,4	379,4	61,4	22,3	49,2
2016	530,2	3,4	4,6	383,4	65,9	22,7	48,9
Increase (+) Decrease (-)	9,2	0,3	0,2	4	4,5	20,7	-0,3

Source: The report… (2017)

In process of revival of the economic growth the adverse load of an ecosystem of the city increased. The influence of stationary sources of atmospheric air pollution on the population is mainly of a local nature (complaints about emissions of a particular plant) and can be solved by local measures, whereas motor vehicle emissions influence all city districts. This problem requires the complex solution and introduction of innovative technologies in city transport.

5. BSC approach to knowledge economy development in the context of sustainable development

The main problem of St. Petersburg's public administration is the unsatisfied level of the strategic management. Innovative policy of the city needs the effective mechanism of the strategic planning and control such as BSC.

The most common form of Balanced Scorecards, BSC is the model by Kaplan and Norton (1992). However, their BSC-model is not the only one. There is a number of alternative models designed to evaluate business activities and associate the indicators with the strategy of organization.

Mac-Nair, Lunch, and Cross (1990) were among the first who presented the model known as the "pyramid of efficiency". This was an attempt to unite indicators of strategic development inside frameworks of single model. The Maisel's model was proposed in 1992, and is called as the Kaplan-Norton's model - BSC. Maisel (1992) also defines the four perspectives, which are the basis for business activity evaluation. The Kaplan-Norton's model was developed by Adams and Roberts

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(1993). Their model was called the EP2M (Effective Progress and Performance Measurement). However, according to most researchers (Kloot and Martin (2000); Low et al. (2012); Ioppolo, Saija, and Salomone(2012); Matei and Enescu (2013) Ferreira da Cruz and Marques(2014); Speklé and Verbeeten (2014); etc.), the adaptations of the Kaplan-Norton's model are the most promising for regional administration.

BSC-model should convert the specific activities and strategy to fairly full set of indicators, which in fact form a system of strategic control and management.

The strategy map shows, how many different parameters are transformed into the strategy implementation instrument. The strategy chart can help to formulate the long-term plans and disclose them to the staff. In order to do so, the model uses a system of indicators, which are characterized by certain cause-effect relationships.

The balanced system of indicators, developed for management of competitiveness in St. Petersburg, based on the knowledge economy development, should include appropriate strategic development priorities. You can see the model of the balanced system of indicators developed for management of competitiveness on the figure2 below.

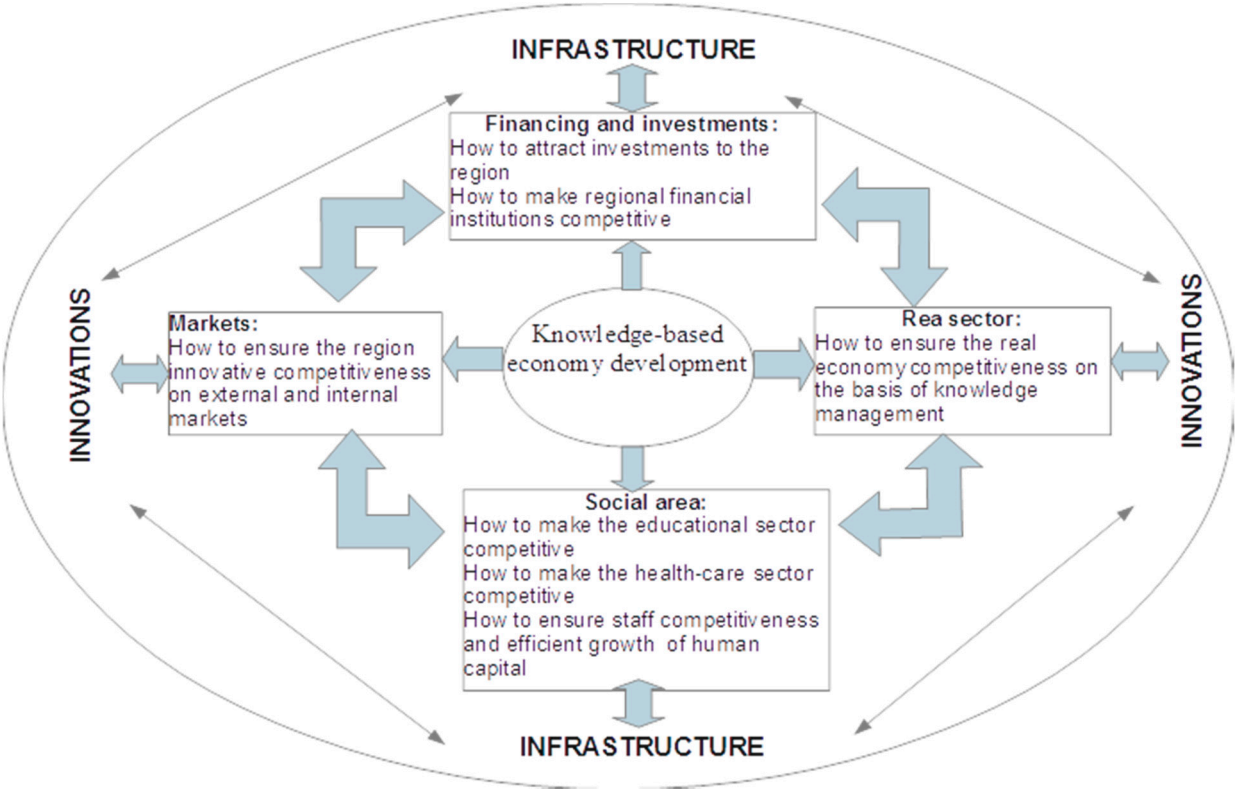

Figure 2. The balanced scorecard of competitiveness, based on the knowledge economy

Adequate systems of indicators for each area are to be generated to the form of business projections. This research proposes a system of key performance indicators (KPI), which may be used for management, planning and control of competitiveness. The effective use of KPI requires regular planning and monitoring of strategic and operational indicators (Figure 3).

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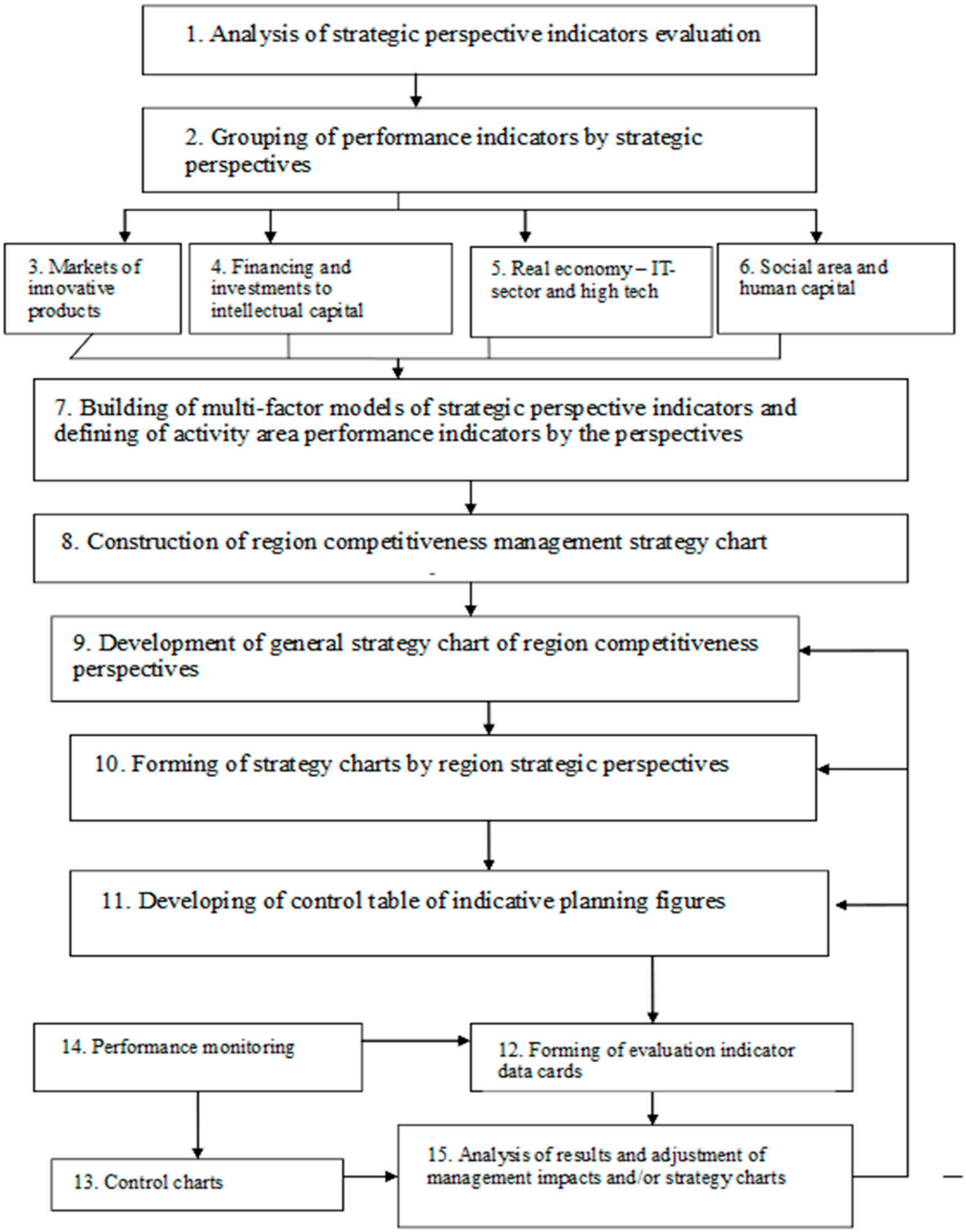

Figure 3. The process of planning and monitoring of KPI of region competitiveness based on knowledge economy

The first step is to review the existing systems of indicators. The second step is to group the selected indicators by strategic perspectives. The steps 3-6 involve building a hierarchy of competitiveness management objectives in order to form multi-factor KPI models on the seventh step. The eighth step is to construct a strategy maps for region competitiveness management based on the multi-factor models. The steps 9-11 suggest the strategy maps detalisation by the indicative plans design in the form of tables of indicative planning figures. The 13th step suggests processing of

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the information on implementation of the selected competitiveness management strategy. It is based on strategic and operational monitoring data (step 12). The 14th step involves decisions on management impacts adjusting.

7. . BSC approach implementation in the Saint Petersburg' KBD governance

Applying the BSC approach presupposes the availability of a development objectives system in the strategic management system of the city's economy. The main strategic document setting out the St. Petersburg development directions is the Social and Economic Development Strategy 2030, on which the present authors collaborated. The system of strategic objectives, in accordance with this document, includes environmental and energy efficiency objectives, which is inextricably linked with the transition to fundamentally new standards and methods of business organization, the growing role of the knowledge economy in the city's economy and the reduction of the obsolete production share.

At the city level, in order to achieve the set objectives, the Committee for Nature Management, Ecology and Environmental Protection of the St. Petersburg Administration developed a special state programme "Environmental Improvement and Protection in St. Petersburg for 2015-2020". For this programme, the KPI system was formed by Committee experts with the participation of the expert community. (Table 3).

Table 3 - KPI for the state programme "Environmental Improvement and Protection in St. Petersburg for 2015-2020"

Item No.	Target name	unit	Immediate value of the target by years					Final value of the target
			2015	2016	2017	2018	2019	2020
1	Reduction of pollution level in the air basin of St. Petersburg (to the level of 2012)	%	1.2	2.4	3.7	5	6.2	7.5
2	Reduction of pollution level in the water basin of St. Petersburg (to the level of 2012)	%	1.2	2.4	3.7	5	6.2	7.5
3	Proportion of residents positively evaluating the level of the living environment improvement (from the number of respondents)	%	72.5	72.8	73.1	73.4	73.7	74
4	The share of utilized and neutralized wastes in the total volume of generated waste in the process of production and consumption	%	13.5	13.5	39.1	38.1	36.9	36

Source: www.spbstrategy2030.ru

Thus, two key directions for implementing the strategy came to the forefront:

A system of measures to improve air quality and reduce greenhouse gas emissions.

A system of measures to improve the state of water resources, primarily through in-depth wastewater treatment of industrial enterprises and the modernization of hazardous industries.

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Since 2016, the State Register of objects affecting the environment has been maintained in St. Petersburg, and the Environmental Council of the city has been formed and effectively operates. To improve the situation in the sphere of water use, a special investment program has been developed, implemented by the "Vodokanal of St. Petersburg" company - a monopolist in the wastewater and sewage treatment. This programme by objectives and KPI is linked to the city programme mentioned above. Also, the targeted programme for cleaning the water area of St. Petersburg is being implemented in the city.

To stimulate the introduction of water protection technologies in the activities of industrial enterprises, a strict system of penalties for exceeding permissible concentrations of harmful substances and discharging specific contaminants into the sewerage system has been introduced.

To improve the atmospheric air condition, a large-scale program is being implemented to transfer the electricity generating capacities of St. Petersburg enterprises to natural gas instead of coal and fuel oil. This programme affects small and medium-sized energy projects and has demonstrated good local results.

In order to identify the main factors adversely affecting the atmosphere, a comprehensive analysis was carried out, revealing the problem with the growth of air pollution in connection with the development of the road transport fleet due to the increase in greenhouse gas emissions, primarily CO, into the atmosphere from industrial enterprises.

The growth of emissions from enterprises in 2016 compared to 2015 is a result of the restoration of industrial production volumes. Emissions of pollutants from stationary sources (in total) to the atmospheric air of St. Petersburg amounted to 78.3 thousand tons in 2016. Emissions from stationary sources in comparison with the previous year increased by 7.0% (5.1 thousand tons), including: solid pollutants - by 4.5% (0.1 thousand tons), sulfur dioxide - by 13.6% (0.3 thousand tons), carbon oxide - by 13.1% (2.5 thousand tons), nitrogen oxides - by 11.3% (2.6 thousand tons), and hydrocarbons - by 2.0% (0.4 thousand tons). Emissions of volatile organic compounds decreased by 13.6% (0.8 thousand tons). But if we compare the current data with the data of 2013, then with the production volume restoration up to the level of 2013, CO emissions have reduced by 2%. At the same time, an increase in the mass of pollutant emissions from motor vehicles (by 0.2%) in 2016 compared to the previous year is associated with an increase in the number of automobiles in the St. Petersburg city limits. This is in proportion to the overall increase in automobiles, and this problem shall be addressed further.

The problem of transport's impact can be solved by switching cargo and passenger transport to compressed natural gas. Considerable positive experience in this sphere has been gained, for instance, in the USA, where such cities as Los Angeles, San Francisco, New York have switched most of the buses and municipal taxis to gas.(America's Natural gas alliance booklet, 2012).

A specialized subsidiary of Gazprom PJSC — Gazprom Gas-Engine Fuel LLC — was established in December 2012. It will control gas-engine assets of Gazprom Group, as well as its financial, labour and other resources.

The key functions of Gazprom Gas-Engine Fuel LLC in the gas-engine fuel market of the Russian Federation:

1. Consolidation of investment resources to create the infrastructure of gas-engine fuel market;
2. Coordination of the programme for the development of infrastructure of all market participants with a view to create synergistic effects of gas-engine industry development;
3. Creation of project-specific infrastructure to implement projects for construction of CNG filling stations, cryogenic car filling stations, natural gas liquefaction complexes, and other required facilities (coordination of the development of specialized EPC/EPCM-contractors, primary equipment manufacturers, outsourcing companies for market development, etc.);

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4. Work on the optimization of the Russian Federation legislation in the field of the gas-engine market and creation of effective mechanisms of state regulation of the industry;
5. Creation of the infrastructure for the development of consumer demand.

To reach its targets, Gazprom Gas-Engine Fuel LLC has to implement a large-scale programme for the construction of networks of CNG filling stations, cryogenic car filling stations and natural gas liquefaction complexes by 2020. The plans for annual construction of infrastructure facilities of the gas-engine fuel market exceed the peak volumes of construction of CNG filling stations in the USSR in the 1980s by a factor of 3 to 4 and are at the level of the peak values of introduction of CNG filling stations in Iran, Pakistan and China during the intensive development of the gas-engine industry in 2006-2011. Gazprom and major Russian car manufacturers have reached agreements on including natural gas models into their range of vehicles produced. As a result of the cooperation, the sales volume of these models in Russia has almost quadrupled over the last three years. While 559 gas-engine vehicles (including 536 of domestic manufacture) were sold in 2012, as many as 2170 units (including 2045 of domestic manufacture) were sold in 2014.

7. Results of monitoring of an ecological situation on the basis of polls of the population of St. Petersburg

In parallel with the measurements reflecting the objective changes in the air quality, regular population surveys on the environmental situation in the city are conducted. They make it possible to take into account qualitative and quantitative parameters, objective and subjective assessments to monitor the implementation of strategic maps in the innovative development of the city's economy.

During the period 2014-2016, the authors conducted the studies based on subjective assessment of the environmental situation. The study was based on two series of interviews. Polls were conducted in 7 administrative districts of St. Petersburg, taking the first positions from 18 districts of the city in terms of the level of pollutant emissions into the atmosphere. (Fig. 4)

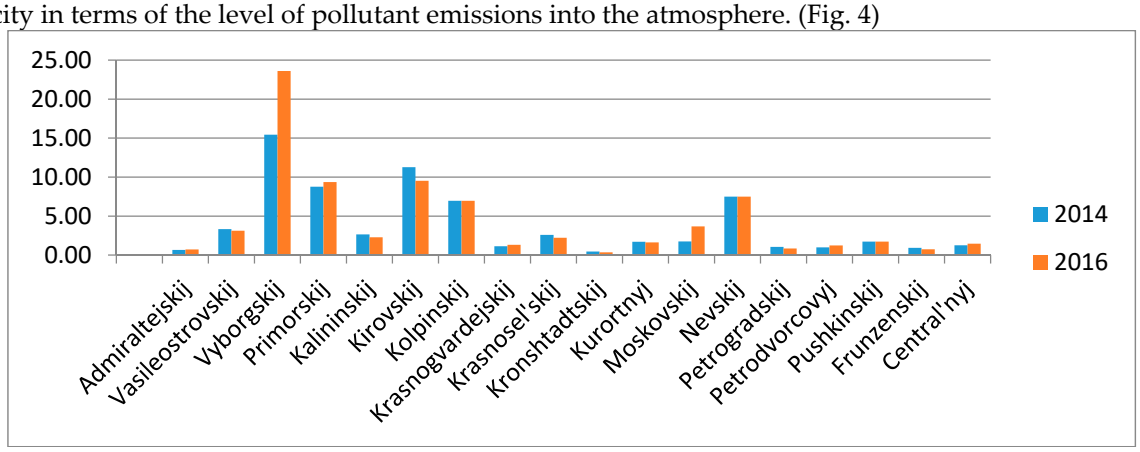

Fig.4 Level of pollutant emissions into the atmosphere in cities districts
Source: The report… (2017)

The first survey was conducted in June 2014, and the second in October 2016. Surveys of the population were conducted near metro stations located next to pollution sources, as territorially the areas of St. Petersburg are large units with variable environmental characteristics. The key criterion for selection is the adult population living permanently in the territory located within walking distance from the point of the survey. A total of 504 respondents took part in the survey in 2014, and 486 respondents in 2016. The age and sex structure and educational level of the respondents are shown in Fig. 5 a-c.

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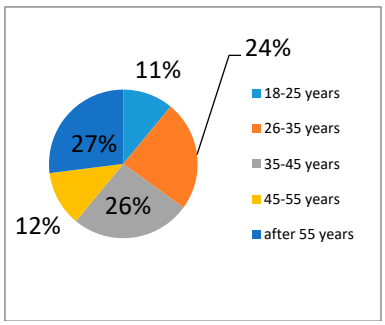

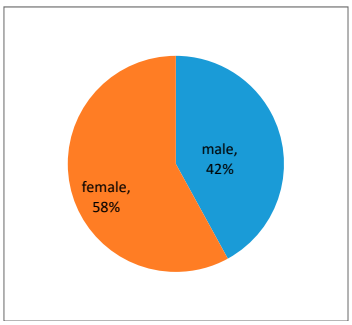

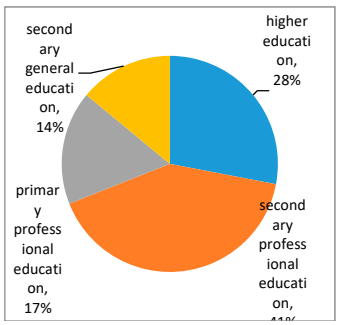

Fig. 5a - age structure Fig.5b - sex structure Fig.5c - educational level

According to the poll (Fig. 6), the number of respondents positively assessing the environmental situation increased by 2% over 2 years (with the exception of the Vyborgsky District, where 78% of respondents negatively characterized the environmental situation, which is 24% more than in the previous poll.

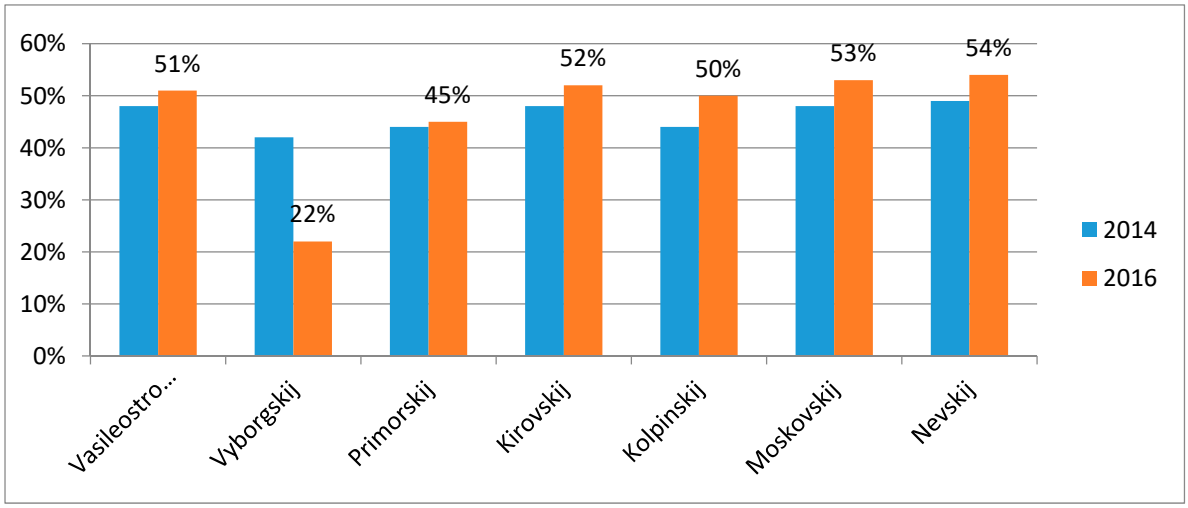

Fig. 6 - Share of the respondents satisfied with an ecological situation

The data on the Vyborgsky District are confirmed by objective observations - emissions into the atmosphere in this area increased by 30% over 2 years.) Thus, the surveys allow us to supplement the monitoring system with performance indicators and track the dynamics of achieving such a KPI as the proportion of the population positively assessing the living environment (fig.7)

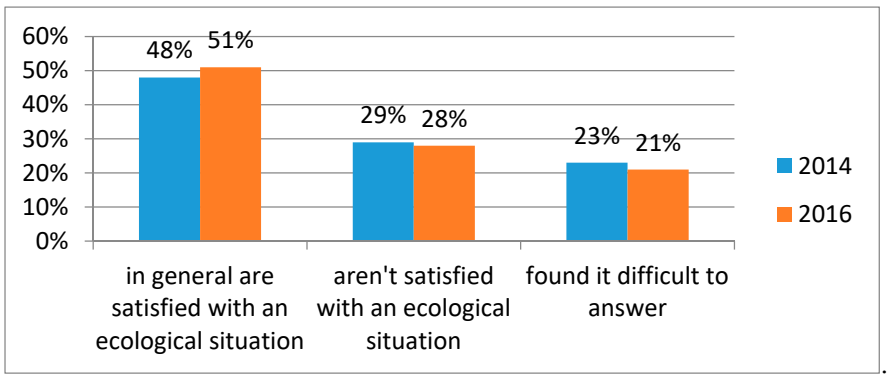

Fig.7 - Dynamics of assessment of an ecological situation respondents in 2014-2016.

8. Conclusion

The research undertaken demonstrates direct relationship between the regional innovative policy and the formation of knowledge economy elements. However, the policy will be successful only in the case of maintaining confidence of the business community towards the government policy. Over the past 20 years the business community of St. Petersburg and Russia as a whole, has come a long way from trust and enthusiasm to disappointment and indifference, which adds a certain negative inertia to the development of the city economy. To ensure a breakthrough it is necessary to radically change the business climate in the city, to carry out consistent policy, demonstrating the actual support for the innovative sector and compulsory fulfillment of all obligations which are undertaken. Using of the region competitiveness management system concept allows to form long-term competitive advantages at the regional level and maximize the use of regional development capacity. It includes combined advantages of the theories, concepts and methodology of managerial approach to the knowledge-based regional competitiveness Thus, sustainable development becomes a logical result of the introduction of the principles of the green economy in the implementation of innovative development programmes.

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