INNOVATIONS AND SMALL BUSINESS

CURRENT SITUATION AND MODELING

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INTRODUCTION

Economic growth in the markets' volatility circumstances needs to use high-tech instruments for managing the economic processes and entities. The paper studies such key elements of this field as innovations, science and technology parks and small scale enterprises.

Innovations have been the major factor of economic growth for the countries with different economic structure (from agricultural to high-tech ones) through all the times. The development of the economy, increasing of its flexibility, mobility and stability strongly depends on how fast is the process of turning innovations into real products, services and how fast they can get to the clients. The scale of the particular economic entity, no matter if it's a country, a region, a local or a global corporation, is not important.

Small scale enterprises in all the countries consider being a very important economic entity, which has a number of specific features. Most of the innovation products are "growing" out from the small scale enterprises and start-ups. In many developed economies small scale enterprises contribute a very significant share into GDP. And, finally, high mobility of the small scale enterprises makes them a unique economic instrument.

The important role in the matter of developing innovations into the practical usage during the last decades is played by science and technology parks (hereinafter – S&T parks, this word also can be used for science parks, industrial parks, business-incubators and other structures with the similar functions).

The S&T parks as an institution are the lever that can provide the growth of the innovation activity of the sectors, regions, economies. And this growth's "guide" can be small scale enterprises, functioning inside the S&T parks.

However, S&T parks are not the one and only "channel" of innovations' materialization (commercialization). Innovations can "become a part of life" also through the modernization or habitual renovation of the technologies, procedures, product lines in the operating enterprises. This paper analyses these two considerations about the way of using innovations in the enterprises' operating:

1. Developing, launching, adoption of innovational products by legal and natural persons in the field of special infrastructures (like S&T parks), made by government.

2. Using and adoption of the finished innovational products and technologies by operating enterprises.

In Russia the questions of development on the basis of innovations becomes very actual, because till recent time the main component of the growth is due to forced exploitation of the production facilities remaining from the Soviet period and intensive mining of the natural resources. The problem of the new sources for the growth reached its critical stage when obsolescence and physical depreciation of the equipment started to menace by complete

suspension of production and total transformation of the Russian Federation into a source of raw materials for the other countries.

Recently the Russian government has been repeatedly taking efforts to modernization of the Russian economy using different approaches, but most of them turned out to be low effective because of the absence of the necessary institutions. S&T parks being an institution, approved lately in different countries of the world and partly during the Soviet period in Russia, can be ranged with the high effective instruments of the development intensification.

The efforts to create S&T parks in Russia started to take part from the "bottom" in the late 90's, but the legal support in the form of the legislative acts appeared only in 2005-2006 [1]. The informal social organization Association of Russian S&T parks has been created to provide support for their establishment, functioning and development. But up till now there is no integrated targeted effective mechanism of the support for the functioning of the S&T parks' system, targeted to the final result, i.e. the country's economic growth, represented by the number of corresponding indices.

The problem is, that such mechanism obviously must function on the level of the corresponding economic entity, i.e. government, region etc. Perhaps, this mechanism must be hierarchically arranged and integrated into the vertical organizational structure and consist of not only the instruments of the passive support, but also the mechanisms of managing the creation and developing the S&T parks in the most important industries and regions. In order of that there must be created the necessary functional systems, in particular, the S&T parks' condition and indices monitoring system, modelling system for the S&T parks' development variants and scenarios, the S&T parks' human resources system etc. Some elements of these functional components, mainly about small scale enterprises, are analyzed in this paper.

Novelty (innovation points) of the work:

1) Systematic analysis of macro- and micro-objects interacting within the single economic environment, including the influence of the macro-object on the development of science and technology parks, especially the influence of the country's macro policy in the field of innovations on the development of the science and technology parks.
2) Estimation of the contribution of the small enterprises into the country's GDP and assessment of the development trends.
3) The work proposed directions of the small enterprises' development and trends for the changing of the institutional mechanisms and evolution of the country's policy, also there have been created an algorithm for choosing the type of innovation.

This paper undoubtedly does not claim to be exhaustive for the fields mentioned in the title. Each one of them is extensive, deep, changeable, has vague limits and usually it's hard to say where one field ends and the other one begins. The paper represents only one of the points of view on the economic entities' development problems, and there has been made an attempt

of analysis for the condition, contents and features of the essences of these fields.

The research **consists of introduction, 8 chapters, conclusion and the references**.

The first chapter gives the analysis of the researches which have already been made about innovations, dividing the resources into 4 groups: the definition of innovation, innovations on the global level (the theory of national innovation system), on the country level (analysis of the papers about the innovation development of particular countries) and the papers about Russian economy and its innovation system.

The second chapter examines the national strategy of innovations driving economic growth, its concept, structure, participants, types of models of the national innovation systems in the world, analyzes the types of the innovation system using the term of innovation clusters.

The third chapter takes a closer look at the one of the main instruments of the innovation policy, the science and technology parks (STP), their elements, the reasons for their creation, types of activities, classification and models, then it goes through the stages of development of STPs, the characteristic of their performance.

The fourth chapter starts with the brief historic view on the economic and innovation development of Russia, then analyzes the current situation, examining the innovation policy and strategy of the government.

The fifth chapter analyzes one of the core elements of Russia's innovation policy, i.e. the science and technology parks, their main characteristics and examples and takes a closer look at the most ambitious project in this sphere – the Skolkovo project.

The sixth chapter starts to discover the importance of the small enterprises, examining the situation in the different countries of the world and then compares it with the situation in Russia, analyzing indicators of innovative activity of the small enterprises on the Moscow region, assessing their potential in increasing the country's GDP within the environment of the technoparks.

The seventh chapter explores how innovation can help in rising the small enterprises' survival rate, giving the tools of procedure management of survival and development of small enterprises on the basis of innovations, then showing the application of the methodology of innovative development of small enterprise on the basis of scenario analysis, naming the characteristics of business processes and then analyzing and evaluating the scenarios, using one particular company to choose the most profitable type of innovation suitable for achieving the goal of surviving and making calculations on the volume of the company's expenditures decreasing due to the innovation chosen.

The eighth chapter gives some estimation perspectives of innovational economic development in Russia.

The methodology used in the research, includes:

1) analysis of the existing researches available in the libraries and online resources;
2) analysis of the statistical data from the official Russian, foreign and international sources;
3) model-making;
4) scenario analysis.

Huge amounts of statistical data from very different levels of economic structures nowadays (in Russian Statistics Bureau, in regions, in enterprises etc.) allow to build models of the mechanisms of particular economic entities, combine them into integrated complex and solve the research and management problems. In this paper there are several models, complex usage of these models allow to make more scientifically grounded and effective managerial decisions.

The instruments used in the research are analytical instruments will be used here are basic software tools (MS Excel, Project Expert, etc.) and economical-mathematical models.

1 REFERENCES REVIEW ON THE TECHNOLOGY DEVELOPMENT AND THE THEORY OF DRIVING INNOVATION

1.1 DEFINITION: INNOVATION

The definition of innovation was first introduced by Y. Schumpeter in the 30-ies of the 20th century, who introduced the concept of innovation, interpreting it as a change for the introduction and use of new kinds of consumer products, new production and transportation means, markets and forms of organization in the industry [119]. Sometimes innovation is seen as a process-based system, and this recognizes that innovation is evolving in time and has a distinct stages.

The "Oslo Manual", which is a methodological document developed by the Organization for economic cooperation and development (OECD) jointly with the Statistical office of the European Communities (Eurostat) and contains recommendations in the area of statistics on innovation, adopted in 2005 [120], for example, gives the following definition: "Innovation is the introduction to the use of any new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" ([121], p. 55). Thus, this definition focuses on the fact that innovations are meaningless without their intensive distribution.

1.2 GLOBAL LEVEL: NATIONAL INNOVATION SYSTEMS

The basic elements of the concept of national innovation systems (hereafter - NIS) began to appear in the 80-ies of the last century. One of the first fundamental works in this direction was the monograph of the international group of authors "Technical change and economic theory" [4]. The study summarized the results obtained earlier by J. Schumpeter (theory of economic dynamics), F. Hayek (the concept of multiple knowledge), D. North (institutional theory), R. Solow (the role of the scientific and technological advance in economic growth), P. Romer and R. Lucas (new growth theory).

According to K. the Freeman, NIS is "a network of private and state institutions and organizations, the activities and interactions which lead to appearance, import, modification and diffusion of new technologies".

Lately there are more and more papers describing, discussing, analyzing NIS (or NSI, national system of innovations) being published. According to the topic of this work, we can divide them into several groups.

1) General research (including national and regional innovation system)
2) Analysis of the NIS of the particular countries
3) Russian innovation system

We will analyze these groups of the researches made in the latest time.

1. In this group of researches authors analyze the term of NIS, its development features and forecasts. Like, N. Sharif [122] analyzed the emergence and development on the concept of NIS, examined how the formal body of codified NIS knowledge was produced, developed and spread, and how it is used. He examined genesis and development of NIS concept.

The main factors of NIS development is analyzed by O. Golichenko [5] talks about the limits that inhibit the achievement of its greater operability and efficiency of application in practice. The most significant of them is the lack of a standard approach to logically organized research of NIS, which would allow to track and build a cause-effect chain of factors, locate system bottlenecks and determine the set of necessary political, institutional instruments aimed at eliminating these bottlenecks and increase of efficiency of functioning of the NIS. In his research he made attempt to neutralize the above mentioned shortcomings of the theory. This applies to a systemic structural-object and functional approaches to the analysis of NIS and its effectiveness. The first is used for decomposition of objects of a higher level of aggregation. The second is to analyze the efficiency of NIS and its factors.

Following the trend for globalization, B. Carlsson [123] in his research examines the degree of internationalization of innovation systems, because there are a few studies show that national innovation systems are becoming internationalized, even if the institutions that support them remain country-specific. To the extent that the far more numerous studies of internationalization of corporate R&D discuss innovation systems at all, they point to the continued importance of national institutions to support innovative activity, even though that activity is itself becoming increasingly internationalized.

M.M. Matei, A. Aldea [125] measured and compared the performance of the National Innovation Systems using the information available in IUS 2011 database. In order to fulfill this purpose, the variables describing the innovation process included in this database are used to estimate the technical efficiency of the EU27 Member States as well as Croatia, Iceland, Norway, Switzerland and Turkey.

Innovation systems and governance are found to be of particular importance for economic development in the study made by J. Fagerberg and M. Srholec [126], out of four different types of “capabilities” (the development of the “innovation system”, the quality of “governance”, the character of the “political system” and the degree of “openness” of the economy) on the basis of factor analysis on data for 25 indicators and 115 countries between 1992 and 2004.

The problem of the **efficiency** of the national innovation systems has been a focus of the many research papers throughout the whole period of time of their existence. W. Nasierowski and F.J. Arcelus [127] used a non-parametric approach to the disentanglement of the related effects of efficiency and productivity of a country's technological effort and they identified the extent to which the alleged decrease in the productivity growth of many countries

can be explained by differences in efficiency and by differences in its components, namely scale and congestion.

Jiancheng Guan and Kaihua Chen [128] proposed a relational network data envelopment analysis (DEA) model for measuring the innovation efficiency of the NIS by decomposing the innovation process into a network with a two-stage innovation production framework, an upstream knowledge production process (KPP) and a downstream knowledge commercialization process (KCP). The hybrid two-step analytical procedure is used to consider 22 OECD (Organisation for Economic Co-operation and Development) countries. They found out that the overall innovation efficiency of an NIS is mainly subject to downstream commercial efficiency performance and that improving commercial efficiency should thus be a primary consideration in future innovation policy-making in most OECD countries.

The new direction of the development in the technologies is analyzed by A. Kazantseva, V. Kiselev, D. Rubvalter and O. Rudenskii [2] in the research paper about **NBIC-technologies** in the context of innovation civilization of the XXI century.

Innovations in the times of **economic crisis** and the ways of its impact on the NIS has been examined by A. Filippettia, D. Archibugia [130], they used micro- and macro-data to investigate to what extent some structural characteristics of National Systems of Innovation, along with demand, affect firms' persistency in terms of innovation investment. It emerges that the effects of the economic downturn in terms of firms' innovation investment are not the same across European countries. The competences and quality of the human resources, the specialization in the high-technology sector, together with the development of the financial system seem to be the structural factors which are able to offset the effect of the economic downturn on innovation investments of firms across Europe.

The economic crisis in the US is the subject of the research for A. Hausman and W. Johnston [133] in their paper that develops propositions based on this review and discusses implications for staving off future economic difficulties. They used theoretical literature and contemporary media accounts, building the argument for a significant impact of innovations on the economy and its potential role in pulling the US economy out of the financial crisis.

The impact of the innovation policies on the performance of national innovation systems has been analyzed by E. Samara, P. Georgiadis and I. Bakouros [131]. They developed NIS model with the use of system dynamics (SD) methodological approach. In particular the SD model is used as an "experimental tool" to conduct extensive what-if analysis scenarios with regard to alternative innovation policies. The effectiveness of policies has been investigated through the dynamic behavior of product innovation and process innovation which are obtained by simulation results. By using data from a European Union country with innovation performance below that of the

EU27 average, the analysis of results reveals insights over a strategic time horizon.

The regional level of innovation system is analyzed by J. Howells [129] in his paper about innovation policy within a regional context. He explores a number of contrasting perspectives in relation to innovation policy and the regions and seeks to highlight the implications of this both for policy, but also in the development of conceptual understanding about innovation and geography. The difference and complementarity of the approaches to the infrastructure and production as factors of innovation and technological changes are examined by C. Werker and S. Athreye [132] on the basis of the theories of Alfred Marshall and his disciples

As we can see, the most of the research is analyzing the NIS of the European countries as the most developed ones. The more works will be mentioned in the main part of this book.

1.3 ANALYSIS OF THE NIS OF THE PARTICULAR COUNTRIES

The analysis of NIS of the particular countries takes the most part of the research materials examined.

Although Switzerland is considered to be the most effective economy, including innovative development, but there are not so many researches analyzing its NIS. Among them the paper of C. Marxta and C. Brunnera [138] addresses the question, how the country can keep its leading position by enlarging and strengthening the national innovation system in a sustainable way. Using a systemic approach, in particular an adapted national innovation system framework, this study analyses the current innovation system of Switzerland and comes up with recommendations for improvement.

Some of the previously mentioned researches analyze the general features on the basis of the groups of countries, but mostly European ones.

But the success of Asian economies (first Japan, then Taiwan, South Korea, Singapore, Hong Kong and, more recently, China and India) has made it tempting to look for “an Asian model of development”. However, the strength of Asian development lays less in strategies that reproduce successful national systems of innovation and more in the capacity for institutional change to open up new development trajectories with greater emphasis on knowledge and learning. In the study Asia's Innovation Systems in Transition (New Horizons in the Economics of Innovation) [134] the analysis of the select group of contributors demonstrates that although there are important differences among Asian countries in terms of institutional set-ups supporting innovation, government policies and industrial structures, they share common transitional processes to cope with the globalizing learning economy.

Taking into account such an important player in the global economy, presenting high growth rates of the economy throughout the resent years, as China, quite many researchers put their attention on the innovation system

and infrastructure of this country. For example, Xia Gao, Xiaochuan Guo, K.J. Sylvan and Jiancheng Guan [140] used scale-independent indicators to explore the Chinese national and regional innovation systems during economic transition. As reported for the European and Canadian innovation systems the Chinese systems exhibited scaling correlations between GERD (Gross Expenditure on Domestic R&D) and GDP (Gross Domestic Product) over time and at points in time. The scaling factors of the correlations indicate that between 1995 and 2005 the Chinese GERD exhibited a strong nonlinear tendency to increase with GDP. Furthermore they show that the GERD of the Western region is growing much slower than its GDP as compared with Eastern and Central regions. This observation has policy implications suggesting further improvements need to be made to the research infrastructure and funding of the Western region. The authors used the GDP–POP (Population) scaling factor to show that the 'wealth intensity' or GDP per capita is increasing much faster than the exponential growth of the Chinese population. In contrast the systemic GDP–POP scaling factor shows that regional development is non-linear. Finally, the paper–GDP and patent–GDP scaling factors tell us that outputs of science and technology for China are growing faster than economic growth. The systemic paper–GDP and patent–GDP scaling factors show that the growth rates are uneven across the provinces.

G. Haour and D. Jolly [141] consider China as the next innovation hot spot for the word, giving an overview of the dynamic of the Chinese innovative development, including historical overview, current situation and the prospects, analyzing the programs of the Chinese government, number of students, patents, the trend of the GERD in China comparing with the other countries, the structure of the investments, although the work has more of introduction-like paper for the foreign companies want to develop in China.

G. Fabre and S. Grumbach [142] in their research have focused on the emergence of the innovation policy in China, the 2006-2020 Plan for S&T, with a historical perspective explaining the legacy of the past in today's choices, and also illustrated China's catching up strategy through four sectors (high-speed trains, aeronautics, clean energy, IT) and discuss its potential impact on the world industry. The topic of the Chinese innovation strategy is developed also by F. Wu and K. Shen [144], who described the general goals of the strategy, though without any particular indicators.

A quite complete study on the efficiency determinants and efficiency of the Chinese national innovation system has been made by J. Zhang [147] who made a really magnificent research on the topic itself and the national innovation system of China, including the historical precondition and the detailed structure of the current system.

The question of a regional perspective on the structural transformation of China's national innovation system since 1999 has been analyzed by Y. Sun and F. Liu [145] who observed the structural transformation of China's National Innovation System (NIS) since 1999 that is useful for understanding

the rapid economic growth experienced in China and for adjusting the development strategies of other late-industrializing countries. In their article they used the regional specialization coefficient (RSC) method to analyze the structural transformation of China's NIS from the perspective of eight large economic regions (8LERs) from 1999 to 2006. The NIS has achieved its initial objectives and two of the three major characteristics of China's NIS identified by Sun earlier have changed since 1999: the funding structure — from a government- to an enterprise-centered model; and the performing structure — from a double-centered model divided into enterprises and research institutions, to one solely led by enterprise. The regional structures of China's innovation system conform to the macro structure on a national level, while regionally, a wide variety of changing models of RSC affect different locals.

The structural approach to the mapping the functionality of China's **regional innovation** system has been performed by K. Chen and J. Guan [143]. By constructing a rich province–year panel dataset over the 10th five-year plan period of China, the used the novel analytical framework to detect and untangle the periodically operating state of China's regional innovation systems (RISs) in terms of the effectiveness of functional constructs shaping and influencing the innovation process. The examination results showed that China's RISs perform well in terms of the performance of most functional constructs except for "innovation linkage" as well as "innovation sophistication". With respect to the interactive effects between the contextual innovation environment and the innovation process, however, they found out that China's RISs perform poorly from the perspective of system thinking.

As an example of the international cooperation within the globalization of the innovation systems, J. Jin, S. Wu and J. Chen [146] analyze the international university-industry collaboration to bridge R&D globalization and national innovation system in China.

J.-D. Lee [136] was examining the R&D linkages in a national innovation system and the success and failure factors of Korea. They used a sample of successful and failed innovation projects drawn from firms in the Korean electronic parts and mechanical industries, which are typical of the Korean intermediate goods industry, which has experienced rapid technological advances in those years. The authors divided the data according to two main criteria—type of innovation (product versus process innovation) and source of innovation (demand-pull versus technology-push innovation)—and base the empirical analysis on the four resulting domains. They found out that:

1) financial support from government in the early stage of R&D and from downstream firms in general improves innovative activities' chance of success;
2) collaborative R&D, especially collaboration with downstream firms and universities, likewise improves the chance of success.

C. Chaminade, P. Intarakumnerd and K. Sapprasert [135] identified and grouped systemic problems (using hierarchical factor analysis) in Thailand

into four components: institution, network, Science and Technology infrastructure and other support services. Their analysis allows researchers to investigate the mismatch between policies and problems and identify policy gaps. The authors provide a framework to empirically identify systemic problems in a given system of innovation.

The research on Moroccan NIS has been made by S. Hamidi and N. Benabdeljalil [137] who proposed an analysis of the architecture of the Moroccan NIS, its achievements in the field of innovation, and its limits. They found out that low efficiency of Moroccan NIS is not linked to financial resources or the skills of the actors but to weak interactions and coordination failures between actors.

B. Ponomariova and H. Toivanen [139] examined the Brazilian innovation system, the role of domestic knowledge capabilities for developing countries and emerging economies, and in particular in the build-up of their national systems of innovation. Using bibliometric methods, they described the geographic sources of knowledge and the users of Brazilian research in 2005–2009, analyzed the roles of domestic and foreign knowledge bases in it. They suggested that increasing reliance on domestic sources of knowledge is a feature of Brazil's improved science and technology capabilities. The ascendancy of Brazil's research informs us about the unfolding re-organization of global research and underlining nascent South-South knowledge flows, the prevailing relevance of EU research, and the relative decline of US research for Brazilian knowledge creation.

The overview of the international experience of the innovative development [148] gives a brief analysis of the main countries of the world and their innovative policy and the main features, as well as the key innovation programs.

The NIS of Japan has been analyzed by E. Avdokushin [16], NIS of Belarus – by A. Piskunov [36], the innovation policy and national innovation systems of Canada, the UK, Italy, Germany and Japan were examined by V. Kiselev, D. Rubvalter, and O. Rudensky [58].

1.4 RUSSIAN INNOVATION SYSTEM.

There are quite a few researches examining the earlier periods of the Russian innovation policy, among them are:

The analysis of the national innovation systems in Russia and EU by V. Ivanov and others [12] describes the main elements of the Russia's innovation system, Russian academy of science, as a backbone factor of the Russian innovation system and the critical analysis of the place and role of Russian innovation system in the international perspective, the authors also provided their recommendations on the improvements on the system.

OECD prepared the report on the national innovation system and state innovation policy of the Russian Federation on 2009 and 2011; the last report

was quite short and was made in 2012. The previous two consist a comprehensive analysis on the Russian NIS and some recommendations, but the last one has been made for OECD to make a decision about whether or not accept Russia as a member to this organization, but the character of the report is more on the negative side of the situation, hiding the positive sides.

The corresponding member of RAS, A. Kuznetsov [114], who is using scenario approach of the Russia's innovation development, basing on Kondrat'ev's theory of technological modes, described inertial and innovation strategies of development, presented the forecasts for innovation and inertial scenarios of the Russia's development, created the model of Russia's development up to 2030, listed reasonable measures to be able to obtain the innovation scenario of the development.

The state analysis of innovation development in Russia, its content, trends and crucial tasks has been provided by A. Belkin [148], who presented one of the definitions of the state analytics concept, which has been used in the innovation infrastructure of the subjects of the Russian Federation. The author outlined the rationality factors of analytical activities, classified the interrelations of analysts, public officials and business agents and also highlighted the responsibility of decision making at the public level.

Z. Wang [149] used quantity analysis, C-D function and Solow residual value method to measure the ratio of Russian scientific and technological contribution; he has analyzed the Russian science and technology system and technology innovation during the period of reforms in the 90's of the last century, adding some perspectives possible to happen in according to the current situation.

Analyzing such indicators of Russian innovation capacity as the share of R&D in the country's GDP (1991-2011), the number of applications for patents (1992-2012), the number of researchers (1992-2011), J. Zhang [147] examines the policy and the measures taken by the state and the main directions and critical technologies.

1.5 CONCLUSION

Despite of the high interest to the innovations in recent years, there not many publications on the topic of the innovational infrastructure and innovation policy of the countries. The research are mainly focused on the theoretical aspect (as it shown in the first part of this chapter), or the analysis of the innovation system of particular countries (like one country for one analysis), focusing just on the country, rarely comparing its innovation development and policy with other countries, or comparing just on one or two indicators, which is not enough for the comprehensive analysis of the all aspects of the innovation development or even can lead the researcher to the conclusions that are not quite right and can mislead the readers.

The researches and papers do not examine or count in numbers the importance of the science and technology parks' development, variants and scenarios of their development in the country's economic development, for instance, in the country's GDP growth rate (which is quite significant, as will be shown in the main part of the work). The papers also put a very few attention on the factor of the small enterprises as an important part of the innovation development of the country, although small and medium enterprises take 60 to 97% of the whole amount of the enterprises in the countries and actually play a very important role in the innovation development (as also will be shown in the book) and just can't be ignored.

2 NATIONAL STRATEGY OF INNOVATIONS DRIVING ECONOMIC GROWTH (WORLD'S EXPERIENCE)

During the latest couple of years the trends of building the innovational policy of the Group of Eight countries (England, Germany, Italy, Canada, Russia, USA, France and Japan) now experiencing significant and important changings. The reason is not so much because of financial and economic crisis, but in the first signs of a new scientific-technological (and industrial) revolution, connected with the emergence of new nano-, bio-, information-communication and cognitive technologies, called NBIC technologies [2]. This stage of development of world civilization is more and more often called the "NBIC-revolution" [3], characterized by convergence and the emergence of synergy effects of NBIC technologies that have direct or indirect impact on industry, education, economy, trade, society, culture, human potential, i.e. on civilization as a whole.

Until recently innovation policy of the G-8 countries was aimed at building an innovation economy, but because of the NBIC-factor these countries increasingly start using an integrated, interdisciplinary and intersectional approach. It appears in the coordination of goals and tasks of the innovative development of the state and private sectors, science and industry, as well as in their efforts to build not just an innovative economy, and in fact new, innovative society, innovative civilization.

The elements of innovation infrastructure are being built in chains "education - science - technology - industry", which causes the appearance of the whole complexes of the funds established to finance various stages of innovation.

In general, it becomes more obvious that the preparation of the society to innovative economy, innovative market and innovative civilization is one of the most important goals and tasks of the innovation policies and strategies of the G-8 countries in the near future.

2.1 NATIONAL INNOVATION SYSTEM: CONCEPT, STRUCTURE, PARTICIPANTS

The concept of National Innovation System

The main ideas of building the national innovation system are as follows:

1) Main factors in the development of modern economy, which are forming the competition, are innovations and scientific research in behalf of businesses;
2) Institutionalization is a factor influencing the content and structure of innovative activity;
3) Scientific knowledge plays an important role in economic development.

Despite the commonality of basic ideas, the authors' attitude to NIS was different. The study addressed the problem of the relationship between producers and consumers of innovations within the framework of one country because according to this concept technological cooperation of companies in the process of technology development is often implemented in the country and is determined by the specifics of its institutional structure. It allows innovation processes to preserve national identity and the relationship with companies within the country to a greater extent than with foreign partners.

In the framework of this concept it assumes that NIS should be an institutional network in the state and private sectors of the economy, the functioning of which will promote the dissemination of innovative technologies. Not only should the institutional level be involved in this case, but also the managerial one, which will help to implement the organization and management of resources at different levels, from corporate to national. Items which confirm this concept were already visible in the fact that by that time in NIS of Japan already was possible to see organizational innovation borrowed from the production field (for example, horizontal relationships within the firm; the principles of "Just-in-Time" used in the industry; competitive engineering and others). And the emerging American NIS copies the organizational model of the Ford and Taylor (with vertical interaction of research and production elements).

Important point in the proposed system of views was the realization that NIS is not so much as an immobile object that should be created, but more as the process of integration of structures with purposes and tasks, the structures which are in charge of the production and commercial realization of scientific knowledge and technologies within national boundaries (small and large companies, universities, research institutes and others), maintained by the legal, financial and social institutions with national roots, traditions, political and cultural characteristics.

NIS forms a system of relations between science, industry and society, in which innovation and knowledge are the basis of development of economy and society, and the need for innovation development, in turn, to a large extent determines and stimulates the development of scientific activity.

Development of the NIS concept has led to the emergence of a large number of definitions. Here is one of them: "NIS is a set of national government, private and public organizations and mechanisms of their interaction, within which the activity on creation, storage, and dissemination of new knowledge and technologies implements" [5].

It should be noted that NIS does not have any clear and unambiguous definitions and limits (determined physically or documented), but we can definitely speak that certain documents, organizations and facilities are affiliated to it. Important issue for understanding the essence of NIS is the structure of its coalitions of interests and activities [6], i.e. which entities receive the effects of its operation, and which entities manage its structure and elements. The research has shown [7, 8, and 9], that an important and proactive

role in most countries of the world in both coalitions is played by the state, but the influence of the other participants (science, business, society) is also significant.

In relying on the NIS, the state carries out a policy aimed at achieving and maintaining a high level of national socially-oriented competitiveness [10].

The state can affect the elements of the NIS, while providing support and stimulation of innovation activity, with the help of instruments such as:

- formation and development of the legislative and regulatory framework for innovation activities;
- financing the innovative programs and projects from the Federal budget;
- creation the objects of innovation infrastructure;
- purchasing the high technology products, equipment and technologies for state needs;
- establishing in a legislative procedure the favorable conditions for innovative activity;
- encouraging the investors of innovation programs and projects.

The concept of NIS, its semantic content, structure and functions in different countries and contexts are still treated differently. We can distinguish two main approaches to the interpretation of this concept.

1. In the United States NIS is understood in a restricted sense, i.e. as a scientific and technological system, including institutions, generating new knowledge (universities, research laboratories, high-tech corporations, and innovative business).

2. In Europe NIS is understood in a broad sense, i.e. as the production of knowledge, dissemination, uptake and usage in the learning process, interactions between economic subjects. The functions of NIS also include procedures for the improvement of products and technologies in the process of their use.

Recently there are some modifications of NIS are widely used, such as "regional innovation system (RIS), "sectoral innovation system" (SIS), as well as "supranational innovation system" (SNIS) and "global innovation system" (GIS). Innovation system can be supranational in several meanings, i.e. as truly global, covering most countries of the world, or comprising part of the world community (e.g. the European Union).

Another new aspect in the research of innovation systems is the study of NIS in dynamics, i.e. a process of gradual transformation of one set of institutions to another, or as a process of radical institutional changes.

The Structure of NIS

NIS in different countries differs from each other, but they have common features and basic structure required for their functioning, including a set of interacting units. Generally, there are five or six such units (see Fig. 2.1):

1. Creative unit or block of the knowledge generation. This block includes universities, research institutes, social and other networks, providing

informal interaction between researchers from different research organizations.

2. Block of technology transfer. It includes a variety of intermediaries, including nonprofit foundations of professional expertise, forming a special environment with wide network ties, able to provide contacts of authors of creative ideas with the potential buyers and others.

3. Block of funding. These are external funding sources, necessary for the transformation of ideas and launching them. A typical three sources are as follows:

3.1. Bank loan.

3.2. Sale the innovation.

3.3. Venture financing.

4. Manufacturing unit. It can be implemented in two variants:

4.1. The inclusion of production in the existing production structure of one of the firms, which allows to use advantages of vertical integration and reduce transaction costs through common infrastructure (accounting, the accounting system of the personnel and so on).

4.2. The creation of new enterprises where transaction costs of production are minimized due to its small dimensions.

5. Personnel training block. Includes educational infrastructure (universities, national engineering school and other institutions oriented to formation of scientific personnel and innovative managers) [11].

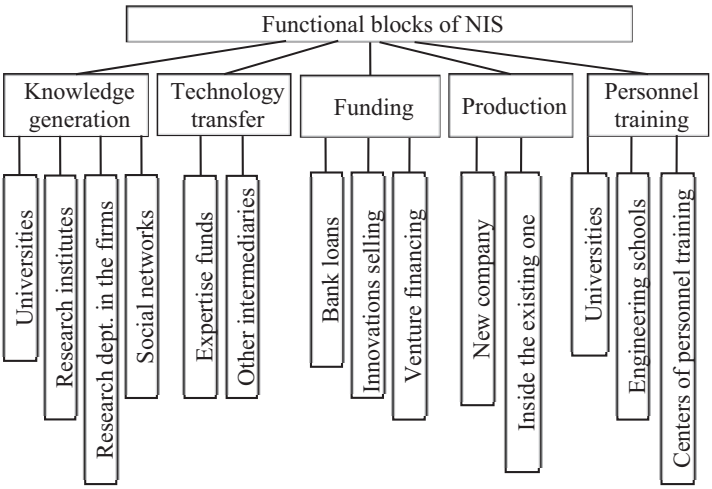

Fig. 2.1. Typical functional structure of NIS

Participants of NIS (coalition of interests and activities)

All parties involved in the national innovation processes interested in its results, as well as affecting its members, or each other in the context of the

NIS, can be represented by the following sets of subjects (actors) (see Fig. 2.2).

1. State (government agencies that determine the innovation policy, and also ministries, departments and other regulatory and funding agencies).

2. Business community (companies that produce innovative products).

3. Research sector (universities, research institutes, research departments inside the companies).

4. Organizations for the technology transfer and other elements of innovation infrastructure (S&T parks, business incubators, centers for commercialization and innovation transfer).

5. Civil society (social organizations, influencing innovative development).

6. Foreign partners on innovation activity [12].

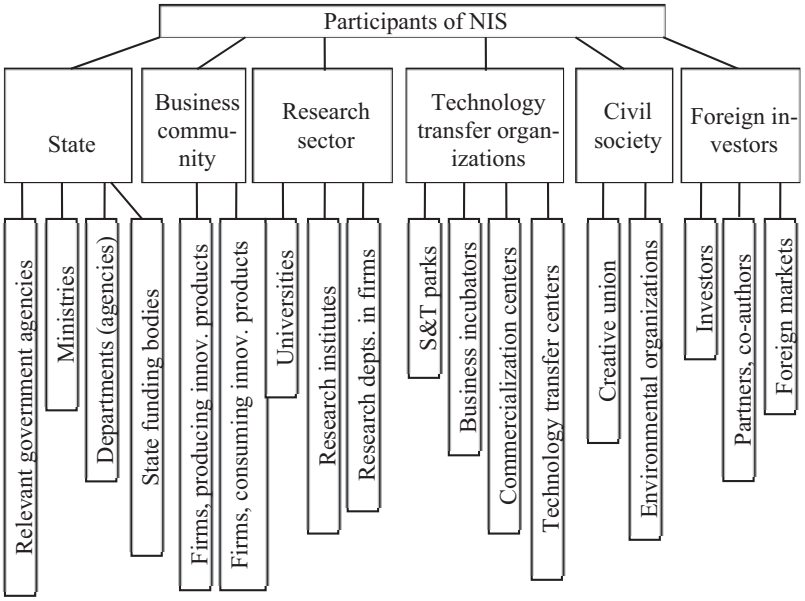

Fig. 2.2. Participants of NIS (coalitions of interests and activities)

Usually the interaction between the participants of NIS is tied up by pairs: state - science, science - production, state - production. Moreover, interactions in most cases are vertical in nature. These three options of pair interactions can be considered as "coalitions of the actions".

One of the directions of intensification of innovative processes in NIS is shifting the main share of the interactions on the level of horizontal links,

aided by the cluster approach in the organization of NIS, and also the creation of local zones of S&T parks' type, etc.

The second direction of intensification (will be discussed below) is that the principle of "triple helix", in which there are not only pair-type but also multiple horizontal interactions of participants of processes in the NIS provided.

The main functions of the state as one of the participants of the coalition of actions are to facilitate the production of fundamental knowledge and complex technologies of strategic character, establish the infrastructure and favorable institutional environment for innovative activity [13].

2.2 MODELS OF NIS

There are four models (types) of NIS:

1. Euro-Atlantic;
2. East Asian;
3. Alternative;
4. "Triple helix" model

For each model has one or more countries, where this configuration of NIS exists (see Fig. 2.3). We will have brief look at the features of each of them.

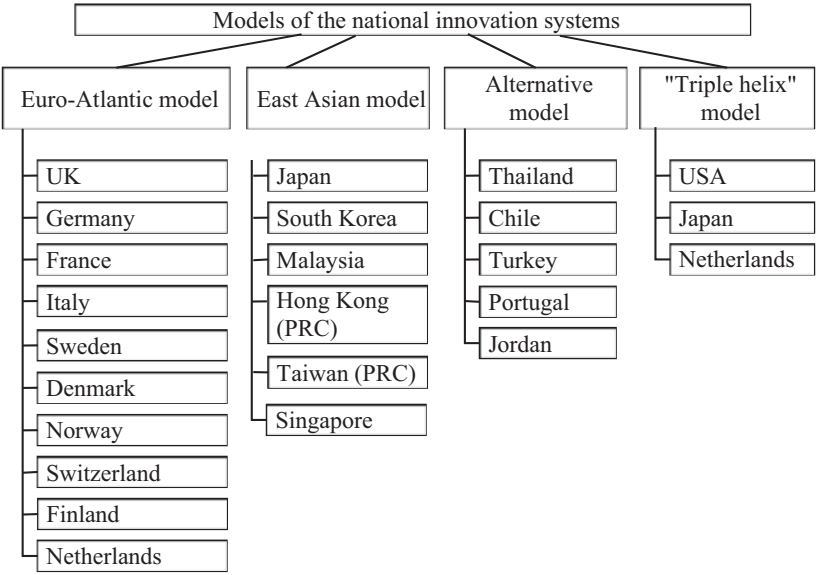

Fig. 2.3. Typical functional structure of NIS

2.2.1 Euro-Atlantic model (Europe: Germany, France, UK, Italy etc.)

1. Euro-Atlantic model of NIS is a model of the full innovation cycle; it presents all the main functional components of the innovation system:

- fundamental and applied science;
- research and development;
- creation of prototypes;
- manufacturing the experimental samples.

This model of NIS is widespread in Western Europe (UK, Germany, France and others), countries with long scientific tradition. In the postwar period, these countries have radically changed their research priorities, focusing on relatively cheap ways to get scientific and technical information. For example, the UK has focused on radio astronomy and the study of biological properties of macromolecular substances, and has achieved considerable success, marking the beginning of the creation of two fundamental scientific disciplines - astrophysics and molecular biology. Today, the British system of innovation is concentrated around a small number of world-class universities (Oxford, Cambridge, and London University). Its innovative infrastructure has received a new impetus in the early 2000-ies, when the Technology Strategy Board was established and the innovation strategy of long-term development of the country was accepted. The Board invests the development budget into scientific research, creation of new technologies and their commercialization. There is a large amount of innovation centers of two types [14] are being created in the country:

Some focused on the development of a specific technology and promotion of it usage in accordance with the business needs or opportunities;

The latter focuses on a specific sector or market, integrating the interdisciplinary research and different technologies in this direction.

Here are some typical (but not specific to this type of model) properties of NIS organization.

The centers of scientific research concentration in NIS diverse. In Italy and Germany they are concentrated around major universities, in France - in the National center for scientific research (similar to the Russian Academy of Sciences). Mathematical research in France is concentrated in a few major universities (Ecole Normale, Nancy University and Sorbonne).

Small European countries (Sweden, the Netherlands, Denmark, Switzerland, Finland) focus on the development of the university fundamental science. So in Sweden mathematics and classical studies are being developed at Uppsala and Lund universities, economy - in the University of Uppsala and Stockholm school of Economics, computer studies are at the University of Linkoping, biology and medicine are in the Carolingian Institute, new technologies and problems of urban planning are in the Royal Institute of technology in Stockholm. In the Netherlands, physics, law, Economics, clas-

sical studies and Oriental studies are at Leiden University, economy and energy problems are in Groningen University, the administration and the history of science are at the University of Amsterdam.

An important place in NIS of the small countries of Europe is occupied by the national Academy of Sciences, in Sweden (Uppsala) and the Netherlands (Wassenaar) there are Institutions of higher studies operating.

Branch research institutes are a feature of NIS in Denmark. They are attached to various ministries and conduct research in the interests of the appropriate Ministry. Along with this there is a system of GTS-institutions that acts as a link between the state and private structures. These institutions are independent consulting companies that develop and sell applied knowledge and technology services to the private enterprises and public institutions. They are non-profit organizations established by the Ministry of science, technology and innovation, carrying out activities such as: development of know-how; participation in joint projects together with the state research institutions and private companies. Important elements of the Danish NIS are science parks and innovation incubators.

The main trend of recent years in Western Europe is the need to accelerate the process of consolidation of NIS into an integrated scientific, technical and innovative space of the European Union. This strategy aims at building a European integrated market for innovations in order to increase the competitiveness of the EU and address the key European social challenges: climate change, building a low-carbon economy, health care, etc. As a result of these processes NIS of the particular countries in Europe shall cease to be a national and will become regional or pan-European. At the same time national borders of NIS will be blurred and responsibilities will be moved to the other levels [15].

Funding in NIS of the European countries is not as diverse as forms of concentration of the research centers. Financing of fundamental and theoretical research is mainly carried out by the state. Financing of applied research in most cases is carried out through grants and joint projects with the large multinational corporations (Shell, Philips, Volvo, Ericsson), and also at the expense of small and medium businesses.

Localization (clustering) of participants of NIS is a very important condition of the innovation process success. Therefore, there are S&T park zones (similar to Silicon Valley in the USA) in NIS of the European countries. For example, it's "energy valley" in Groningen (the Netherlands), which became the center of energy saving technologies and alternative hydrocarbon fuels, and also "computing valley" in Linkoping (Sweden), where the research institutions, industrial parks and venture companies in the field of computer technologies and telecommunications are concentrated. We can give other examples, which, however, are more appropriate in connection with description and analysis of S&T parks, as it is done in the appropriate section of this paper.

As an example of Euro-Atlantic model of NIS we will analyze the NIS of Switzerland as the most developed and successful country in Europe.

Swiss Innovation System

According to the European Innovation Scoreboard, Switzerland is the innovation leader in Europe (Global Innovation Index 2014). Switzerland surpasses countries such as Finland, Sweden or Germany in most of the relevant indicators. Additionally, Switzerland is also one of the most competitive countries in the world, as investigated by the World Economic Forum.

Overview:

Switzerland, also the Swiss Confederation, is a relatively small country in the middle of Europe. It is bordered by Germany in the north, Austria and Liechtenstein in the east, Italy in the south and France in the west. The country was founded in 1848 and enfolds 41.285 km2. The 7.8 million inhabitants speak four official languages.

Switzerland is prosperous and modern market economy with low unemployment, a highly skilled labor force, and a per capita GDP among the highest in the world (see Table. 2.1). Switzerland's economy benefits from a highly developed service sector led by financial services and a manufacturing industry that specializes in high-technology and knowledge-based production.

Its economic and political stability, transparent legal system, exceptional infrastructure, efficient capital markets, and low corporate tax rates also make Switzerland one of the world's most competitive economies. The Swiss have brought their economic practices largely into conformity with the EU's to enhance their international competitiveness, but some trade protectionism remains, particularly for its small agricultural sector. The fate of the Swiss economy is tightly linked to that of its neighbors in the euro zone, which purchases half of all Swiss exports.

Table 2.1. Main indices of the Swiss economy

Index	*Value*	*Rank in the world*
GDP (purchasing power parity)	$371.2 billion (2013 est.)	37
GDP (official exchange rate)	$646.2 billion (2013 est.)	
GDP - real growth rate:	2% (2013 est.)	142
GDP - per capita (PPP)	$54,800 (2013 est.)	11
Unemployment rate	3.2% (2013 est.)	25

Source: CIA World Factbook [https://www.cia.gov/library/publications/the-world-factbook/geos/sz.html]

Due to the small area of the country and a high degree of specialization of labor, a key economic resource for Switzerland are industry and trade, the important part for the economy is the fact that the Swiss Confederation is included in the list of offshore zones.

Switzerland is poor in natural resources, except hydropower. In the period 1950-1990 the economy is steadily developing, unemployment has remained at a low level, the inflation was constrained by the Swiss National Bank, and downturns were short.

The economic downturn that gripped most of the European countries in the early 1990-ies, has affected Switzerland: unemployment reached the highest level since 1939, the inflation rate has increased. However, the level of life in the country was still very high. In 1997, the gross domestic product (GDP) Switzerland was nominally estimated at 365 billion Swiss francs (real) 316 billion. In per capita terms – 51.4 thousand Swiss francs (nominal) and 44.5 thousand (real) (Worldbank, Country Data Switzerland).

The Swiss government implements programs aimed at the transition from the industrial economy to a knowledge-based one since the 1950's. In the 90-ies there was created the structure of government departments in charge of the formation of the economy based on knowledge, innovation economy that exists till today. Since 2007 the government has defined the priorities of the country and outlined the main innovative industries with the perspective of the industrial introduction for which the government gives the main state resources.

In Switzerland the main directions of innovation policy have not changed significantly from 2000 to 2007. There were some changes, first of all, in education, research and technology sectors. The government has increased spending in these sectors on average by 6% each year between 2004 and 2007. In addition, the government adjusted the direction of the National Centres of Competence in Research (NCCR), NCCR running since 2004, became more focused on humanities and social sciences. The government also identified several priority directions of development of science and Economics in addition to the NCCR, to the network of competence inside the universities of applied Sciences, increasing the value of knowledge, the promotion of dialogue between science and society etc.

The Swiss innovation system ranks among the best in Europe (OECD, 2006-2011) (Fig. 2.4). One major source of this excellent position is the outstanding reputation of Switzerland's universities and scientific research facilities.

This reputation is mirrored in a ranking of per capita publications, which is headed by Switzerland (King, 2004) . Apart from that, Swiss companies also contribute with a substantial amount of R&D spending to the innovation performance of Switzerland.

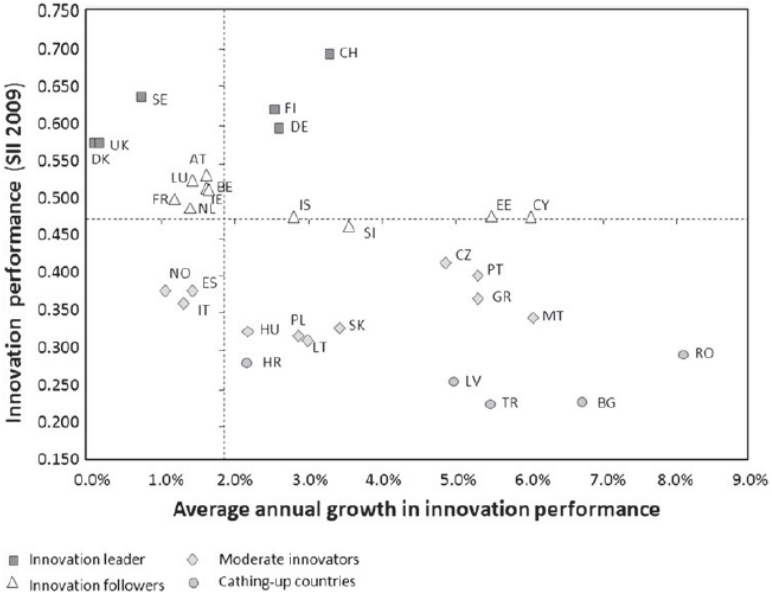

Fig. 2.4 European Innovation Scoreboard (EIS)—SII and growth 2009. Unfortunately newer versions of the EIS do no longer show Switzerland in this particular graph.

Surrounding Conditions

The surrounding conditions of the innovation system are comprised of different aspects, which can potentially influence the innovative output. These are, for example, the political system and its stability, legal aspects, competitive regulation, such as the protection of intellectual property, fiscal aspects, the provision of infrastructure and public spending.

Switzerland as a whole is economically very well developed and politically very stable (Worldbank, 2011). The country has strong federalism. A great part of innovation funding is controlled and decided by the 26 cantons. This fragmentation sometimes leads to delays in decision-making, but also ensures a continuous and sustainable development.

Also controlled by the cantons is the effective taxation rate, which is between 13.8 and 22.8% and quite low in an international comparison.

Next to a fragmentation in decision-making, Switzerland's policy on innovation by 2009 was not very well coordinated. In 2009 basic laws for innovation are in place, but are not really suitable for making funding decisions. One reason lies surely in the federalism, another one in the distribution of the regulation into various laws and finally in a lacking comprehensive innovation policy.

Enabler and Supplier

In this area, two major input factors are:

- human resources,
- financing of innovation.

R&D facilities or organizations with a focus on knowledge and technology transfer are also important. Furthermore, innovation is not limited to people with tertiary education. Consequentially, looking at a direct correlation of the innovativeness of a country with its quota of tertiary education is not meaningful (Lundvall, 2007).

However, education and continuing education are central to the enablement of innovation. Therefore, financing this type of education is an important input factor, and both public and private expenditures account for the innovation potential.

In 2009 around 30% of the Swiss population has tertiary education. When compared to all EU-member states this is quite high (EU-average: 23%), however it is far smaller than e.g. in the United States (about 38%) or Canada (about 46%) (Marxta and Brunnera, 2013). The number of people working in R&D per 1000 inhabitants is also quite low. Although slightly above EU-average, Switzerland (12 people/1000) is far behind e.g. Finland (about 22 people) (OECD, 2008). These numbers seem curious, when considering the countries' overall innovation performance.

Especially, since overall expenditures on R&D have continuously topped 2% of GDP, since 1986. This high percentage of R&D spending is only surpassed by Japan and Finland in the OECD area (Eurostat, 2008). Also the share spent on education has been above EU-average for more than 20 years (between 5 and 6% of GDP since 1990). And finally, Switzerland disposes of excellent universities, world-renowned research facilities (e.g. CERN) as well as a number of regional KTT institutions, which are mainly Science & Technology Parks.

Financing Research

In Switzerland, public and private expenditures for innovation are not directly measured. However, Figures for spending on R&D, education facilities and grants for SME as well as innovative research projects are available. By way the biggest amount is spent for R&D projects. Annual expenditure for R&D in Switzerland amounted to CHF 13.100 million ($14.150 million). Hereof 16% (CHF 2.085 million) were public, the bigger part however, was provided by the private sector (70%; CHF 9.135 million).

Between 1992 and 2004, an average annual growth rate of public spending of 2.3% was realized. Even when including the results of the year 2006, during which expenditure decreased, an average growth rate of 1.7% is reached. Adding both public and private R&D expenditure up, the quota never dropped under 2% since 1986; in 2006 a maximum of 2.9% of GDP was put into effect. This quota entitles Switzerland to the top ranks compared with all OECD countries and is almost at the set goal of 3% by the European Union (Eurostat, 2008).

Expenditure for universities amounted to CHF 5.956 million in 2007. Hereof 51.6% (CHF 3,074.9 million) was dedicated to R&D activities. Financing for universities of applied sciences was significantly lower at CHF 2,118.5 million, and only a small portion (15.4%; CHF 326.3 million) was intended for research purposes (Eurostat, 2008).

Altogether public spending on education in relation to GDP is above average in comparison to other OECD countries. The Swiss quota is relatively robust between 5 and 6% since 1990. In 2005, it was at 5.81% (Marxta and Brunnera, 2013).

R&D Facilities

Next to renowned universities, such as ETH Zürich, Switzerland is also the home of a number of leading and famous research facilities. Among them is the European Organization for Nuclear Research (CERN), where 3000 employees research on elementary particles and were already awarded with several Nobel prices.

Knowledge and Technology Transfer Facilities

Altogether, Switzerland is the home of more than 23 Science and Technology Parks („Enabler"). These parks support young as well as start-up companies with different services. Among those services is the provision of infrastructure, consulting or public relations. Furthermore the opportunity to exchange ideas and knowledge with peers and partners is facilitated. Many of these parks even maintain partnerships with universities and the industry. In most cases, the parks focus on specific branches to enhance spillover effects.

Business

Business is also a major actor in the innovation system. About 80-90% of the innovative performance of Switzerland is done by or with business [OECD, 2011]. Huge differences exist in terms of R&D spending depending on company size and branch.

Further Actors:

State

The state plays a major role when the advancement of innovation is concerned. As yet, the Swiss government defines innovation as an accomplishment, which is primarily achieved by research. This definition of innovation is quite small and does not include the commercial exploitation of the results of research. As a consequence, the state focuses for one thing on the KTI (Commission for Technology and Innovation, CTI) and for another thing on sponsoring education and research. Other or advanced means to promote innovation are not intended by the government. A future distinction between means to promote innovation and means to support research is recommendable.

Cantons

Innovative activities in the cantons are part of the NRP (New Regional Politics) and various cantonal acts on economic promotion. The NRP consists of three different directions and aims at the promotion of innovation and

the development of a market-oriented economy. It wishes to enhance the regional competitive ability and the adaptation of local business to new conditions under globalization. Projects, initiatives and programs are directly supported.

The process for promoting innovation in particular consists mainly of the activities of the KTI and also some regional means to promote economic development. The KTI (Commission for Technology and Innovation) is a public agency with the mission to promote innovation. An annual budget of CHF 100Million is granted by the state. The promotion of applied sciences, knowledge- and technology transfer as well as the support of start-ups is part of their work. In particular, market-oriented R&D projects, conducted by both business and universities or universities of applied sciences, are funded. Essential for the funding is always a partnership of these two constituents. Several hundred projects are funded each year. On average the grant amounted to CHF 351.300 during 2008. These funds are awarded directly to the participating academic institution.

Findings:

Innovation

Switzerland is top ranked in terms of innovation performance in the European Innovation Scoreboard in 2008 compared to 27 EU-countries (Marxta and Brunnera, 2013). In all measured indicators, Switzerland is above average. Especially impressive is the relation in terms of throughputs and innovators. Still above average, but weaker in relation is the performance in the areas "economic effects" and "linkages & entrepreneurship". When considering the growth over the last five years, the picture is similar. A relatively very high growth rate was reached in throughputs, smaller growth rates can be observed with the enablers, human resources and finance and support. However, factors from this area, primarily an increase of venture capital and an increase in the number of PhD graduates, are key elements for the improvement of the overall innovations performance [OECD, 2011].

When having a closer look at the results, weak points in the Swiss innovation system, which have the potential for optimization, can be identified.

In relation to the average of 27 EU countries, Switzerland realizes fewer products, which are new to the firm, compared to products, which are new to the market. The performance in „new to firm products“ being better than in the area „new to market products“ implies a tendency of Swiss companies to adapt and integrate products from other markets into their portfolio rather than developing new products.

Societal Climate for Innovation

Switzerland is top ranked in various factors concerning its innovative power, and its overall performance is excellent (OECD, 2011). In contrast, Switzerland is less successful, when soft factors are concerned. The German Institute for Economic Research (DIW – Deutsches Institut fur Wirtschaftsforschung) publishes annual studies („Innovationsindikator Deutschland 2008“), which among others focuses on the social climate for

innovation in several countries. This evaluation for the social climate is composed of several indicators, such as the ‚willingness of the people to undertake entrepreneurial risks', ‚degree of openness and tolerance', the ‚positive attitude to the participation of women', a ‚positive attitude to science and technology', the ‚support for sciences' and the ‚trust in innovation actors' (Marxta and Brunnera, 2013).

In the overall ranking, Switzerland is close to the bottom at position 13 out of 17 countries, far behind Sweden, the United States and Finland, which rank at the top.

One of the before mentioned indicators is particularly bad ranked. When considering the high class education in Switzerland and the emphasis of the government on education and research, it is even more amazing, to see Switzerland on position 16 out of 17 countries in the indicators, positive attitude to science and technology' and ‚support for sciences'. On the other hand, Switzerland scores very high (position 5) in the indicator "openness and tolerance" (OECD, 2011).

Analysis

From the analysis of the current situation of the Swiss innovation system, it becomes clear, that the system is multifaceted. While overall it is quite successful and elaborate, a number of weak points can be observed and lessen its performance. Additionally, external threats and opportunities influence the system. Some of the major aspects are depicted in the following chart.

A. Strengths

Switzerland is top ranked in comparison to all European countries in terms of innovative performance. Also the ranking in academia is excellent, even more so in regard of its publication performance. Additionally, Switzerland disposes of one of the best education systems. Lifelong learning is also actively supported. Both the number of employees in knowledge intensive services and the expenditure of business on R&D is way above average. Especially the share of this money, which is dedicated for basic research, is large.

Finally, Switzerland has one of the best infrastructures of Europe.

Strength	**Weaknesses**
• Very good infrastructure • Top ranks in research • High R&D spending of private sector • High number of employees in knowledge intensive services	• Amounts of funding for innovation • Data quality • Surrounding conditions and opportunities for financing of start-ups and spin-offs • Commercial implementation of results of scientific research in products

	• No coherent innovations policy and according instruments for the implementation
Opportunities • Simplify and strengthen collaboration of universities and business • Promotion of non-technical innovation • Establishment of centers for innovation • Further development of continuing education • Export of knowledge intensive services • Sustainable and coordinated communication of Switzerland as a place for innovation	**Threats** • Changes in the macroeconomic surroundings (economic circle, global competition) • Intensification of competitive regulation (worsening of fiscal situation for business)

Fig. 2.5. SWOT-Analysis of the Swiss innovation system

B. Weaknesses

As of today, Switzerland does neither dispose of a coherent innovation policy, nor of according instruments for implementation. The KTI (Commission for Technology and Innovation) is the positive exception and the state uses this agency to support innovation directly, even though the amount of the funding per participating company is quite small in comparison to other countries. The opportunities for financing and the surrounding conditions for start-ups and spin-offs, as well as the available data quality are suboptimal.

Peculiar is the poor realization of results from scientific research in commercial products and the quite bad societal climate for innovation.

C. Opportunities

Even though Switzerland is top ranked in its innovation performance, some weak points can be identified and opportunities to remove those become evident. E.g. an enhanced demand for knowledge intensive services can have a positive influence. Another big opportunity lies in a change of Switzerland's image and reputation to a science and service hub.

D. Threats

Threats for the Swiss innovation system can result from a change in the economic structure and development. Financial as well as economic crises are particular risky. Increasing global competition and an intensification of the competition for geographic locations could also be a threat. A too strong competitive regulation, in Switzerland and the European Union, might provoke a decline of new settlement of business.

Recommendations

Based on the analysis of the current Swiss innovation system, there are nine recommendations for a future successful innovation system. Those recommendations were developed for the Swiss Science and Technology Council (SWTR – Schweizer Wissenschafts- und Technologierat or SSTC) and handed over to the Swiss government (Marxta and Brunnera, 2013).

1. It is necessary to develop a coherent national innovation policy and trans-sectorial instruments for its implementation.

2. Existing institutions and instruments for the promotion of innovation are to be enlarged: The Commission for Technology and Innovation (KTI) is supposed to use its new autonomy and flexibility to adapt to the actual requirements of business.

3. The transfer of results of scientific research with excellent innovation potential is to be promoted by enhancing the surrounding conditions and means for financing spin-offs and start-ups.

4. The collaboration and the knowledge transfer between universities and innovative companies are to be supported by long-lasting firm and at the same time open-minded particularly in natural and engineering sciences, have to be ensured both national and international.

5. To enhance the access to academic knowledge and scientific research results, especially for SME, regional innovation centers with a focus on specific Swiss requirements shall be established.

6. To support innovation in non-technical areas, specific funding instruments have to be expanded.

7. Requirements in regard to communication technology increase for society and business. An effective offer of education and continuing education to close this gap is necessary to capture these opportunities for innovation.

8. A national monitoring system for innovative performance will have to be established, in order to be able to provide data for effective decisions.

9. A sustainable and coherent national and international communication of the "innovation hub Switzerland" is to be continued and enhanced further.

As we can see, being on the top of the list of the most innovative countries of the world, Switzerland still have some fields to improve and to work on in future. Let us analyze in brief the national innovation systems of the other countries within the Euro-Atlantic model of NIS.

Features of the other countries in this model

We will analyze the other countries within this model according to the several fields, i.e.

1. The basic stages of formation of the state innovation policy;
2. Peculiarities of state innovation policy of some countries;
3. Key success factors of innovative development.

The basic stages of formation of the state innovation policy:

In the **UK** until the early 2000-ies were not carried out purposeful centralized policy on stimulation and development of innovations. In 2003 the Ministry of trade and industry of Great Britain published the government's

strategy in the sphere of technological development, in 2004 there was established the Council on technological strategies, which invests in the development of new technologies, supports their development and commercialization. A relatively coherent innovation strategy of long-term development in the UK was formulated only in 2008.

Innovative development of **Sweden** is consecutive and has a long history. However, in Sweden only in 2005-2008 were identified 4 priority areas for financing R&D: medicine, biotechnology, environment and sustainable development. Sweden started to develop "centers of high technologies" (centers of excellence), which are the connection of the research and commercial forces in the interest of efficient and effective commercialization of innovations.

In **Ireland**, the transition to an innovative way of development was also carried out quite recently. In 2007 the government of Ireland allocated 8.2 billion euros for implementation of the Strategy for Science, Technology and Innovation, which assumes improvement of human capital, physical infrastructure, and development of science, technology and innovation through various projects.

The state strategy of innovation in **Spain** was approved in 2010. Guidance on the implementation of the SSI is held by the Ministry of science and innovation Spain. In 2010 the state budget allocated 6720 million euros for the implementation of the SSI.

The main directions of ongoing regional innovation policy of the **Netherlands** were set in 2003. Ministry of economic affairs implemented a program called "Path to innovation: the struggle with the Lisbon ambitions" in order to improve the innovation climate, to encourage companies to conduct innovative activity and to focus more resources in strategically important areas.

Since 1998, **France** has a national plan to stimulate patenting the inventions of the domestic firms. In 1999 there was a Law on innovation and research adopted, this law aims to reorganize and modernize the national system of innovation, towards a more effective commercialization of scientific and research potential. Implementation of the law has led to the adoption of a number of decisions of the government and a special "innovation plan" (2002), which purpose is to create general legal framework facilitating the development of partnerships between the public research sector and non-governmental participants of the innovation process. Since 2007-2008, the authorities made pointed tax measures to support investment in innovation.

The first attempts of realization of innovation policy in **Denmark** was made in the early 1980's, when the government launched the program of technological development aimed at the development of information technology, which was considered as one of the priority areas. For 20 years, Denmark has experienced a full-scale transformation of economic policy, i.e. the traditional short-term stabilization policy was replaced by the long-term structural policy.

The beginning of the purposefully innovative development in **Germany** applies to the period after the Second World War, when the main role in formation of national innovation system was played by the state bodies, which were defining the directions of conducting research activities. In the initial period of Germany's post-war reconstruction, special role was played by the United States under the Marshall plan, which provided financing to businesses in the most developed industries, i.e. mechanical engineering, automobile industry, chemical industry, etc. Since the 1950s, together with the American researchers, there has been carried out joint work in the fields of space, aviation and nuclear energy, during which the country had access to the American developments.

Financing of innovative activity subjects in Germany began in the 1950s with individual programs of targeted support for specific fields. During the 1970s, the first venture capital funds began to appear, they were aimed at the development of innovative companies in the sphere of small business.

In the 1970s there were the program of private-state partnership in the research field began to implement, making the share of the budget system in R&D expenses decreased from 70% in 1970 to 30% by now.

Industry of **Finland** was able to move to the production of goods with a large amount of added value in the period from the mid 60's through the 80's, due to intensive partnership between the state and the private sector. The role of a venture financing pioneer was played by a state Fund Sitra, which was created in the 1980s, and since the early 2000s, it became the major investor in biotechnology.

Peculiarities of state innovation policy of some countries:

In the **UK**, the practice of public funding of research is carried out as a system of "double support." Strategic funding is made through one-off subsidies. In parallel, the Department of innovations, universities and competencies is funding the Research councils, which, in turn, fund the research in the country on a project basis. Thus, one-time subsidies provide stability and strategic resources that universities can spend in accordance with their priorities and development programs, while project funding from the Research councils provide vigorous competition between the projects.

In the UK there are numerous innovation centers of 2 types are being created: 1) focused on the development of specific technologies and promotion of its use (created in response to needs or business opportunities, for example, Printable Electronics Technology Centre (PETEC); and 2) focused on a specific sector or market (created in order to bring together the complementary disciplines of science, parts of the technological chain, etc.). Such centers are considered as strategic drivers of economic development at the regional level. The shortcoming in the activity of the majority of these centers of innovations and technologies is that they are not integrated in the national innovation system and often not linked to broader development programs, for example, to the programs implemented by the Council on technologic strategy.

A regional approach to investment in the centers has led to a high variance of the innovation activity and overlap. For example, there are 8 centers of innovation and technology dealing with composite materials at the moment in the UK.

In **Ireland**, the state plays an important role in innovation processes; in particular, it is crucial in attracting foreign investments into development of hi-tech industry. One of the directions of measures to stimulate the development of high-tech industries is allocation of grants for research and development, and also reduction of tax rates for companies that perform R&D. Although Ireland is home to 1% of the EU population, 25% of American investments in the EU are received in Ireland.

The state in Ireland is investing in a number of projects for opening access for the developing business to information, advisory and educational resources. To support the flow of researchers to Ireland the government has adopted a resolution by the European communities to attract researchers from third countries (EC Directive on Mobility of Researchers from Third Countries).

In Ireland there are a number of initiatives for the development of ties between higher education and industry being supported. An example of such initiatives can be the establishment of Centers of science, engineering and technology for the purpose of accumulating and sharing knowledge, creating and using opportunities for innovation. Applied research centers at higher educational institutions work with researchers to identify commercial opportunities of projects, make agreements with enterprises and to protect intellectual property rights. In addition, the support of the links between academic researchers and industry is carried out within the Strategic research clusters, which are specialized mainly on bio - and computer technology.

In **Denmark**, the universities are financed mainly from the state budget. The interaction between universities and industry in Denmark is less developed than in many other countries. An important part of the Danish innovation system lies in the branch scientific research institutes. They are attached to various ministries and are conducting research according to the needs of the appropriate Ministry. Institutions receive basic funding from the national budget; they may also receive funding from public funds distributed through open competition and through research councils, ministries or other institutions, and also from a commercial activity.

An important part of the Danish innovation system are GTS-institutions ("Godkendt Teknologisk Service", i.e. approved technological services provider), acting as a bridge between public and private actors. GTS-institutions are private, independent consulting companies that develop and sell applied knowledge and technology services for private enterprises and government institutions. GTS-Institute is a non-profit organization established by the Ministry of science, technology and innovation for the period of three years. There are three main areas of activity of GTS-institutions: independent development of know-how, participation in joint projects with public research

institutions and private companies, and commercial activities. Another important element of the Danish innovation system is S&T parks, co-founders of innovation incubators. The country has created a powerful innovation infrastructure. However, a large part of the innovation activity is reduced to small innovation aimed at improving the production process on-site.

In **Norway**, great attention is paid to interaction of education and science: there are a large number of both public and private research institutions (almost 23% of all expenditure on research activities, and about 27% of all scientific research). All higher education institutions in Norway are obliged to carry out fundamental research and train the researchers, using the work of graduates of universities and programs of doctoral students. Higher education institutions are responsible not only for fundamental research and training of scientific personnel, but also for commercial use of the results of inventions made by their employees. The share of public investment is relatively high, as in other countries with a low share of R&D to GDP (about 1.7% of GDP).

Norway has been able to make foreign corporations operating on the local market, hold the localization of their technologies in the country or transfer them to the Norwegian research institutions. This was done through different incentives and rewards. As a result, in Norway there have been formed the shipbuilding companies, IT sector, linked to the oil and gas production, appeared innovative developments in the monitoring of reserves in hard-to-reach places, as well as in technologies of drilling and production on shelf.

The government of Norway co-funds R&D for the raw material companies. The ultimate goal is to create a scientific environment of the world level and accumulation of knowledge in Norway in the field of oil production. To encourage the development of R&D in industry, Norway has a system of tax deductions in spending on research and development. High taxes on oil production in Norway directly stimulate oil and gas companies to develop new technologies, allowing to reduce production costs and increase the production of oil from the reservoirs.

Innovation policy in the **Netherlands** is characterized by the predominance of regional components, and there is offset from support the lagging Northern regions to support the economic advantages of regions, which is the driving force for national growth. The disadvantages of the national innovation system of the Netherlands are: insufficient density of the research activity in the Dutch companies (1% compared with the average level of 1.5% in the OECD) and the increasing shortage of doctors of Sciences on scientific and technical fields.

Participation of the Netherlands in international programs on innovative cooperation is centralized and coordinated by the key ministries and agencies within their primary specialization. During organizing the participation in the international innovation projects the main attention is paid to research of the small and medium enterprises, and also the promising innovative companies.

In **Spain**, the main direction of the state innovative policy is realization of projects on creation the technology research consortia (CENIT, NSCTR), Fund of funds and the program "Torres Quevedo". National strategic consortia of technological research (NSCTR) are the practical implementation of the tasks on improving the interaction between public and private organizations through the establishment and co-financing of NSCTR. To obtain grants and other support from the state the formed NSCTR must satisfy several conditions.

Fund of funds unites venture capital funds to support the creation and growth of high-tech companies. Participants of the Fund are state-owned and private companies. The share of the private sector is more than 30%. The program "Torres Quevedo" carries out saturation of the private sector with university staff. Within the program there are contracts with doctors of science and technologists is being financed to support research projects in companies.

Innovative potential of **Austria** is characterized by high level of spending on R&D, high degree of dependence on state funding (high share of enterprises receiving public subsidies for innovation activities) and at the same time - lack of staff and low returns on new developments. In recent years in Austria there have improved tax mechanisms to encourage scientific research and innovative activities of enterprises. So, for expenditure incurred on research and experimental development, the Austrian tax legislation gives deductions from the base of the profit tax in the amount of 25% of the expenses made for research and introduction of new technologies, for expenditure on education is 20% of the costs incurred. The remaining constraints are low share of graduates with higher and higher technical education, as well as a substantial lag in the development of venture financing.

In promotion the high-tech products on foreign markets, particularly in implementing major infrastructure projects, Austrian enterprises in many cases are acting as members of clusters, groups of enterprises. These clusters are organized on the basis of the leading enterprises in the sectors of industry, primarily related to infrastructure development, where the competitive position of Austrian firms in international markets is strong. This also allows ensuring the access to the market for a large number of small and medium enterprises, for whom the individual participation in large infrastructure projects is impossible. There are currently four of such clusters, which are Austria Rail Engineering (ARE), Austrian Power and Environment Technology (APET), Austrian Health Care System (AHS) and Austrian Technology Corporation (ATC).

Except for that, there are quite a number of different forms of organizing business, research and production centers, i.e. specialized S&T business centers, business incubators, the competence center, pulse-centers, etc.

Innovation activities in **Finland** is regulated by the Decree of the Government on Council of policy in the field of science and technology in Finland, Communique of the Government of National innovation strategy of

Finland to the Parliament in 2009, the intellectual property laws, and small and medium-sized enterprises laws, regional development and other laws and regulations. In Finland they pay great attention to the development of technology parks, which are considered as one of the most important elements of innovation infrastructure of the country. On the basis of the 20 universities in Finland municipal authorities created 22 Technoparks.

In **France**, the share of public R&D expenditures in the total expenditures for these purposes is 49.9%. The rest of the funding provided by the private sector and 70% of R&D expenditures falls on industrial companies. The French innovation policy aimed at stimulating private investment in science, improving interaction between all the participants of the innovation process in the framework of the poles of competitiveness and at supporting the development of small and medium enterprises (SME). With this purpose, with the participation of state and non-state actors there have been various activities carried out, including international, national and regional levels of interaction. In order to improve the cooperation of the participants of the project and transfer of technologies, there have been created special innovation clusters in France ("Sophia Antipolis", "Marseille innovation cluster"), the country has developed and launched a special program of "Competitiveness poles".

In **Sweden** most of the spending on R&D is carried out by the entrepreneurial sector. Government support of R&D in the business sector, mainly limited to the research in the field of defense (13% of total governmental R&D funding). At the same time, fundamental research is funded mainly by the state, while the share of the business sector is extremely low.

The important features of Sweden are the high level of education and skills of the personnel employed in the public sector, effective work of state institutions and stable political system. Venture capital market is developed in Sweden. However, the national system of support and stimulation of commercialization the R&D results through the creation and development of new enterprises is often characterized as relatively weak and fragmented.

Low efficiency of commercialization of R&D results became the reason for the creation of a whole chain of institutions responsible for the implementation of the policy in relation to business development. The Innovation Bridge supports the commercialization of research results and provides the (limited) funding for pre-stage (pre-seed); ALMI Business Partner supports the creation of business (not conducting R&D); The Industrial Fund is a public venture investor; the Invest in Sweden Agency (ISA) promotes investment.

One of the most serious problems of the Swedish innovation system is relatively low level of knowledge-intensive production outside of a few large, technically advanced transnational corporations. Their technical achievement (for a small number of exceptions) historically associated with traditional technologies and industries.

In **Germany** there is a legal base for the innovation system, the legal acts in it can be divided into three groups - related to the educational institutions, to the research institutions and to the business sector. Especially successful is considered to be the current system of patent laws providing for, among other things, the simplified registration of inventions. The effectiveness of the patent legislation in Germany is confirmed by the increase in the number of patents since 1977, the number increased 20 times. At the same time in the field of nanotechnologies there is no full-fledged legislative base, so it is regulated by legal acts from related sectors (e.g. pharmaceuticals).

All in all, nowadays there are three main areas of support of the national innovation system: 1) the improvement of conditions for conducting innovative entrepreneurship, 2) development of education and science to prepare qualified specialists and improve the quality of research and 3) funding of innovative entrepreneurship. The German state authorities are working on these tasks, and doing it quite successfully, however, there are some shortcomings. In particular, the incentives for doing research and implementation of innovations in the tax system are undeveloped in Germany. The cooperation between science and business is also underdeveloped. One of the measures for solution of this problem was the creation the departments of enterprise in universities, designed to promote greater commercialization.

Key success factors of innovative development:

One of the main factors of the success of the **UK** innovation policy is that it's focused on the private initiative. Unlike many other countries, the leading role in the innovative development of the Great Britain does not belong to the state: innovation strategy of the country is aimed primarily at the development of the demand for innovation, and here it's practicing a regional approach to investment.

In **Ireland**, although the private sector is the main generator of innovations, it is the state that forms the basic conditions for innovative development. The success of this national innovation system can be described by three basic components: 1) Ireland is included into the global financial system, which led to a significant growth of foreign investments in the economy and the arrival of multinational corporations; 2) creating innovative "centers" of development on the basis of the country's participation in international technology traffic and various forms of international IT cooperation; 3) improving the quality of human capital due to immigration of qualified specialists (mainly former expatriates) in the country.

The support of fundamental research in institutes and universities is one of the main priorities of the **Norwegian** innovation policy. Free education makes it possible for children from remote regions and the poor to study at the leading universities and colleges. At the same time, the practice of lifelong education increases the skills of workers throughout life.

The main success factors in the **Netherlands** was the selected support of leading innovative regions, as well as developed scientific and educational

complex, which includes the system of student support, the system for technology transfer within the scientific sector, developed network of research universities with state funding.

In **Spain** a major role in innovative development is played by more active interaction between the state and private structures.

The main factors of success in **Belgium** in the innovative development are balanced regional innovation policy and an elaborate system of financial support of innovation activity.

The success of **Austria** on the way of innovation development is contributed to the structural support programs that were taken in order to organize cooperation of high-tech enterprises without rigid binding to specific technological areas. In addition, the country has a well-developed cooperation between higher training colleges and small and medium enterprises in the field of creation and introduction of innovative developments. The network of S&T parks is developing successfully, which creates optimal conditions for the development of SMEs, including innovational ones. At the state level there is a formation of clusters has been initiated and that also is a way of supporting high-tech exports.

The main factors for success in **Finland** are the state ownership of stakes in the key companies; regulation of interest rates; state support for the private sector; the alternation of state cooperation and the competition of state and the industry. The leading role in the development of telecommunication industry of Finland and the industry in general belongs to Nokia. A significant impact on its long-term growth has had public funding through the agency Tekes, which financed 8% of all expenses of Nokia on research and development.

One of the main strengths of the national innovation system of **France**, contributing to its innovative development, was the poles of competitiveness which allow the enterprises, universities and research developers to work together.

The key factor for success of innovative development of **Sweden** is long-term large-scale investments in education, which contributed to the development of science.

Important role in the innovative development of **Germany** is played by the cooperation with the US (post-war reconstruction of the economy), and also the development of a mechanism of state-private partnership, which has become to a certain extent, the replacement of venture financing, that did not become widespread in Germany.

2.2.2 East-Asian model (Japan, Korea, Hong Kong China, Taiwan China etc.)

East Asian model is a model of innovative development, in which there is no stage of fundamental (and often applied) scientific research, as the main sources of innovative ideas.

This type includes NIS of Japan, South Korea, Hong Kong (China), Taiwan (China), Malaysia. These economies have been focused on high-tech exports for a long time, as a rule, borrowing the technology from the countries with the traditional organization of the NIS (Euro-Atlantic model). A classic example of this model is NIS of Japan.

Table 2.2 Main indices of the Japanese economy

Index	*Value*	*Rank in the world*
GDP (purchasing power parity)	$4.729 trillion (2013 est.)	5
GDP (official exchange rate)	$ 5.007 trillion (2013 est.)	
GDP - real growth rate:	2% (2013 est.)	144
GDP - per capita (PPP)	$37,100 (2013 est.)	36
Unemployment rate	4.1% (2013 est.)	34

Source: CIA World Factbook [https://www.cia.gov/library/publications/the-world-factbook/geos/ja.html]

Partly this situation can be explained by the fact that in these countries the universities, as a center of fundamental research, play a much smaller role than research divisions of corporations.

In NIS of Japan there are three stages of its formation and development, each of which has its own characteristics.

1. **The first** period covers the period from the 50's through the 80-ies of the last century. Until the 70's, scientific-technical and innovation policy of Japan were based on borrowing foreign achievements (purchase the licenses, establishment of joint ventures, participation in multinational research projects) and on promoting the development of own researches on the basis of the largest corporations.

2. **The second period** lasted from the 80's till 2000's. At this time the direction of maximum scientific and technical self-sufficiency based on national innovation began to shape. A number of research programs has been implemented, the most significant of which were the "Program of development of basic technologies for new industries" and the program called "Flexible research system for the development of creative science and technology" [16]. During this period a unique organizational research technology was implemented, it called the system of "design leaders" or the state venture capitals. In 1985 the Council on science and technology published a policy document "Bases of scientific-technical policy", which in its revised edition (1992) have identified 7 key principles of development of Japanese science till the end of the 20th century:

1) providing harmony in the system "science and technology - human and society";
2) supporting the employed in the field of science and technology;
3) increasing the R&D expenses;
4) developing the research infrastructure;
5) promoting original thinking and creativity of the researchers;
6) intensification of international scientific-technical activities;
7) promotion of scientific and technical development of peripheral regions of the country.

3. **The third period** from the beginning of the 2000s till the present time. The old model of development based on borrowing and further improvement of foreign innovation and technology, has exhausted itself. During this period, the Council for scientific and technological policy, basing on the analysis of global trends of the world economy and urgent problems facing the Japanese society, has developed a plan of the national strategy in the field of scientific and technical development. The strategy basis is the selection of two large-scale priority areas:

The first area includes four sections:

- life sciences;
- informatics and telecommunication systems;
- nanotechnologies and materials;
- ecology.

The second area covers mainly applied research and technologies:

- energy and resources;
- industrial technologies;
- production and social infrastructure;
- problems of Earth and Space.

All of these topics are the priorities of innovative development also at the end of the first decade of XXI century.

Currently, a large part of the fundamental research in Japan is conducted in universities and government laboratories. However, the degree of their implementation is still insufficient. The most part of scientific-technical developments of applied type is still running in the laboratories of large corporations without transfer to potential users of other companies.

The basic share of expenditure on R&D in Japan is paid by private sector (corporations). This approach ensured Japan's excellence in the field of production of consumer goods of mass demand. But in the field of basic research and not mass production, the country’s lag behind the other developed countries is obvious.

The attempts to solve the problems of interaction between universities and research institutes with industries were made back in the 80's and consisted in the creation of technoparks and technopolises (with active state support at different levels of governance). There were established more than 100 S&T parks, 70% of which provided support for small and medium business

in the regions, and 58% of the total number of technoparks was focused on making the high-tech products.

By 2001, Japan had achieved a high level of competitiveness of its innovative products, occupying the second place after the USA on export of high-tech products. However, by the end of the first decade of the 21st century Japan lost its global leadership in production of notebook computers, semiconductors, telecommunication equipment and biotechnological products. The decline in the competitiveness of Japan on the market of innovative products continued at a high level of expenditure on R&D (over 3% of GDP).

Low efficiency of investments led to reassessment of the principles of innovation activity in the country. The Japanese government with considering foreign and its own experience, using the forces of the three councils, members of the Cabinet of Ministers of Japan, has developed a set of documents, regulating the innovative activity of the country by 2025, called "Innovation 25".

The organizational structure of the NIS in Japan (see Fig. 1.4) has features, special only for this country, caused by the fact that the model of NIS of this country since the third stage of its development, is transforming into the first type, probably with elements of the fourth. We will show the basic elements that define the Japanese innovation policy of the last time.

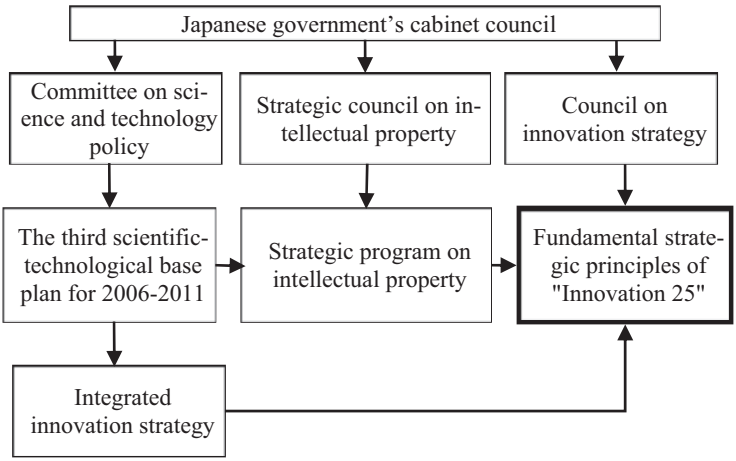

Fig. 2.6. Organizational structure of management of innovative activity in Japan

Document basis of modern innovative policy of Japan are:

- The basic law on science and technology, from 1995
- Basic scientific and technical plan with five versions:
    - for 1996-2000;
    - for 2001-2006;

- for 2006-2010

Version of the plan for 2006-2010 has a hierarchical structure and contains three ideas, six goals and 12 sub-targets. Let's see them.

Idea # 1: Forming the "smart human".

Goal 1: Accumulation of various forms of knowledge.

Sub-goal 1.1: Opening and interpretation of new principles and phenomena.

Sub-goal 1.2: Creation of knowledge as a source of constant technological innovation.

Goal 2: Outstanding achievement in modern scientific and technological fields.

Sub-goal 2.1: Implementing the projects of the highest world's standards as the basis for scientific and technological achievements.

Idea # 2: Maximization of the nation's potential.

Goal 3: Sustainable development that meets the ecology and economy needs.

Sub-goal 3.1: Solve the energy problems and the problem of global warming.

Sub-goal 3.2: Formation of a "recycling society", existing in harmony with the environment.

Goal # 4: Innovative Japan (forming a strong economy based on innovation).

Sub-goal 4.1: Establishment of a society with a comprehensive network economy, attracting the interest of the international community.

Sub-goal 4.2: Creating the world's №1 nation in the field of manufacturing technologies (technologies monozukuri).

Sub-goal 4.3: Growth of international industrial competitiveness through science and technology.

Idea # 3: Protection of the nation's health and safety.

Goal 5: Forming a healthy nation by improving health and quality of life.

Sub-goal 5.1: The victory over the diseases, affecting the Japanese nation.

Sub-goal 5.2: Creation of a society in which all citizens can have a healthy and active life.

Goal 6: The safest nation in the world.

Sub-goal 6.1: Security of the nation and society.

Sub-goal 6.2: Safety of people in daily life.

As in many other countries (including Russia) there are priority areas of development are being highlighted for the next planning period. Japanese basic plan has defined the priority areas (see table 1.1).

Table 2.3 The basic plan for 2006-2010: priority areas, objectives, expected results

№	*Priority areas*	*Objectives*	*Expected results*
1	Life sciences	Practical application of research results in the development of drugs and therapeutic equipment. Creating a diagnostic infrastructure for the treatment of diseases.	Bioinformation technologies.
2	Informational and communicational technologies	Using scientific and technological advances and innovation to gain competitive advantage on world markets of supercomputers.	Nano-equipment and nano-sensors.
3	Ecology	Leadership in the Asian region in the field of studying global warming.	Technologies of climate observations.
4	Nanotechnology and materials	The satisfaction of social and industrial needs in nanotechnology and innovative materials.	Therapeutic tools and equipment for early diagnosis of diseases.
5	Energy	Reducing the dependence of Japan on oil and oil products.	The electric vehicles of the next generation. Industrial technology of energy saving.
6	Industrial technologies	The development of Japanese management techniques - monozukuri.	Transfer of technology and know-how into small and medium sized businesses.
7	Infrastructure	Significant reduction of damage from natural disasters.	Protection from natural disasters.

№	*Priority areas*	*Objectives*	*Expected results*
8	The vanguard of science and technology	The use of advanced technologies in research of space and the world ocean.	Improvement of space systems and rocket technology.

In addition to the basic five-year plans, the important and characteristic feature of the recent years is the creation (in 2006) of the strategy called "Innovation 25", that covers the period up to 2025 (see Fig. 1.4). The main features of this strategy are as follows.

- three fundamental objectives has been identified:
    - Achieving a new level of the Japanese nation's welfare.
    - Forming "Big Asia" and activization of innovative cooperation with the rest of the world.
    - Forming a highly spiritual, creative nation.
- Increasing the competitiveness of Japan on the market of intellectual labor. At the same time to increase the number of Nobel laureates form Japan, to increase the level of international mobility of scientists, researchers and students (for this purpose need to reform the universities).
- During the period of the strategy, it's important to take into account the following three main trends:
    - The rapid aging of society and reducing of the population in Japan, which will affect innovative development of the country.
    - The explosive-type development of the global information society that will affect the culture of all the nations, including Japan.
    - The threat of disruption of social and ecological balance of the Earth, which may have an impact not only on particular countries, but also on civilization as a whole.
- The strategy envisages different scenarios of innovative development of Japan by 2025, based on prognostic studies.
- As part of the strategy they present more than 60 innovative combination of technologies to be developed until 2025 in the following areas:
    - medicine and health care;
    - environment, water resources and energy;
    - advanced technology and industrial development;
    - safety and comfortable life for the population.

In general the plans of innovation development of Japan of the last years are formed under the sign of greater openness, global competitiveness and social orientation.

So as we can see innovation policy of Japan is quite special and ambitious. Let us compare it with the innovation policies of the other countries of this model.

Other countries of this type of model:

South Korea

The first program of innovative development in South Korea have been launched in 1999, and the development of innovative sector with very rapid progression.

Originally the modernization here was built on the adoption of foreign technologies, which took place in different forms: contracts, turnkey, licensing, consulting services. The study of foreign experience occurred, mainly, by creation of joint venture firms with Japanese partners. At present, despite the fact that Korea on many high-tech types has leading positions in the world exports, the country still depends largely on imported equipment due to insufficient development of their own core technologies.

In 1998, the government restructured the state research centers, creating a competitive environment. From this point, research institutes provided spin-offs office areas and laboratories for research. One of the distinctive features of the innovative development of South Korea is dedicated support, basically, for the big companies. At present, on the contrary, downsizing, and in some cases liquidation of financial and industrial corporations (chaebol) is recognized as one of the main achievements of post-crisis adaptation and structural reforms in South Korea.

Korean patent system is considered to be one of the most productive in the world. The Korean intellectual property office (KIPO) since 1997 has been reoriented toward the adoption of principles of regulation of patent activity in the USA. Patent policy has played an important role in the development of small business and capitalization of universities. Previously professors were required to transfer their patents to the government, as inventions made in public institutions were considered to be the property of the Republic. The revision of patent rights has facilitated patents transfer technology through a legal entity.

Quick and successful innovative development of South Korea became possible due to active borrowing of foreign technologies and wise patent policy. The important role in the "economic miracle" of Korea has played by major financial-industrial groups (chaebols), which for many years was the basis for the development of the national economy.

India:

1. Overview

India has made an economic leap forward with its market opening policy in the early 1990s and drawn worldwide attention by being recognized as CHINDIA and BRICs. As of 2011, India’s population surpassed 1.2 billion to become the world’s 2nd largest population. India also became one of the fastest growing countries along with China.

In particular, India's technology development in ICT and pharmaceutics has led its fast economic growth and placed more importance on public R&D. Accordingly, public R&D is pushing initiatives that focus on commercial and market perspectives.

In addition, in order to achieve quantitative and qualitative improvement of its scientific workforce, the Indian government is attracting a third agency to concentrate on science and engineering education. The number of foreign R&D centers has skyrocketed to about 750 in 2009, from less than 100 in 2003, of which most are involved in ICT, automation and pharmaceutics. Recently, there have been several investment takeovers in overseas technology-based companies in the medium-tech or high-tech sectors.

2. Major S&T Innovation Policies

2.1. Flaw of S&T Policies

The Scientific Policy Resolution adopted in 1958 is the first attempt by India to bring about technological progress and change in its industry. In 1983, the Indian government issued the Technology Policy Statement with an aim to develop local technologies in addition to effectively adopting and applying foreign technologies.

In Jan. 2003, India's Prime Minister officially announced that research in India increased to 2.0 percent of its GDP, from 0.80 percent in 2003, until the completion of its 10th 5-year plan in 2007.

Although India failed to attain this goal by recording 0.88 percent, it found the following four characteristics: 1) the number of scientists and engineers were smaller compared to the total population; 2) the necessity of managing a brain drain was recognized and therefore a clear statement had to be issued; 3) the importance of both domestic and international patents needed to be emphasized; 4) monitoring and review mechanisms were in need of highlighting based on efficiency, transparency and scientific methods.

2.2. S&T Policy of 2003

The S&T Policy of 2003 displayed the basis of recent S&T policies that built upon the Scientific Policy Resolution of 1958 and the Technology Policy Statement of 1983. It stressed the social and economic implications of S&T policies and consisted of forewords, policy goals and strategic plans of action.

2.3. 11th five-year plan (2007 - 2012)

The 11th five-year plan emphasized innovation with the following eight objectives:

- The national mechanism should formulate policies and consolidate the foundation for charting a course of basic research;
- In order to expand the S&T workforce and strengthen infrastructures, the government should actively attract young talent with the necessary scientific backgrounds;

- The government should initiate tasks in the fields of regional water supply development, sanitary facilitation, health care provision, communications and education management as its primary programs;
- Research facilities and excellent research centers need to be established to gain global competitiveness;
- Innovation should be reinforced by highlighting the importance of R&D to scientists;
- A new model should be developed for the public-private partnership in advanced education organizations, especially in university research and in the high-tech sector;
- Methodology and tools that can play a trigger role in industry – university cooperation should be identified;
- Cooperation with advanced countries should be promoted in international big science projects such as the Large Hadron Collider project of CERN, international atomic fusion and nuclear reactor projects along with the rice genome project in Japan.

2.4. Patent Act in India

The Indian Patent Act is a recent policy change that took effect on Jan. 1st 2005. The act outlined major changes including the acknowledgement of patents for both products and processes since the past act of 1970 had not recognized the sole patent rights for processes. This act was adopted in compliance with the TRIPS of WTO.

According to "TRIPS and Declaration on Public Health," India was given the obligation to export medicines to countries with no market capability and Indian companies were tasked with exporting AIDS cures to Asian that is Southeast Asian countries.

China:

1. Overview

Since opening its market in 1978, China has repeatedly faced economic ups and downs and gone through conventional economic cycles such as high economic growth, inflation, tightening policies and economic downturns. In recent years, however, it has maintained a stable economy backed by advanced industries, increased exports, enhanced government control over the macro-economy and a growing inflow of foreign investment. Its GDP for 2010 grew to CNY 39.7983 trillion, with a 10.3 percent growth rate, which is the second highest in the world.

China's GDP per capita also soared to 29,748 CNY, an increase of 10.6 percent from the year before.

2. Major S&T Innovation Polices

2.1. Development of S&T Policies

S&T policies in China have been greatly influenced and steered by the political ideology of the Chinese Communist Party. In this light, China's S&T policies can be classified in four phases to identify the major developments and changes.

Stage 1: Defense and production-oriented S&T policies (1949-1977)

In its early incarnation after the foundation, the Chinese government recognized the "development of natural science, encouragement of scientific invention and finding, and distribution of scientific knowledge for establishing industry, agriculture and national defense" as important components of building the nation. Therefore, it pushed forward S&T policies aimed at strengthening production and national defense.

In particular, as the relationship between the old Soviet Union and China deteriorated in the late 1950s, China became part of more complex international surroundings. In a situation where the protection of national sovereignty and land emerged as the nation's central task, the strengthening of defense became an essential part in China's S&T policies.

Stage 2: S&T policies focusing on economic development (1978-1994)

The National S&T conference held in Mar. 1978 first suggested the concept that "S&T Leads to Product Capacity" and a shift began in the national S&T development strategy. It defined the principles that S&T should serve economic development and S&T, with the economy and society preferably being developed in harmony. Accordingly, the government formulated a series of S&T development policies, laws and regulations intended to build China's economy.

At the same time, in line with changes in its economic system, China faced increasing problems in its S&T system, including the separate development of S&T from production and education in addition to any weaknesses in industrial technology. China decided to reform its S&T system to meet the market economy by shifting its paradigm from "defense-oriented" to "economy-oriented".

Stage 3: "Science education boosts the nation" strategy (1995-2005)

In the 1990s, rapid development of S&T made the world recognize the importance of the knowledge-based economy. Plus, in the ever-intensifying competition of national power, the focus was placed on human talents and education. At the National S&T conference in 1995, China submitted the "Science education boosts the nation's strategy" and presented the goal of achieving S&T-based economic development. This emphasized overall social development and the enhancement of wide-ranging national powers as well as realizing the harmonious development of the economy, society and ecosystems.

Also during this period, multinational companies (MNCs) started to set up R&D centers in China (J. Jin, S. Wu and J. Chen [146]). For example, there is cooperation between Chinese universities and foreign MNCs or their subsidiaries (e.g. Microsoft Joint Master Programs in some Chinese universities (P. Almeida and A. Phene, [146]), as well as more cooperation between Chinese MNCs and foreign universities (e.g. the strategic alliance between Sinochem Group, China and University os Leeds, UK in 2010) (J. Jin, S. Wu and J. Chen [146]).

Stage 4: "Autonomous Innovation" strategy (2006-present)

Since its opening and reform, China has maintained an economic growth with an annual average close to 10 percent. As a result, China appeared to have reached the "Limits to Growth": China's economy has quickly grown but its employment rate has slowed since the 1980s. Related problems included serious environmental degradation, imbalance in the ecosystem, a gap between the rich and poor and the dominance of core technologies and industrial standards for the manufacturing industry by foreign companies, which placed local companies at the bottom of the value chain.

Faced with such challenges, the Chinese government presented "Harmonious and consistent science development based on humanism" and actively sought for development strategies based on autonomous innovation and balanced development.

In 2006, China officially announced the outline of the National Program for Medium and Long-Term Science and Technology Development Plan (2006~2020) and implemented strategies for autonomous innovation in addition to becoming an innovative power.

Needs to mention, that R&D activities of MNCs in China and those of Chinese abroad companies contribute to the building and improvement of Chinese NIS [153, 162]. Statistic data reveal that more than 20 percent of R&D expenditure of enterprises in China is from subsidiaries of MNCs [153]. So this is one of the examples how globalization influences the national innovation systems of different countries and brings the synergy effect.

2.2. The 12th National 5-year Plan on S&T Development

In July 2011, the MOST officially announced the 12th National Five-year Plan on S&T Development. The general objectives of this plan are: to greatly enhance autonomous innovation capacity; to strengthen S&T competitiveness and international influence; to achieve significant results in securing core technologies for priority sectors; and to support the acceleration of economic development. In addition, the plan aimed at building up a national innovation system with clear functions, a reasonable structure and high efficiency. By doing so, it plans to make a substantial step forward in constructing an innovative country by raising its ranking in the national comprehensive innovation capacity from its current spot of 21st to 18th place, and enhancing the S&T progress contribution rate to 55 percent. Table 2.4 displays the detailed goals.

Table 2.4 Major S&T development indicators for the period of 12th five-year plan

Indicators	*2010*	*2015*
Share of R&D expenditure to GDP (%)	1.76	2.2
R&D Personnel per 10,000 employees (annual number of people)	33	43

Indicators	*2010*	*2015*
World rank for citation of SCI papers	8	5
Invention patent holder per 10,000 people	1.7	3.3
Application for patent by R&D personnel (case/annual 100 people)	10	12
Total transaction contract of national technology market (100 million CHY)	3906	8000
Share of high-tech industry in manufacturing industry (%)	13	18
Citizen with basic scientific knowledge (%)	3.27	5
World rank for national comprehensive innovation capacity	21	18

Taiwan (China):

Overview

Taiwan promoted export oriented industrialization led by small and medium sized national capital. Its industrial development was characterized as the technology-intensive export industry and introduction of technology through direct investment and reverse engineering. As industrialization started to peak in Taiwan during the late 1980s, the advancement of an industrial structure was stimulated. In addition, since the development centering on strategic businesses was pursued, investments concentrated on the electricity, electronics and chemistry sectors.

Major S&T Policies

1. Primary S&T Innovation Policies before the 1980s

In 1959, the Executive Yuan approved the Guidelines on Long-term National Science Development Programs, the 1st long-term and specific S&T policies with the goal of "expanding a foundation for the development of science". In 1968, a Twelve-year National Scientific Development Program (1968 - 1980) was formulated through which Taiwan aimed to improve science education at all school levels, develop both basic and applied research together, and connect S&T to the national development demand.

National Science and Technology Development Program (2009-2012)

In the 8th NSC meeting in Jan. 2009, the National Science and Technology Development Plan (2009-2012) was issued, which would be the groundwork for strengthening S&T policies and R&D activities in Taiwan for the next four years. In the Plan, the NSC laid out six major objectives: strengthening knowledge innovation systems, creating competitive advantages for

industries, enhancing citizens' quality of life, promoting sustainable development for the nation, raising the public's capabilities in S&T, and reinforcing the nation's autonomous defense technologies. It also included 6 major strategies to attain the above objectives:

- Strategy 1: integrate people and technology to improve quality of life
- Strategy 2: train S&T human resources
- Strategy 3: provide a stable foundation for legal and regulatory systems through the integration of S&T resources
- Strategy 4: pursue academic achievements that reflect social interests
- Strategy 5: strengthen technology innovation by improving the industrial environment
- Strategy 6: connect technological capacities by pursuing sustainable development

STAG Meeting

The STAG has organized a meeting each year since the 1980s to provide advice on S&T administration and important plans. For example, the 29th STAG meeting in 2009 was held under the theme "How to Stimulate six Emerging Primary Industries". The Taiwanese government proposed detailed strategies for diversification, exporting products and the learning of major technologies. The Executive Yuan selected six industrial sectors including agricultural quality, medical service, cultural industry, tourism, green energy and bio-technology to develop detailed measures for promoting industrial development and provide a better life for the public.

Singapore:

Overview

Because of its geographical advantage, Singapore has enjoyed prosperity for some time through trading. It has also made a successful transition from a labor-intensive consumer goods manufacturer and exporter to a leading player in the bio-medical industry. Until the beginning stages of industrialization in the mid-1970s, the country was highly dependent on multinational companies. However, beginning in the late 1980s, public research organizations actively carried out R&D activities. Furthermore, the importance of BT, IT and other high-tech-based industries and technological capacity has put more emphasis on relevant S&T policies from the late 1990s.

Major S&T Innovation Policies

1. Flaw of S&T Innovation Policies

From 1980 to 1991, the government of Singapore played a leading role in domestic technology development and strengthened innovation policies to support SMEs development and the positive spillover effect from foreign companies. After 1991, the government's role has become even more important in furthering domestic R&D activities of both foreign and local companies, as well as in establishing such organizations as the NSTB. Singapore has since developed and tried a variety of policies to strengthen domestic S&T research by foreign and local companies.

In 2010, Singapore set a long-term goal and emphasized an economic transition to research innovation and new growth engines for creating high-value jobs and strengthening industrial competitiveness through a research-intensive, innovative and entrepreneur based economy. In addition, the government plans to make 1.6 billion SGD in R&D from 2011-2015, which accounts for one percent of its national GDP (currently government investment in R&D is 0.9 percent).

2. Main points of S&T Innovation Policy

After the 1960s, the government of Singapore increased training programs to build a technological capacity platform for its workforce and increase the supply of local technicians and engineers who could be recruited by foreign companies. As economic development has stressed the importance of advanced education, Singapore's education system has primarily focused on S&T sectors: 75 percent of new technical college students and 62 percent of new university students are science and engineering majors, including degrees in engineering, information technology, architecture, civil engineering, health physics and application S&T.

Singapore has also strengthened its technological infrastructure by establishing research institutes and research centers. From 1991, the NSTB founded 13 research institutes and centers that concentrated on their specific fields. These research agencies performed not only R&D but also HRD activities.

From 1991, the government of Singapore has operated diverse incentives schemes including the Research Incentive Scheme for Companies (RISC), Innovation Development Scheme (IDS), Cluster Development Fund (CDF), Patent Application Fund Plus (PAF Plus) and Technology for Enterprise Capability Upgrading (T-Up).

In addition, the government provided various types of tax benefits as financial incentives to foreign and local companies that perform S&T research.

In 1983 Singapore became the first country among developing countries to introduce venture capital. Now, 60 percent of the total venture capital is granted to technology-based companies in the fields of computer, electronics and electricity, information technology, bio technology along with telecommunications.

Since the Foreign Direct Investment (FDI) had positive effects on local SMEs, Singapore has strengthened its technology infrastructures for local SMEs and provided foreign companies the ability to offer input and other services. In addition, through the Local Industry Upgrade Program (LIUP), the government of Singapore encourages multinational companies to hire local SMEs for technology transfer while the Economic Development Administration encourages cooperation with the industry and strategic partnerships. In this way, promising local SMEs can benefit from cooperation with multinational or other domestic companies.

2.2.3 Alternative model (Other: Thailand, Chili etc.)

An alternative model of innovation development is inherent to more agricultural countries that do not have any significant potential for fundamental and applied research and do not have significant reserves of raw materials. In NIS of this type of countries, fundamental and applied science and also high-tech production are poorly represented.

NIS of such countries mostly focused on training the personnel in economics, finance, management, sociology and psychology of labor, as well as on the development of different branches of light industry. In the educational block such these countries' NIS most of the attention is paid to the preparation of management personnel for the local offices of multinational corporations, international banks and international organizations.

So, Thailand and Chile, developing the agricultural sector and being the largest exporters of agricultural products, during the formation of their NIS focus on the development of innovative management of these sectors, as well as the adoption of new technologies, and not on the development of these technologies. In these countries, as in other models, the necessary innovation infrastructure is being formed; a network of high-tech parks, including local universities, public and private research institutes is being created; and foreign scientists are being attracted.

In these countries, however, the boundaries of their NIS models is gradually disappearing, the countries are developing fundamental and applied research at local universities in such non-traditional areas as telecommunications, communication technologies, bioengineering, etc.

Thus, an alternative model of innovation development, in which the blocks of fundamental and applied sciences, as well as complete production cycle of high technology are practically not represented, becomes a priority for countries without the capacity to carry high financial and organizational costs in the sphere of supporting NIS.

2.2.4 Triple helix

The "triple helix" model (hereafter, "THM") is the newest (appeared in recent decades) trend for organization of innovative development. This term is a certain modification of the "spiral", but not "motion in a spiral", and "the DNA double helix". The double helix has elements (nitrogenous bases - adenine, guanine, thymine and cytosine), which provide communication/interaction between the two spirals. In THM important part is the horizontal interaction of three elements (something analogues of spirals).

THM is unlike the three previous models not only in the structure of the NIS, but in the mechanism of interaction of its individual elements. Today the formation process of separate elements in THM starts to develop in some countries of Western Europe and Japan.

Let us analyze some characteristic elements of THM and its separate kinds on the example of specific countries because it doesn't have a final form yet.

The THM can be considered as the development of the Euro-Atlantic model. The greatest development the THM has received in the USA, and its separate elements can be seen in some developed countries of Western Europe, Brazil and Japan.

Theory of triple helix as modernization of the innovation development model, has been established in England and the Netherlands in the beginning of XXI century, by Professor of the University of Newcastle, Itskovitz, and Professor at the University of Amsterdam, L. Leydesdorff [17, 18, 19].

In relation to the innovative development, the THM describes the interaction of the three institutions (science, state, business) at different stages of the creation of innovative product. If previously the interaction between the three institutions was linear-hierarchical, that in modern economy it reminds the grip of spiral structures of DNA, allowing the institutions to adopt and retain some of the characteristics of each other.

The main elements of the THM are the following traits:

1) in a society based on the scientific knowledge it is typical that there is the strengthening role of universities in cooperation with industry and government;
2) three institutions (universities, state, business) seek cooperation, with innovative component is generated from this interaction, not from the initiative of the state;
3) in addition to traditional functions, each of the three institutions partly takes upon itself the functions of the other institutional sectors, and the ability to perform non-traditional functions is a source of innovation (due to the absence of behavior stereotypes in new areas).

In practice, this is reflected in the fact that universities, traditionally engaged in education and research, contribute to the development of the economy through the creation of new companies in the University incubators. And business, in turn, if necessary, provides educational services. The state acts as a social entrepreneur and venture capitalist, in addition to its traditional legislative and regulatory role.

In this model, the leading role is given to the universities, which turn into entrepreneurial universities or universities of industrial type, applying knowledge in practice and putting the results into a new educational discipline [20, 21]. Thus the cycle of "knowledge-practice-training", implemented by the university, becomes very short in time, which provides a very quick check of new ideas in practice and further run of this experience in training, which again can generate new knowledge and the cycle repeats. I.e. such chain actually implements "the principle of positive feedback" (hereinafter - PPF), leading at each iteration to the strengthening of the signal (in this case - new knowledge and experience). In physical systems PPF leads to

increasing of self-energizing oscillations that can become a cause of destruction ("separation") of the system, if there is no limiting amplitude. Using in the innovative processes the destruction is impossible, but at essential increase of the "amplitude of oscillations", i.e. some state parameters, such as the amount of new knowledge or volume of production, the possible thing to happen is "budding" - the division of one subject of research for a few, which can further be developed in a mode of PPF, "budding" again or go to the mode of commercialization and so on (see figure 2.7). As in some other systems, based on the response, to support self-oscillations on each cycle there required a minor "paging" whose role in pendulum systems is played, for example, by pushing electromagnet which is included on the each cycle. In innovation systems creative staff should be the swap (push) factor.

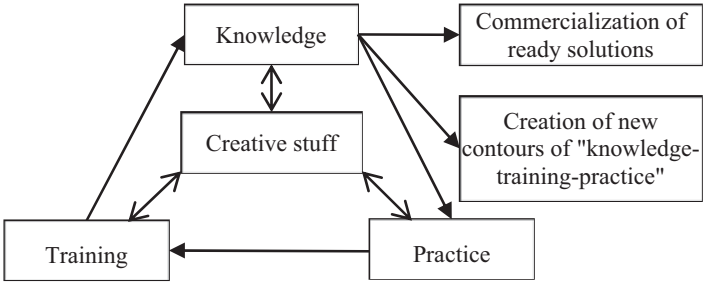

Fig. 2.7. Resonant circuit of the “triple helix” innovative model

A typical example of the implementation of the principle of triple helix was the creation of a Silicon Valley in the US. It has been more than 70 years, many people are still interested in the mystery of the Silicon Valley phenomenon (hereinafter SVP), it’s like a philosopher's stone, in which existence alchemists (researchers) believed passionately and that had some results – there were many important discoveries made simultaneously... To analogues of the philosophical stone can be considered also many other modern mysterious and intriguing phenomena, including such effective Japanese technology management as Just-In-Time [22], Kanban and others. Attempts of transfer of these technologies in an environment of other countries ended in failure. These technologies, however, same as SVP, was endemic, living only where they incurred.

Originally SVP was a double interaction "university - enterprise" and "state - university". At the University (Massachusetts Institute of technology) the focus was on the development of not only the fundamental sciences, but also the applied sciences, focused on the practical application of the results in the production activity. Gradually there have been created a critical mass of firms for which the state support for R&D was organized (despite the fact that the intellectual property rights the state left for universities) and in this environment there have been tested the policy of effective business support. So the dual relationship gradually escalated into a triple one.

Today the NIS of the USA includes about 150 universities, large proportion of which is on the first places in the world rankings (Harvard University, Yale University and others). Universities concentrate the main share of fundamental and applied research. Except for the universities, in the United States the fundamental research is being carried out by the research institutes in Princeton, in Los Angeles, Santa Fe, Santa Monica and other places. Another important group within the NIS of the U.S. is the group of national laboratories, which are developing specific areas of applied science (Bell laboratories, the Los Alamos laboratory and others). In addition, there is a huge number of private research corporations (Rand-Corporation and others).

Technology transfer in the USA is carried out mainly either from universities into industry with the support of venture capital companies, either through the establishment of research units within the companies.

However, with all the diversity and multiplicity of the research organizations, the role of universities is dominant.

The role of the state in the NIS of the U.S. is not only in the implementation of the traditional functions in the legislative, financial and managerial fields, but also in the organization of advanced studies aimed at the development of the economy through the development and implementation of strategic projects involving private companies, universities and non-governmental laboratories. Programs are usually focused on a limited number of priority areas. Research purposes are formulated by the companies, not the state.

Thus, the above-mentioned measures of the state, and also programs of small business support, the regulation of intellectual property rights, instruments promoting the interaction between science and business in the field of R&D contributed to the process of forming a new model of NIS.

Another interpretation of SVP is the cluster approach [23], which can be considered as another variant of the "triple helix" model. If the above resonance interpretation of the "triple helix" model reflects the dynamics of innovation processes, the cluster paradigm is more to characterize the statics and the disposition of the system's specific elements.

Innovation clusters

Regional innovation cluster (RIC) has a significant share of innovative products (compared to industry's and country's indicators). Also the RIC must have an innovative infrastructure, including:

- Educational institutions;
- Centers of research and development;
- Technology transfer centers;
- Business incubators;
- Industrial parks;
- Centers of collective use of scientific equipment;
- Public organizations;
- Financial institutions;
- Centers of cluster development.

The result of the activity of RIC includes innovative goods and services, and as a result of activities of the regional innovation system can be patents, samples of products, personnel for enterprises and organizations serving several clusters of the region.

The development of RIC is usually the result of cluster policy of the state.

In many countries (Australia, Brazil, Britain, Germany, India, Spain, Italy, Canada, Malaysia, Norway, Republic of Korea, Singapore, Slovenia, USA, Finland, France, Sweden, Japan) the state cluster policy is aimed at stimulating the creation and development of RIC [24]. In 2010 in the USA created the Federal Task Force on Regional Innovation Clusters. Finland, France, Norway and Sweden also established interagency bodies to coordinate cluster policy.

The leading international organizations like the OECD, the World Bank, Asian development Bank, European Commission also favor the stimulation of the cluster policy. With the support of the European Commission in order to provide informational, educational, consulting and marketing support to the territorial clusters, there were created the organizations, such as European Cluster Observatory, European Cluster Policy Group, European Cluster Alliance, Cluster Innovation Platform. There is also the monitoring of the development of regional clusters (see database ERAWATCH-INNO-Policy TrendChart) is being implemented.

In most leading countries of the world there is direct public funding of the development of regional clusters, for example:

Germany, under the program BioRegio, provides the allocation of the 90 million euros within 7 years to support the implementation of development projects of 4 clusters. As a result of implementation of this program, the number of biotechnology companies has increased 4 times, that has allowed to create more than 9,000 jobs in the industry. The gap in the field of biotechnology between Britain and Germany was essentially reduced. At present, Germany is the European leader in the field of biotechnology, having on its territory approximately 500 companies, the turnover of these companies reached 2.19 billion dollars, while the number of employed in the industry has reached 14450 people;

within the program InnoRegio, it is expected to allocate 253 million euros for 7 years to support 23 clusters. In the result of the InnoRegio program, from 2000 to 2004 the number of employed in companies included in the program increased by 11%. 44% of the companies included in the InnoRegio program, were able to apply for a patent and 40% released new products;

within the program Spitzencluserwettbewerb (the Best clusters) it is planned to be provide 200 million euros within 5 years to support 5 clusters;

France, within the framework of Competitiveness poles, provides the allocation 3 billion euros for 6 years to support 71 clusters.

To ensure high competitiveness, clusters are created focused on certain breakthrough directions and on promising market niches (see tab. 2.5).

Table 2.5 The main directions of clusterization of the several countries' economy

№	*Fields*	*Country*
1	Electronic technologies and communications, computer science	Switzerland, Finland
2	Biotechnology and bio-resources	The Netherlands, France, Germany, UK, Norway
3	Pharmaceuticals and cosmetics	Denmark, Sweden, France, Italy, Germany
4	Agricultural production and food production	Finland, Belgium, France, Italy, Netherlands
5	Oil and gas complex and chemistry	Switzerland, Germany, Belgium
6	The engineering, electronics	The Netherlands, Italy, Germany, Norway, Ireland, Switzerland
7	Healthcare	Sweden, Denmark, Switzerland, Netherlands
8	Communications and transport	The Netherlands, Norway, Ireland, Denmark, Finland, Belgium
9	Energy	Norway, Finland
10	Construction and development	Finland, Belgium, Netherlands
11	Light industry	Switzerland, Austria, Italy, Sweden, Denmark, Finland
12	Wood & paper complex	Finland

Unlike industrial clusters [25] the main goal of innovation clusters lies in the motivation of universities, research centers and companies in the creation and commercialization of innovative technologies. Clusters usually occur on the basis of territorial concentration of specialized suppliers and manufacturers of related technological chain. One of their essential characteristics is a close relationship not only between firms, their suppliers and customers, but also the interaction with the large research centers and universities that generate innovative knowledge and thus form a high educational level of the region.

Main distinctive features of innovation clusters are as follows [26]:

- geographical concentration (firms are next to each other and they are attracted by the opportunity to save on rapid industrial cooperation, social capital exchanging and learning processes);
- specialization (clusters are concentrated around specific sectors, in which all parties are involved);
- the multiplicity of economic agents (companies, public organizations, academia, financial intermediaries and others);
- competition and cooperation between the companies - members of the cluster.
- the need for a critical mass of the cluster size (the effect of internal "chain reaction" or "self-oscillation", stimulating development);
- the vitality of clusters (long term existence needed to sustain "chain reactions");
- involvement in a variety of innovative processes (technological, operational, organizational, managerial and others).

In the last two decades the tendency of clusters' formation was greatly accelerated in many developed countries around the world [27]. The share of clusters is about 50% of all industrial production in the world. The number of clusters in the most successful countries is shown in Fig. 2.8.

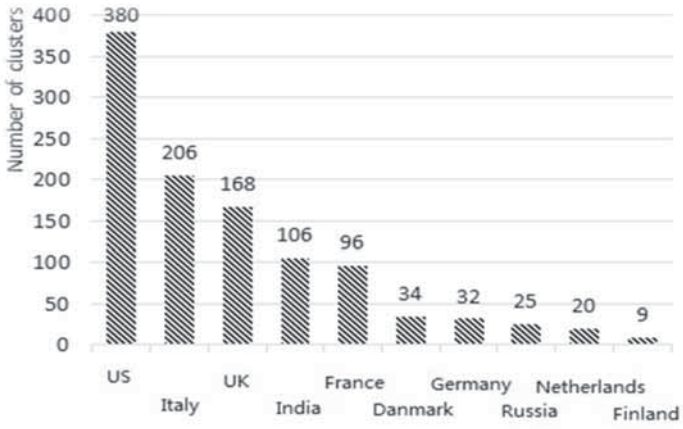

Fig. 2.8. The number of clusters in the world

The process of forming a triple helix model of innovative development can be found today in some European countries (on the basis of the poles of competitiveness, as it is in France), the Scandinavian countries, Brazil, Japan (on the basis of technopolises).

Currently there is a complicated type of the triple helix model is being developed, it's the fourfold spiral described in 2009 by Yu. Karayannis and D. Campbell [20]. The fourth element is civil society involved with interactive network interactions at the level of the entire national community, not only between the three leading institutional sectors. It is believed that the fourth spiral characterizes the modern post-industrial economy than better than the triple one, because in the XXI century civil society acquires a critical role in the creation and dissemination of new goods and values.

2.3 CONCLUSIONS

On the base of the above analysis of innovation systems of several countries, as well as analysis of sources we can conclude that in modern conditions successful competition with the leading players of the global market without the establishment and continuous improvement of the national innovation system is impossible. In most models of national innovation systems either the main or one of the key players is the state.

Particular examples of the successful implementation of the idea of national innovation system can vary greatly depending on the historical and economic context, for example, due to historical reasons, the American system is the most diversified and flexible, and Finnish, on the contrary, is more structured. But both systems are effective. However, it is possible to formulate some basic provisions, largely common to different countries.

The successful development of the national innovation system is promoted by the following factors:

1) consistent and long-term innovation policy of the state with clearly articulated goals and objectives;
2) rational use of available innovative capacity as a foundation for building an innovative economy and realization of innovation policy;
3) systematic efforts to establish and strengthen cooperation between the private, research and educational sectors;
4) identify and target support is essential to technological and innovation potential directions not so fast developing or not developing yourself;
5) the coverage as much as possible potentially innovative firms through the provision of state support;
6) the developed programs of commercialization of innovations and created and adopted technologies;
7) reasonable attracting foreign investment from the transnational corporations;
8) availability of developed legislation in the field of intellectual property;
9) the systematic study and implementation of the best international experience.

On the base of the analysis of countries we can also conclude that the low level of development of individual institutions is not always interferes with

the innovation development. The key importance in this case is a choice of the state policy realization strategy and often - good luck.

The analysis of the historical background has allowed to reveal several patterns on the basis of which the world experience of innovative development can be structured as follows:

- Countries which have recently converted to the path of innovative development (China, South Korea, Norway), which can show concrete measures to implement the accelerated transition to innovative economy;
- Countries, which historical development logically came to innovation. This is mainly developed countries. They share the following basic prerequisites of successful innovative development:
    - free education (Germany)
    - social cohesion, uniformity (Denmark, Sweden)
    - high expenditures on science (Germany, Denmark, Japan, Finland).

The retrospective analysis of innovative development allows to select the comparative position of the starting points of countries that can be considered as common factors of innovative development:

- presence of important minerals (Germany, Norway),
- geographical position (Singapore, Netherlands, UK),
- the English language (India, Singapore, the Netherlands, UK).

The factors hindering the development of innovation systems, in particular, include the following:

- low share of business in R&D expenditures (France, Sweden, the Netherlands, India);
- poor involvement of small business in innovation activity (France, Sweden, Netherlands, Japan);
- "brain drain" (France, Germany);
- territorial disproportions in development (Germany, India, China, France, Norway);
- rapid population ageing (European Union);
- high spending on the military-industrial complex (Sweden, Israel);
- underdeveloped venture capital markets (Denmark, Germany);
- problems of commercialization of innovations (India, Germany, Brazil);
- bureaucracy (India, Brazil, Asian countries).

Analysis of selected state policies of different countries, taking into account the mentioned shortcomings of the innovation systems, allows to select several components of the state innovation policy, which, as a rule, are used for the development of the national innovation system:

- creation of special organizations and bodies responsible for the definition and implementation of innovation policy (almost all countries);
- active cooperation with other countries in the exchange of technologies (almost all countries);

- creation of innovation clusters (France, Germany);
- implementation of the key innovations in large transnational corporations (Sweden, France, Netherlands, India, Japan);
- provision of free education (Germany, Norway);
- using the "innovation voucher" (the Netherlands, UK, Germany);
- significant direct budget financing of R&D in various forms.

In the next chapter we will take a closer look at the one of the main instruments of the innovation policy, the science and technology parks (STP), their elements, the reasons for their creation, types of activities, classification and models, then it goes through the stages of development of STPs, the characteristic of their performance.

3 SCIENCE AND TECHNOLOGY PARKS (STP): CREATION, PECULIARITIES AND CHARACTERISTICS

3.1 ELEMENTS OF S&T PARKS AND TERMINOLOGY

Innovation infrastructure is a set of organizational and economic institutions providing the implementation of innovative activity of business entities. All organizations within the innovation infrastructure have certain technological and economic relations, providing the unity of the stages of innovative activity. The basis of the innovative infrastructure is made of such organizational structures as: the Agency for innovative development, business incubators, innovative-technological centers, technoparks, industrial parks, science parks, technopolises, science cities, centers of technology transfer, innovation funds, the exchange of intellectual property and others.

Some of these forms have fundamental differences, due to specific objectives, the characteristics of the organizational structure, functional purpose, while the nature of the differences of others is rather terminological that is usually associated with features of the innovative infrastructure of the country [33].

Technological or scientific parks (hereinafter – science and technology parks - STP), as an institution, highly variable by names, forms and functions. However, they share such an important mission as the infrastructural nature of their functions in relation to their residents, which, in the majority of cases, are entrepreneurial entities of small scale, i.e. small businesses, startups, incubators, individual entrepreneurs, etc.

In the economies of different countries there is a different experience of creation and use of STP as one of the institutions of economic development. While their structure, functions and efficiency are substantially influenced by the specific economic and political life of the host country. The concept, as well as the functions and properties vary significantly.

Despite the fact that STP structures exist more than a half of a century, today there is no standard definition or universal classification.

Simple working definition of STP can be, for example, the following: STP is compactly situated scientific and production complex, based on commercialization of scientific and technical activity and acceleration of the promotion of innovations in the productive industry. The main task of STP is creation of favorable climate for development of small and medium enterprises (SMEs), involved, as a rule, into innovative activity.

International Association of Science Parks (IASP) in the beginning of 2002 proposed the following definition [34]:

"STP is an organization managed by specialists, the aim of which is to increase the welfare of the local community by promoting the culture of innovation and competition of innovative business and scientific organizations. To achieve these goals, STP stimulates and manages the flow of knowledge

and technology between universities, research institutes, companies and markets".

Organizations and government structures aimed to develop the institute of STP on its territory identify them more specifically. Thus, the Innovation Council of Queensland [34] suggested the following wording:

"STP is a legal entity created for a more adequate use of scientific and technological resources to improve the economic base of the region. The mission of STP is the stimulation of regional development and to facilitation of commercial and industrial innovations. The activity of the STP enriches scientific and/or technical culture of the region, creates jobs and value added".

Along with this interpretation, in the Russian economic practice there are other definitions of STP are being used, in particular, for example, the following:

"**Science and technology park (STP)** is a property complex, which combines scientific research institutes, industry objects, business centers, exhibition halls, educational institutions, as well as servicing facilities: transportation, roads, housing and security. Management of STP is provided by an external management company. STP simplifies the stages of creation and growth of innovative companies through incubation processes and development of new companies from the existing (spin-off processes). STP except for the high-quality areas also provides other services" [24].

Such a broad definition of STP was aimed to embrace the entire world's models of organizations of this type; it defines the minimum set of standards and requirements for the applicants for the name "science and technology park".

In some cases, STP is [14] the set of "centers", then the typical composition of the functional centers of STP can be, for example, as it's presented in Fig. 3.1.

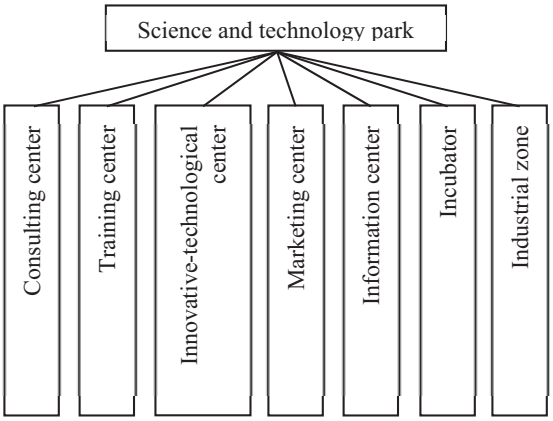

Fig. 3.1. Typical composition of the STP centers

Centers in STP provide their clients various types of services, such as accounting, legal, marketing, information, etc. Leading place in the structure of STP, as a rule, is occupied by innovative-technological center. Innovative-technological center, like the incubator, can be a separate element of the innovative activity infrastructure system, i.e. operating independently from any of STP's structures.

According to the IASP, STPs contain different number of functional centers of different types (see table. 3.1).

Table 3.1 The composition of the functional centers in STP

№	*Functional center*	*Percentage of STPs having it*
1	Business incubators	88
2	Research centers	72
3	Universities (in the radius of less than 50 km)	60
4	Training centers	58
5	Exhibitions and conferences	45

International Association of Science Parks IASP highlights [34] the equivalence of such concepts as "technological park", "technopolis", "technological area", "research park", "science park" and "industrial park". In the UK they usually use the term "science park", in the USA - "research park", in Russia - "technopark". Hereinafter all kinds of science park structures will be named "STP" (science and technology park), and where necessary, we will emphasize their differences and to use exact terms.

In some cases [34], in addition to the STPs, there are their subspecies:

- technological incubators,
- scientific/research parks,
- technological areas.

Incubators (technological) or business incubators are multifunctional complexes, providing a variety of services to legal entities and individuals, making innovation activity and being on the emerging stage of development. Incubators are designed to "grow" innovative goods and services, as well as to commercialize scientific and commercial developments. Even in the case of financial independence, incubators, as a rule, are located within the existing STP. Incubators provide a very wide range of services, i.e. legal, accounting, marketing, consulting, training, information, brokerage and other necessary services for the establishment of enterprises in a complicated, rapidly

changing environment with a high level of risk. They also provide for premises and equipment at a reduced price.

The main distinctive features of the incubators are as follows:

- business incubator is not a "hotel for business", but a service and educational center;
- business incubator needs the premises not only an office, but as a platform for effective communication;
- an innovative enterprise at its beginning stage should be granted only with the premises and services it currently needs.

The ancestors of modern incubators can be so-called creative communes of artists, designers, architects, masters of national crafts and others. Their Motherland is considered to be the UK. The hallmark of these communes was that they were altering the occupied buildings, trying to create a favorable atmosphere for work.

An important role in the emergence and development of incubators has been played by zones of new opportunities. The first zones of this kind were created in connection with the closure of major industries in the 70-ies of XX century in Europe and the USA, which entailed the increase of unemployment and, as a consequence, it was necessary to encourage the unemployed specialists to open own business, to develop small businesses. During that period large companies, public authorities, universities and public organizations in different countries participated in the creation buildings with many offices and production complexes, which created favorable environment for the emergence of new small enterprises. In these zones, small firms were provided with various assistance and services. So with the support of corporation "British steel" in 1979 near the city of Glasgow was created such a complex (incubator), which was providing relevant services.

The largest number of incubators related to development of new companies currently located in the United States (about 600), they united within the National Association of business incubators [34], the main purpose of which is creation and development of small enterprises, improvement of socio-economic activity of the population, expansion of an innovative environment. All incubators, providing support for new enterprises and having innovative activities are divided into the following types:

- incubators within STP;
- independent incubators;
- virtual incubators (incubators without walls).

Incubators without walls is a relatively new type of incubators, they appeared in Japan, USA and Western Europe in the late 90-ies of the last century, in connection with the development of new information technologies and the beginning of the active use of the Internet. Virtual incubators can provide its customers with all kinds of traditional services, which provide regular incubators, with the exception of the lease of premises on preferential terms. Indisputable advantages of virtual forms of incubators are: relatively

low costs of establishing and maintaining of its activity and broader coverage of target audience in comparison with traditional forms.

Scientific/research parks [15] have closer than technological parks links with universities and concentrate highly educated workforce and large volumes of high-tech research.

Technological areas is a whole cluster of interrelated enterprises working in the same and/or related industries, and located in the same geographic region. These companies share a common infrastructure, labor market and services and have to deal with similar opportunities and threats.

There are several organizational forms in which STPs are successfully operating [35]. University or research institute can be the sole founder of the STP. More common options are when STP has 2 to 20 founders. In this case, the mechanism of STP management is much more complicated than the mechanism with one founder, however, it is considered to be more effective, especially in terms of financial management. In the case of multiple founders STP, there is a joint venture or limited liability company is being formed for management. Thus, the contribution of each founder depends on its resources and usually consists of the following:

- university: technology transfer, land, working capital;
- local government: land, infrastructure, grants;
- bank: investments, financial expertise, venture capital;
- industrial enterprises: land, infrastructure, investment, project expertise.

However, regardless of the forms of organization, the successfully functioning STP can make a significant contribution to the economy of the region by:

- stimulation of economic growth of the region;
- diversification of the local economy, making it more resistant;
- development of successful small and medium business;
- increase income of the local budget.

Unlike high-technology parks STP are being created not only to attract high-tech enterprises, but more for their creation and development, and the areas of activity of STPs are not limited by high-tech industries [36]. But the main purpose of STPs and parks of high technologies is the same and consists of creation of favorable conditions for formation and development of firms-participants (residents) of the parks. In terms of institutional Economics, this goal is to maximize the reduction of transaction costs due to the high concentration of qualified personnel and to create conditions for their fruitful work. The concentration of experts in a limited space (creation of a critical mass) also contributes to a more effective exchange of ideas and experience, which gives impetus to the development of the industry to the next level. [37].

The concentration of highly qualified personnel is being achieved mainly thanks to posting on the same place not only scientific and technical firms,

but also supporting structures, including counselling centers, technology brokers, etc., This ensures a dynamic and efficient division of labor, resources, simplicity and relatively cheap transactions (including those carried out on an informal level and not recorded in the financial statements) [38].

In other words, STP is a friendly environment that provides a high survival rate of small university firms in high-tech industry and creates favorable conditions for their development. It should be noted that in the economically prosperous Finland only 2/3 of small firms develops within five years if left without support, without friendly habitat.

Industrial parks is another kind of STP. The main types of industrial parks are:

- greenfield;
- brownfield.

Industrial Park of the greenfield type is created on the newly allocated undeveloped land, as a rule, not originally provided by the infrastructure.

Industrial Park of the brownfield type is created on the basis of previously existing production sites, usually secured by buildings, facilities and infrastructure which go through the reconstruction and/or repair, in accordance with specialization of the industrial park and the needs of its residents.

3.2 THE REASONS FOR THE STP CREATION

There is a widespread point of view that the creation of innovation centers (e.g. in the form of STP) is inherent only in developed countries (as a result of "wealth"), while the studies [16] suggest that these centers help to stabilize the economic situation. Even in the developed systems in some cases, they are being created in the period of economic recession, restructuring and job cuts, reducing the amount of budget allocations for scientific development, a substantial accumulation of scientific and technical potential in the absence of a mechanism of bringing existing ideas to particular consumer and reaching commercial success.

The analysis has shown that the innovative structure of a new type in the number of cases [12] emerged as the condition of the crisis (table. 3.2) [39].

Table 3.2 The reasons to create STPs and technology centers (the world practice)

№	*Name of STP*	*Reasons to create STP*
1	• Research Park Evanston at northwestern Illinois (USA)	• the loss of competitiveness of products manufactured in the state; • public concern about the "brain drain", the depar-

№	Name of STP	Reasons to create STP
		ture of highly skilled experts and scientists in other States; • the decline of innovation and productive activity, which led to the reduction of jobs in the state; • the reduction of tax payments to the city and state, which led to the limitation of the possibilities for support and stimulation of science and education.
2	• Research center of the University, Austin, Texas (USA)	• the need to overcome the difficulties connected with conducting the structural reorganization in the state; • the reduction of the Federal funds for research and the ability of states for the financial support of higher education institutions (budget allocations decreased by 1/3).
3	• Technology Park, Dortmund; • Innovative technological center, Saarbrücken; • Technological center, Schwerte	• the desire to get free from the dependence on steel production to economic diversity; • stop the economic depression.
4	• Technological center, Aachen, Technological centre, Hanover, • Technological center, Munich (Germany)	• reduce dependence on one or two heavy industries; • stop the economic depression.

STPs can act as a form of decentralization of decision making in the field of scientific and technical policy and also activate risk activities "from below", supporting the development of small high-tech companies and venture entrepreneurship. STPs allow to increase the qualification of the employed in the production of science-intensive products and high technologies, and

also to evaluate the compliance of the level of production on breakthrough directions to the skill level of those employed in the economy of the region.

Promoting the creation of small businesses, STPs help to solve the problem of employment and social stability. Characteristically, the small and medium enterprises create jobs, while large enterprises are liquidating jobs. An equally important reason for the creation of STPs is the lack of competitive, import-substituting products for scientific-technical and industrial purposes.

3.3 THE TYPES OF STP'S ACTIVITIES

Speaking about directions of STPs' activity, it is necessary to distinguish the activities of STP and activities of its residents.

The main activity of STP is providing systematic support to the residents through the following measures:

1. Assistance in creation of manufactures with new technologies.

New technology is a system of production and other operations, methods and processes with higher qualitative characteristics compared with the best analogues available in the market on a particular market segment or market niches, for which these technologies are new or high-tech industries based on high technologies.

High technology is a system of production and other operations, methods and processes, which have the highest quality indicators in comparison with the best world analogues and meet emerging or future needs of man and society, and producing finished high-tech products for the market.

2. Assistance in the implementation of foreign economic activity for the purpose of promotion on the external market the products produced with new and high technologies;

3. Provision on contractual basis (in accordance with the legislation) of movable and immovable property, including of premises;

4. Provision the report in mass media on the activity of the STP and its residents;

5. Other services (performance of other works) related to scientific, technical and innovative activity of STP [40].

In addition, STPs can also provide transfer of the technology, using the following techniques:

- **assistance in business.** Commercial companies that provide services on certain issues related to technology can be regarded as specialized organizations working in the scientific and technical sector. To navigate properly among these companies, many of the parks have developed the database and the STP consultants in turn have their own area of specialization;
- **spreading the technology.** Means the transfer of knowledge from research institutions to the group of small and medium enterprises with common needs in technology (projects, designed for many users);

- **searching for the technology.** Means to study the national and international market to acquire advanced technologies and commercial opportunities, which can be used by companies of this region. This task is often performed regardless of the specific needs of industry.

Many parks provide small and medium-sized businesses in need for the protection of their inventions and intellectual property rights associated with patenting and licensing. This function is often implemented at the national level, where it is possible to use the existing database effectively [41].

As for the residents of the STP, they can be legal entities or individual entrepreneurs, who have made the contract with the STP for a period of not less than one year on lease (sublease) or free use of buildings and premises belonging to the STP on the property rights, or have been transferred to it for the right of economic management, operational management or lease. STP maintains records of its residents and exercises control over their activities.

3.4 STP'S CLASSIFICATION AND MODELS

Science park is the form of integration of science and industry; it belongs to the category of territorial scientific and industrial complexes. The fundamental elements that define this type of parks are as follows:

- unity (locality) of the territory in which all participants of the park are located;
- availability of scientific organizations carrying out fundamental and/or applied research;
- availability of industrial enterprises, capable to embody the results of applied research in experimental and/or serial products.

In the development of science parks two stages can be seen clearly: the 60-ies, when the most science parks appeared on their "homeland", in the US, and their rudimentary forms appeared in Western European countries, i.e. the UK, France, Germany. From the beginning of the 80-ies there started to form the "second generation" of STPs in the US and Western Europe, there were STPs appeared also in countries where there was none before (Japan and other Far Eastern countries), the diversity of parks has been replenished by its varieties.

Science parks can be reduced to three models:

- American (USA, UK);
- Japanese (Japan);
- Mixed (France, Germany).

The American model

In the US and the UK at present, there are three types of science parks:

1) **science parks** in the narrow sense of the word;
2) **research parks**, different from the first type by the fact that in their framework the innovations are being developed only up to the stage of technical prototype;

3) **incubators** (in the US) and innovation centers (in the UK and Western Europe), in which universities "give shelter" to the emerging companies, providing them for a relatively moderate rent with land, buildings, access to laboratory equipment and services.

The largest science park in the U.S. is the Stanford Park, created in the late 40-ies of the last century. It is located on the grounds of the University (270 hectares), leased for a period of 51 years to high-tech companies interacting with the University, where there are a lot of engineers-researchers are teaching. It took about thirty years to create the effective innovation infrastructure. The Park was declared completed in 1981 and has about 80 companies as its residents, which employed about 26 thousand employees. Among these companies there are the three main institutions of the U.S. geological survey, electronics giants (IBM, Hewlett Packard, Yahoo, Sun Microsystems, Cisco Systems and others), aerospace company (Lockheed), chemical and biotechnological companies. Today in the USA there are over 150 parks are operating, the area they occupy range from 60 ha to 2600 hectares [12], the main factors that influence the allocation of technopolises, are given in table. 3.3.

Table 3.3 Factors influencing the placement of technopolises in USA

№	*Factors influencing the placement of the technopolises*	*Group 1*	*Group 2*	*Group 3*
1	Proximity to major universities or research centers	C	C	C
2	Proximity to developed industrial centers	B	C	M
3	Proximity to important transport arteries and airports of the country	C	B	B
4	Beneficial trade and economic position	B	M	M
5	Proximity to cheap sources of energy	B	B, M	M
6	The location in an urban area or in the vicinity	C, B	B	M
7	Proximity to administrative and capital centers	B	B, M	M
8	Proximity to military objects and other objects of the defense complex	B	B	B
9	Favorable recreational conditions	B	B	M

№	*Factors influencing the placement of the technopolises*	*Group 1*	*Group 2*	*Group 3*
10	The large space for test sites	M	B, M	C
11	Seaside position	B	M	M
12	Focus on other scientific and industrial complexes	M	M	M

Note:
Groups of technopolises:
Group 1: The Silicon Valley, Highway-128, Satellite Alley;
Group 2: Policy in Detroit, Highway 41, Research Triangle Alley of Robots, Silicone Zone, Silicone Plain;
Group 3: Silicone Mountains.
The value of the factor of placement: C - critical, B - big, M - minor.

A typical example of a research park, where on the grounds of the university there are not enterprises and laboratories of the actual industrial companies, but the research institutions of non-commercial type, closely related to industry, is Center of Illinois Institute of Technology (IIT), which is a private research center.

The "ideal" type of research park is the oldest science park in Scotland, Heriot Watt park. This is the only science park in Europe, which allows only to conduct the scientific research and the mass-production is prohibited.

From the beginning of 80th years in Western European countries has spread new (for these countries) form of STP, tailored to the needs of small high-tech enterprises, i.e. innovation centers, similar to the American incubators. Their task is to connect ideas and inventions with capital and entrepreneurs, and also to attract public and private funds to provide for the starting period of new innovative companies.

Functions of innovation centers cover the various stages of the innovation process, in particular, the promotion of the transition from pilot production to the commercial development of new products. It does not always require the creation of new companies. Often, innovation centers provide researchers entrepreneurs with assistance in the sale of licenses for new product to already existing producers.

A number of innovative centers are under the local authorities, and the larger ones are included in the European network based in Brussels, which unites about 40 innovation centers. Linking innovation centers of different countries, the European network facilitates cross-country trading of the technologies for the firms.

The Japanese model

The extension of the idea of STPs in some countries led to the emergence of more sophisticated and complex element of innovation infrastructure,

Technopolis. It is very difficult to distinguish between Technopolis and science and technology park, because these actors have a lot in common. For example, some experts believe that the development of science park "Sofia-Antipolis (France) has turned it into a Technopolis.

Technopolis is a city or town with a special infrastructure and legal status, which contributes to the development of technologically advanced business, and also to development and production of new high-tech goods. This city includes, as a rule, technological park, universities, research institutes, and several large, medium, small enterprises based on high technologies. Technopolis is sometimes called the "city of brains", scientific city or a science city.

Examples of successfully functioning technopolises are Valles in Spain, Enschede in Holland, Tampere in Finland, Sheffield and Cambridge in the UK, Toyama, Kumamoto, Oita, and Tsukuba in Japan, Leuven and Liege in Belgium, Silicon Valley in the USA, Shenzhen, Nanhu in China and others.

The greatest spreading of technopolises is in Japan, and that was the reason to call this kind of science parks the Japanese model. The government of Japan in 1982 developed and adopted a special law and the long-term plan of development of Technopolises [16].

The Japanese model of science parks, unlike the American model, involves the construction of a completely new cities concentrating on its territory research in new, cutting-edge industries and knowledge-intensive industrial production.

For creation of technopolises there have been chosen 19 areas evenly scattered to the four islands. The main criteria for the territory, claiming the construction of technopolis, were:

- location not farther than 30 minutes' drive from the city with a population of not less than 200 thousand inhabitants and within a day's drive from Tokyo, Nagoya or Osaka;
- occupied area should be not less than 500 square miles;
- the location near airports or high-speed train stations;
- to have a balanced set of modern scientific-industrial complexes, universities and research institutes in combination with comfortable living areas, equipped with the cultural and recreational infrastructure;
- availability of modern information networks;
- favorable socio-economic climate for life, promoting creative work;
- to be located in scenic areas and in harmony with the local traditions and natural conditions.

The main goal of technopolises is the commercialization of results of scientific research (of applied kind). However, in Japan there are urban structures similar in structure but focused solely on fundamental researches. To this type of sciencepolises refers "the city of brains", Tsukuba, located 35 miles northeast of Tokyo. In Tsukuba there are 30 of 98 leading public research laboratories in Japan, which makes the town one of the largest scientific centers of the world. There are about 200 thousand people, 21 thousand

of whom are the scientists (40% of the total number of scientists in the country)), operating in 50 research institutes and two universities specializing in such areas as: higher education and training, engineering studies and physics, construction, agriculture and biology. Alongside them there grew two hundred and fifty private research institutions. The greatest popularity in the world scientific community has been received by National laboratory for high energy physics. In 2008 Professor Makoto Kobayashi, who represents this laboratory, received the Nobel Prize for research in the field of elementary particle physics.

In Tsukuba, except for science centers, there have been established developed transport and social infrastructure. However, unlike other technopolises, in Tsukuba the role of the private sector in infrastructure financing is quite small and provided mainly at the expense of state support.

The construction of technopolises is financed at the regional level - at the expense of local taxes and fees of corporations. A number of technopolises (such as Hiroshima, Ube, Kagoshima) are arranged in a way so that their "core" is science-polis, as Tsukuba. Some technopolises are providing the fundamental scientific aspects by expansion of scientific and engineering departments of local universities. Most of technopolises to enhance the efficiency of "breaking down barriers" create centers of "frontier technologies", i.e. incubators of joint research and venture business.

In the U.S. there are also STPs, based on the Japanese model of technopolises. An example of such a technology Park can be North Carolina's STP. In North Carolina in the 20 years has formed the Research Triangle. This is a complex structure, based, on the one hand, on three campus universities located in three neighboring towns, part of their territory and all the free space between them are rented by STP.

There are options when STP is based on a set of local and transnational corporations. Some of these quite famous in the world, corporations, with permission of local authorities built for their own money the research buildings and production workshops, focused on new technologies. Such structures can be considered as technopolis or science-polis. This is a special kind of urbanized highly intellectual environment where specialists of different fields communicate and exchange ideas (in the dining room, during the rest, walks, etc.). In this intellectual "broth" there are totally unexpected inventions often born, inspired by stories of colleagues from other fields of science about their problems. Because of this feature, some of not very successful companies (stagnating or even a crisis, especially if the crisis is creative) are also trying to penetrate there. They dwell there, without profit, but only supporting the existence, at the same time trying to catch some promising idea (for that they sometimes attract specialists from other companies or from university environment, because the environment of technopolis, it's simple and quick), which may revive the company.

Technopolis has its own rules, set out in the Charter, which governs all. Technopolis usually contains several STP in different fields, and a number

of training structures (usually from outside). There is a special school for managers, designed to eliminate the shortage of managers, often occurring against a background of plenty of scientists and engineers-researchers. In technopolises the infrastructure (transport, travel agencies and other) is rather developed, which in the normal (single) STPs does not happen, it even has its own police.

Technopolis is usually located in remote provinces, far from major centers, but people living and working in it are connected with the outside world by its own international airport and can visit any leading company in the world at any time. Due to the influx very prestigious and highly paid professionals in technopolis there are higher levels of recreational conditions.

It often happens that technopolis, a God-forsaken place earlier, thanks to the efforts of management and the support of local authorities, becomes one of the best places for work and rest. And to get an opportunity to bring to perfection the development of the products in this powerful intellectual center is honorable, prestigious and highly profitable even for well-known companies. In technopolises there are not only research laboratories are being built, but sometimes the production halls too, where the residents organize the release of test series. Mass production is usually transferred to other cities, focused on a powerful industry, or abroad, in the countries with cheap labor.

Some European companies are also using the Japanese models in work. For example, Technopolis PLC is a Finnish company that manages a network of STPs in Finland and Russia. Founded in 1982, Technopolis PLC owns more than 450 thousand square meters in Finland, serving approximately 1200 customers in 13 industrial parks. Except for premises and related services (telecommunications, security, etc.), Technopolis PLC is engaged in attraction of external financing and preparation of business plans for their clients (this area is the responsibility of its subsidiary Technopolis Ventures) [42].

In Russia now there are also a number of small towns, which can be attributed to the category of technopolises. These are small closed territorial formations, previously related to the defense complex, and now included into the list of scientific cities, for example, technopolis of nuclear industry Sarov (Sarov city), technopolis of space industry Zheleznogorsk (Krasnoyarsk region) and others [33]. They remained after the collapse of the USSR, and now produce competitive high-tech products. However, it should be stated that technopolises of new generation in Russia has not appeared yet, although it is extremely necessary in connection with the urgent need for the development of high-tech industry and the presence of a powerful scientific potential and a large number of scientific ideas which haven't been implemented in practice yet. The main problem of the present moment is the archaic organizational structure of educational and scientific institutions, although in recent times the leadership of the country is making efforts aimed at resolving these contradictions.

The mixed model

An example of a mixed model of science parks, focused both on Japanese and American types, is science parks France, in particular, the largest of them, "Sophia Antipolis". It is situated on the Riviera, an area of 2400 hectares. Established in 1970-1984 years, it is intended mainly for the companies working in the field of computer technology, electronics, pharmaceuticals and biotechnology. Park's residents are more than 1,400 companies, including Hewlett Packard, Accenture, Air France, American Express, IBM, ST Ericsson, France Telecom, Wall Street Systems. Here are several universities and the European headquarters of the W3C. By the mid 80-ies the land was sold to the companies and research organizations, and the maximum number of employed is about 6 thousand people [12].

Another example of effective functioning park is MATAM Park in Israel [34]. It was created in the 70-ies of the last century by Economic Corporation of Haifa. One of the first inhabitants of MATAM was Israeli research and development center of INTEL, who built a four-floor building in 1974. Since the mid 90-ies the office of the organization built a complex of several interconnected buildings, able to accommodate more than two thousand employees. Today MATAM has the centers of development of such famous companies as Microsoft, Google, Philips, IBM, NDS Group, Yahoo, NetManage, etc. Total area of the Park is about 250 hectares and they are planning its expansion.

3.5 STAGES OF DEVELOPMENT OF STPS

3.5.1 Stages in the life cycle of STPs and its residents

Many economic entities (as representatives of techno- and biosphere) have certain regularities and specific periods of development, often called stages/phases of the life cycle. There are concepts [25] about the top-end stages for goods/products, technologies, enterprises and others.

In relation to the context of this work we can talk about the stages of the enterprises' development which are taking place in their formation through the environment of STPs and the stages of STPs' development. Let's analyze the characteristic features of stages of these two economic entities.

The stages of formation and development of enterprises in the environment of STPs. According to technology of supporting the initiatives for the development of small innovative enterprises, which has been accepted by EBN [7], the main stages are the following:

- query/request of the initiator for creation of the enterprise;
- development of feasibility report;
- development of project of creation of the enterprise;
- development of the business plan of the enterprise activity;
- creation of start-up;
- the period of formation of a start-up, team building;

- development of the idea, its commercialization, the creation of products.

The infrastructure of the EBN Association is organized in such a way that individual STPs (or, in the terminology of EBN, it called BIC, Business Innovation Centers) specialize in specific areas of activity of the enterprises-residents. Candidates for the residents to get the support of STP in the selected direction of research and business must meet certain requirements and pass all these stages of development, after which they can start the "independent swimming". Reports of EBN [7] show that during the transition from one phase to another, the number of entities, as a rule, is reducing. Usually this is due to the requirements for applicants that leads to this reducing.

The stages of STPs' formation and development can be viewed from various positions. The easiest way is to divide the time interval for several periods with relatively stable values of basic characteristics (see table 3.4 [57]). According to this periodization every 15-20 years there is changing of STP formats happening, due to changes in the technological structure, changes in economy and society.

Table 3.4 Main Periods in STP history

№	*Characteristics*	*Stage 1 (1947-1970)*	*Stage 2 (1971-1985)*	*Stage 3 (1986-2013)*
1	The main type of STP	• University STP; • Regional branch of STP; • Science cities.	• Business incubators; • Specialized STP; • Centers of the technology transfer.	• Network STP, • Associations of STP.
2	The main activity of the STP's residents	• Research and development.	• Commercialization of research and development.	• Creating a space of information sharing; • Creation of joint

№	*Characteristics*	*Stage 1 (1947-1970)*	*Stage 2 (1971-1985)*	*Stage 3 (1986-2013)*
				projects.
3	The dominating type of STP's resident	• University laboratories; • Research laboratories of transnational companies.	• Office complexes; • Technological business incubators.	• Virtual networks; • Network division of STPs
4	Owners of STP	• Universities; • Transnational corporations.	• Countries' governments; • Governments of the regions; • Municipalities.	• Innovative brokers and agents; • Venture companies; • Investment funds.
5	The main product of STP	• Innovative product.	• Technological solutions and technologies.	• Research potential.
6	The main type of services provided by STP to its residents	• Access to the source of knowledge (university); • Access to equipment and services (companies).	• Real estate business; • Related services.	• Access to the professional community.

№	*Characteristics*	*Stage 1 (1947-1970)*	*Stage 2 (1971-1985)*	*Stage 3 (1986-2013)*
7	The prevailing name of STP	• Technopolis; • Science city.	• Megatechnopark.	• Associations of STP.

The stages of STP development can be considered as natural development, as a transition from one state to another, with gradual increase of functionality. From this point of view, the evolution of the STP can be represented in the form of four major stages of "maturing" (see tab. 3.5 [35]).

Table 3.5 The main stages and tasks of STP development, as innovative centers

Stages of development of the innovation center	*Basic management tasks*
1.Concentration of resourses	1.1. The involvement of scientists and engineers, research and development departments of industrial and high-tech companies.
	1.2. The formation of a favorable business climate for all startups and small businesses in the region.
2. The start of the transformation of the region's economy, where the innovation center is located, and the formation of an innovation ecosystem	2.1. The creation of an efficient system of services (primarily business training) for the budding technology companies
	2.2. Creation of the system of financial support for innovative startups on the pre-investment stage.
	2.3. Establishment of mechanisms stimulating the involvement of researchers in the creation of startups.
	2.4. Conducting advertising and PR-companies for the positioning of the innovation center at the national and international arena, creating a strong brand.
	2.5. Development of the technology transfer system.
	2.6. Ensuring high quality of life.
	2.7. Formation of a pool of investors loyal to the innovation center, attraction of private investors in the infrastructure of support of innovative business.

Stages of development of the innovation center	*Basic management tasks*
	2.8. Creation of management bodies of support infrastructure, independent of the state, private investors and universities.
3. Innovative and technological breakthrough	3.1. Expansion of the support infrastructure of innovative business, scaling and replication of the service system created in the previous step.
	3.2. Creation of a mechanism of sharing the risks of private venture investors, including private-public venture funds.
4. Muturity	4.1. Embedding into the existing technological chain and creation new ones on the basis of international cooperation.

Although these stages are conditional, it can be useful as a sort of coordinate system for projects of innovation centers, created in similar or without significant differences in conditions. Moreover, in the innovation centers which have proven their effectiveness, at each stage, there has been solved a strictly defined set of priority management problems, without the successful solution of which, the following steps would be hardly possible. Let's consider the content of these stages in more detail.

3.5.2 Concentration of resources

The processes taking place in the preparatory phase before the creation of center of innovation development in the region can be called "concentration of resources". At this stage, the economy of the region retains the traditional way. High-tech industries in the region are usually represented by individual small and medium sized companies, whose contribution to the GRP and the impact on the labor market is insignificant. The analysis shows [35] that in most efficiently operating innovation centers, technology boom was preceded by an increase of the research capacity in the region. This tendency concerns not only the development of the research and University centers existing in these regions, but also the development of new ones.

The emergence of strong scientific centers conducting research and development in the most promising directions begins to attract the attention of major high-tech and industrial companies, which open has their own R&D departments in the region and also create science intensive subsidiaries.

The creation of new and development of old research centers, as well as attraction of major tech corporations often occurred against the background

of the decline of traditional industries of the regional economy. The development of research potential and attraction of anchor investors (large high-tech companies) at this stage are the main directions of the policy of increasing competitiveness of the region at the national level.

At the preparatory stage also appear the relations between R&D centers and industrial enterprises. The rate of formation of such relations depends on the characteristics of the national systems of higher education, academic research and legislation on protection of intellectual property. In countries where legislation assigned the priority of researcher in obtaining benefits appearing as a result of the intellectual property created at government expense, the technology transfer and involvement of representatives of university and academic science in joint projects with private companies, as well as in the creation of technology startups were carried out faster.

The main outcome of the preparatory phase in the creation of innovation centers is the formation of foundations of an innovation ecosystem, i.e. the emergence of a network of personal contacts and joint projects with academic and university scientists, managers of high-tech enterprises and representatives of regional authorities. Thus, it can be assumed that the rapid development of high-tech industries in the created innovation centers preceded by the accumulation of a critical mass of people, engaged in developments in the most promising technological fields, as well as the emergence of large consumers of these technologies.

The peculiarities of the preparatory phase are illustrated by several examples [35]. So in Montpellier (France) higher education for many centuries has been an important part of the regional economy, one of the largest medical universities of southern Europe is operating here since Medieval times. There also is one of the most important French universities of natural sciences and one of the country's largest university clinics which gave the city the status of the national center of research in the field of pharmaceutical, medical and biological technologies. However, municipal authorities, seeking to diversify the economy of the region during the 1970s and 1980s attracted in Montpellier some new scientific centers created as part of the international, European and national programs. During this period, thanks to active lobbying of the administration of Montpellier the town housed a number of research centers on the latest scientific directions, as well as R&D centers of such high-tech giants as IBM, Dell, Sanofi, Veolia, Ubisoft and Intel.

Another typical example is the city of Oulu in Northern Finland [35]. Turning it into the largest innovation center of Northern Europe would have been impossible without the University, founded in 1959. The establishment of the University was a response to the decline of the region, started after the war. The region started to lose to the industrially developed South of Finland. Electro-engineering faculty of the University and later the Department of data processing played a prominent role in the emergence of the "phenomenon of Oulu". So the graduates from the faculties became the founders or top

managers of the majority of the companies of the IT industry operating in the region, including Nokia Mobile Phones (Mobira until 1989), Nokia's Network Business Group (now Nokia-Siemens Networks), CCC (now – a part of Webmedia Group). A significant role has been played also by branch of the national research technological center of Finland founded in 1972 in Oulu, thanks to which the region has become one of the largest centers of development of technology of data transmission and IT. The key role in the development of innovative technological center has played the moving the units of Nokia Corporation, specializing in the production of equipment for radio communication in Oulu in 1972. The main motive of this move was, first of all, low-cost labor. Nokia in that period had a significant impact on the development of small technological enterprises in the region, the emergence of startups, as it widely used the strategy of outsourcing in production and research and development.

There is a number of typical examples of the formation of such centers [35, 58].

The most important management tasks solved at this preparatory stage of creation of the innovation center are the following:

- attracting the highly qualified and creative research and engineering personnel to a region, as well as promotion of new research centers. Often these tasks are solved through lobbying by the regional authorities;
- overcoming the "barriers" between research centers and industry, establishing mutually beneficial contacts;
- involvement anchor investors from large high-tech enterprises and R&D departments of major high-tech companies in the region;
- formation of favorable business climate for all small businesses and startups.

3.5.3 Networking in innovation ecosystem

At the second stage of creation of the innovation center there are three important processes occur, they can develop in parallel or sequentially.

1. **Significant growth of technology startups** and general increase in the number of new enterprises of high technology industries. At this stage in the innovation centers started to develop sustainable clusters of high-tech companies. And, as a rule, this occurred on the background of the continuing degradation or stagnation of traditional branches of region economy and the gradual transformation of the regional labor market in the direction of new high-tech industries.

2. **Creation of the infrastructure** needed to support the innovative entrepreneurship, at this stage, as a rule, is carried out by regional authorities. So in the beginning of 1980-ies there appeared the first European industrial parks and technological incubators, and by the end of the decade they become so common in Western Europe that we can speak about the emergence of a kind of fashion in the industrial parks. Besides the STP infrastructure at

regional and national level institutions, there are institutions of financial support for technology companies (projects) on the phases of presowing and prestartup are being created.

An important element of the development and support of regional infrastructure is the formation of a new innovative brand of the region with a large-scale advertising and PR-campaigns. So in Montpellier in the second half of 1980-s there was a national campaign called "City-wunderkind", and Oulu, since 1985, has positioned itself as the "Technology city". In the framework of PR-campaigns they also usually create the image of the region as the best place to live for educated and creative people.

3. **The formation of an innovation ecosystem** - that is the synthesis of technology startups and small businesses, large high-tech businesses, research centers, and private investors. In most of the innovation centers ecosystem was created mainly on personal contacts between participants of the process. On this phase the appearance of the first private venture capital investors is also important.

It should be noted that the increase in the number of startups created in innovation centers has more to do with the suitability of these places for doing business, and not only (or rather not so much) with the establishment of the infrastructure of support for innovative business. Although this infrastructure in these centers is becoming a catalyst for the growth of high-tech industries and the number of startups in high-tech industries is growing due to the rapid growth of the IT industry, microelectronics, data transmission technologies, pharmaceuticals, etc. So, the first Finnish technopark in Oulu, opened in 1982 and until 1985 was located in a small building of a former oil mill in the city center, was physically unable to accommodate the large number of companies, as well as to provide conditions for R&D. However, the increase in the number of technology startups in Oulu, primarily in the ICT industry, can be noted already in the first half of the 80-ies (Fig. 3.2 [35]), where during the observation period (23 years) the rate of annual growth in the number of startups is one enterprise every three years (see equation trend $y=0.25+0.33x$).

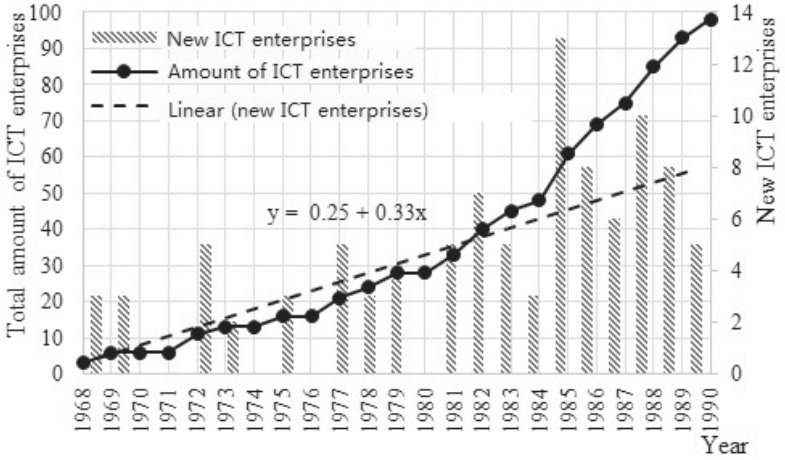

Fig. 3.2. Dynamics of the number of ICT enterprises in Oulu

However, it should be noted that the effect from creation of the infrastructure of support for innovative business may not be immediately obvious, and it requires certain time lag, so the new institutions could "take root" and the support technologies they apply would become adequate to the task.

Besides, legislative support of the startups creation processes and management of intellectual property are also very important. So in Montpellier [35] the transformation stage began in the late 1980's, the infrastructure of support for small innovative enterprises was formed in 1989 (then was created Innovative business center, BIC). However, until 2002, the number of residents of center's business-incubators has hardly changed (20-25 companies). A steady rise, started only since 2002, when the number of resident companies for three years has reached one hundred. In many aspects the growth became possible due to the liberalization of the national legislation of France in management of university intellectual property, and due to the involvement of teachers of public universities in the creation of companies. The revenue growth of Montpellier Agglomeration is shown in Fig. 3.3. It shows that, on average (according to the trend line y=217+63x) annual revenues from the office and laboratory premises rental and provision of services to residents in BIC is about 63 thousand Euros a year.

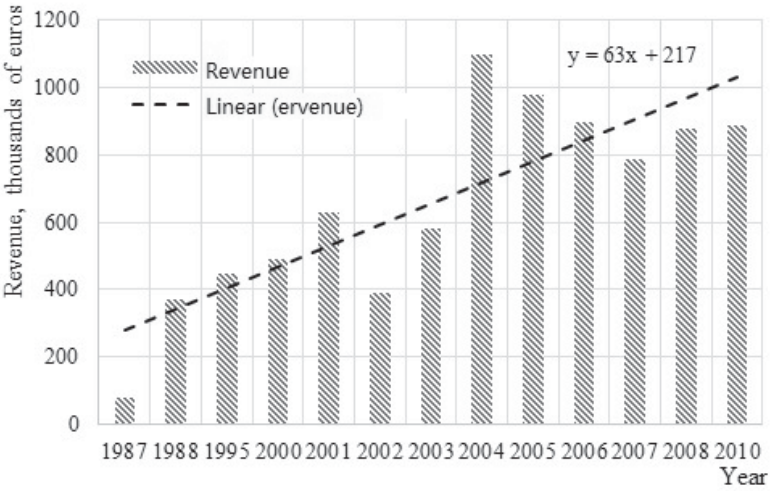

Fig. 3.3. Revenues from sales of services in BIC (agglomeration de Montpellier, France)

To the most important management tasks of this stage are the following:

- establishment of an efficient system of services (first of all - business training) for the budding technology companies;
- creation of an effective system of financial support for innovative startups on pre-investment stage;
- development of mechanisms promoting the involvement of the scientific staff in the creation of startups (for example, reservation of jobs in universities and research institutes for several years for scientists, who decided to create a company);
- conducting advertising and PR-campaigns for the positioning of the innovation center on national and international arena and creating trustful brand;
- development of the technology transfer system;
- ensuring high quality of life;
- formation of the circle of investors loyal to innovation center, attraction of private investors in the infrastructure of support of innovative business;
- creation of management bodies of infrastructure, independent of government, universities and private investors.

3.5.4 Breakthrough

The peculiarities of the third stage are:

- the turnover of anchor companies significantly increases, and they usually become global players;

- new large companies appear in innovation center;
- number of technology startups significantly increases.

For effective innovation centers the third phase took place in 1995 - 2005. This was a period of rapid development of a number of new markets, and first of all IT market and biopharmaceuticals. Such innovation centers, as Lund, Oulu and Montpellier [35], have been prepared for the technological boom and took full advantage of benefits created during the previous years.

The growing number of technology startups had a significant impact of rapid development of anchor corporations and new large companies. A significant share of startups at this stage appears to implement the projects, which have separated from large companies operating in the region. Innovative activity in large companies is often hindered by the "corporate bureaucracy", as some inertial force that is not willing to take a risk. Therefore, there is a common practice of transferring promising projects in the subsidiary or technology transfer to third companies for carrying out of necessary R&D and launch a new product on the market. If the project is successful, small enterprises which created it are being absorbed by the parent company. Besides the developments, large companies are the main consumers of some other products of the small innovative enterprises.

It should be noted and the trend of globalization of innovation centers, i.e. in addition to the regional and national here come also the global players. Corporations like Intel and IBM, are buying prospective companies in Lund and Montpellier.

Along with the growth of technology startups, as a rule, the venture investment market also begins to form. While a significant share of this market is owned by business angels, there is a lack of large venture capital funds. To compensate this imbalance there are private-public venture funds being created, both nationwide and regional (for example, Technoseed in Lund or Technoventure in Oulu).

At this stage, following a rapid increase in the number of technology startups, there is the expansion of the infrastructure of support for STPs, so their size can be increased many times.

At this stage, important management tasks are the following:

- expansion of the infrastructure for support of innovative business, scaling and replication of the service system created in the previous step;
- involvement and the establishment of private venture capitalists and private-public venture funds.

3.5.5 Mature development

On the 4th stage, unlike the 3rd, the rate of growth of existing companies and startups is slowing down (see Fig. 3.4). For example, the number of residents of the Technopark Ideon [35] in the second half of 2000-ies increased markedly slower than in the years 1995-2002. The increase in the number of residents has slowed down in about 3% a year (see the trend in Fig. 3.4).

Additional attenuation factors are the growing global competition in high-tech markets, fading of the technological wave, caused by the development of the IT sphere and biotechnology.

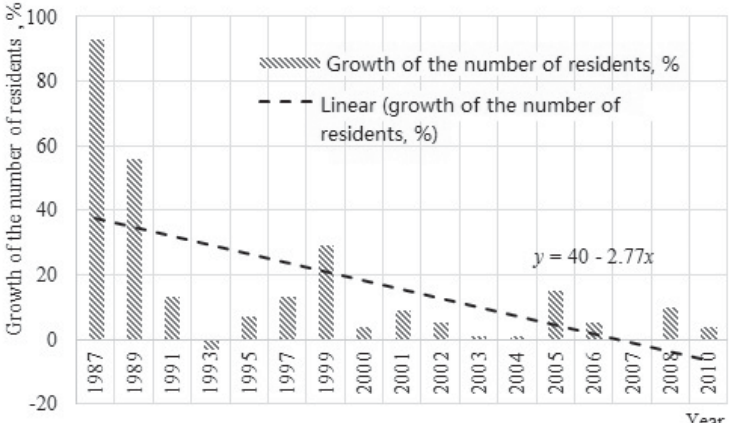

Fig. 3.4. Dynamics of the number of the companies-residents in Technopark Ideon (Lund, Sweden)

At this stage there is gradual erosion and the "obsolescence" of the brands of the most effective innovation centers, because they are being copied in other countries, and also because of the absence of new notable examples of success. For a large number of residents of STPs their absorption by some large multinational corporation is becoming desirable.

Infrastructure of support for innovative enterprises at this stage works effectively; it is becoming more "technological" and scalable. However, there are some negative side effects begin to show, for example, easy access to grant and equity financing for startups is available also for medium-sized projects which have no perspectives on international markets. Such externalities inhibits the development of venture investment market, despite efforts to create mechanisms for sharing risks as venture capital investors want companies that have the potential to become global leaders in order to get an acceptable level of profitability of the portfolio.

In addition, steps to involve participants of University research in the creation of technology startups, undertaken in Europe, had not led to the emergence of a class of scientists-entrepreneurs as the main driving force of innovation system.

Overcoming these deterrent trends is a task which is being solved now and will being solved in the near future. We can assume that the innovation centers, which will be the first to catch and ride the new technological wave, will cope with it most successfully.

Meanwhile, the innovation centers, which past three previous stages, resort to the strengthening and development of managerial tasks, realized on these stages, namely:

- attraction of new companies;
- maintaining and development of their own brand;
- embedding into the existing technological chain and creation new ones on the basis of international cooperation.

3.6 THE CHARACTERISTICS AND PERFORMANCE OF THE INSTITUTION OF STPS

As the STPs are complex infrastructure elements, serving residents, the activity of which is also a complex of processes, so describing the current state of these facilities and the quality of their work is not a simple task. The state of complex systems and processes is usually represented as a set of indicators that reflect various aspects of their activity. Therefore, in this section, in order to view the current values of the quantitative characteristics of STPs we will give statistics, regularly published in the form of reports by a number of reputable international organizations, such as the IASP, EBN and others [34, 7]. These data are formed on the basis of the statements or the results of surveys conducted among members of the associations of STPs. The primary data array reflects the situation in the period from 2006 to 2013.

The values of the indicators presented, as a rule, in percentage, rounded to integers. All data will combine in several thematic groups that reflect various aspects of STPs' activity. To view modern "portrait of STP" we will present the characteristics according to the groups.

3.6.1 The location of technoparks

This group presents characteristics such as:

1) The share of STP in different regions of the world.
2) The size of the city, within or near which situated the STP.
3) Location of STP relative to universities.

The size of the STP area.

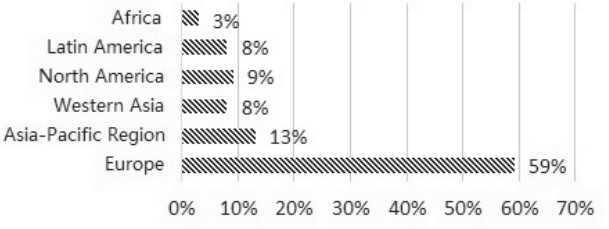

Fig. 3.5. The share of STPs in the regions of the world

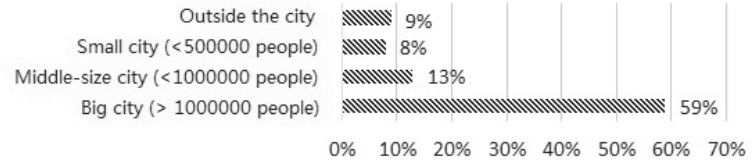

Fig. 3.6. The size of the city, within or near which the STP is situated

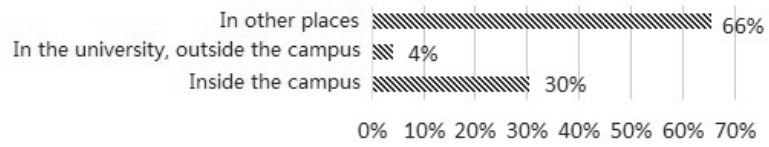

Fig. 3.7. The location of the STP relative to universities

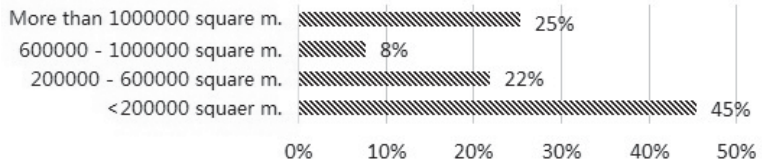

Fig. 3.8. The area occupied by STP

As we can see on the pictures above, most of the science and technology parks (about 60%) are situated in Europe, also about 60% of them are next or within the big cities, 66% are not on the territory of the universities, only a quarter of STPs takes place more than 1 million square meters and 45% are less than 200 thousands.

3.6.2 Infrastructure of STPs

This group presents the characteristics such as:

1) The share of STPs, having in its composition this functional element.
2) The primary type of ownership of the STP.
3) The presence of business incubator and/or incubator programs in the STP.

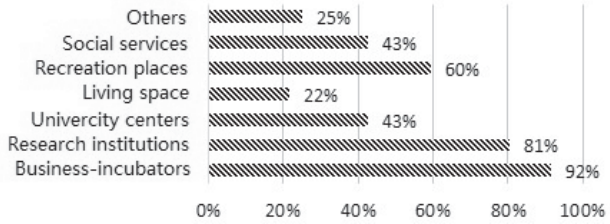

Fig. 3.9. The share of STPs, having in its composition this functional element

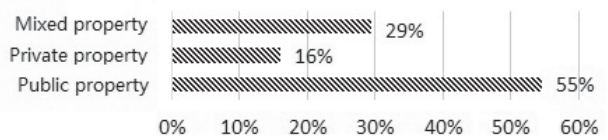

Fig. 3.10. The primary type of ownership of the STP

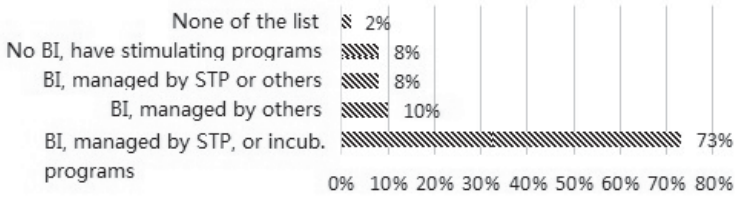

Fig. 3.11. The presence of business incubator (BI) and/or incubator programs in the STP

Out of this group of indicators we can see, that business-incubator is a "must-have" of almost all the STPs, but only every 5th of them have a living space. Although more than a half of STPs are the public property, there still have which are in private, and almost one third of them are the result of co-operation – mixed property. Only 2% of the STP doesn't have any connections with the processes of business-incubation, managed by them or anyone else.

3.6.3 Contacts with other technology parks or economic subjects

This group presents the characteristics such as:

1) Participation of STP in local projects.
2) Participation of STP in external projects.
3) Involvement of the STP in the cluster.
4) University's participation in the management of the STP.

5) Number of local residents (the origin of the tenant companies, number of companies coming to the STP from the city in which it is located, or from the surrounding area within a radius of 15 km).
6) Monitoring of the impact of STP on the environment. Is there any monitoring of the economic impact of a STP on the environment (city, region, country).
7) Competition with neighboring STPs (the level of competition of the STP with other parks or incubators of the city or region).

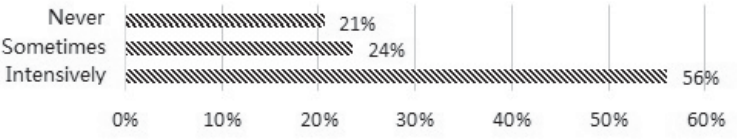

Fig. 3.12. Participation of STP in local projects

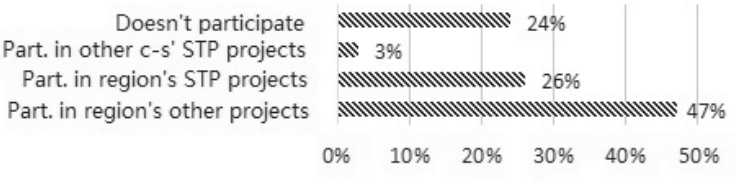

Fig. 3.13. Participation of STP in external projects

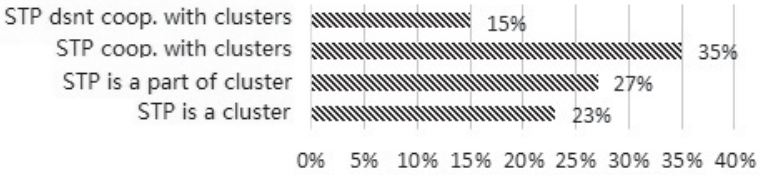

Fig. 3.14. Involvement of STP in clusters

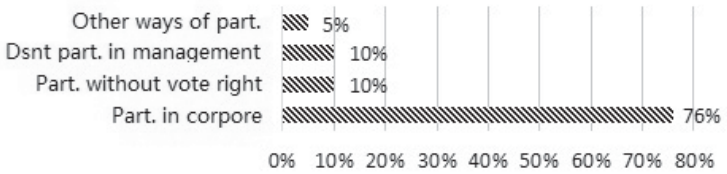

Fig. 3.15. University's participation in the management of STP

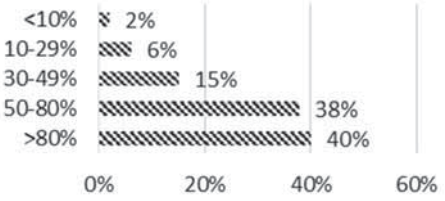

Fig. 3.16. The number of local residents in STP

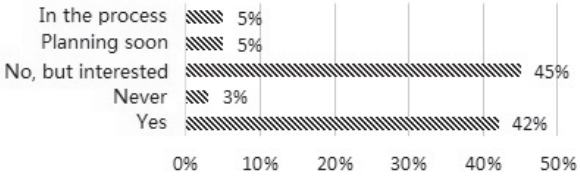

Fig. 3.17. Monitoring of the impact of STP on the environment

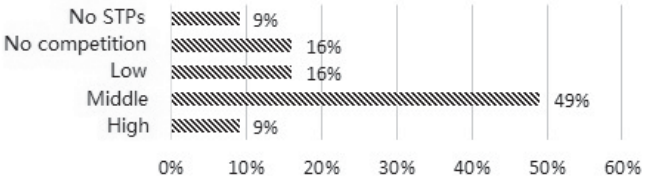

Fig. 3.18. Level of competition with neighboring parks

The contacts between the STPs or with economic subjects, shows that more than a half is quite active and participating in local projects, but still every 5th of them don't. Every 4th park does not participate in any external projects another one of these 4 participating in the region's projects and only 3% are taking part in the other countries' projects, going on the international level in this field. Clusters appear to be quite an important part of the STP's activity, as one third of them are involved in cooperation with clusters. Universities is an integral part of almost all the STPs (95%), both taking part in management and having a vote right (79%).

Local residents are more than 80% of all in almost a half of the parks (40%) and almost the same number of them having more than a half of locals.

Quite a lot of parks paying a great attention on the impact of it on the environment - 42% are already monitoring the process and 45%are interested in it.

A half of the parks estimate the competition with the neighbors as middle.

3.6.4 Conditions provided by the parks for residents

This group presents such characteristics as:

1) The degree of specialization of STP.
2) The degree of maturity of the companies receiving the resident status of STP.
3) The change in the number of residents in the period of economic crisis.
4) The degree of influence of the global economic climate for the support of STPs by the authorities of various levels.
5) Cost of rent in the STP (how expensive is the rent in this STP relative to the average cost of rent in the region).
6) The share of management personnel in the total number of employees in STP (in full-time equivalents).
7) The promotion of residents' products (by providing services or service systems to help in selling their products and technological solutions in markets or assistance in finding clients).
8) The presence of cultural events organized by the administration of the STP.
9) Measures of soft landing (providing additional measures that facilitate the involvement of companies).
10) Open innovation in the STP (if the STP works with the concept of "open innovation").

Note. Open innovation. This term reflects the paradigm of doing business, which stipulates, in contrast to traditional approaches, more flexible attitude to the results of R&D and intellectual property [24].

This term has been proposed in 2003 by Professor G. Chesbro, CEO of the Center for open innovation, University of California, in his book "Open innovation. The new imperative of creativity and profit". Its essence is that instead of developing technology from scratch, passing through all the phases to the final product, you can buy already existing in any degree of its readiness and invest in its improvement and subsequently make up the final product or sell the intermediate product.

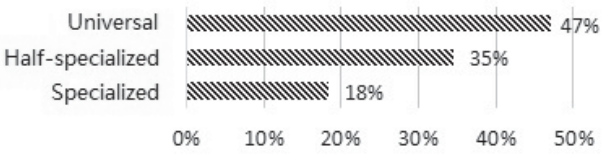

Fig. 3.19. The degree of specialization of the STP

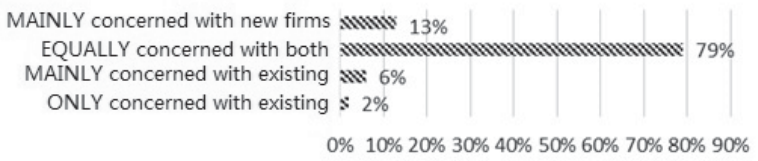

Fig. 3.20. Priority between already existing companies and new companies (to be created or in the process of being created)

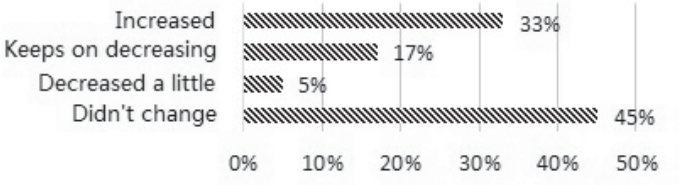

Fig. 3.21. The change in the number of residents in the period of economic crisis

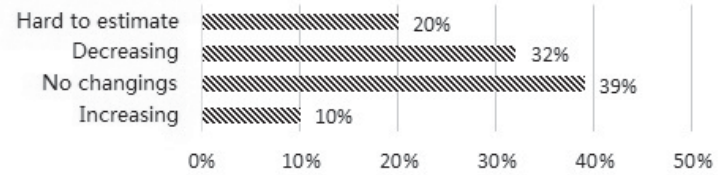

Fig. 3.22. The degree of influence of the global economic climate for the support of STPs by the authorities of various levels

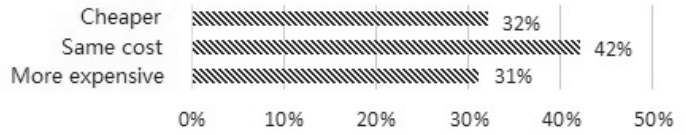

Fig. 3.23. Cost of rent in the STP comparing with the rent cost outside the STP

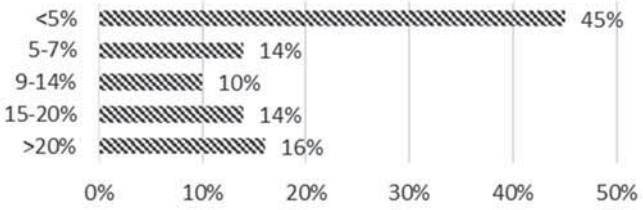

Fig. 3.24. The share of management personnel in the total number of employees in STP

Fig. 3.25. The participation of STP in promotion of its residents' products

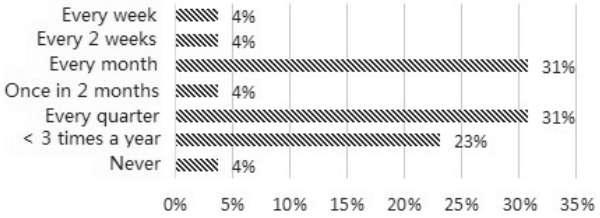

Fig. 3.26. The presence of cultural events organized by the administration of the STP

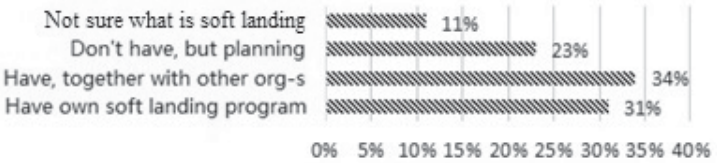

Fig. 3.27. Using the additional measures facilitating the involvement of companies ("soft landing")

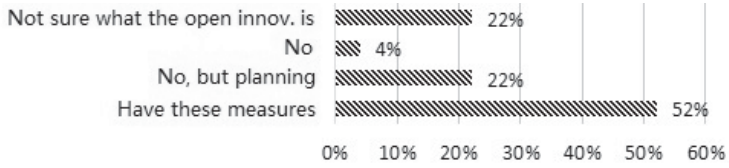

Fig. 3.28. Using “open innovation” in the STP

This part shows the situation in the one of the most important fields, i.e. the conditions provided for residents. As we can see, a half of parks are universal and only every 5th is specialized, that makes good chances to the companies no matter if which field they are working in. Almost 80% provide equal conditions for new and “old” residents, among the left part of parks the most of them are more concerned in new companies.

The economic crisis didn’t affect the number of the residents in the half of the parks, which is a very good result, and the amazing effect is that in every 3rd park the number of residents kept on increasing, that reflects the importance of the STP as a factor of the economic growth. Although the global economic climate still has quite big influence on the support from the authorities of the various levels.

The policy about the rent cost is almost equal between the same as outside the park (42%) and the ones with the cheaper rent (32%) and the more expensive rent (31%), which can depend on also the placement of the park and the facilities it provides, and also the share of support of the state and regional funds, which allow or don’t allow to make rent cost lower.

Almost a half of the parks have less than 5% of management personnel in the total number of employees and 16% have more 20%. That can be telling that in the most of the park the people within the parks are scientist and other personnel. And this can be explained by the fact that the managerial function has been given to the special companies by outsourcing.

As for participating in promotion the residents’ products only 26% of parks have this service, but almost a half of parks are planning to have it, and 10% are providing this service by outsourcing.

The cultural events are important part of the life in the parks, but they do not have to be too often, 1/3 of parks organize the events every month and another third have them every quarter. Only 4% are too serious for any cultural events, although it can be explained by the fact, that the events are being organized by municipality of university on the territory of which they are staying.

The important service as “soft landing”, i.e. providing additional measures that facilitate the involvement of companies, is being used in more than 60% of parks, another 20% are planning to have it, which means this service is helpful and is needed by residents. And “open innovations” are in the list of the half of the parks, while 22% of parks are not sure about the meaning of it.

3.6.5 The effectiveness of the science and technology parks

This group presents such characteristics as:

1) The growth of companies in STP in 2011 (total revenue growth of its residents).
2) The share of the number of residents, which appeared in 2011 (in the total number of existing).
3) The share of residents with their own patents.
4) The proportion of types of innovations created by STP's residents (in 2012, according to EBN statistics [7])
5) The average number of transactions of STP (BIC) on cultivation of startups (in 2012, according to EBN; conversion rate/efficiency amounted to 10.6%, i.e. 28 startups from 263 filed applications).
6) The average number of jobs created with the help of STP (BIC) in startups and companies-residents (in 2012, according to EBN).

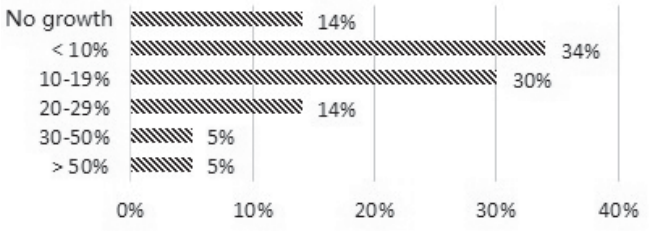

Fig. 3.29. The growth of companies in STP in 2011

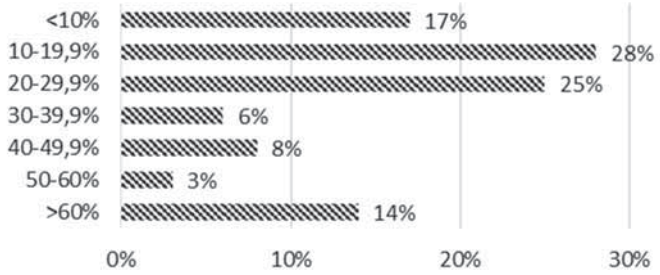

Fig. 3.30. The share of the number of residents appeared in 2011

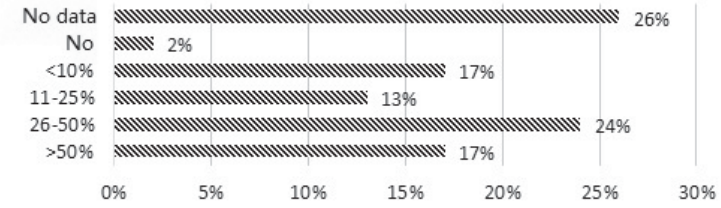

Fig. 3.31. The share of residents with their own patents

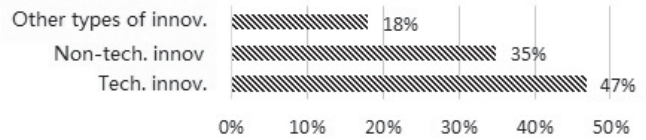

Fig. 3.32. The proportion of types of innovations created by STP's residents

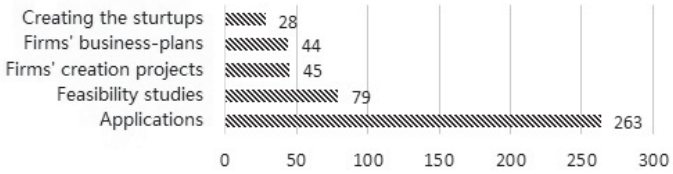

Fig. 3.33. Average number of deals on cultivation the startups per STP/BIC

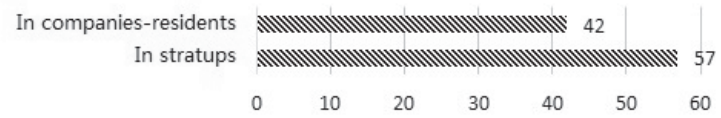

Fig. 3.34. The average number of jobs created in one STP/BIC

The effectiveness of the parks can be seen on the graphs above, for example, more than 60% registered the growth in 2011 in the range till 19%, and the growth of 5% of companies exceed 50%. In 2011 in 1/3 of the parks welcomed 10-20% of the new-comers (as a share of total amount of the park's residents), which means the growth rate is quite high. And 14% of parks got more than a half of their residents in 2011.

As for the ownership of the patents in the parks, the quite big share of parks (26%) is not aware of the situation, and in other parks the share is impressive (26-50% and even more).

The data about the types of innovations shows that only a half of innovations are in the technological sphere, and more than a third belongs to non-tech field.

The effectiveness of the park in the field of cultivating the startups from the application till the creating the company is quite high – if we consider, that all these stages happen within one year, then the effectiveness of cultivation is more than 10%, but it's not necessary for all these stages to be performed within one year, so the graph gives just a general view. And the average number of jobs created in the companies, which are already residents of the park, and in the startups are almost the same, which can reflect the fact that the speed of the development is almost the same, so the residents are growing almost as fast as the firms which just been created. So we can talk about the high effectiveness of the science and technology parks.

3.7 CONCLUSIONS

In this chapter we analyzed the science and technology parks as on the most important instruments of the innovation policy and one of the most significant factors of the innovation economy development. We examined the STP's concept, terminology, reasons for their creation, types and models, the history and stages of their development and their characteristics and performance. In the following chapter we will examine the situation in Russian economy and its innovation development.

4 INNOVATION DRIVING ECONOMIC GROWTH IN RUSSIA: HISTORY OF DEVELOPMENT, CURRENT SITUATION, STRATEGY AND POLICY.

4.1 HISTORY OF DEVELOPMENT AND THE EVOLUTION OF RUSSIAN INNOVATION POLICY.

The development of the Russian innovative policy will be presented by the following groups: main events, innovation drive, public research and innovation infrastructures, each of the group will contain the main factors.

4.1.1 Soviet period (till 1991)

Main events:

Creation of the Ministry of Science, Technology and Higher Education (1991)

Creation of the Russian Academy of Sciences (RAS) which inherits all facilities of the USSR Academy of Sciences on the territory of Russia (1991)

Innovation drive:

Government demand dictates technological innovation in large scale engineering projects. Science is largely mobilized for the needs of the defense industry. Little innovation in consumer goods and non-priority capital goods sectors.

Public research:

The Academy of Sciences carries out most of basic research. A myriad of specialized institutes and other organizations carry out applied research and technological development for civilian and military purposes.

Innovation infrastructures:

Idiosyncratic features with geographical distribution reflecting strategic (military) and political considerations, as well as historical circumstances (especially World War II).

4.1.2 Turbulent restructuring, with early experimentation of new innovation policy approaches (1990s)

Main events:

- Foundation for Technological Development (1992).
- New legal framework for IPR (1992-93).
- Foundation for Basic Research (1993).
- Creation of the status of State Research Center (1993).
- Foundation for Research in Humanities (1994).
- Foundation for Assistance to Small Innovative Enterprises (FASIE) (1994).
- Creation of the status of Federal Research and Production Center (1995).

Innovation drive:

Collapse of government demand for innovation, collapse of corresponding supply chains. With a few exceptions, successful firms in the new market environment rely mainly on foreign technologies and business know how.

Public research:

Abrupt downsizing and restructuring. Many organizations involved in applied research or engineering design are abolished or incorporated to the business sector. Foreign financing helps survival but pauperization leads to large scale emigration of scientists and engineers.

Innovation infrastructures:

First Technoparks appear in Tomsk, Moscow and Zelenograd (1990-91).
First Innovation Technology Center created in Saint Petersburg (1996).
Necessity encourages many experimental commercialization strategies in the public research sector.

4.1.3 Stabilization, with significant additions to the innovation policy framework (2000-2005)

Main events:

- Creation of the status of Science City ("Naukograd") (2000)
- 1st Federal Target Program (2002-2006)
- Russian Technology Transfer Network (2002)
- FASIE START Program (2003)
- Innovative Mega Projects (2003)
- Restructuring plan for public R&D organizations (25% downsizing by 2008) (2004-05)

Innovation drive:

First success stories of market-led innovation in some areas, e.g. software, advanced materials. Small innovative firms emerge, often as spin-offs of public research. But innovation remains low on the agenda of most large, often state-owned enterprises.

Public research:

Increased federal spending stops the degradation and lays the ground for renewal of viable organizations. Better working conditions, including salaries, and the development of innovation networks create new motivations and opportunities.

Innovation infrastructures:

Constant development of Incubators, Technoparks, Centers of Technology Transfer and Innovation Technology Centers, around universities and public research institutes. Many bottom-up Initiative at local (e.g. science cities) and regional levels.

4.1.4 Consolidation and expansion of the innovation policy framework (2005-2010)

- **Main events:**
- Presidential Priorities & List of Critical Technologies (2006).

- Federal program to support development of high-tech clusters (technoparks) (2006).
- Russian Venture Company (2006).
- 19 Regional Venture Funds (2006).
- OJSC "SEZ" founded to develop Special Economic Zones (2006).
- Government Commission on High Technology and Innovation (2007).
- "Long Term Social and Economic Development Plan" (2008).
- Improved IPR legislation (2008).
- Improved tax treatment of R&D and patenting activities (2008).
- Creation of the status of National Research Center (1st one is "Kurchatov Institute") (2008).
- Creation of technology-oriented State Corporations, Rosnano, Rostechnologii, Rosatom (2007).
- 2nd Federal Target Program (2007-2012).
- Innovation Initiatives in Higher Education (2007).

Innovation drive:

FDI and R&D centers of multinational corporations start to play a significant role. The number of innovative SMEs continues to grow but not enough to compensate the lack of a sufficient demand for innovation from large firms and the government.

Public research:

Sustained federal budgetary support allows upgrading of research capabilities through an increasingly selective approach. Reinforcement of university research capabilities. New support programs and infrastructures facilitate commercialization at national, regional or local levels. But conservative forces continue to resist both market-led and government selection process.

Innovation infrastructures:

In 2008, there were about 120 Business Incubators, 85 Technoparks and 100 Centers of Technology Transfer. New programs and approaches aim at consolidating these infrastructures around stronger nodes. Technology-oriented Special Economic Zones (SEZs) are created in Saint Petersburg, Zelenograd, Dubna and Tomsk. Industrial SEZs are created in Lipetsk region and Republic of Tatarstan.

4.1.5 Towards a mature and efficient national innovation system (2010+)

Main events:

- Presidential initiative to create a Russian equivalent of US DARPA (Defense Advanced Research Projects Agency) (2010).
- Creation of "Technology Platforms" (2010).
- Presidential Initiative to create Innovation Centre Skolkovo (2010).
- Government Commission on High Technology and Innovation (reformed, 2010).

- Presidential Commission for Modernization and Technological Development (2009).
- Special status and support granted to 14 (+15 in 2010) national research universities and 7 regional universities (2009).
- New funding principles for the RAS (2009).
- MICEX launches new hi-tech segment on Russian stock exchange (2009-10).

4.2 CURRENT SITUATION IN RUSSIAN ECONOMIC DEVELOPMENT

4.2.1 Comparing of the innovation indicators for different countries.

Analytical materials [33] are comparing the data in the period from 2000 till 2006, for the most developed countries of the world and, more generally, with OECD countries (30 countries) and the EU (27 countries).

One of the most important indicators used for international comparisons of policy of states in the field of contribution to research and development (R&D) is **domestic expenditures on R&D** (hereinafter DE). By the absolute value of the DE, Russia is behind all of the major countries, and by the increase it is ranked second after China. In Fig. 4.1 and Fig. 4.2 we can see the share of DE on R&D in GDP, their rates of growth and structure of science in Russia.

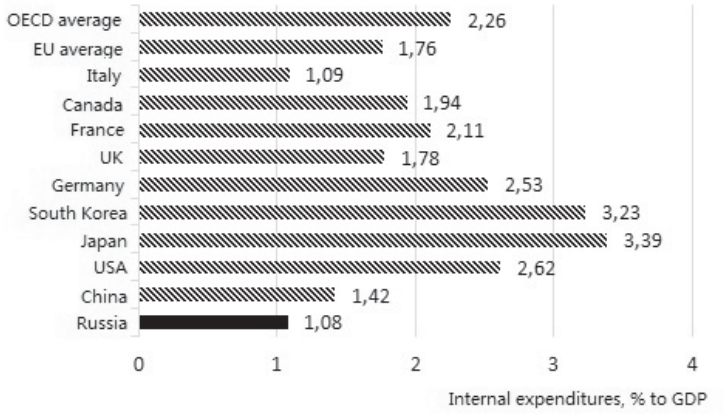

Fig. 4.1. Countries' domestic expenditures on research and development.

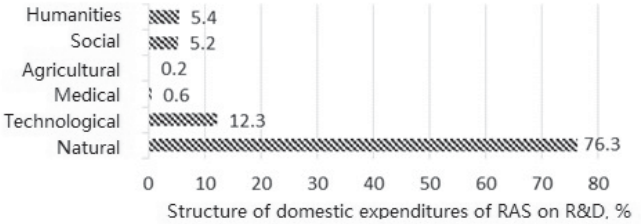

Fig. 4.2. Structure of domestic expenditures of Russian Academy of Sciences in 2007 by fields of Sciences

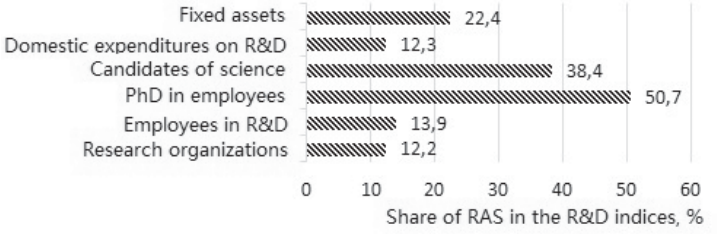

Fig. 4.3. The share of the Russian Academy of Sciences in R&D indices in Russia in 2007

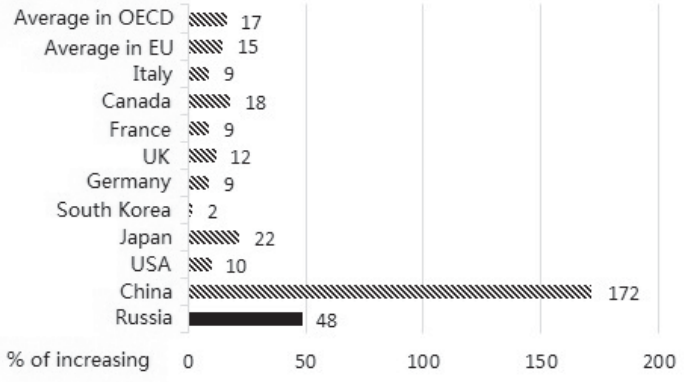

Fig. 4.4. The growth rate of domestic expenditure on research and development

Important indicators of R&D are the sources of financing the DE. Fig. 4.5 shows the share of public funding of R&D, and Fig. 4.6 shows the percentage of recipients of DE on R&D by groups: state organizations, business,

universities, private (non-profit) companies. These pictures showed that Russia is the only country with such a high share of the state (61%) in the total volume of financing of R&D. But the biggest consumer of these costs is the state-owned enterprises (27%), when higher education institutions, in comparison with other countries, receive the smallest share of the DE (6.1%). Innovative way of development, as the experience of many developed countries shows, involves giving a very important role to institutions of higher education, as the main generator of new knowledge. Although this does not mean absolute correctness of the DE distribution, because in China the share of universities among consumers (9.2%) is only slightly more than in Russia.

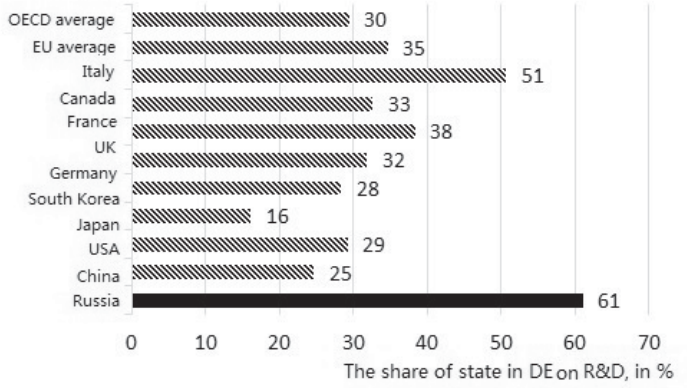

Fig. 4.5. The share of the state source in DE on R&D

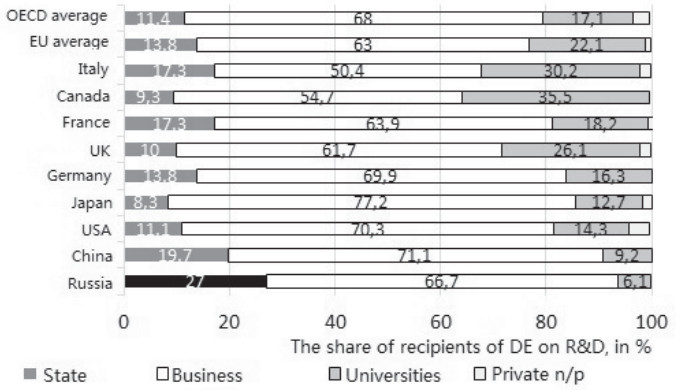

Fig. 4.6. The share of recipients of DE (performers of R&D)

The number of researchers employed in the R&D sector of the country (science community in Russia) is presented on Fig. 4.7 and Fig. 4.8. On the first of them there is the relative number, the number of researchers per 1,000 employed in the economy, and the second picture shows the absolute number of researchers across countries.

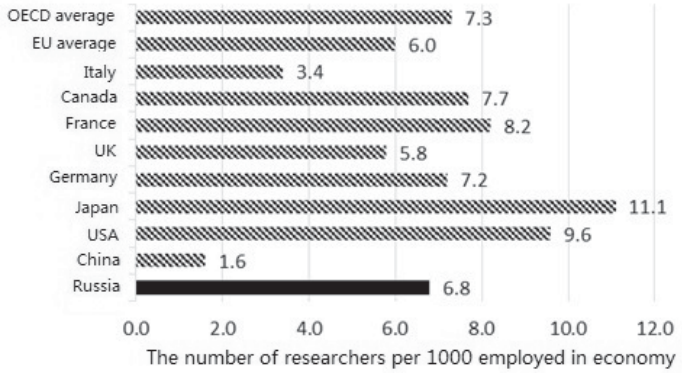

Fig. 4.7. The share of researchers in the economies of the different countries

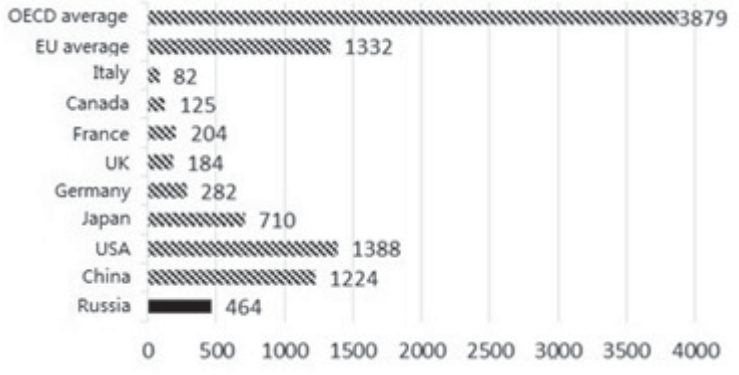

Fig. 4.8. The number of researchers in the economies of countries

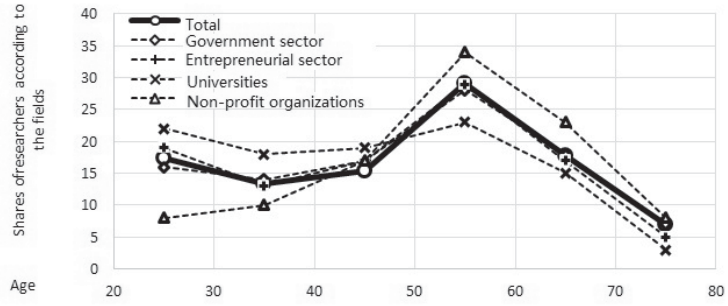

Fig. 4.9. The shares of researchers by age and sector of the economy in Russia (Rosstat in 2008)

Fig. 4.10. Average monthly salary of researchers by sectors in Russia (2008)

The relative indicator (as the density of the "population of researchers" in Economics) shows that Russia is at the level of other developed countries, although, the research capacity of the country is obviously determined not only by the number of researchers, but also the performance of their work, which in Russian research institutions is low due to the low financing of equipping laboratories with advanced techniques and equipment due to the age structure of researchers in major sectors (peaking at pre-pension and pension age) capable to provide innovative economic growth.

According to the absolute indicator, Russia is also at the level of average European country, but far behind the U.S. and China, and also from the EU and OECD.

A significant factor, demotivating involvement of young researchers in the field of R&D is low level of salaries, as compared to the average level in the economy, and in relation to the salary of foreign researchers or to the salary in such popular areas of employment of young specialists, as, for example, application programming, where wages can be several times higher.

Effectiveness of scientific research sector of the economies may serve as an indicator of innovative activity. Among the most representative indicators of scientific-technical (applied) activities the following are usually taken into account:

- number of patents;
- volume of technologies trade (technology balance), as indicator of the level of fundamental research is usually such bibliometric indicators as:
    - number of scientific publications;
    - citation of scientific publications.

According to these indicators the position of Russia is presented in Fig. 4.11 - Fig. 4.13. Fig. 4.11 shows the number of patents registered in 2005 in the "triad of patent families" per 1 million population. For Russia such a low level (0.44) can be explained, besides the low patenting activity, by still existing (from the Soviet times) burdensome (expensive) and cumbersome procedure of patenting abroad. It should be noted that despite the visible difference in the structure of import and export of technology [61] (Fig. 4.12.) the correlation coefficient between them (k = 0.85) shows a high degree of closeness of these structures.

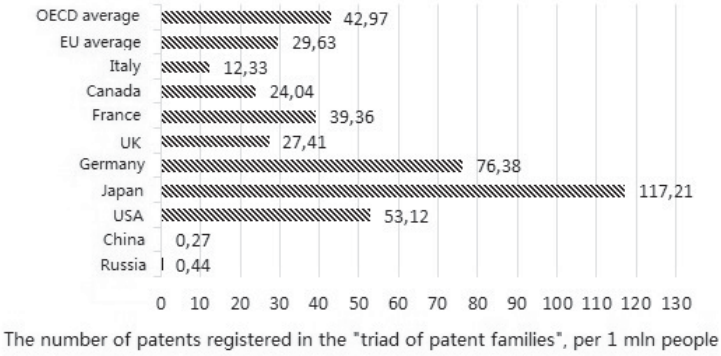

Fig. 4.11. The number of patents registered in the “Triad of patent families” in 2005, per 1 million people

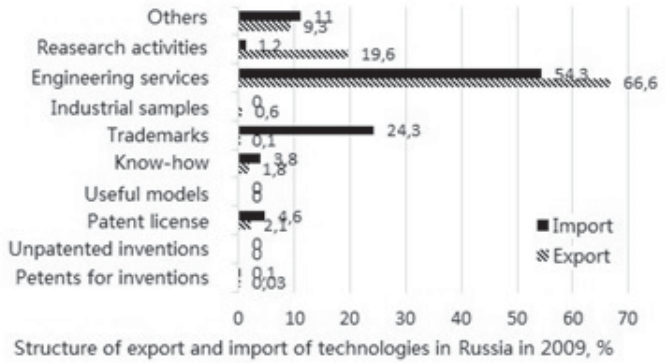

Fig. 4.12. The structure of export and import of technologies in Russia by categories in 2009

Fig. 4.13. Technology balance of payments in 2006 (technology exports - imports of technology), in million US dollars

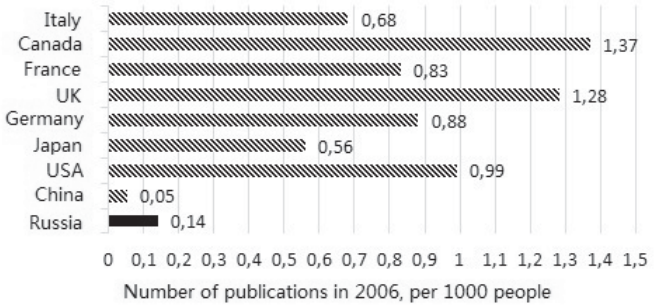

Fig. 4.14. The number of publications in 2006, per 1000 people

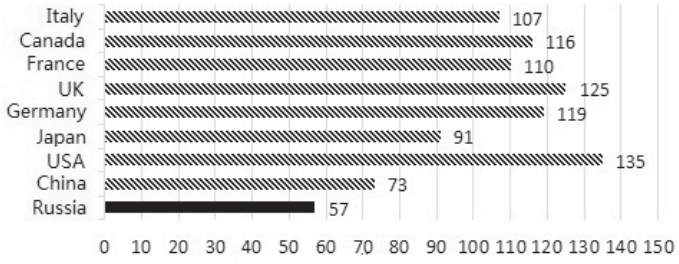

Fig. 4.15. Relative citation index of publications (relative to the global average, taken as 100%)

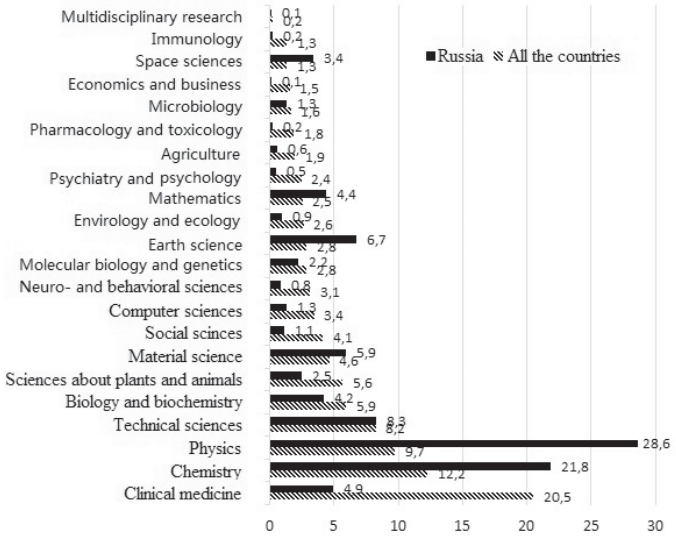

Fig. 4.16. The structure of the publications of Russian authors in scientific journals indexed in Web of Science, by the fields of science (2002-2006)

Statistical (regression) analysis of the two series (in the world and in Russia) of the structure of publications indexed in Web of Science, showed that the coefficient of correlation k = 0.55 when the value of R2 = 0.33, which can be seen as practically absent correlation between the structures of the publications of Russian researchers and the rest of the world. It should not be construed as clearly negative evidence, since there are two possible interpretations:

1. A significant difference of profiles of the publications patterns can be interpreted in a way that in Russia there are the fields of science, in which

Russian researchers have greater potential, which can be implemented and will provide competitive advantages in economic development. I.e. Russia can specialize in those scientific fields where there is more fundamental and/or applied potential.

2. The difference can be interpreted also as a negative phenomenon, reflecting the fact that Russia conducts research in the areas not popular now, assuming that all other countries are developing their research in the right direction. However, this interpretation may not be well-grounded, if to assume, that in the world there is a specialization of countries in research that will lead to the same weak correlation profiles if try the similar regression analysis of other countries. On the other hand, there is currently no reason to believe that Russia participates in the international division of efforts in R&D.

The chart data shown reflect the innovative activity of scientific research sector of the countries, but also the degree of their integration into the international system of exchange of knowledge and results of their use in socio-economic development. Data indicate a low level of innovation activity of the research sector in Russia, which confirms the high level of potential and opportunities for growth. The low contribution of the Russian research community in the world database of patents also, in our opinion, is a consequence of the still unfinished process of restructuring the economy of the Soviet period.

Important characteristics of the current state of the innovative capacity of the country is the **innovation activity of business**. Indicators of this group were defined in the European Innovation Scoreboard 2007 [62], where the counties (not only within the EU) are consolidated according to the results of innovation activities in 4 groups:

1) **leaders** (Denmark, Finland, Germany, Israel, Japan, Sweden, Switzerland, UK and the USA);
2) **catch up leaders** (Austria, Belgium, Canada, France, Iceland, Ireland, Luxembourg and the Netherlands);
3) **moderate innovators** (Australia, Cyprus, Czech Republic, Estonia, Italy, Norway, Slovenia and Spain);
4) **lagging** (Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania and Slovakia).

According to the Innovation Union Scoreboard 2013 the countries are divided into the following groups (only 27 EU countries):

1) Leaders (Denmark, Finland, Germany and Sweden);
2) Innovation followers (Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg, Netherlands, Slovenia and the UK);
3) Moderate innovators (Czech Republic, Greece, Hungary, Italy, Lithuania, Malta, Portugal, Slovakia and Spain);
4) Modest innovators (Bulgaria, Latvia, Poland and Romania).

Fig. 4.17 and Fig. 4.18 show two indicators reflecting innovation business activity in industrial activity.

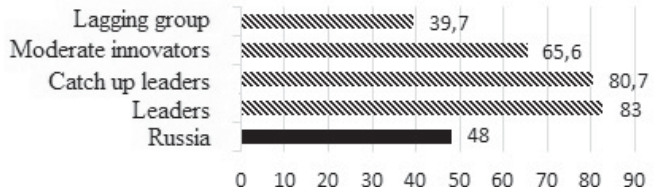

Fig. 4.17. The share of revenues of innovation-active organizations in the total sales (in Russia in 2007, other countries in 2004)

Fig. 4.18. The share of innovative products in the revenue (for 2004)

As for the first of these indicators, Russia is closer to lagging group. While by the second indicator, the picture is not so clear, although this figure for Russia is the lowest since the shares in the groups of other countries are in reverse order - the leaders have the smallest share of innovative products in revenue.

Thus, in the pre-crisis period the indicators of innovation activity for Russia in comparison with other countries were low (although there still are improving trends), and this made the government to develop a number of strategically important documents aimed at the improvement of the situation and competitiveness of the economy.

4.2.2 The SWOT-analysis of the Russian innovation system.

In recent years, the Russian economy is in recession due to the global financial and economic crisis in the period 2012-2013.

As the main reasons for the slowdown of the Russian economy the government names:

- high dependence on natural resource exports, prices and demand for which are very variable;
- insufficient competitiveness of non-commodity sectors of the economy;
- insufficient development of the financial sector and banks.

In the current conditions to ensure a long-term sustainable development Russia needs inner sources of growth. The strategic course of the Russian Government (see Fig. 4.19), aimed at the comprehensive modernization of

the Russian society, is defined in the Concept [60] as the basis for the anti-crisis Program, which provides for:

- carrying out the policy of structural renovation;
- diversification of the economy;
- macroeconomic rehabilitation;
- increasing of level of social protection.

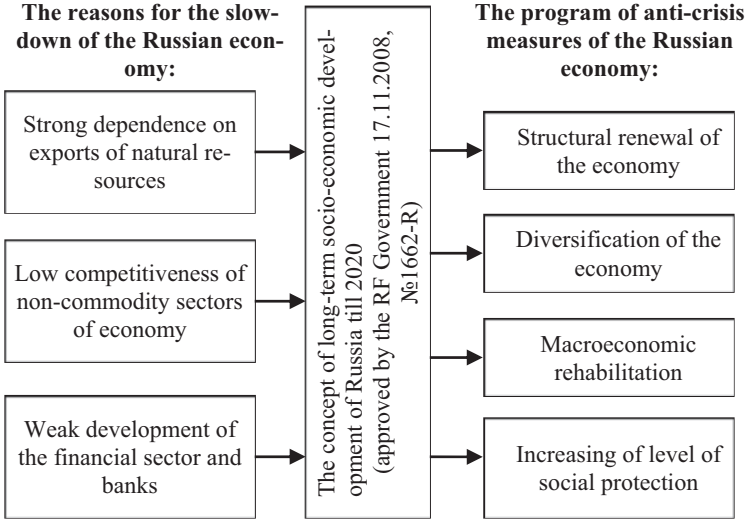

Fig. 4.19. The strategic course of Russia's economic modernization

Here are the lists of the four components of the SWOT analysis of the Russian NIS, made in [33] and the report of OECD on the innovation policy of Russia (2011).

Strengths

1) Generous endowment of natural resources which can be effectively developed with help of innovative companies.
2) Technical modernization of a number of economically successful industries in the pre-crisis period.
3) Highly qualified (higher than in China), quite cheap (cheaper than in Europe) labor and scientific and technological community.
4) Geographical proximity to (and historical links with) many advanced and emerging countries.
5) High general level of education of the population. A well developed and recently reinforced higher education system in science and technology which attracts a large but decreasing share of enrolments.
6) Joining WTO and the reduction of barriers to access to world markets.

7) Rapid growth in the number and variety of objects of innovation infrastructure
8) Long-standing scientific and engineering culture, traditions and accumulated experience in the field of organizing and implementing the research and development. Many centers of world excellence in the modernized part of the public research system. International reputation and even prestige in key S&T fields, such as aerospace, nuclear science and engineering, and advanced software.
9) An increasing number of firms, including a significant proportion of fast-growing ones, with best practice production and management methods capable of seizing new market opportunities through innovation when incentives are sufficient. A critical mass of new technology-based firms in some sectors and locations.

Weaknesses

1) The high level of monopolization of the national and regional markets, the domination of large companies in the field of resources within the group of leaders of Russian business.
2) Inadequate coordination between the state and the private sector in the development of priority of scientific-technical and innovative development and measures for their implementation.
3) The predominance of budgetary financing of all forms of research and innovation activities and innovation infrastructure.
4) The lack of a coordinated policy of transfer of knowledge and technology.
5) Low level of support of small innovative enterprises.
6) The low level of innovation activity of business. The prevalence of not innovative ways to create competitive advantage in the most companies.
7) Outdated technological structure of fixed capital in most industries, reduction of possibilities for modernization in the present crisis.
8) The crisis of the industry and company's science, the heterogeneity of the research sector, the gap between the needs of industry and science.
9) Insufficient level of domestic demand for innovative products.
10) The low level of innovation culture and the lack of experience of innovative entrepreneurship.

Opportunities

1) Opportunities for leapfrogging to higher levels of technological development in some sectors due to the effect of lagging development.
2) The rapid development of the global market of engineering services, in which Russian companies and scientific organizations are positioned rather high. The industries of specialization in this field are: development in the field of aviation and space technology, software, some areas of ICT.
3) Integration into the global technological chain in traditional and high-tech sectors of industry.

4) Increased competition on domestic markets as an incentive for innovative activity.
5) The multiplication of success stories brought about by new commercialization channels and platforms, such as Rosnano or emerging high-technology clusters, can contribute to a change of mindset in the broader research and business communities.
6) A vast reservoir of would-be innovative entrepreneurs exists among the younger generations, as revealed by responses to several programs of the Foundation for the Promotion of Small Enterprises in Science and Technology.

Threats

1) Saving the technological lagging behind in some important monopolized sectors of the economy.
2) Exhaustion of benefits in the quality of human capital and other components of the innovation potential.
3) A sharp decline in spending on research and development in the conditions of financial-economic crisis and deepening of technological backwardness.
4) The growing trend of protectionism in the conditions of financial-economic crisis.
5) State control over the economy and reduce of incentives for entrepreneurial activity.
6) Strong competition for grasping new global opportunities from both advanced countries and very dynamic emerging economies.
7) An ageing society, with an even more rapidly ageing population of engineers and researchers.
8) The state-owned corporate sector remains a black box from the perspective of civil innovation policy; nontransparent processes for the allocation of resources create numerous "black holes" (large resources are used to produce little marketable outcomes).

This analysis presents the current situation in the Russian economy and will allow us to understand the measures being taken by government and the ones to be taken in future.

4.3 INFRASTRUCTURE OF THE RUSSIAN INNOVATION SYSTEM.

4.3.1 Elements of the Russian innovation system.

The **infrastructure of the innovation system** is a set of subjects, contributing to the implementation of innovation activities, including the provision of services on creation and implementation of innovative products [64].

Currently in Russia, according to the National information-analytical center on monitoring of innovation infrastructure of scientific and technical activity and regional innovation systems (НИАЦ МИИРИС) [65], by February 2014, there are about 3300 organizations registered, of which directly

related to the innovation infrastructure - about 1200. Among registered in the database are the following:

- science and technology parks (over 80);
- innovative-technological centers (about 100);
- technology transfer centers (more than 100);
- national analytical innovative centers (10)
- centers of scientific and technical information (about 90);
- business incubators (over 120);
- centers of innovation consulting (more than 15);
- organization of the Russian Academy of Sciences (44);
- universities (453);
- organizations-participants of the scientific-technical and innovative activities (812).

Basic integrated components of innovation infrastructure of Russia are shown in Fig. 4.20.

Informational infrastructure is represented by the organizations that provide information and consulting services. It includes analytical centers; databases; information-analytical centers; information centers.

Analytical centers (AC) usually are consulting companies providing services in different fields.

Information centers (IC) and information-analytical centers (IAC) are not much different in functions. The IC in Russia is mostly public organizations and is subordinate to the Ministry of industry and trade and the Ministry of energy.

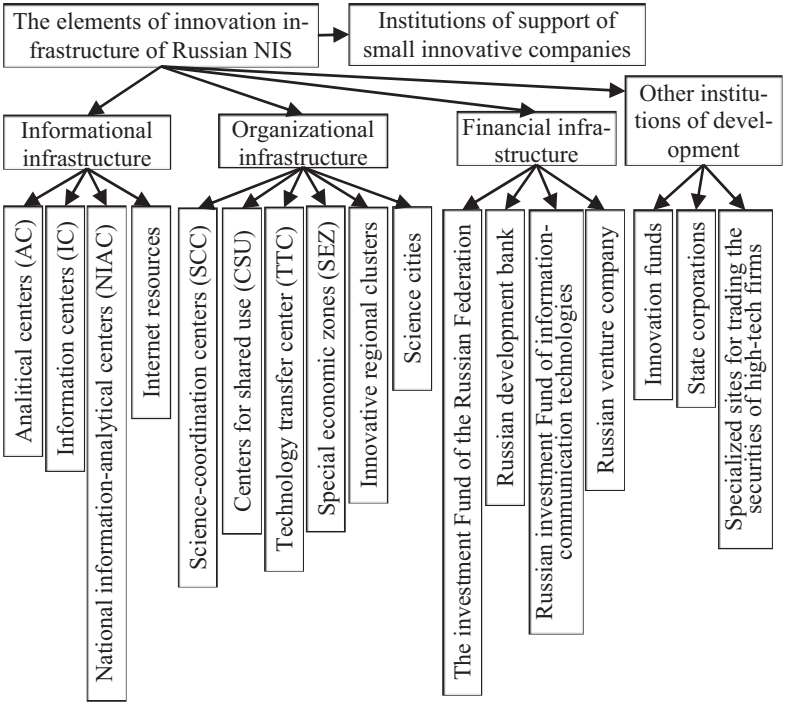

Fig. 4.20. Components of innovation infrastructure of Russian NIS

National informational-analytical centers (NIAC). In 2005 within the Federal program "Research and development in priority directions of development of science and technology for 2002-2006" ("Commercialization of technologies" part) there were established 10 national informational-analytical centers. Their goals are:

- Monitoring of:
    - priority directions of development of science and technologies;
    - innovation infrastructure of scientific and technical activity;
    - regional innovation systems;
    - personnel training for scientific-innovative activity;
- creation of the instrument base for scientific research, including:
    - the centers of collective use;
    - unique stands and installations.

Internet resources provide information on the innovation infrastructure and innovation activity in Russia. The most notable are:

1. The Federal portal for science and innovation (www.sci-innov.ru) contains links to the main points:

- documents on scientific and innovation activity;
- organization connected with the implementation of innovative activity;
- information on the content and the implementation of the Federal target program.

2. The portal of information support of innovation and business "Innovation and entrepreneurship" (www.innovbusiness.ru), which contains a database on innovation projects, as well as analytical materials covering the main issues and problems faced by entrepreneurs engaged in innovation activity.

3. Information Internet-channel "Science and innovations" (www.rsci.ru), founded in 2000, operates under the auspices of the Russian Foundation for fundamental research, Fund of assistance to development of small forms of enterprises in scientific and technical sphere.

4. The electronic edition "Russian Science and Technologies" (http://www.strf.ru), established in 2005, with the support of the Federal Agency for science and innovations, Ministry of education and science of the Russian Federation, is the information-analytical expert presentation of actions under the Federal program "Research and development in priority areas of development scientific and technological complex of Russia for 2007-2012".

5. Information portal of InfoNTR (www.infontr.ru) provides information on modern scientific and technological achievements.

6. Portal of "Competition of Russian Innovations" (www.inno.ru), created with the support of the magazine "Expert" in 2001. The Expert Council of the contest includes representatives of the Ministry of education and science, academicians, representatives of big business. The portal holds competitions of innovation in different nominations.

7. Information portal "Science and innovation in the regions of Russia" (http://regions.extech.ru/) was established by Federal state institution "Research Institute - Republican research scientific-consulting center for expertise" (ФГУ НИИ РИНКЦЭ), focused on informing and participation of the regional scientific-coordinating centers, which may submit proposals to the regional innovators.

Organizational infrastructure includes organizations that perform support functions, research and innovation processes. They include: scientific and coordination centers, centers of collective use, technology transfer centers, special economic zones, regional innovation clusters. Their main features are as follows.

Scientific coordination centers (SCC) whose main function is to coordinate research and innovation processes, by the beginning of 2014 there were

22 centers [65]. Some SCCs perform the role of affiliated territorial structures of the Central organizations of innovation infrastructure, for example, "Federal Fund of assistance to development of small forms of enterprises in scientific and technical sphere" and others.

Centers for shared use (CSU) is a type of innovation infrastructure organizations that provide services on the use of unique equipment and instrument base, program complexes for different subjects of innovative activity: employees of universities and academic institutions, industrial enterprises, commercial organizations, etc. At the beginning of 2014 there were registered 80 centers [65]. Often CSU are created by the RAS institutions that need the unique and expensive equipment in their research. The CSU is not simply provide on a contractual basis the unique equipment, but also carry out of complex research on orders from other scientific and industrial organizations, teach students, work with graduate students and doctoral students, organize courses on improvement of qualification of specialists - users of the newest analytical equipment.

Technology transfer centers (TTC) since 2003 are based on the basis of RAS institutes, universities and public research centers of the Russian Federation. By the beginning of 2014, there are more than 120 of them [65]. The main functions of TTC are to foster commercialization of results of scientific and technical activity obtained by the use of budgetary funds, mainly through the creation of small high-tech enterprises.

Special economic zones (SEZ) are one of variants of the mechanism of state-private partnership and investment promotion. The status of resident of SEZ is carried out on a competitive basis. The main goals of creating special economic zones for the state are the following:

- Attraction of foreign direct investments, advanced technologies of production of goods and services.
- Creating new jobs for highly qualified personnel.
- Development of the export base.
- Import-substitution.
- Approbation of new methods of management and work organization.

The goals of participation of foreign investors in SEZ:

- Bringing the production closer to the consumer.
- Minimization of costs connected with the absence of export and import customs duties.
- Access to infrastructure.
- The use of cheaper labor.
- Reduction of administrative barriers.

According to the SEZ law (Federal law No FZ-116, July 22, 2005) in Russia can be created SEZ of four types:

1) industrial and manufacturing SEZ;
2) tourist-recreational SEZ;
3) technical-implementation (innovative) SEZ;
4) port SEZ.

The techno-implementation special economic zones should become an important tool of innovative development providing for public-private partnership (PPP) in the innovation sphere.

Five innovative SEZ are located on the territory of Tatarstan, Tomsk, St. Petersburg, Moscow (Zelenograd) and Dubna (Moscow region), the priorities of which are:

- nano - and biotechnologies;
- medical technologies;
- electronics and communication facilities;
- information technologies;
- exact and analytical instrument-making;
- nuclear physics.

Innovative regional clusters are characterized by a combination of world-class competitiveness of companies based in their territory and demonstrate high dynamics of growth of production volumes, with research and educational organizations with high scientific and technical potential, concentrated in the cluster (more details on this type of infrastructure of innovative development are discussed below).

Science cities are one of the first forms of state support of municipal formations in Russia, having on its territory a large city-forming scientific organization of the same specialization (this type of infrastructure of scientific and technical development are examined in more detail below). The status of the science city, unlike other elements of the institutional infrastructure, mainly allows count only on additional state subsidies for the development of municipal infrastructure.

The financial infrastructure is integral system of supporting innovations, including financial development institutions. In Russia the system includes: the Investment Fund of the Russian Federation, the Russian development Bank, Russian investment Fund of information and communication technologies, the Russian venture company, funds of the innovative-investment.

The investment Fund of the Russian Federation established in 2006 with the aim of state support (on a competitive basis) in the implementation of investment infrastructure projects and ensuring institutional transformations of the NIS in the form of:

- co-financing of investment projects;
- an investment in authorized capitals of legal entities;
- provision of state guarantees (and other prescribed methods of securing obligations) for investment projects.

Russian development Bank (public corporation) was founded in 1999, and since 2004, is implementing the "Program of financial support of small and medium business" in the following directions:

- projects in the sphere of science, innovations and high technologies;
- national projects in health, education, housing, agriculture and demography;

- infrastructure development projects of regions in the Russian Federation;
- projects in regions with a lack of financial resources;
- projects on enhancing the competitiveness of small and medium enterprises in foreign markets.

Russian investment Fund of information and communication technologies (public corporation "Rosinfocominvest") is a fund, the scope of investment interests of which are small and medium-sized organizations in the sphere of information-communication technologies. The Fund's investments into each project are not more than 30 million rubles. The obligatory condition of the Fund's investments in the project is the existence of a private co-investor.

Russian Venture Company (public corporation "RVC" is a wholly state-owned company, established in 2006. The Mission of RVC is to ensure accelerated development of effective and competitive (in a global scale) NIS by creating a self-developing venture capital industry in cooperation with other development institutions, with the involvement of private venture capital, development of innovative business and technological business expertise, mobilizing human potential of Russia.

RVC formed 7 venture funds:

1) "VTB Venture Fund";
2) "Bioprocess Capital Ventures";
3) OAO "Alliance ROSNO Asset Management";
4) OOO "Maxwell Asset Management";
5) ZAO "Leader";
6) LLC "Managing company "North asset Management;
7) ZAO Management company "CenterInvest".

The main characteristics of venture funds are:

- legal form - closed unit investment Fund (closed-end funds);
- parity of co-investment funds of RVC and private investors (49% / 51%);
- the possibility of early redemption of the share by private investor at a price equal to the purchase price, increased at the rate of 5% per annum, but not above the level of inflation;
- investment funds' objects are enterprises, whose activity corresponds to the priority directions and critical technologies of the Russian Federation;
- in the generated funds OAO "RVC" has no right to vote on investment decisions.

Other development institutions are a set of organizations the activity of which is fully or partially directed at the support and promotion of innovative processes in Russia.

The state corporations (SC) as one of the development institutions have a special place because they are a transitional form created for consolidation

of state assets and to increase efficiency of the strategic management. Currently, there are three state corporations oriented on activities in the field of R&D that were created in 2007:

1) Rosnanotech (nanotechnology).
2) Russian technologies (high-tech products).
3) Rosatom (nuclear energy).

With the development of the financial market in the sphere of support of R&D and the development of other elements of innovation infrastructure, the state corporations should be corporatized, and some cease to exist.

Funds of innovative investment (FII) are the organizations of various forms of ownership; one of directions of activity is investment in innovation. Among them there are two groups of funds:

- budgetary:
    - Russian Foundation for basic research (RFBR);
    - Russian humanitarian scientific Fund (RHSF);
    - Fund of assistance to development of small forms of enterprises in scientific and technical sphere;
- extra-budgetary (financed by voluntary contributions of up to 0.5% of gross proceeds), there are more than 30 of them, of which more than 15 are established by the Federal Executive bodies, and the others – by commercial organizations. Among the most significant ones are:
    - Russian Foundation for technological development (RFTD) is the leading organization in the system of extra-budgetary funds to support science and technology (performs the functions of registration of non-budget, first of all, industry funds and control over their activities);
    - Fund of assistance to development of innovative activity of the higher school;
    - Fund of support of small business (the European Bank for reconstruction and development);
    - Russian technology Fund (the international Fund of venture investment);
    - Bashkir Fund of support of innovations;
    - Ekaterinburg Fund of support of small business "Business Incubator";
    - Regional Fund of scientific and technical development of St. Petersburg;
    - International Fund for technologies and investments (IFTI);
    - Innovation Fund "AZ capital" (Yekaterinburg);
    - Khakass innovation Fund (OAO).

It should be noted that the branch funds of innovations support are created by relevant ministries or large Russian corporations (Ministry of transport, Ministry of information and communications, Minatom, OAO "RZHD" and

others) and are intended to support the development of innovative processes in order to ensure competitiveness.

Specialized sites for trading of securities of high-tech companies at this stage of the formation of the innovative infrastructure are designed to compensate for the shortage of stock markets in Russia, aimed at high-tech companies. Existing Russian exchange specialize mainly in the securities of large companies specialized on raw materials. To provide opportunities to trade the securities of R&D companies in 2000-ies there was created a number of such trading platforms as:

- The Growth market of Saint-Petersburg as a segment of the St. Petersburg currency exchange (SPCEX), to trade stocks of growing innovative companies.
- Stock exchange of high technologies (SEHT), the mission of which is to attract investments in the promising Russian high-tech projects.

However, these sites have not yet found the expected demand nor by innovative companies nor investors.

Institutions of support for small innovative companies are the aggregate of organizations, activity of which is aimed at supporting and promoting innovation in small business in Russia. All the above elements of the innovation infrastructure aimed at ensuring of innovation activity of companies of all levels. However, the sphere of small business has many specific features, which often do not allow them to take advantage of the services that are available for large companies (this situation is typical for the whole world). There are three features of small enterprises, which make all governments to create a special infrastructure add-ins for small business, they are:

- almost all of the enterprises and/or private businesses in the process of their formation are passing through a phase of "infancy", when they need special support;
- small businesses all over the world make a highly significant contribution to GDP (in Russia - by 15-20%, in Europe - up to 60%, in China - up to 80%), while the number of small companies is very significant (in China over 97%);
- small businesses, in contrast to large, are very dynamic, and that allows them to adjust quickly adapting to their needs and environment.

Therefore, in Russia same as in other countries, there are special institutions of support of small business in general and innovative business in particular, because it’s able to provide rapid development of the economy. The main of such institutions are presented in Fig. 4.21.

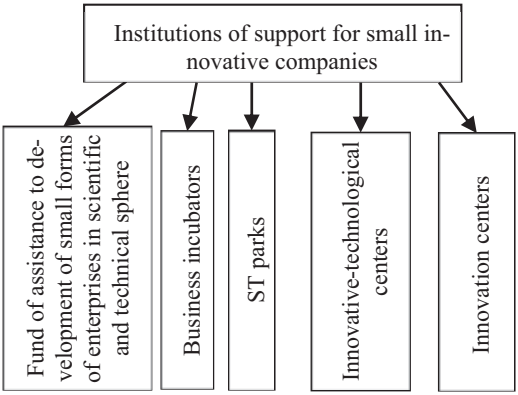

Fig. 4.21. Institutions of support of small innovative business in Russia.

Fund of assistance to development of small forms of enterprises in scientific and technical sphere is a state non-commercial organization established by the Government of the Russian Federation in 1994. The Fund receives 1.5 % of Federal budget funds allocated for civil research and development. The amount of funds allocated to the Fund in 2013 was over 7052.2 million rubles (including budget ones - 4402.2 million rubles and extra-budgetary - 2650 million rubles), which is about 220 million US dollars.

The Fund provides financing for R&D companies at the initial stages of their development. Fund's main tasks:

- carrying out state policy of development and support of small enterprises in scientific and technical sphere;
- offering direct financial, informational and other aid to small innovative enterprises, implementing the projects on the development and mastering of new kinds of science intensive products and technologies on the basis of their intellectual property;
- creation and development of infrastructure of support for small innovative entrepreneurship.

The basic part of means of the Fund is used on R&D projects, and the rest (about 15%) are directed on:

- the creation of a network of innovative-technological centers (there are more than 30 established in Russia);
- development of infrastructure for technology transfer;
- involvement of universities students and young scientists of the RAS in innovative entrepreneurship;
- support to companies ' participation in exhibitions, seminars;
- training of managers.

Activity of the Fund is carried out on the basis of special programs:

1) The program "Start", supporting project authors, beginning innovative business, within three years.
2) The program "UMNIK" aimed at identifying young scientists who are prone to innovation through organizational and financial support of innovative projects.
3) The program "Start" directed to financing innovation projects implemented by small innovation companies on the basis of development and with personnel support of universities of the Russian Federation.
4) The program "TEMP" supports projects on development of small enterprises licenses for new technologies and technical solutions purchased from Russian universities, academic and branch institutes.
5) The program "Development" aimed at project support (on a parity basis) which is provided to small companies, involving the commercialization of specific scientific ideas.
6) The program "Rate" - aimed at compensation of the part of interest rate on credit or leasing payments to small businesses, implementing innovative projects.
7) The program "INTER" is designed for small enterprises - residents of special economic zones of technology-innovative type and technology parks.

Business incubators are designed to support companies in their early stage of development. In Russia there have been created more than 180 business incubators (as for the beginning of 2014 [65]), which provide for rent on a preferential basis premises, and also provide consulting, accounting and legal services.

Science and technology parks (STP) provide a wider range of services than the business-incubators. In Russia their number is constantly growing, according to НИАЦ МИИРИС [65], at the beginning of 2014 there were registered 166 science and technology parks.

Among Russian STP the share of effectively working ones is not so big, accreditation of 2003 showed that there is no more than 25-30%. As indicators were used the following ones:

- the number of small innovative enterprises (SIE) in STP;
- communication system of STP and SIEs with the university (basic organization);
- the origin of the SIE;
- dynamics of SIE's growth;
- the tasks of SIE;
- sources of financing of SIE;
- qualification of managers in STP;
- training of personnel in STP.

In Russia, as around the world, STP vary greatly in the goals, functions, composition. They can be equivalent to the innovation technology center, or a business-incubator, or innovative organizations, etc.

In 2006 the Government of the Russian Federation adopted the state program "Creation of STPs in sphere of high technologies in the Russian Federation " (coordinated by the Ministry of communications of the Russian Federation), which provided for the creation of a network of STPs of a class higher than most of the existing closer to the technopolises, as basic elements of high-tech clusters.

Innovative-technological centers (ITC) are public organizations that represent a conglomerate of many small enterprises located in one territory to support established and operating small innovative enterprises. ITC are designed to provide a sustainable connection of small business with the industry, so they are often created at the enterprises or research - and-production complexes. The number of ITC is growing quickly, at the beginning of 2014 [65] there were 118 of them.

Features of ITC are quite blurred, and the goals and tasks are very different: in addition to the delivery of premises in rent, they provide technical, informational and consultancy support, as well as formal and informal guarantees for small enterprises seeking funds for their development, provide for the integration of education, science and business.

Among ITC there are those that were created long time ago, but never started work. However, organizations that have not been accredited in the beginning of this decade continue formal existence. Blurred features of ITC make it difficult to monitor their effectiveness.

Innovation centers (IC) is a group of organizations of innovation infrastructure with uncertain and wide functions. Some of them perform the functions of STP, innovative-technological center, center of technology transfer and also production. Other IC perform mainly consulting functions.

The number of IC at the beginning of 2014 [65] was 90.

4.3.2 Innovational clusters in Russia.

Concept 2020 [40] provide for the establishment of **innovative regional clusters network**, which will allow to optimize the position of the domestic enterprises in production chains, will increase the degree of processing of raw materials, import substitution and growth of localization of assembly plants, as well as raising the level of competitiveness of domestic goods and services due to:

- using the critical technologies and the latest equipment;
- providing the cluster enterprises with access to modern methods of management;
- getting access to highly competitive international markets.

The formation of regional innovation clusters is the essential argument of attracting foreign direct investment and the intensification of external economic integration.

In August 2012 the government of the Russian Federation approved the list of pilot programs for the development of 25 innovative regional clusters in the form of public-private partnership (table. 4.1) [23].

Table 4.1 The list of innovative regional clusters Russia

№	*Region*	*Cluster's field*
1	Altai region	Biopharmaceutical cluster
2	Arkhangelsk region	Shipbuilding innovative regional cluster
3	Kaluga region	The cluster of pharmaceuticals, biotechnology and biomedicine
4	Kemerovo region	ITC "Complex processing of coal and industrial waste"
5	Krasnoyarsk region	The cluster of innovative technologies, ZATO Zheleznogorsk
6	Moscow	Cluster "Zelenograd"
7	Moscow	New materials, laser and radiation technology (Troitsk)
8	Moscow region	Biotechnological innovation territorial cluster Pushchino
9	Moscow region	Innovative regional cluster of nuclear-physical and nanotechnologies, in Dubna
10	Moscow region	Cluster "Phystech XXI (Dolgoprudny, Khimki)
11	Nizhny Novgorod region	Nizhny Novgorod industrial innovation cluster in the automotive field and petrochemicals
12	Nizhny Novgorod region	Sarov innovation cluster
13	Novosibirsk region	The innovative cluster of information and biopharmaceutical technologies
14	Perm region	Innovative regional cluster of rocket engine, "Technopolis "New star"
15	Republic Of Bashkortostan	Petrochemical territorial cluster
16	Republic Of Mordovia	Energy efficient lighting and intelligent lighting control

№	Region	Cluster's field
17	The Republic Of Tatarstan	Kama territorial production cluster
18	Samara region	Aerospace cluster
19	Saint-Petersburg	Development of information technologies, radio electronics, instrument making, communication facility and info-telecommunication
20	St. Petersburg (Leningrad region)	Cluster of medical, pharmaceutical industry, radiation technologies
21	Sverdlovsk region	Titanium cluster
22	Tomsk region	Pharmaceuticals, medical equipment and information technologies
23	Ulyanovsk region	Consortium "Educational-scientific-production cluster "Ulyanovsk-Avia"
24	Ulyanovsk region	Nuclear innovation cluster of Dimitrovgrad
25	Khabarovsk region	Innovative regional cluster of aircraft-and shipbuilding

The selected clusters are located in the areas with high concentration of scientific-technical and production activity. These include, in particular, a number of science cities and territories of special economic zones, closed territorial entities, including Zelenograd, Dubna, Pushchino, Obninsk, Troitsk, Sarov, Zheleznogorsk, Dimitrovgrad and agglomerations of Saint-Petersburg, Novosibirsk, Nizhny Novgorod, Samara, Tomsk, Perm, Ulyanovsk, Nizhnekamsk, territories in the Khabarovsk and Altay regions, Arkhangelsk region, republics of Mordovia and Bashkortostan.

Among the participants of innovative regional clusters there are also a number of leading Russian scientific and educational organizations and enterprises, including:

- institutes of RAS (Russian Academy of Sciences) and RAMS (Russian Academy of Medical Sciences);
- leading machine-building companies;
- leading companies of the ICT sector and the sector of biotechnologies;
- largest enterprises of fuel and energy complex and metallurgy.

Also in clusters contain the branches and subsidiaries of foreign multinational corporations. Among them are close corporation "Intel Russia", representative office of Oracle Corporation in Russia, Novartis Pharma, LLC, close corporation "Berlin-Chemie/Menarini" (structural division of Berlin-Chemie AG); LLC "AstraZeneca industries (a division of Astra Zeneca Ind), JV Ford Sollers holding, joint venture Ural Boeing Manufacturing and others.

The selected clusters represent different models of territorial organization and relations of scientific-technical and production activity.

Territorial organization of clusters is presented as models with clearly defined boundaries of existing municipal formations (Sarov, Zheleznogorsk, Troitsk) and models, which unites enterprises, scientific and educational organization in the framework of large agglomerations (St. Petersburg, Novosibirsk and Tomsk regions). The leading role of large industrial production is typical for cluster programs of Republic Tatarstan, Bashkortostan Republic, Arkhangelsk and Nizhny Novgorod regions, Khabarovsk region. The development of the cluster is supposed at the expense of more intensive transfer of results of scientific and technical research in the activities of existing industrial companies, as well as the creation of new small and medium enterprises, embedded in value added chain generated by the large companies.

At the same time, the programs of development of clusters of Pushchino, Obninsk, Troitsk, Dimitrovgrad, cluster "Phystech-XXI" are characterized by orientation to the use of capacity of scientific and educational organizations of the world level within their territory. It will attract large Russian and foreign companies to expand high-tech production at the expense of human resources and research infrastructure available in cluster, as well as active development of small and medium innovative entrepreneurship through commercialization of developed technologies here.

Variety of models of cluster development predetermines flexible tools of state support, taking into account the specifics of each particular region. All the clusters have significant growth potential. The main areas in which they planning achievements of significant results are:

- development of the research and development sector;
- development of industrial activity;
- development of investment activity.

Scientific and technological potential of the clusters is largely determined by the amount of R&D expenditures. Selected clusters are characterized by a high level of expenditure on research and development. So, for 25 selected clusters total expenditure on R&D over the last five years (2007-2011) was 1110 billion rubles or an average of 222 billion rubles annually in the period under review. Expenditure on R&D performed by the participants of the clusters makes up a significant proportion (43%) in the total volume of the respective costs on the economy, which for the period 2007-2011 is estimated by The Ministry of economic development of Russia as 2552 billion rubles.

For the period 2012-2014 the sum of planned expenditures is 968.8 billion rubles or an average of 323 billion rubles annually. Thus, the program of development of these clusters provides for a substantial increase in expenditure on R&D by 145% ratio of average annual expenditure on R&D for the period of 2012-2014 to the same indicator in 2007-2011. For all cluster groups the ratio of the average annual R&D spending for each period is planned to be more than 100%. Leaders of increasing R&D expenditures are clusters of two groups: "Nuclear and radiation technologies" and "Pharmaceuticals, biotechnology and medical industry", where the increase is expected to be over 200%.

4.3.3 Science cities in Russia.

In 1999 there was adopted the Federal law of the Russian Federation "On the status of the science city of the Russian Federation" [66]. In accordance with which the science city (also called monotown) is "a municipal formation with the status of city district with a high scientific-technical potential, with a city-forming scientific-industrial complex", i.e. the city's economy is dominated by a single industry or company. The status of the science city of the Russian Federation is assigned to municipal entity by the Government of Russia for a certain period of time. The law provides for the possibility of early termination of the status of a scientific city.

By the beginning of 2012, there were 14 municipalities in Russia assigned the status of science city (table. 4.2, Fig. 4.22), 9 of which are on the territory of Moscow region.

Table 4.2 Science cities of the Russian Federation

№	*Municipal formation*	*The subject of the Federation*	*Year of assigning the status*
1	2	3	4
1	Biisk	Altai region	2005
2	Obninsk	Kaluga region	2000
3	Dubna	Moscow region	2001
4	Zhukovskii	Moscow region	2007
5	Korolev	Moscow region	2001
6	Puschino	Moscow region	2005
7	Reutov	Moscow region	2003
8	Troitsk	Moscow region	2007

№	*Municipal formation*	*The subject of the Federation*	*Year of assigning the status*
9	Fryazino	Moscow region	2003
10	Chernogolovka	Moscow region	2008
11	Protvino	Moscow region	2008
12	Kol'tsovo	Novosibirsk region	2003
13	Petergof	Saint-Petersburg	2005
14	Michurinsk	Tambov region	2003

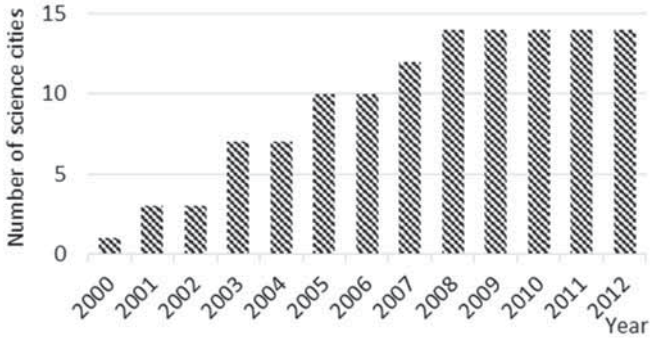

Fig. 4.22. Dynamic of the growth in the number of science cities in Russia

The main criteria which must be met by the municipal formation claiming for the status of the science city are the following:

1) the presence scientific-industrial complex forming the city's economy;
2) the number of employees in the organizations of the scientific-industrial complex is not less than 15% of the working population on the territory of this municipality;
3) the volume of scientific-technical products in terms of value should constitute not less than 50% of total products of all business entities located on the territory of the municipal formation, or the value of assets of the complex, actually used in the production of scientific and technical products, shall be not less than 50% of the value of fixed assets actually used for all business entities located on the territory of the municipality, with the exception of the social and housing-and-municipal sphere.

Scientific-production complex of the science city usually includes:

- scientific-research institutes;
- design bureau;
- institution of higher professional education;

- organizations providing:
- scientific-technical activities;
- scientific activity;
- innovative activity;
- production of science-intensive products.

The municipal formations, which have the status of a science city of the Russian Federation, receive additional state support in the form of interbudgetary transfers from the Federal budget and budgets of regions of the Russian Federation. Government authorities exercise control over performance of the functions assigned to the organizations of scientific-production complex in the science city.

4.4 STRATEGY OF THE CHANGING THE RUSSIAN ECONOMY DEVELOPMENT TYPE TO INNOVATIONAL ONE.

4.4.1 The Concept 2020

In 2011, by order of the Russian government there was prepared **Concept 2020**, which was an updated version of the concept of long-term socio-economic development of Russia until 2020 (CLTD).

Strategy 2020 on behalf of the Russian government has been developed during 2011 by more than 1000 experts under the leadership of the State University - Higher school of Economics and the Russian Academy of national economy and public service.

Strategy 2020 is the second variant of the Concept of long-term development of Russia until 2020. The first variant was developed in 2006-2007 in accordance with the instruction of the RF President Vladimir Putin by the Ministry of economic development and other agencies. The aim of the first draft of the Concept was declared to be "identification of ways and methods to ensure sustainable improvement of the welfare of Russian citizens, national security, the dynamic development of economy, strengthening of Russia's positions in the world community in the long term (2008-2020 the years) "[1]. The final text of the CLTD-2020 [2] was approved by the RF Government in November 2008.

The need to develop a second version of the CLTD -2020 was caused by two reasons. Firstly, the verification of the concept coincided with a serious intensification of the global financial and economic crisis. Until the autumn of 2008, it was only in developed countries, but CLTD was approved by the government already after the economic crisis began in Russia. So in fact CLTD was outdated already at the moment of its adoption. The crisis led to a sharp and deep decline of economic indicators and made impossible the majority of the quantitative targets of the first phase of implementation of the CLTD-2020, which had to cover 2007-2012.

Secondly, departmental character of the development of CLTD has led to the fact that it is in detail stated quantitative benchmarks which should be achieved by 2020 in a particular areas, but the problems and challenges facing the Russian economy and society in the program were not analyzed in detail. And the methods to achieve the goals were formulated in declarative form, for example:

"In Russia there will be formed a society based on trust and responsibility, including confidence in the public and private economic institutions. Social polarization will be reduced greatly. This will be achieved by ensuring equal opportunities for social mobility of talented representatives of all layers of society, the implementation of social policies to support vulnerable groups of population and policies aimed at the integration of migrants".

Concept 2020 [60] also declaring the main directions of transition from raw materials export to the innovative model of economic growth. For this purpose it is necessary to overcome a number of problems exist in these areas (see Fig. 4.23):

Direction 1: Increasing the demand for innovation in the economy.

Problems:

- Low demand for innovation, due to lack of stability of the economic environment.
- Underdevelopment of the sector of venture capital for innovation.

Direction 2: Increasing the effectiveness of the sector of knowledge generation (fundamental and applied science).

Problems:

- Gradual loss of the created in the Soviet period the backlog of R&D.
- Ageing of workforce.
- Reduction of level and volume of ongoing R&D.
- Weak integration of the Russian sector of R&D into the world of science and the world market of innovation.
- Low orientation of R&D in Russia on the needs of the economy.

Direction 3: Combining the elements of innovation infrastructure into the system.

Problems:

- Elements of the innovation infrastructure are not linked in a unified innovation process (generation, commercialization, and introduction).
- Archaism of the innovation legislation.

The planning guidelines of the innovative economy modernization, according to the Concept 2020 can serve the checking digits of changes by years of value added in major sectors of the Russian economy (see Fig. 4.24). During the 13-year period there is the growth of the innovation sector by almost 6% expected. The transition to the innovation model was planned to be implemented in two stages.

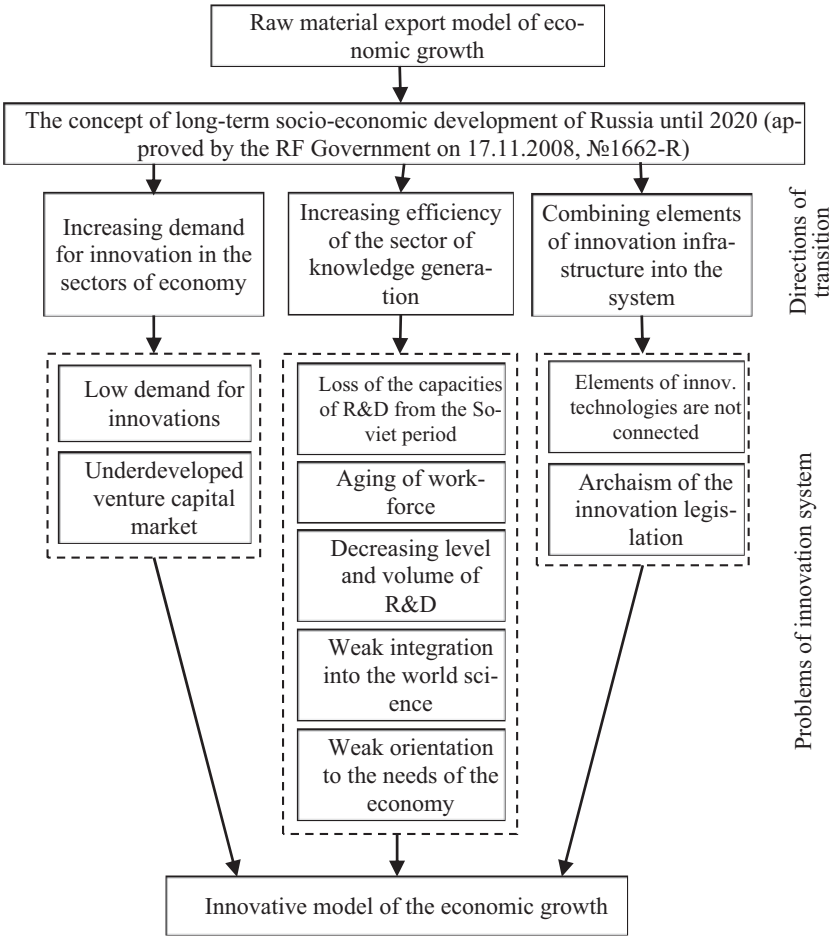

Fig. 4.23. Problems of innovative development that need to be solved during the transition to a new growth model

Stage 1. In the period of 2008 - 2012 it was planned to expand the traditional global competitive advantages of the Russian economy in such areas as:

- energy;
- transport;
- agricultural sector;
- processing of natural resources.

At the same time it was supposed to create the institutional conditions and technical capacities, ensuring the transition to innovation development for the Russian economy at the next stage.

Stage 2. In the period of 2013 - 2020 it is planned to increase significantly the competitiveness of the Russian economy on the basis of:

- transition to a new technological base;
- improving the quality of human potential and social protection;
- structural diversification of the economy.

The survey of Russian enterprises [33] has shown that the most significant reasons for the weak implementation of innovations in the majority of Russian enterprises are the following:

1) adequacy of the traditional (non-innovative) growth models;
2) low level of competition in local and regional markets, where the majority of companies (50-75%) work.

Fig. 4.24 shows the proportion of companies (among which a survey was conducted in 2006), noting the most significant factors hindering innovation. All respondents were divided into two groups: active and passive innovators whose position in relation to innovation is somewhat different. Evaluations of active innovators were largely based on personal experience, and passive ones had more of forecast. However, the correlation analysis showed fairly close relationship between them with the coefficient of correlation $k = 0.94$. It is important to note that factors such as demand, infrastructure, problems with intellectual property and cooperation, rarely evaluated by entrepreneurs as the most important. At the same time, these factors (marked with an asterisk in the figure) dominate as the most significant in the various documents that reflect the modern state innovation policy.

Such traditional Russian high-tech industry as the followings should become the locomotives of innovation development:

- aviation and engine-building;
- rocket and space industry;
- shipbuilding industry;
- radio-electronic industry;
- nuclear power engineering complex;
- information and communication technologies.

Technological modernization is also expected in other sectors through effective embedding of innovative management and marketing solutions into them.

Fig. 4.24. Factors hampering implementation of innovations in companies (according to Rosstat, 2006)

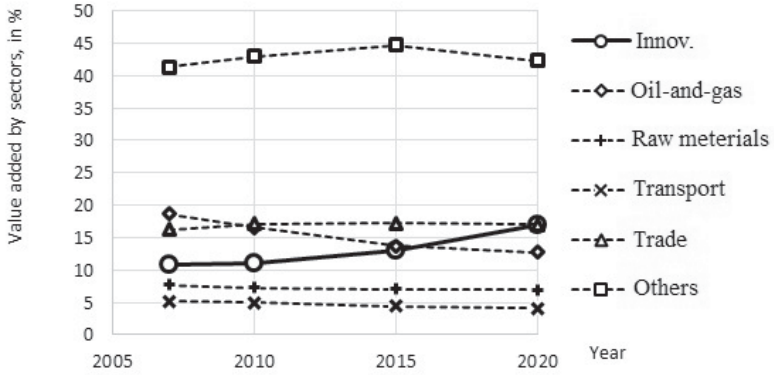

Fig. 4.25. The planned value added of the Russian economy according to the Concept 2020

Among the **key tasks** of the Concept 2020 are the following:

1) The expansion of demand for innovation in the economy.
2) Development of scientific-educational potential.
3) Development of innovation infrastructure.
4) Integration into the global innovative system.
5) Providing breakthrough of Russia's positions in the world markets.
6) The formation of innovation culture in the society.

The target forecast guidelines for 2020 within the Concept 2020 are:

Increasing the share of enterprises engaged in technological innovation up to 40-50%.

Russia's share on the world markets of hi-tech goods and services (in the key sectors) will reach not less than 5-10%.

Share of exports of the Russian high-tech goods in total world exports will reach 2%.

The share of innovative products in the total volume of industrial production will increase up to 25-35%.

Domestic expenditures on research and development will increase up to 2.5-3.0% of GDP.

4.4.2 State funding of the science and technology development

The economic crisis has shown that, despite its obvious advantages, the Russian economy still retains the raw material export orientation, and in many sectors there is a significant technological gap. An important reason for the absence of clear progress in the implementation of innovations is slow and inflexible system of financing of R&D. Here is a brief characteristic of the existing system of financing of science and innovation in Russia.

There are three main mechanisms of state financing of scientific and technological development:

1. **Estimated:** the budget of Russia provides funding for basic and applied research in the sections of "General state issues", "National defense" and others.

2. **Program-targeted:** implementing the targeted funding through the Federal target program (FTP).

3. **Stock-grant:** the funding is provided through the system of state funds of scientific-technical activity and innovation, through extra-budgetary funds, starting, "crop", venture capital, private equity funds and others, in some cases, in the form of grants.

While drawing up the budget (budget financing), as well as to control its execution, there are three types of classification of expenses used:

- on functional purpose;
- on departmental purpose;
- on financial assignments.

A characteristic **feature of the Russian budget process** is the frequent change in the functional component of the budget classification, which complicates the assessment, monitoring and correction of government activities in the funded spheres.

Currently, the main funding of R&D is directed by departmental channels, which does not allow responding effectively and efficiently to the global challenges including the global financial and economic crisis.

Stock financing system is more flexible as it allows arranging competitions of various projects: the initiative projects of individual researchers, inventors, creative teams organized without creating a legal entity, etc. However, this form of financing of R&D has a number of disadvantages:

1) **Outdated legal and regulatory framework** for the work of extra-budgetary funds for R&D, which hindering the development and increase of efficiency of funds' activity;
2) There are **legislative restrictions** to the investment of funds' assets into the organizations of innovation infrastructure (STPs, technology transfer centers, etc.).
3) The requirement of **obligatory repayment** of all financing received from the funds within 3 years limits the scope of the projects proposed to support.
4) **The lack of a legal status** of a number of funds doesn't allow them to reinvest the repaid funds and to attract extra-budgetary resources.
5) Currently in Russia there are **no funds to support applied R&D performed by individuals** (private inventors).
6) **The underdevelopment of the system of private-public venture funds** (regional and sectoral), industry funds for direct investment aimed at support of innovation projects of small and medium hi-tech business.

4.4.3 Priority areas of development and critical technologies

The system of economic planning of the Soviet period (Gosplan, the State Planning Committee) used the number of effective economic-mathematical instruments (balance models, methods of mathematical programming and others), which later were successfully used also by Western economists, departments, institutes.

In Russia during the post-Soviet period in the formation of scientific-technical and innovation policy there were used some methods and approaches proven in developed economies. Among them are definition of priorities of development of science and technology. Practice has shown [67] the importance of this instrument in the formation of the Federal target programs (hereinafter - FTP), programs of innovative development of companies with state participation, programs of development of innovation infrastructure of universities and others.

Priority areas and critical technologies in Russia's recent history were first established in 1996 and since then have been revised several times. In the first versions the list of priority directions and critical technologies was quite big, because of the desire to take into account practically all the major areas.

In the version of 1996 there were seven priority areas and 70 of critical technologies (average of 10 technologies in one area). In the list of 2002, there were eight priority areas and 52 critical technologies (averaging around six technologies in one area). So many positions in the lists partly can be explained by the absence of well-founded and constructive procedures for the selection of priorities.

In later versions the lists were formed according to the algorithms that are close to those developed and used in the world practice, which allowed to

reduce the number of critical technologies. The decrease is driven by two main factors as:

1) the need to concentrate efforts and limited resources on a narrow range of key areas;
2) the exception of the trends and technologies, which are mainly sectoral in nature.

Since the strategic priorities should be based on research and development fields, which have a real prospect, so during the selection process there were used the techniques of long-term forecasting to identify the major trends of scientific and technological development.

In 2006 on the basis of expert studies there have been prepared the list of the eight priority areas of development of science, technologies and technics in the Russian Federation and 34 of critical technologies of the Russian Federation (in average four critical technologies in one priority area) [68]. The choice of composition of the list included the following steps:

- collection and analysis of information to identify the key scientific and technological trends and challenges;
- expert evaluation of the results;
- identification of the promising areas;
- formation of lists of critical technologies with linkage to specific perspective directions.

In 2009 there has been made a new list, but not as a brand new from scratch, but as the updating of the list from 2006, although all procedures were performed in full. In the basis of the new list the following criteria were used:

- contribution to the acceleration of GDP growth, improving its structure and increasing the competitiveness of the Russian economy;
- ensuring the national security of Russia, including its technological, environmental, energy, food and informational aspects.

The expert group consisted of more than 250 experts of higher qualification, representatives of different communities, such as:

- specialists of scientific-research organizations;
- specialists of higher educational institutions;
- members of expert councils of the Higher Certifying Commission of the Russian Ministry of education;
- heads of projects implemented in the framework of Federal and departmental target programs;
- representatives of industrial enterprises;
- representatives of the business community;
- representatives of foundations for support of scientific and scientific-technical activity.

In the selection of experts the following characteristics was considered:

- bibliometric indicators of scientific activity, reflecting publication activity, citation index and other indicators;

- data on the participation in the most large-scale projects provided by scientific funds;
- the recommendations of the Ministry of education and science, other bodies of executive power and state academies of sciences;
- information on leading research centers and industrial companies.

The procedure of formation of the priority areas and critical technologies is shown on Fig. 4.26.

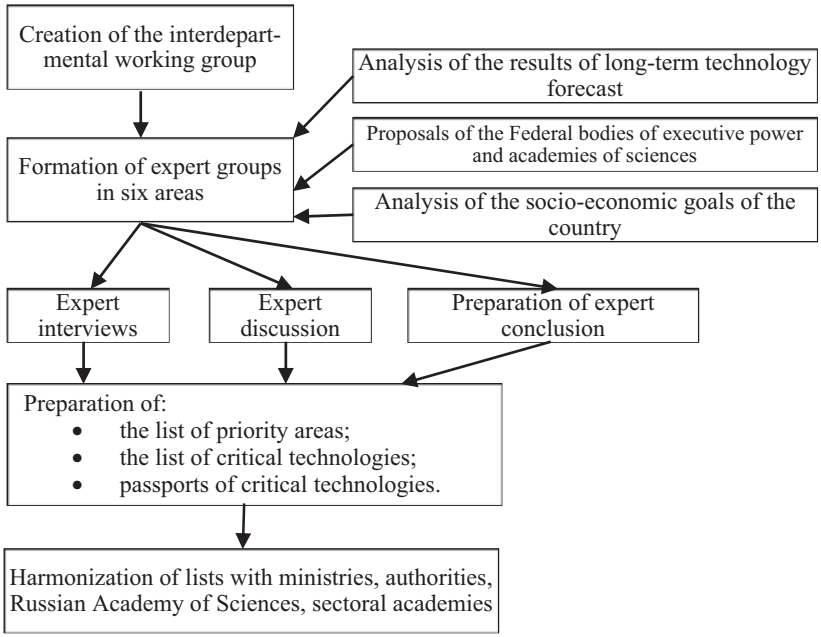

Fig. 4.26. The scheme of formation list for priority areas and critical technologies of the Russian Federation in 2009.

New methodological tool for the selection of scientific and technological priorities became long-term forecasting of nine topics using the Delphi method to identify potential demand for innovative development. List of thematic areas included the following:

1) Industry of nanosystems and materials.
2) Information-telecommunication systems.
3) Living systems.
4) Medicine and healthcare.
5) Rational nature management.
6) Security.
7) The production system.
8) Energy and energy efficiency.

9) Transport, aviation and space technology.

The following indicators have been used:

- the time of appearance of scientific results;
- the index of the importance of scientific results;
- the current level of research and development in comparison with the world standards;
- integrated effect, including:
    - strengthening of positions in world markets;
    - integration into global value chains;
    - increasing competition on domestic markets;
    - contribution to the solution of social problems.

As potentially innovative and developments in demand, there were discussed the topics with the terms of implementation up to 2020 and with high values of the index of the importance, and with the greatest values of the integral effect and the current level of research and development.

The results show that the thematic areas of the "Living systems" and "Medicine and health" have a high level of importance, and therefore one can expect the realization of the most popular innovative projects (in particular, in the sphere of diagnostics and prevention of diseases, genomic and postgenomic technologies for production of medicines).

The area of "Rational nature management" also has a high level of importance, there are a number of developments correspond to the world level (in particular, the technology of resource assessment and forecasting of the state of lithosphere and biosphere).

In the area of "Energy and energy saving" Russian developments have the level of research and development which is above the average (primarily due to the prospective works at nuclear power plants). Many topics in this area have a high evaluation of the integral effect and the index of importance.

The area "Information-telecommunication systems" has the average level of importance and integral effect, and its level of research and development as a whole lags behind the world. In the medium term we can expect the appearance of fundamentally new scientific results in the field of software, distributed computing and systems, intelligent control systems and navigation.

"Industry of nanosystems and materials" is characterized by high expected integral effect; with many themes correspond to the world level of research and development (especially in the technologies of membranes and catalytic systems).

The area "Transport, aviation and space technology" also has a level of research and development above the average. The most promising are the technology of aviation and space vehicles and engines.

The second important methodological element, in addition to long-term thematic forecast, was taking into account the goals of socio-economic development in the process of choosing the scientific and technological priori-

ties. Socio-economic goals were taken into account on the basis of the analysis of strategic documents that define the prospects of development of economy and society (strategies, concepts, programs and other). In recent years, such formulation of the problem is in a global trend and is used in most developed countries (Japan, Canada, the EU and others).

As a result of expert and research works there were allocated only six basic priority areas (see table. 4.3). In the near future in these areas we can expect significant scientific and technological results that will lead to the formation of new markets, and to increase the competitiveness of domestic products, quality of life and national security.

For the selected set of priority areas there were formed lists of critical technologies, an important purpose of which consists in the concentration of resources for the development of promising cross-sectoral developments with a wide range of potential innovative applications.

It should be noted that the study also identified the significant areas, which are characterized by the greatest lags behind the world level.

Table 4.3 Priority areas and critical technologies

Priority areas		*Critical technologies*	
1	Informational - telecommunication systems	1.1	Access technologies for broadband multimedia services
		1.2	Technologies of information, control, navigation systems
		1.3	Technology and software for distributed and computing systems of high performance
		1.4	Technology of creation of electronic component base
2	Life Sciences	2.1	Biomedical and veterinary technologies
		2.2	Biocatalytic, biosynthetic and biosensor technologies
		2.3	Genomic, proteomic and postgenomic technologies
		2.4	Cell technologies
		2.5	Bio-engineering technologies
		2.6	Technologies for reducing losses from socially significant diseases

Priority areas		*Critical technologies*	
3	Nanosystems	3.1	Computer simulation of nanomaterials, nanodevices and nanotechnologies
		3.2	Nano-, bio-, info-and cognitive technologies (NBIK-technologies)
		3.3	Diagnostic technology for nanomaterials and nanodevices
		3.4	Technologies of production and processing of constructional nanomaterials
		3.5	Technologies of production and processing of functional nanomaterials
		3.6	Technologies for nanodevices and Microsystem equipment
4	Transport and space systems	4.1	Technology of creation of high-speed transportation vehicles and intelligent control systems for the new types of transport
		4.2	Technologies of creation of rocket-space and transport equipment of new generation
5	Rational nature management	5.1	Technologies of monitoring and forecasting the state of the environment, preventing and eliminating the pollution
		5.2	Technologies of prevention and liquidation of emergency situations of natural and technogenic character
		5.3	Technologies of prospecting, exploration and development of deposits, extraction of minerals
6	Energy efficiency and energy saving	6.1	Technologies for atomic energy, nuclear fuel cycle, safe management of radioactive waste and spent nuclear fuel
		6.2	Technologies of new and renewable sources of energy, including hydrogen power engineering
		6.3	Technologies for creation of energy-saving systems for transportation, distribution and use of energy

Priority areas		*Critical technologies*	
		6.4	Technologies of energy-efficient production and energy conversion from fossil fuel

An additional result was that each critical technology was set in accordance with a set of scientific and technological groups that are crucial for its implementation (the group included 5 to 24 positions). In total there were allocated more than 200 important perspective scientific and technological groups. On their basis options the variants of the development of critical technologies can be considered, the subjects of inter-sectoral strategic studies and complex innovative projects can be formed.

Fig. 4.27. shows the quantitative characteristics of the periodic updating of priority areas and critical technologies.

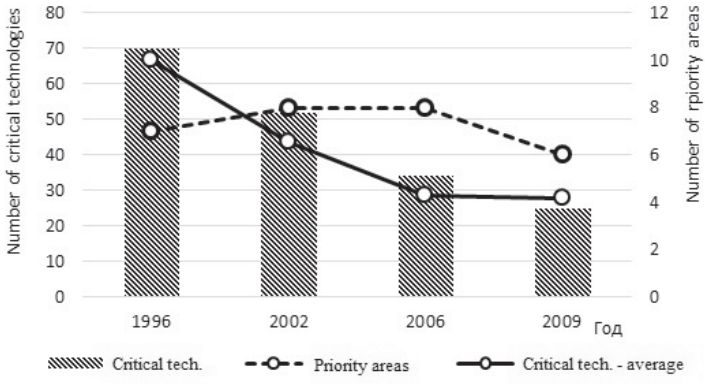

Fig. 4.27. Number of the key topics on the cycles of their renewal

Priority lists allows to concentrate the available funds to those areas that pose the greatest economic and social effects, also to improve the current scientific-technical and innovation policy, for example, in the following areas:

1) When formulating projects in the framework of the Federal program "Research and development in priority areas of scientific-technological complex of Russia for 2007-2013" [69], and the Federal program "Research and development in priority areas of scientific-technological complex of Russia for 2014-2020" [70].
2) When implementing the variants of the development of the national innovation system (NIS).
3) At creation and development of technological platforms.

4) At formation of programs of innovative development of companies with state participation.
5) In order of better awareness of potential users of the results of selection of scientific and technological priorities, i.e. formation of road maps for all priority areas on the basis of which business can get an idea of the possibilities of commercialization and development of breakthrough decisions in the framework of critical technologies, and investors can get an idea about potential areas and conditions of investment. They can be used by executive authorities at different levels in the process of formation of scientific-technical and innovation policy; by the companies of the real sector of the economy, by scientific organizations and higher education institutions in the planning of their scientific-technical, innovative and educational activities.

4.4.4 Instruments of the regional innovation policy

Innovation policy of Russia recently is being built not only on the state level but also at regional level. The main task of many innovative centers and/or STPs is the development of the regional economy, which inevitably must be based on the tools of legislative regulation at the regional level. As such region let us analyze the Moscow region (hereinafter - MR), where currently operates about 20 legal acts, regulating the innovative activity of enterprises [90].

The main mechanism of regulation of this sphere of activity of public authorities envisaged in the Law of Moscow region "About scientific, scientific-technical and innovative activity on the territory of the municipality" [91], according to which regional authorities of MR have the authority to do the following:

- identification of prior for the MR municipality directions of development of science, technologies and technics;
- development, approval and realization of regional target programs and projects of the scientific, scientific-technical and innovative activity, including territories of scientific-technical and innovative development of the MR municipality;
- participation in formation and/or in the development on the territory of the MR municipality of technical-promotional special economic zones;
- formation of territories of scientific-technical and/or innovative development of the MR municipality;
- providing state support to the subjects of scientific and/or scientific-technical and/or innovation activities, including the granting of tax privileges and state guarantees to the MR municipality;
- placement of state customers of orders for the supply of innovative products and for fulfillment of scientific-research, scientific-technical

works in order to ensure the activities of public authorities of the Moscow region and state institutions of the Moscow region;
- creating, financing, reorganization and liquidation of the state scientific organizations in the MR.

Important for the development of innovation economy of the MR is the Law of Moscow region "On industrial districts in the Moscow region" [92], which stipulates legal, organizational and economic conditions for the creation and functioning of industrial districts, which, depending on the specialization, can be created in the form of technopark, logistics park, agro-industrial park, industrial park, business park, multifunctional park. The decision to choose a particular form for industrial district is determined individually by the governing bodies of the relevant territory of the MR municipality.

The main principles of creation of industrial districts are [92]:
- rational use of scientific and industrial potential of the MR, land, natural and labor resources;
- the need for balance, proportionality and complexity of socio-economic development of the MR;
- social partnership in the sphere of workers, employers, state bodies of the MR and the local authorities;
- delimitation of powers and responsibility of all participants when creating industrial districts;
- use of private-state partnership;
- ensuring stability of conditions for investment activity throughout the period of creation of the infrastructure and equipment of the industrial district;
- efficiency for Moscow region's budget and the budgets of MR municipalities;
- preservation and improvement of environmental quality of the MR.

One of the elements of the financial mechanism of support for innovation activity is represented by the law "On grants of the Moscow region Government in the spheres of science, technology, engineering and innovations" [93], aimed at the implementation of scientific-technical and innovation projects especially important for MR. In accordance with this law "The Government Grant of the MR in the spheres of science, technology, engineering and innovations is the funds provided from the budget of the MR in the form of subsidies on gratuitous and irrevocable bases for the implementation of scientific, scientific-technical and innovation projects, particularly significant for the MR". For selection of projects and the allocation of grants for them there have been formed the Competition Commission, which is guided by such principles as:

1) competitiveness;
2) publicity;
3) targeted funds;
4) accountability for the use of allocated funds;
5) co-financing of projects;

6) effectiveness and efficiency of project execution.

Since the majority of innovations, as a rule, pass through the stage of startups, the Government of the MR pays great attention to development of innovative activity in small business. For support of this the Government of the Moscow region has approved a long-term program "Development of small and medium enterprises in the Moscow region for 2013-2016" [94], which, in particular, provides for the improvement of the infrastructure of support for the subjects of small and medium business, development of innovative high-tech, export-oriented enterprises. The program also provides for the partial compensation of expenses of subjects of small and medium business at:

- patent-licensing operations;
- protection of intellectual property;
- payment of services on development and introduction of the quality management system;
- certification according to the quality standards, environmental standards.

The volume of carried out compensation costs is shown in Fig. 4.28.

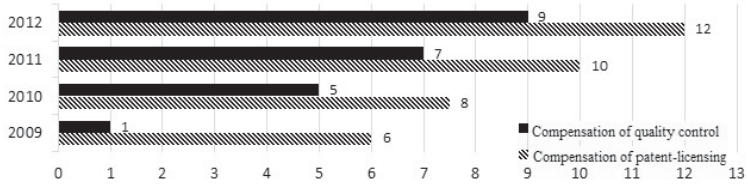

Fig. 4.28. The amount of compensation cost of SMEs of the MR on patent and licensing activities and quality control system

In accordance with the legislation of the MR regional innovation and modernization projects are being implemented in the framework of a number of long-term target programs [95]. Strategy of socio-economic development of the Central Federal district (including the MR) up to 2020 [96] provides for increasing share of domestic expenditure on research and development in GRP from 3.5% in 2005 to 8% in 2020, the number of innovation-active organizations is going to change from 138 to 500.

For coordination of scientific-technical and innovation activities at the level of the MR there were established operative control bodies:

- Moscow regional Council on scientific-technical and innovation policy under the Governor of the MR;
- working group on cooperation between the Government of the MR and the Russian Academy of Sciences, which made an agreement, the main objectives of which are:

- formation and development of regional segment of the national innovation system on the basis of scientific-technical and innovation potential of the RAS and Moscow region;
- organization and implementation of scientific and scientific-technical activity of scientific centers of the RAS, located on the territory of the MR, for the purpose of socio-economic development.

In the system of bodies of Executive power to the competence of the Ministry of economy of MR is the implementation of the state policy of Russia in the areas of:

- economic relations between entities;
- investment policy;
- price and tariff policy;
- accreditation of the subjects;
- development of small and medium enterprises, in order to create a competitive environment in the region.

Coordination of activities on development and support of small business in the structure of the Ministry of economy of MR is maintained by Department of development of small and medium enterprises, which includes:

- Department of formation of innovation system in the MR;
- Department of state support of SMEs;
- Department of coordination and development of SMEs.

In 2012 as part of the Moscow region Government there was created the Ministry of investment and innovation of the MR.

The main purposes of it are:

1) formation of a favorable investment climate in the MR;
2) attraction of private investments in the economy of the MR;
3) assistance in the implementation of investment projects;
4) determination of the optimal forms of state support for investment projects implementation;
5) development of highly effective and competitive industrial production.

By the end of 2013, the main organizations designed to support small (including innovative ones) business in the Moscow region, created by the Ministry of investment and innovation of the MR, are given in table 4.4.

Table 4.4 Organizations providing support to SMEs in the MR

№	*Organization*	*Main directions of activity*
1	State institution of the Moscow region "Moscow regional Fund for small business support"	- Assistance in realization of state policy in the field of development and support of SMEs; - Ensuring the implementation of measures of state programs for SMEs support in the MR; - Participation in the development of territorial programs, projects and activities aimed at the development of SMEs.
2	Non-profit organization "Moscow regional guarantee Fund of assistance to crediting of small and medium enterprises"	- Provision of guarantees for the liabilities of SMEs: - credit agreements; - loan agreements; - leasing agreements.
3	Non-profit organization "Moscow regional Fund of development of micro financing of subjects of small and medium business"	- Loan providing: - for the SMEs in the MR; - for the microfinance organizations of the MR.
4	Non-profit organization "Development Fund of investment promoting in small and medium enterprises in the Moscow region"	- Development of the infrastructure of investments in SMEs of the MR.
5	Non-profit organization "Development Fund of promoting venture investments in small enterprises in scientific and technical sphere of the Moscow region"	- Development of the infrastructure of venture financing of SMEs in the MR.

The existing normative-legal base, regulating the innovative activity in the MR and the set of organizational structures listed in table 5.3 create the minimum necessary conditions for development of innovative activity in the region.

Despite the measures taken for the support of innovative development, some problems still remain unresolved. In this regard, solving next several problems seems relevant [97]:

- Increasing of the economic turnover of results of scientific research and development in the form of new or improved products, services, processes, etc.;
- Increasing of the gross regional product due to the mastering of production of fundamentally new for MR products and technologies;
- Changing of structure of economy of the Moscow region in the direction of increasing the volume of high-tech, intellectual, innovative services;
- development of innovation infrastructure;
- creating conditions and incentives for integration of scientific, scientific and technical activity and production;
- more complete use of the potential of science cities of the MR.

The solutions of these problems in the MR in the field of innovation development should be based on creation of an effective system of support and development of SMEs, carrying out the innovation activity.

4.5 CONCLUSIONS

In this chapter we analyzed the history of economic development and the evolution of Russian innovation policy by the stages, compared the indicators of Russia and other countries and saw the current place Russia possess in the field of innovation development comparing to the other countries and regions and made a SWOT-analysis for Russian economy. Then we examined the elements of the Russian innovation system and the strategy of the government for its improvement and the regional innovation policy of the government.

5 SCIENCE AND TECHNOLOGY PARKS IN RUSSIA: CHARACTERISTICS AND EXAMPLES

Technoparks (STPs), as a tool for increase the efficiency of the economic entity, is very attractive as a lever, ensuring subsequent increase of the values of performance indicators in municipalities, regions, countries, unions, associations of economic entities and the world economy as a whole. Institute of technoparks is recognized worldwide [34] as an effective tool to promote innovation and support of small and medium enterprises. The significance of the STP in the economic structure of the subject is different for different subjects - for some, their contribution is very important, for others is weak and insignificant. And considering the shift of phases of beginning of STP, the current performance of the stages of STP's life cycle, and a number of other factors and circumstances, it becomes obvious that there is no general recipe can guarantee the effective use of STP. We can only talk about the regularities in relation to individual elements of the STP's tools used in these or those conditions, as well as about general tendencies, and using example of the specific experience of economic entities under specific conditions. An important feature of the STP movement is the attitude of authorities of all levels.

5.1 S&T PARKS IN RUSSIA.

5.1.1 Main characteristics and examples

Russia's transition to a new technological system, proclaimed by the country's leadership [60], is impossible without the development of the national innovation system and its various elements, including science and technology parks.

In Russia from the beginning of 90th years of the last century the number of STPs is constantly growing. According to different sources, these data are significantly different. So the number of technoparks, registered on the portal of the National center for monitoring of innovation infrastructure [65], at the beginning of 2014 was 166 (Fig. 5.1). According to other sources there are about 2000 of them.

According to official information from the Ministry of communications, there are only 12 technology parks in Russia (at beginning of the 2014), including only certified, i.e. the ones satisfying certain criteria.

In recent years in Russia the development of the Institute of technoparks is being coordinated by the Ministry of communications [71] in the framework of the Complex program "Creation of technoparks in the sphere of high technologies in the Russian Federation" [1], for the period from 2006 to 2014.

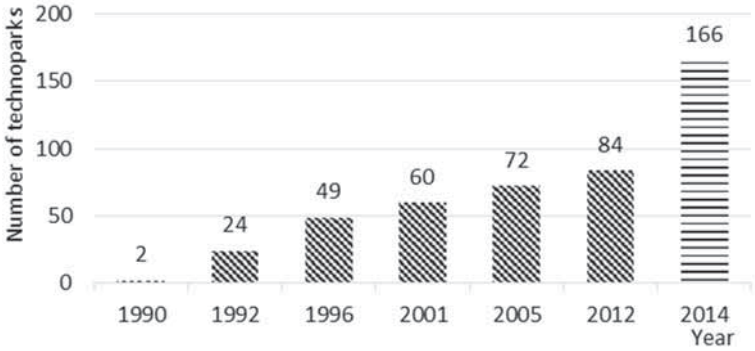

Fig. 5.1. Dynamics of growth of technoparks in Russia

According to the program, the infrastructure facilities are being created at the expense of the state financial support. STPs are being created by the regions of the Russian Federation in accordance with the needs, areas of expertise and competence of the regions. The main goal of the Ministry of communications is the implementation of strategy on integration of territorial business, fundamental science and applied research. The priority is given to the projects of STPs in the regions with scientific and industrial potential, developed system of preparation of qualified personnel that will ensure the emergence of growth points and reduce the risks of private and state venture capital investments in innovative projects. The further activity on the development of technoparks should be taken up by the business community.

The program is developed in 3 stages:

1) During the period from 2006 to 2007 - design work and preparations for the creation of technological parks.
2) From 2008 to 2010 - infrastructure development.
3) From 2011 to 2014 - created an ecosystem of technology parks.

Technoparks should provide the opportunity to realize all stages of development of the innovation project - from research to small-scale production, i.e. technoparks should be the objects of a full cycle. According to the concept of the program, the STP should closely interact to provide residents with a comprehensive range of services, including those provided by other STPs, thus providing a synergistic effect.

According to the data of the Ministry of communications at the end of 2011 investments was only about 610 million US dollars (19.5 billion rubles) from different budgets (Fig. 5.2). There were created about 9,000 new jobs and approximately 175 million. USD (5.6 billion rubles) has been returned to the budget in taxes.

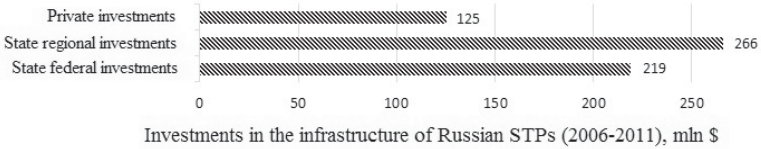

Fig. 5.2. Structure of investments in the Russian technoparks in the period of 2006-2011

An important step for the development of technoparks was the creation of non-commercial partnership "Association of technoparks in sphere of high technologies" [51] (hereinafter – the Association) in July of 2011 in order to coordinate efforts on development of highly competitive, socially-oriented economy of Russia. The Association developed and adopted (on 25 January 2012) "The statute on granting the status of Technopark in the sphere of high technologies" [72] and "The statute on the expert activity", and on 18 April 2013 was approved The roster of experts of the Expert Council (on granting the status of Technopark).

The functions of the Association are varied, including the role of the "one window" for technoparks in their relations with the Russian venture company [73], the state Corporation "RUSNANO" [74], the SKOLKOVO Foundation [75] and other development institutions.

In July of 2011 there were signed the trilateral agreement between the Ministry of telecommunications (curator of development of technoparks in the period from 2006 to 2014), the SKOLKOVO Foundation and Association, in which innovative projects, selected by the expert council in technoparks should obtain the status of residents of SKOLKOVO and financial support at the initial stage of development. At present, this procedure is successfully functioning.

One of the tasks of the Association of technoparks should be further monitoring of the effectiveness of technoparks after the expiry of the Program, overseen by the Ministry of communications.

By the beginning of 2014 in accordance with the criteria of the Ministry of communications lodged to technoparks, there are only 12 technological parks in 10 regions in Russia are operating and developing.

Including the following existing technoparks:

1. **"West-Siberian innovation center"** [76] in the Tyumen region in which the innovative projects, mainly related to the oil and gas industry, are being supported, however, other areas of machine building, instrument making, power engineering, transport, ecology and nature management, information technologies also receive support. By 2014 in the technopark will be created 570 jobs, the volume of annual income of the residents will reach 1.325 billion rubles.

2. **"Kuzbass Technopark"** [77] in Kemerovo, mainly supports the technologies of energy efficiency and energy saving, IT, ecology. By 2014 the number of jobs should be 3500; the volume of annual income of the residents of the technopark will be 2 billion rubles.

3. **"Technopark Mordovia"** [78] in Saransk, the basic directions of activity of residents are electronic instrument engineering, optoelectronics and fiber optics, energy-saving lighting technology, IT, nanotechnology and development of nanomaterials. By 2014 it is planned to increase the number of working places up to 3360, the volume of annual income of the residents will amount to 2,480 billion rubles, the volume of investments will amount to 1,117 billion rubles.

4. **"Technopark of the Novosibirsk Academgorodok"** [79] supports four areas: information and communications technology; biotechnology and biomedicine; instrument engineering; nanotechnology and new materials. By 2014 in this technopark there must be more than 11500 jobs.

5. **"IT-Park" in Kazan** [80] and Naberezhnye Chelny [81] supports the companies in the sphere of information technologies. In Naberezhnye Chelny there will develop such directions as: space technologies; strategic information technologies; information technologies in mechanical engineering. By 2014 in Kazan, the number of jobs of the technopark must be 1200, the volume of annual income of the residents - 1, 729m billion rubles, in Naberezhnye Chelny, respectively - 1,600 jobs and 1, 729m billion rubles.

6. **"Technopolis "Himgrad"** [82] in Kazan supports innovative companies in areas such as: low-tonnage chemistry and processing of polymers; energy saving technologies; nanotechnologies, creation of perspective materials and components; medical technology.

Among the technoparks which are still under construction, but certified by the Ministry of communications, are the following:

7. **Technological Park "Obninsk"** [83] is developing in the following directions: IT; biotechnology and pharmaceuticals; nanotechnology; nuclear technologies and radio medicine; new technologies and materials. By 2014 in the technology park should be created around 800 jobs, the annual proceeds of residents about 2.7 billion rubles.

8. **"IT-Park Ankudinovka"** [84] in the Nizhny Novgorod region, the main directions of support in the areas of: information and communication technologies; bio - and medical technologies; instrument-making, mechanical engineering, electronic engineering; chemical technology and new materials. Planned figures by 2014: 1750 jobs; the total annual revenues of residents is about 37 billion rubles.

9. **"Technopark of high technologies"** [85] in the Penza region is developing in the following directions: IT; development and production of hi-tech medical products; instrument engineering. Indicators by 2014: 1,500 jobs; volume of annual receipts of residents - 2 billion rubles.

10. **Zhiguli valley** [86] in Togliatti specializes in the fields of it and engineering. By 2014 in the Technopark will be 1,500 jobs, the annual revenues of residents will amount to 2 billion rubles.

11. **Technopark "Pushchino"** [87] in the science city Pushchino in Moscow region will support innovative projects in the sphere of high technologies: biopharmaceuticals, biomedical technology, agriculture and forestry biotechnology, bioinformatics, biological and medical devices and biotechnology of deep processing of raw materials for light and food industry, production of food enzymes, testing and analysis of composition and purity of organic and inorganic materials and substances, energy-saving technologies. The technological bases of the technopark are the research institutions and enterprises making a basis of modern biotechnology cluster of innovation infrastructure of Russia.

12. **Technopark "Green valley"** in the Tambov region is created without support from the Federal budget; its main directions are agro - and biotechnology.

In addition to STPs, certified by the Ministry of communications, at present, the following ones are also often included in the list of technoparks:

1) Technopark "Zelenograd" (Moscow)
2) Technopark "Strogino" (Moscow)
3) Technopark of Russian University of Chemical Technology (Moscow)
4) Industrial Park "Ingria" (Saint-Petersburg)
5) Technopark Of Saint-Petersburg Forestry Engineering Academy (St. Petersburg)
6) Technopark "Smolenka" (Saint-Petersburg)
7) Technopark "Sarov" (Sarov)
8) Technopark "RusLandGroup" (Voronezh)
9) Technopark "Alabuga" (Tatarstan)
10) Technopark "Idea" (Tatarstan)
11) Technopark "Idea-South-East" (Tatarstan)
12) Technopark "Instrument Engineering" (Yekaterinburg)
13) Technopark of Irkutsk State Technical University (Irkutsk)
14) Technopark Kuban State University (Krasnodar)
15) Industrial Park "Kaluga-South" (Kaluga)
16) Industrial Park "Worsino" (Kaluga)
17) Technopark "Grabtsevo" (Kaluga)
18) "The high technology Park" (Khanty-Mansiysk)
19) Technopark "Dubna" (Dubna)

The founders of technoparks in Russia are usually universities or research organizations (design offices or research institutions).

5.1.2 The Skolkovo project

One of the important elements of innovation infrastructure has become "The SKOLKOVO Project", launched on 28.09.2010, with the release of the Federal law № 244 "On the innovation Centre SKOLKOVO [88].

This project is implemented by the SKOLKOVO Foundation (the full title is "The development Fund of the Centre for development and commercialization of new technologies").

Territorial infrastructure and mechanisms of interaction of participants of the Project constitute the ecosystem of SKOLKOVO.

The expected result of the project is self-governing and self-developing ecosystem, favorable for business development and research, promoting the creation of companies that are successful in the global market.

The Innovation center SKOLKOVO " (hereinafter - IC SKOLKOVO) has been created for:

- development of the sphere of research and development (R&D);
- commercialization of results of R&D;
- formation of favorable conditions for the innovation process.

The basic concept of IC SKOLKOVO is to provide scientists, designers, engineers and businessmen together with the participants of educational projects, work on creation of competitive science-intensive developments of the world level in five priority areas, each of which creates the cluster:

1) energy efficiency and conservation (EEC);
2) nuclear technologies (NT);
3) space technologies and telecommunications (STT);
4) biomedical technology (BMT);
5) strategic computer technologies and software (IT).

According to the plans of creation and development of SKOLKOVO infrastructure, it should contain functional and providing elements presented in Fig. 5.3.

All the clusters of IC SKOLKOVO aim at achieving the following administrative tasks:

1. The involvement and support the development of innovative projects and startups in accordance with the technological priorities of the cluster.

2. Support for the preparation of projects for grant financing and attracting of venture investors in the projects.

3. The involvement of international partners, like the leading research centers and technological corporations - leaders of the market, formation of joint projects with Russian companies.

4. Support for commercialization of engineering developments of the companies participating in domestic and foreign markets, including the integration of Russian companies into the global production chain.

5. The development of network interaction formats, including coordination of technological platforms on the clusters' fields.

The main goal of the **IT cluster** is connected with introduction of innovative technological solutions to reduce energy consumption by industrial objects, housing and municipal infrastructure. It is important to develop the areas in which Russia has a competitive advantage and also the innovation trends in the energy sector.

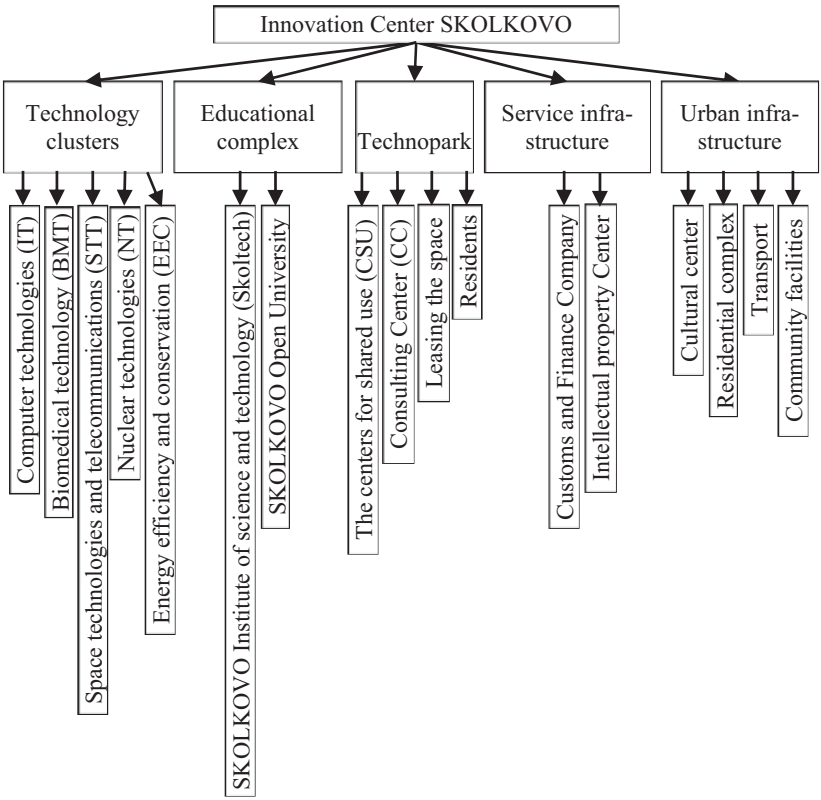

Fig. 5.3. The infrastructure elements of the IC SKOLKOVO

The priority directions of the **Energy efficiency and conservation cluster's** work are grouped in two directions - generation and energy consumption, in particular:

1. Materials and technologies aimed at reducing losses in heating mains and in transmission of electricity (superconductivity technology, energy storages and others).

2. Technologies of accounting of energy resources by generation and consumer;

3. Increasing efficiency in the field of renewable energy sources.

4. Materials and technologies aimed at improving energy efficiency of buildings and structures, industries.

The purpose of activity **NT-cluster** is to support non-power applications of nuclear technologies and implementation the capacity of the industry to

the transfer of technologies formed in the course of the development of nuclear science and nuclear energy in other industries.

Research areas of the NT-cluster:

1. Technologies using the development of nuclear science.
2. Radiation technologies (in industry and medicine).
3. Technologies of creation, modification and certification of materials.
4. Technology of mechanical engineering, instrument making and new microelectronics (accelerators, lasers, microwave electronics and others).
5. Technologies of designing, modeling and engineering of complex technological objects and systems.

The **STT-cluster** provides search, mobilization and selection of potential actors of the innovation process in the field of creation and operation of space systems and diversification opportunities rocket and space industry, supports their interaction and creates conditions for formation of a full cycle of the innovation process. Participants of STT-cluster implementing projects in the field of space technology and telecommunications work in the direction space-to-Earth and Earth-to-space.

Foresight forecast of the cluster has identified 41 priority areas, grouped into 5 sections:

1. Products and services with use of possibilities of space means.
2. Elements and systems for ground and space segments of space systems.
3. Industrial and research technologies and software for the aerospace industry.
4. Priority directions of development of telecommunications.
5. Integrated aerospace technologies.

The main task of the **BMT-cluster** is to support innovation in the area of biomedical technologies. In the concept of cluster the best practices of the leading scientific centers were taken into account, as well as suggestions and recommendations of representatives of scientific and business communities.

Research areas of the BMT-cluster:

1. Materials, devices and products that alter the structure and function of biological tissues for therapeutic purposes.
2. Devices for diagnostics and monitoring of physiological parameters' condition, collecting patients' information, medical Informatics.
3. Methods of radio-beam diagnostics and therapy.
4. Personalized and translational medicine, biomarkers.
5. Cell technologies: treatment based on stem and mature cells.
6. Anti-inflammatory drugs and medicine for the immune system.
7. Antibacterial drugs, diagnostics and antimicrobial vaccine.
8. Antiviral diagnostics, vaccines and medicines.
9. Cancer diagnostics and medicines.
10. Diagnostics and drugs for fight against cardio-vascular pathology.
11. Endocrinology diagnostics and medicines.
12. Neurological diagnostics and medicines.
13. Tools for DNA and protein sequencing, analysis of the obtained data.

14. Tools of comparative genomics, pharmaco - and immune - genetics.

15. Computer systems and tools of computer modeling in biology.

16. Algorithms of image analysis of cells, tissues and organs.

17. Methods and models of integrated data analysis of proteomics, metabolomics and others.

18. Modeling of the structure, functions and interactions of biological molecules.

The main goal of the IT-cluster is creation of a complete ecosystem for the development and commercialization of innovative projects in the IT industry in Russia. To achieve this goal, the cluster provides:

support projects of participants of the IT-cluster on the most critical stages of the life cycle;

promoting the commercialization of research of participants of the IT-cluster, using the opportunities of the IC SKOLKOVO;

concentration of resources and competencies through the partnerships with Federal agencies of Russia, major international companies, scientific institutions and innovation centers, venture investors, as well as with existing Russian development institutions.

Research directions of the IT-cluster are:

1. New system of searching and recognition.

2. New tools for development and testing.

3. Development of technologies of communication and navigation.

4. New ways of storing, processing and transmission of data.

5. Development of new high-performance systems of data computing and storage (algorithms and applications).

6. Secure information technologies.

7. Widespread and cloud computing.

8. Processing and analysis of large datasets (distributed processing, modeling of complex engineering solutions).

9. New man-machine interface.

Technopark SKOLKOVO was established in 2010 and it is one of the key elements of the SKOLKOVO ecosystem, providing innovative companies-participants of the IC SKOLKOVO support for development of technological assets, facilitating their establishment in Russia and on global markets.

The main goals of the STP SKOLKOVO are:

- to create a research infrastructure for the participants of the IC SKOLKOVO, startups and other research institutions in Russia;
- to ensure the recruitment of the required number of candidates for member status of SKOLKOVO to maintain the required number of startups in the ecosystem.

The centers for collective use (hereafter CCU) are to provide startups with technology services. By the beginning of 2014 the CCU consists of 16 companies, equipped with the most modern equipment and providing services in such activities as:

- prototyping;
- development of the equipment;
- machining process;
- metrology;
- spectroscopy;
- microscopy;
- materials science;
- development of medicines;
- clinical trials:
- quantum optics;
- production of electronic equipment.

Consulting center provides operation in the following areas:

- Information support of the SKOLKOVO project participants.
- Information support and assistance to the applicants for membership of the SKOLKOVO project.
- Help in registration of the application for preliminary examination of the innovation project.
- Advising on registration of a new legal person while getting the participant status in SKOLKOVO.
- Consultations on questions of receipt of the grant.
- Providing visa and migration services, including:
    - Assistance in obtaining work permits.
    - Assistance in obtaining work and business invitations.
    - Assistance in obtaining (prolongation) of visas to foreign the experts.
    - Assistance in the notification of state bodies.

Residents in the IC SKOLKOVO are the key elements, purpose and place of application of all infrastructure services in SKOLKOVO. General algorithm of admission of candidates to the residents of the IC SKOLKOVO is shown in Fig. 5.4.

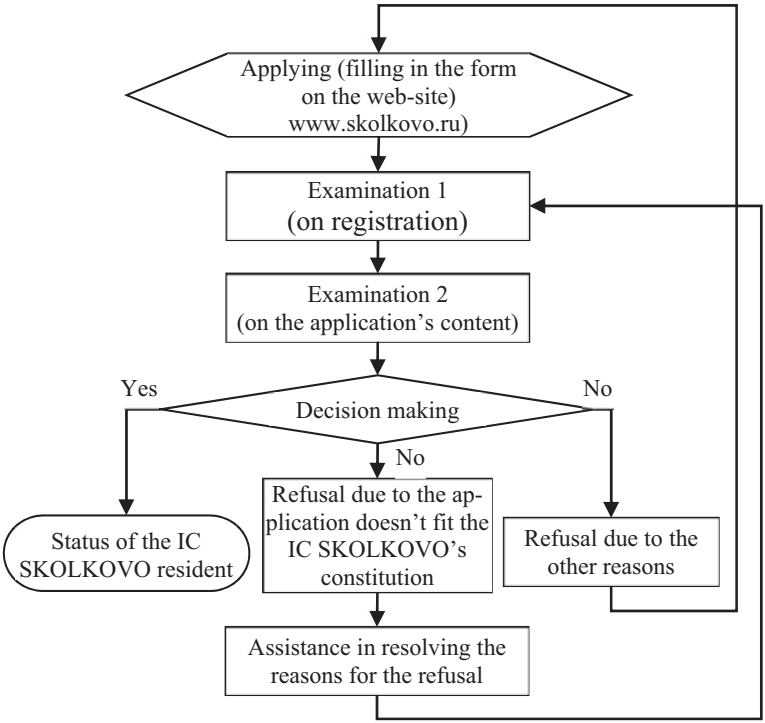

Fig. 5.4. The order of admission to the residents of the IC SKOLKOVO

The applicants must meet the following range of conditions:

1. **Form:** Russian legal entity.

2. **Constitution:** research activities only for one of the five activities of the clusters.

3. **The amount of capital and period of existence of the company:** no restrictions.

4. **Term and procedure of consideration of applications:** the average period of 32 days. Applications shall be submitted on the portal (web-site). There are two expertise held on the documents: correctness of execution and in essence.

5. **Benefits for residents:** on profit tax, income tax, social transfers, customs privileges for import of equipment (Fig. 5.5).

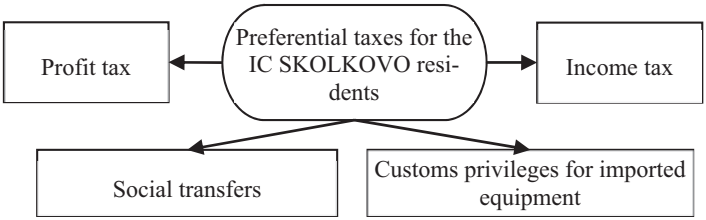

Fig. 5.5. Types of preferential taxes for the residents of the IC SKOLKOVO

6. **Examination of projects of potential residents:** expert board consists of 10 independent randomly selected experts of the selected cluster (50% Russian and 50% foreign experts); decision is accepted, if in the voting involved more than 5 experts; the project is considered by three criteria: innovativeness (including the possibility of commercialization), responding the direction of cluster and the presence of foreign specialist in the team. The project is accepted, if for each of these criteria the potential resident got more than 50% (Fig. 5.6).

7. **The limit of financing of the project:** if up to 1.5 million rubles a decision is made at the cluster level; 1.5 to 300 million rubles - in the competence of the grants Committee, but for every 3 rubles of grant co-investor, attracted by resident, gives one ruble (i.e. the ratio of 3:1); for sums of 30 to 150 million rubles - 1:1 ratio; for sums of 150 to 300 million rubles - 1:3. The gradation of the terms of the grant is shown on Fig. 5.7.

8. **The order of financing of the project:** the money is being issued (Fig. 5.8) depending on the degree of implementation of the project. After the implementation of the next stage of the project grant Committee decides whether the target is achieved and makes the decision on continuing the funding. If not, the resident is obliged to return only funds from the grant, which they didn't use.

9. **Protection of intellectual property rights:** as part of the IC SKOLKOVO there were specially established the Centre for the protection of intellectual property rights, which provides support for the property rights of the residents (all rights belong exclusively to the authors).

10. **The limit on the number of residents:** no statutory limit.

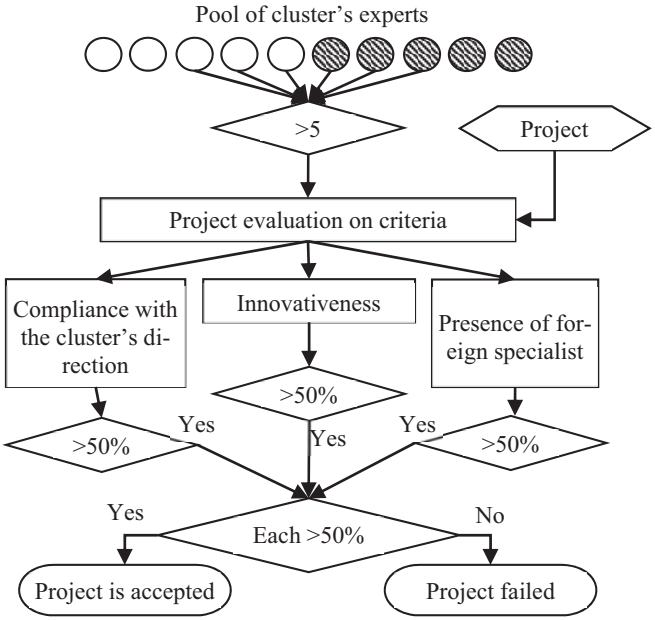

Fig. 5.6. The algorithm of the projects examination in IC SKOLKOVO

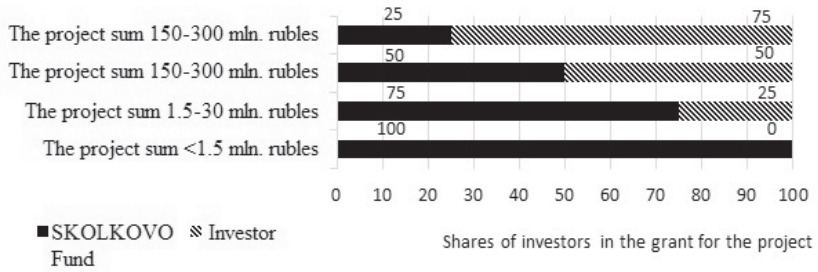

Fig. 5.7. Grading of investments of SKOLKOVO Fund in the grant for the project

11. **Questionnaire for an application:** the Questionnaire consists of 7 parts:

a. General part (contact information and summaries of the project);

b. The problem and its solution (problems of the industry, supported with references to research; a description of how the proposed product or technology will be able to solve these problems);

c. Technology (description of the areas of applied research);

d. Scheme of commercialization and competing solutions;

e. Personnel (description of the experience, skills and abilities of key players in the world scale);

f. Resources (description of the history of project, the dynamics of development, obtained investments);

g. Goals and objectives (project implementation plan).

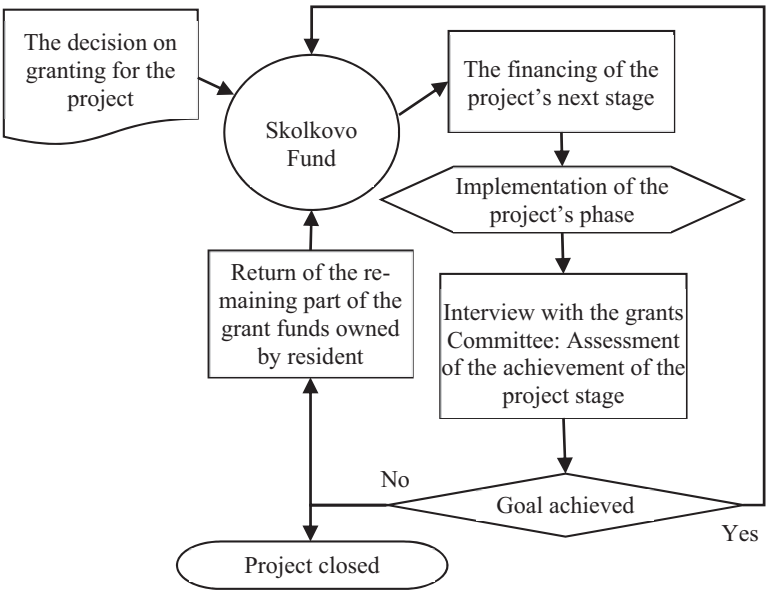

Fig. 5.8. The algorithm of phased financing the projects of the residents with the allocated grant by SKOLKOVO Fund

Urban infrastructure of the IC SKOLKOVO is constructed with the latest trends in urban science.

SKOLKOVO is not just an innovation center, but also a full-fledged city, which creates optimum conditions for scientific research and business, as well as attractive urban environment, convenient for visitors and residents. The main core elements should become the University and the Technopark. Next to them there Congress center, office and laboratory buildings, apartment houses and cottages, sport facilities and shops are being built. Special attention is paid to the parks. Urban planning will ensure the proximity of the housing to the place of work.

The transport network will provide fast moving (30-40 minutes) to the Central part of Moscow. The city is built so that its residents and guests in most situations could get around on foot or on bicycles, thereby reducing the need for public transport. Vehicles using internal combustion engines completely banned on the territory of the city.

According to the SKOLKOVO plan there will be about 21 thousand people on an area of about 400 hectares (in close proximity from Moscow ring road, in 1.5 km). The total number of employees (including visitors from Moscow and Moscow region) will amount to 31 thousand people. The main program of building SKOLKOVO will be completed in 2015.

SKOLKOVO's engineering systems should ensure economical use of resources. Many service functions (e.g. cooling) are centralized, as required by the modern notions of efficient municipal services. For water and heat supply there will be involved ground water, treated wastewater, rainwater. Significant cost reduction will contribute to the "Smart city" system, which optimizes traffic flows, manages the city's lighting, ventilation, and helps enterprises and households to control energy consumption.

SKOLKOVO is being built as an ecologically sustainable city with low or zero emissions of substances harmful to the environment. Household and municipal waste will be carefully sorted and completely disposed in the most environmentally friendly way.

Buildings in SKOLKOVO will consume on average 30% less electric power, heat and water compared with other buildings under construction in Russia. Beyond simple energy efficiency, the innovation center will have energy passive and active buildings, which almost do not consume energy from external sources or even produce more than consume. It is supposed not less than 50% of the city's required energy to be produced from renewable sources.

Educational infrastructure of SKOLKOVO is represented by two universities.

SKOLKOVO Open University (SOU), the purpose of which is creation and development of community of talented young people with scientific-technological and entrepreneurial competencies, with help of which the IC SKOLKOVO and innovation ecosystem of Russia as a whole should receive a stream of qualified personnel and technology startups.

SKOLKOVO Institute of Science and Technology (SIST), a non-governmental educational research institute, created in 2011; with the participation of the Massachusetts Institute of technology (construction of the entire complex will be finished in the end of 2015). SIST prepares new generation of researchers and entrepreneurs, generating new scientific knowledge and introducing innovations in life.

The performance and development of the IC SKOLKOVO

By the beginning of 2014, the establishment of the planned infrastructure of the SKOLKOVO project was not completed yet; its functional elements have not yet withdrawn its designed capacity. However, the basic processes of support for innovative enterprises are already functioning, that gives the basis to assess the current values of key indicators. Official portal of the IC SKOLKOVO publishes regular reports on its activities. Here (table 5.1) are the basic values of the KPI (key performance indicators) at the end of the 3rd quarter of 2013 [89].

The number of applications for resident status of the IC SKOLKOVO and for the preliminary examination of the project during the whole period of the SKOLKOVO project (2010-2013) was 5 309 units, among them for 10 months of 2013 there were 1 231 units.

Table 5.1 Current indicators of the IC SKOLKOVO performance

KPI	*Unit*	*Plan*	*Data*	*Comments*
Indicators on residents				
The number of applications for registration of objects of intellectual property created in the IC SKOLKOVO	pcs	170	839	During 2013 residents filed 839 applications for registration of objects of intellectual property; there were received 406 titles of protection.
The share of external co-financing, attracted for realization of the projects of residents (% of total funding)	%	50	47	Since the beginning of 2013 there were approved 35 grants: 1 – of the stage 3 (with co-financing ≥75%) 9 - of the stage 2 (with co-financing ≥50%) 10 - of the stage 1 (with co-financing ≥25%) 15 - of the mini (do not require co-financing)
The relevance of the foresights: The number of integrated foresights to the total number foresights	%	65	84	
Revenue of residents, obtained from the	milli on	2	8	

KPI	*Unit*	*Plan*	*Data*	*Comments*
results of research activity	rubles			
The total number of jobs created	thousands of pcs.	7.4	2.1	For 9 months of 2013 the companies became residents in 2013, created 1394 work places. Residents, who became such in 2010-2012 created 685 work places.
The number of jobs created in the R&D centers of key partners, the formation of which on the territory of "SKOLKOVO" reached agreement	pcs.	500	370	
The involvement of venture investors (VI): The share of investments from accredited VI in the total volume of investments of residents in relation to the share of residents who attracted external funding from partners	%	20	25.3	
Fund's Indicators				
The average time of decision making on granting: a) resident status in the procedure of preliminary approval;	calendar days	a) 40 b) 30 c) 70	a) 30 b) 25 c) 65	

KPI	*Unit*	*Plan*	*Data*	*Comments*
b) member status without prior approval; c) grants to participants.				
The budget of the SKOLKOVO Fund (except budget for the construction of an innovative city and payments for SIST)	+/- %	+10	-52%	
Online community				
The percentage of attracting new members of the online community (the ratio of registered accounts to the total number of unique visits)	%	1.5	2.3	

As for 31.10.2013, in the IC SKOLKOVO worked 1010 accredited residents, their distribution by clusters is shown in Fig. 5.9, and the distribution of their main number (over 90%) according to the regions of the RF is shown on Fig. 5.10.

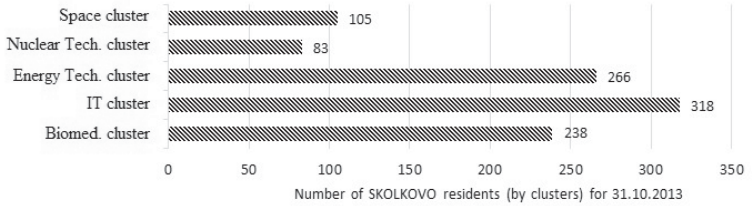

Fig. 5.9. The number of residents of the IC SKOLKOVO at the end of 2013 by clusters (total amount - 1010)

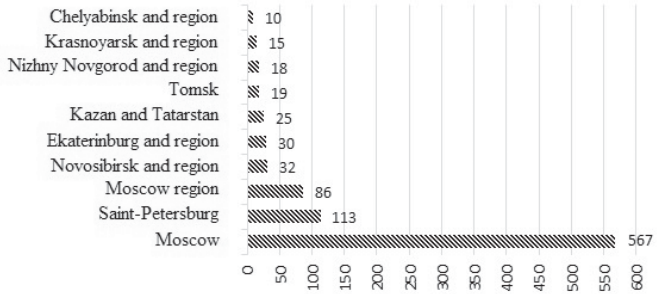

Fig. 5.10. The distribution of residents of the IC SKOLKOVO (>90%) by subjects of the RF (by the end of 2013)

The number of grants approved for allocation for the period 2010-2013 was 218 pieces, 98 of them are mini-grants (up to 1.5 million rubles, does not require a decision of the grant Committee). In 2013 there were approved 35 grants, 6 of them - in October. The average share of co-financing projects (at the expense of investors, attracted by residents) for the same period amounted to about 45%.

Amounts of funding (grants) by SKOLKOVO Fund for approved projects by year and amounts listed are shown on Fig. 5.11 (amounts for 2013 are for 10 months).

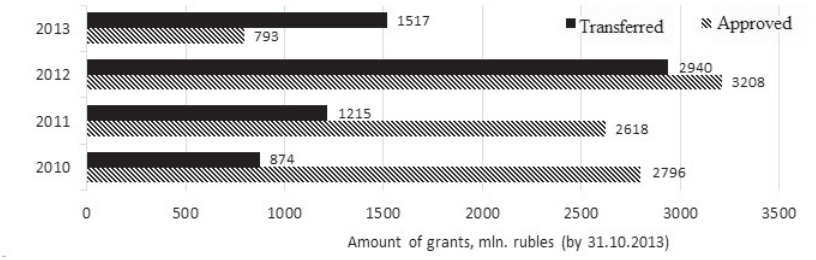

Fig. 5.11. The amount of financing of the projects of residents by year

The distribution of the amount of grant funding of projects in 2013 (for the first 10 months) by clusters is shown in Fig. 5.12.

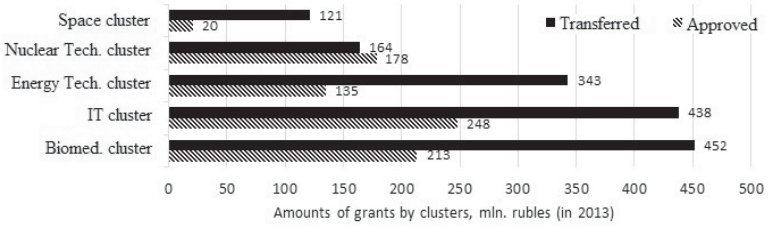

Fig. 5.12. Financing of the clusters' residents in 2013

An important role in building an ecosystem of SKOLKOVO, same as for any other similar entities, is played by key partners, which by the end of 2013 included 35 companies, including 22 large international companies (Nokia, Siemens, Microsoft, EADS, Ericsson, General Electric, Nokia Siemens Networks, Cisco, EMC, Schneider Electric, Honeywell, Alstom, Intel, IBM, SAP, Boeing, FORD, Johnson&Johnson, Samsung, Danfoss, Accenture, Dow Chemical) and 12 Russian companies (KAMAZ, RU-COM, USC, "Composite", ISS them. Reshetnev, AFK "Sistema", "Renova", Tatneft, "Rosatom", "LUKOIL", Transmashholding, TMK, Dauria Aerospace).

Foreign companies planning to build R&D centers on the territory of the IC SKOLKOVO, the total number of employees of which at the end of 2015 will amount to more than 1,600 people, the amount of the invested funds at the same time will be about 18 billion rubles

The main KPIs as of the end of 2013 are given in table 5.2.

Table 5.2 Main key indicators of the IC SKOLKOVO

Indicator	*Value*
The number of companies - key partners of SKOLKOVO	35
The number of corporate R&D centers, planned for placement in SKOLKOVO	30
Estimation of number of employees in R&D centers for 2015, people	3 511
Assessment of the total budget of R&D centers until the end of 2015, billion rubles	32.9

Indicator	*Value*
Assessment of the current number of employees in R&D centers	1 138
The number of corporate venture funds, donor members of SKOLKOVO (NAVI and Columbus Nova ("Renova"), Intel Capital (Intel))	3

The dynamics of the amount of agreements with venture investors is shown in Fig. 5.13. Binding funding contracts were signed for amounting to 1.14 billion rubles, of which the share of foreign investors is around 25%. The number of residents receiving support from accredited investors is 96, 17 of which received support from foreign funds.

The SKOLKOVO project are developing for four years, and in two years it should reach its full capacity, i.e. all construction work should be completed [75]. Although this is true only for building area. Construction, equipment, updating of research centers and laboratories with equipment will never end because this process is permanent and it's underlying the scientific research and development. At some stages of development there is a need also for territorial development, possibly in the form of other regional clusters.

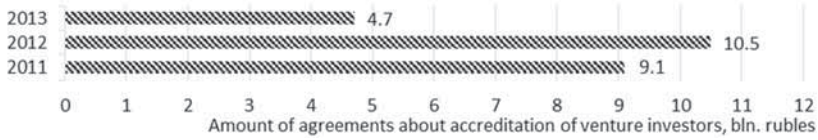

Fig. 5.13. The amount of accreditation agreements of venture investors in the IC SKOLKOVO

Estimations made by different experts of innovative processes in Russian economy and in particular of the SKOLKOVO project, as the Russian Silicon valley, vary greatly, from very optimistic to sarcastic. Comparison of actual statistical values of key indicators of the Russian innovation centers, technology parks and other elements of innovation infrastructure, provided in this chapter, with the corresponding indicators of the advanced economies, given in the chapter 4 of the study, shows a clear backlog of the levels of innovation infrastructure development. However, the growth rates and traditional intellectual potential provide the basis for the optimistic forecast of innovative development of the Russian economy.

5.2 CONCLUSIONS

In this chapter we analyzed the Russian policy about science and technology parks, examined the main characteristics and examples and took a close look at the Russia's most fast in growing project – Skolkovo project, its elements, performance and development.

6 SMALL ENTERPRISES AS THE MOST FLEXIBLE AND ACTIVE ELEMENT OF THE INNOVATIVE DEVELOPMENT

6.1 SMALL ENTERPRISES, THEIR ROLE IN THE COUNTRY'S ECONOMY

In the modern world small business is an integral structural and functional element of any national economy.

In developed countries the share of small and medium business in GDP is 50-65%, this is the area for up to 80% of the working population and there is a significant share of new jobs created in this area.

In Russia the number of small enterprises, their share in the gross domestic product and the number of people employed in them is 3-4 times lower than in countries with a developed market economy. However, in the pre-crisis years, GDP growth in Russia has been provided mainly by small enterprises. In the next ten years the share of small business in GDP is projected to increase to 40% [33]. At the same time the extent of the downswing and the unemployment rate in some regions of Russia reached the level, when the implementation of active programs for support and development of small business today takes the leading place among other problems of economic development. An important feature of small business is that of all areas of modern structural policy the development of small business is the least capital-intensive.

Except for these features small business has such important property as mobility. Small enterprises if necessary can be created and closed, without significant losses and/or socio-economic impacts. This property usually is the most significant for innovative startups, where the risk of inefficiency is very big, and therefore the damage from stop working for unsuccessful startups is not significant, while the positive impact on successful development can be very significant. Statistical reports of the European network of innovation centers (EBN BIC) show [7] that emerging startups usually are in a form of micro-enterprises with 1-2 people working. Large corporations also create small businesses startups, in particular, in cases when there is a need for implementation of R&D in some new field, not peculiar to the corporation and fraught with great risk. However, in case of positive result, the corporation receives a new technology and/or product without significant cost.

6.1.1 Small enterprises in the world

Today there is no unified definition of small business/enterprise. The EU uses the concept of "medium, small and micro - enterprise" [101]:

- **medium enterprise** has from 50 to 249 people, turnover not exceeding EUR 50 million or a balance-sheet total not more than 43 million euros;

- **small enterprise** has from 10 to 49 people, turnover is not more than EUR 10 million, or a balance-sheet total not exceeding 10 million euros;
- **micro-enterprise** has no more than 9 people, turnover or balance sheet total is not more than 2 million euros.

Small and micro enterprises are small enterprises.

In Switzerland, small enterprise is a company with 1 to 200 people and an annual turnover not exceeding EUR 20 million.

In the USA, Canada, Japan, and China criteria of attribution of companies to a category of small enterprises are established for each sector individually. For example, in the US store has the right to belong to small enterprises, if employing not more than 50 people and industrial company may be considered small with a staff of up to 500 people.

In Japan, the shop can be considered a small business, only if it has up to 5 people.

In China a wholesale company has the status of small business with a turnover of 30 million yuan and the number of employees up to 100 persons.

The vast majority of small enterprises in the EU, USA, China, India and Brazil are micro-enterprises employing not more than 5 people. And the main organizational form of it is private/individual entrepreneurs.

In the EU from all set of existing enterprises, small firms make up 87% (or 21 million enterprises).

In the economies of China, India, Brazil and South Korea, the share of small enterprises amounts is 80-90%.

In India small enterprises (small scale industries (SSI)) include such companies [102] whose share capital (machinery, buildings, equipment - everything that can be used for more than one year) does not exceed 30 million rupees (about 667 thousand dollars). The number of small enterprises in India is more than 3 million, having about 80% of hired workers throughout the Indian industry.

The merits of small business in India are that for the last 10 years industrial production increased on 50% and export of high-tech products increased on 65%. To the specifics of the Indian economy is abundant and cheap labor force while culture of labor is high there. The GDP of India is the fifth among the leading world economies, ahead of France and the UK.

Indian business has an attractive investment image for foreign investors, who are attracted mainly by such areas of the Indian economy, as the production of electrical equipment and automobiles, telecommunications, metallurgy, chemical industry and pharmaceutics.

The main spheres of activity of small Indian companies are: farming, information and high-tech. But small businesses are also active in areas such as: cotton and silk weaving; manufacture of products from coconut fiber; the grinding of grain; production of unrefined sugar and vegetable oil; soap; the production of pottery, glassware; manufacture of jewelry and forging products. One of the special features of small Indian companies is to uniting them

in groups according to different principles: clan; professional; production and others.

In India state plays a great role in the development of entrepreneurship, by helping working or newly created companies. An important role is played by trade and industrial chamber. All small business support is planned for 5-10 years by Planning Commission of India. The main state aid is the development of export activities of small companies, as well as attracting foreign investments into the sphere of their activities. In addition, small firms receive tax and customs benefits, lower rental rates, grants and concessional financing.

The essential problems of the Indian business are: high bureaucratization; corruption; excessive "regulation" of all stages of registration and operation of companies. Although, it should be noted that 10 years ago in India all enterprises were doing tax reporting via Internet.

In China's economy small business plays a very important role [103, 104]. To the category of small enterprises fit the companies with number of employees up to 100 people (almost 99% of the total number of enterprises). Medium-sized enterprises are companies with number of employees from 101 to 999 people (their share is only 0.6%).

In 2003 at the XVI Congress of the Communist party of China approved the program of socio-economic development of the country till 2020 according to which the GDP in comparison with 2001 by 2020 should grow four times, which will serve as a base supporting fundamental modernization of China's economy by 2050 and turn it into a rich country.

2005 was the year of rapid development of small business in China, its profitability has increased. There were more than 4.3 million small and medium enterprises and 27.9 million private enterprises, employing more than 75% of the employed population. These enterprises accounted for 99.6 % of the total number of enterprises in the country, which accounted for almost 60% of GDP and 74.7% of the value added of industrial production.

The sector of small and medium business in China owns 65% of patents, 75% of technical innovations and more than 80% of new products. The share of small enterprises accounted for 46.2% of tax revenues across the country and 62.3% of the total exports of China.

The body of the economic policy of China is the National Development and Reform Commission (NDRC). One of the most important activities of the Commission is to create conditions for dynamic development of small and medium enterprises (SMEs), for this purpose the composition of the NDRC has "Department of small and medium entrepreneurship" and The China Center for Business Cooperation & Coordination (CCBCC). The center has developed a number of ongoing state support programs for SMEs, has established a national network of agencies for the comprehensive support and service for SMEs, their cooperation with foreign organizations. The center provides assistance in:

- draw up the development policy;

- organization of trade fairs, exhibitions and conferences;
- business negotiations;
- training;
- information services;
- consultation and business diagnostics.

For information service of the population of China and all state bodies on the questions of activity of SME in 2001 there was created a state non-commercial information service ("China SME online" - CSMEO), its web-site is a very popular platform, that provides active informing for the business community and cooperation with thousands of agencies and service companies. In addition, CSMEO:

- publishes information on important scientific and technical achievements, patents and new technologies;
- informs on the procedure of establishment of the enterprise;
- advises entrepreneurs;
- provides information on the activities of financial institutions;
- provides technical and commercial information about the members of different unions of entrepreneurs;
- disseminating information about the work experience of the most successful enterprises;
- assists in the development of e-business;
- develop training programs and assistance to startups in the establishment of business;
- coordinates the activities of training courses and programs;
- provides a wide range of technical services:
    - e-mail;
    - search engines;
    - selection of thematic information;
    - operational research;
    - video conferencing;
    - creation of web-sites;
    - free information services;
    - distance learning;
    - creation of electronic libraries and databases for SMEs.

6.1.2 Small enterprises in Russia

In Russia using the opportunities of small and medium business is becoming an important priority of state policy. A main legislative act now is the Federal law "About development of small and medium entrepreneurship in the Russian Federation" dated July 24, 2007 № 209-FZ [105].

Category of an enterprise is determined by the number of employees: micro enterprises - not more than 15 people, small enterprises - from 16 to 100 people, medium-sized enterprises - from 101 to 250 people.

In addition to the number of people, there is also the second parameter, which is the classification of categories of enterprises by the amount of revenue, was put into effect by the decree of the RF Government of July 22, 2008 № 556, "On the limit values of the revenue from sales of goods (works, services) for each category of small and medium entrepreneurship" [106], according to which the ultimate value of revenue from realization of goods (works, services) for the prior year, excluding the value added tax for the following categories of subjects of small and medium business is set in the following amounts:

1. micro-enterprises: 60 million rubles (about 1.5 million USD);
2. small enterprises: 400 million rubles (about 10.5 million USD);
3. medium-sized enterprises: 1000 million rubles (about 26.3 million USD).

To refer to micro and small enterprises there is often being used a single term, small enterprises. All three categories of enterprises are commonly called, as in most other economies, medium and small enterprises (SMEs).

As at the year 2012 there are more than 3.7 million small and medium enterprises (SMEs) in Russia, employing over 17 million people. The share of SMEs in the Russian economy is more than 20 % (by turnover). The state provides a variety of measures to support SMEs, for these purposes, for example, in 2009 it was allocated more than 4 billion rubles.

The measures of state support to SMEs include, in particular:

- subsidizing interest rates on bank loans;
- creation of guarantee funds, designed to provide guarantees to banks for loans to SMEs;
- supporting the regional programs of development of the SMEs.

Worldwide SMEs can work, doing not only traditional business, but also innovative activity, remaining in the category of SMEs. The latter are usually referred to small innovative enterprises (SIE). In turn, the SIEs can work in a traditional environment, and also can be within technoparks, business incubators and other support systems for SIEs. All these three options of SME existence give them the right to use different (typical for each category of SME) forms of state support.

The use of innovations allows SMEs to move from one category to another, thus increasing their competitiveness and efficiency.

However, in addition to the positive aspects that contribute to the progress of SMEs, they have some restraining properties; the basic ones are given in table 6.1.

Table 6.1 Stimulating and restraining properties of SMEs

Groups of properties	*Properties*	
	Stimulating	*Restraining*
Economic	- Quick response to changing of consumer demand; - low overhead expenses; - flexible reaction to scientific and technical achievements.	- High level of risk; - high cost of innovation; long payback period of the innovations; - limited financial resources; - low capacity of external funding, including credit; - limited opportunities to meet the massive demand.
Organizational	- Operative management decision making; - absence of bureaucratic procedures in the organization; - minimum managerial hierarchy of enterprises; - high work motivation.	- Low professional level of management; - small degree of division of labor and specialization of work places; - lack of synergy effect from joint activities of many structural units.
Production	- Short duration of the innovation cycle; - susceptibility for innovations; - flexibility of the production process; - prudence in the use of resources; - small list of manufactured products or services; - simplicity of the sales system.	- Limited production resources; - limited diversification of production; - difficulties with renting and acquisition of premises.

Let us see all this on the example of the Moscow region and its SMEs.

6.2 SMALL ENTERPRISES IN THE MOSCOW REGION: THE ANALYSIS OF INDICATORS OF INNOVATIVE ACTIVITY

By 2012 [24] is 378 municipalities, there are 36 urban districts, 36 metropolitan regions, 114 urban settlements, 192 rural settlements on the territory of the Moscow region.

Scientific-technical complex of the Moscow region is one of the largest among the regions of Russia. Its main areas of activity are:

- mechanical engineering;
- instrument-making;
- aircraft engineering;
- defense industry;
- rocket and space technology;
- metallurgy;
- ecology;
- medicine;
- agroindustrial complex.

Currently there are more than 85 thousand people in the Moscow region (MR) working in the R&D, more than 200 scientific organizations in more than 80 fields. The territory of the region also has a number of scientific centers of the RAS, the largest of them are:

The Troitsky research center of the Russian Academy of Sciences, which includes institutions for R&D in various areas of theoretical and applied physics;

The Pushchino scientific center of the RAS, working in the biotechnological field;

The Scientific center of RAS in Chernogolovka, which consists of scientific institutions of theoretical and applied profiles in the fields of solid state physics, chemistry, mineralogy, radio electronics and others;

The joint Institute for nuclear research in Dubna.

The MR has three main economic complexes in the following fields:

- construction and building materials industry;
- scientific-technical and industrial;
- agriculture and food industry.

The Moscow region has unique geopolitical position and a great scientific and industrial potential, but has no significant natural resources. The main component of the potential of the MR development is in the R&D of innovative high-tech products and services.

In 2011, the enterprises of the MR produced innovative products, works and services worth more than 103 billion rubles, the growth rate amounted to 17.4% compared with the previous year [98]. The MR is the leader among regions of the Russian Federation (except Moscow) on such positions as:

- the use of innovative technologies;
- number of organizations implementing technological innovation;
- the volume of industrial and agricultural production;

- receipt of taxes and dues to the budget of Russia;
- the turnover of retail trade;
- commissioning of apartment houses;
- volume of paid services to the population;
- volume of the gross regional product.

The structure of GRP of the MR is determined such basic economic activities of the real sector of economy as:

- wholesale and retail trade;
- manufacturing activity;
- operations with real estate, leasing and provision of services;
- repair of motor vehicles, motorcycles, household goods and personal items;
- transport and communications.

The territory of the MR is the place for 9 from 14 science cities of Russia (Dubna, Zhukovsky, Korolyov, Protvino, Pushchino, Reutov, Troitsk, Fryazino, Chernogolovka). In the MR, there is Special economic zone of **technology-innovative type "Dubna"**, several business incubators, technology parks, technology transfer centers, electronic platform of the exchange of intellectual property, Innovation center SKOLKOVO and a number of other objects of innovation infrastructure (under construction and already operating) of Russia. The small innovative enterprises (SIE) in all these objects play a very significant role, providing realization of competitive advantages of the MR in economic development [99].

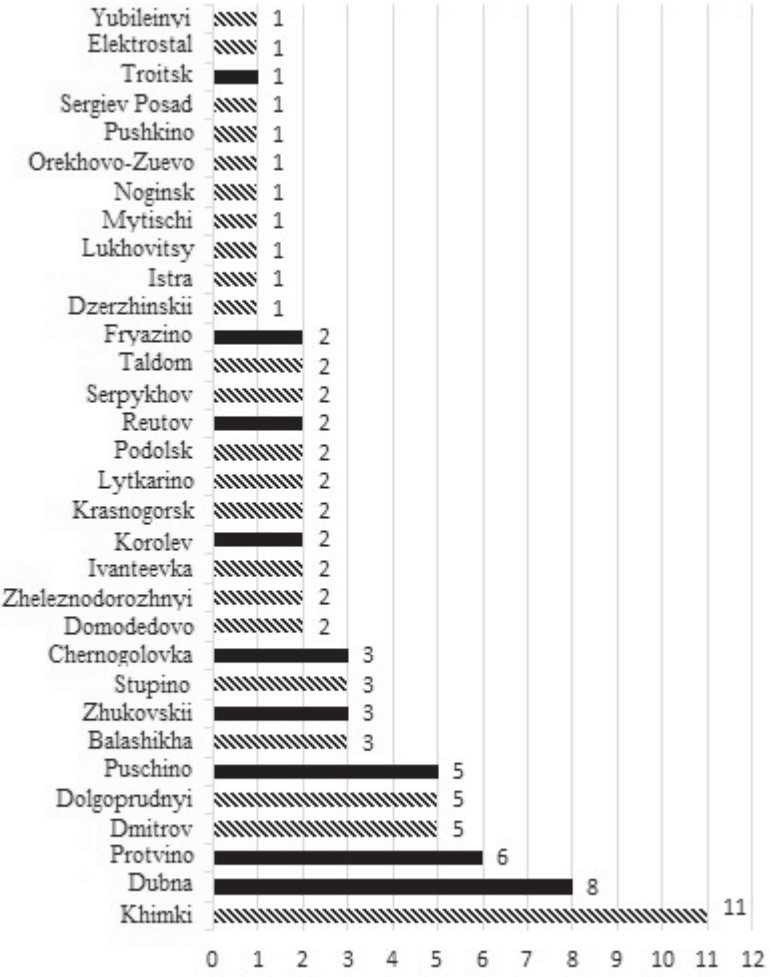

Fig. 6.1. The number of small innovative enterprises in the municipalities of the MR

Fig. 6.1 displayed concentration (number) of SIEs in the municipalities of the MR by 2012 [99], where the science cities are marked with darker shading. The total number of the SIEs is 85 that, at first glance, seem very low for the region. However, considering that innovation can be estimated from a very large number of indicators, the number of SIEs only vaguely reflects the scale of innovation. If compare, for example, with the results given in the report on the technoparks of the North American continent (USA

and Canada) [100], where on average in each of the 108 surveyed university technology parks are created 1-2 startups per year, and only a part of them are innovative, it is clear that the scale of the innovative activity in the MR roughly correspond to the global trends.

Statistical analysis carried out according to Fig. 6.1, showed that there are almost no dependence of the number of SIEs in the municipality on the fact whether they are science cities or not (coefficient of correlation k = 0.25).

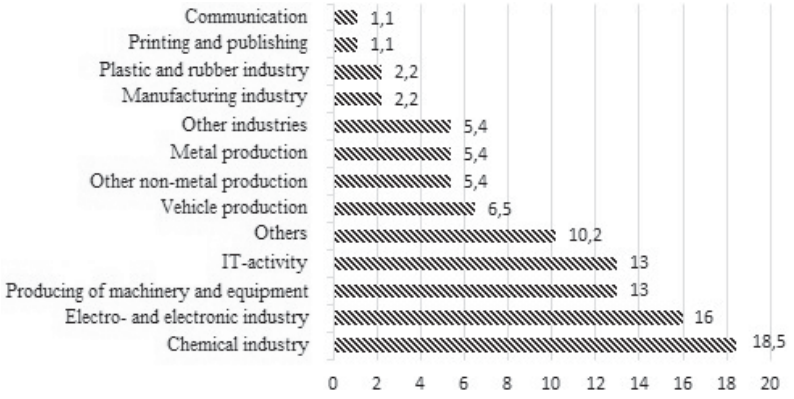

Fig. 6.2. The shares of different activities of SIEs in the MR

The shares of economic activities (according to the sales) of small innovative enterprises of the MR [99] are shown on Fig. 6.2 where you can see that over 60% of high-technology organizations, i.e. chemical industry; machinery and equipment manufacturing; manufacture of electrical equipment, electronic and optical equipment; activities connected with the use of computer technology.

Cost structure of SIEs by type of innovation (product, process, organizational and marketing) according to the data of 2011 [99] is shown in Fig. 6.3, where the share of technological product and process innovations is for more than 90%.

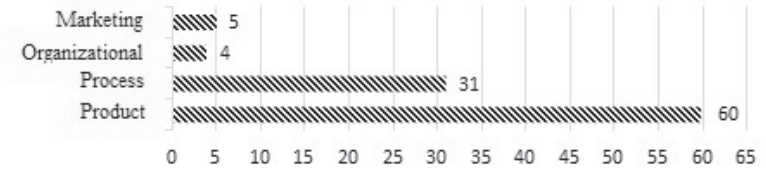

Fig. 6.3. Cost structure of SIEs in the MR by type of innovation in 2011

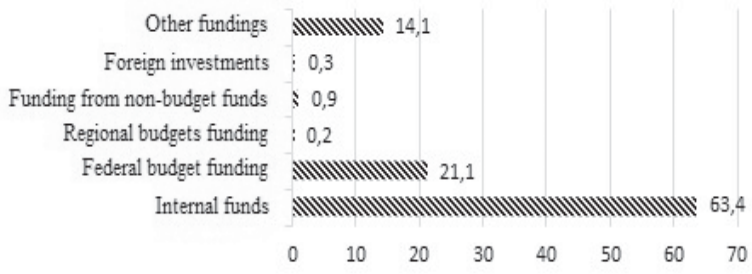

Fig. 6.4. The structure of sources of financing for technological innovations of SIEs in the MR in 2011

As it can be seen from Fig. 6.4, the main source of financing of technological innovations are the own funds of enterprises. The predominant use of own funds is due to the difficulty of attracting other sources. Thus crediting is no longer used for financing innovation because in most cases banks offer short term loans at high interest rates.

A source such as the budget, in most cases, is used for funding the basic research, applied research in the priority areas, as well as for the organization of production for the execution of state functions. The share of non-budgetary funds accounts for only 0.9%, which are used primarily for the financing of applied research and development at the stage of promotion the technologies in production and on the market.

The SIEs' lack of expertise and qualified specialists to attract foreign investment in the innovation sector of the Russian economy is reflected in the low level of the share of this kind of sources.

6.3 THE ESTIMATION OF THE SMALL ENTERPRISES' POTENTIAL.

6.3.1 The concept of the analysis

Various estimates of potential are very important and useful characteristics of economic processes and systems. Knowledge of the potential for growth, development, expansion, etc. allows us to make economic management decisions more effectively, to spend limited resources and gain competitive advantages. In this chapter there is an attempt of creating economical and mathematical tools to determine the potential of economic entity. This subject here is the Russian economy in general, as the main indicator of which is GDP, for the analysis there have been used the data of Rosstat [98], officially published on its website, in the interval of 1995-2012. The calculations are finished, quite general and can be used in practice; however, they can be carried out also according to the statistics of other economic entities

(regions, holding companies, national associations, etc.) for other parameters (not only GDP) or for a group (vector) of indicators or some convolution.

The main indicators of Russian economy:

1. Gross domestic product

Among the most important economic indicators of any country is such an integral indicator as gross domestic product (GDP). The statistical data provides nominal GDP (in prices of the current year). However, to compare results of a number of years it usually takes into account the inflation factor (price increase comparing with the previous year), on the basis of which need to calculate the deflator coefficient that reflects the price changes relative to a fixed year (in this study that is 2013). Then real GDP will reflect the amount, adjusted by the deflator (see table 6.2).

Table 6.2 Russia's GDP for the period 1995 - 2012 (in billion rubles)

Year	*Nominal GDP*	*Inflation*	*Full inflation (to 2013)*	*Deflator (to 2013)*	*Real GDP (to 2013)*
1995	1429	1.881	21.55206	0.04640	30798
1996	2008	1.200	11.45777	0.08728	23005
1997	2343	1.105	9.54814	0.10473	22367
1998	2630	1.681	8.64085	0.11573	22722
1999	4823	1.318	5.14030	0.19454	24793
2000	7306	1.185	3.90008	0.25641	28494
2001	8944	1.205	3.29121	0.30384	29437
2002	10831	1.111	2.73129	0.36613	29583
2003	13243	1.114	2.45841	0.40677	32557
2004	17048	1.111	2.20683	0.45314	37622
2005	21610	1.101	1.98634	0.50344	42925
2006	26917	1.101	1.80413	0.55428	48562
2007	33248	1.097	1.63863	0.61027	54481
2008	41277	1.124	1.49373	0.66946	61657
2009	38807	1.086	1.32895	0.75248	51572
2010	45173	1.085	1.22371	0.81719	55278

Year	*Nominal GDP*	*Inflation*	*Full inflation (to 2013)*	*Deflator (to 2013)*	*Real GDP (to 2013)*
2011	54586	1.060	1.12784	0.88665	61564
2012	56769	1.064	1.06400	0.93985	60403
2013		1	1	1	

Fig. 6.5 shows a graph of real GDP (g) by year (t) and its linear approximation (the regression equation) for the section from 1997 to 2012. The regression equation has a high degree of adequacy of the data column 6 of table 6.2 ($R^2 = 0.940$) and represented by the following expression:

$$g = -6121618.131 + 3074.785t \quad (6.1)$$

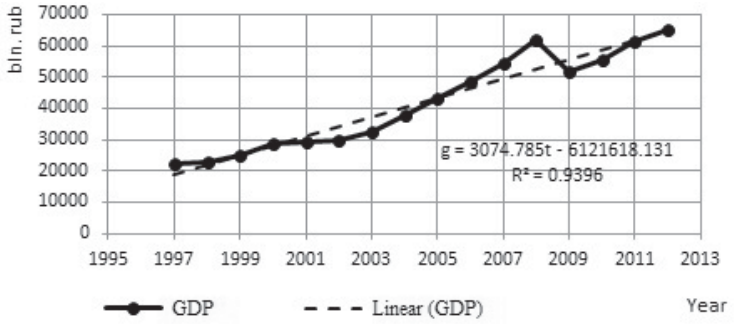

Fig. 6.5. Real GDP in Russia (by 2013)

The GDP decrease in 2009 is due to the crisis of the world economy during this period.

2. The dynamics of the development of industrial and entrepreneurial activity

Since the main contribution to the GDP consists of the results of enterprises' activities, the part of which are small enterprises (including innovative enterprises and residents of STP), let us analyze the statistics of enterprises of all sectors of the Russian economy, including small businesses.

For this study we will need such indicators of enterprises as their number and turnover.

In the period of active privatization there was the denationalization of the industry and the number of private enterprises grew at high rates. Fig. 6.6 illustrates the changes in the number of enterprises of different forms of ownership during these and subsequent years, where it can be seen that the main share of them is private enterprises.

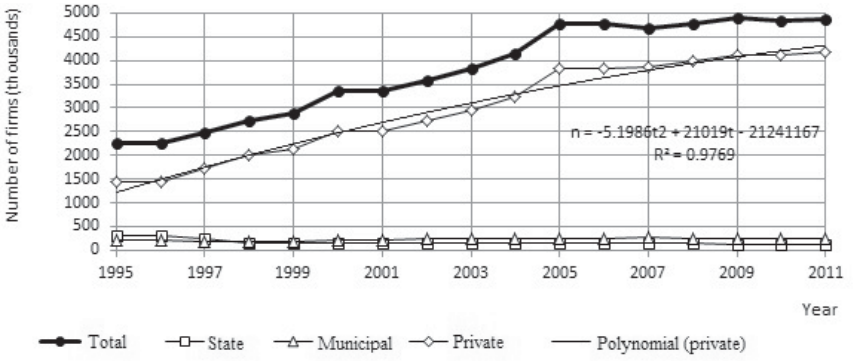

Fig. 6.6. The number of enterprises of various forms of ownership

Change according to the years (t) of the number (n) of small enterprises (SEs), which were the vast majority of private companies, will be approximated by the polynomial regression of the second order:

$$n = -21241167 + 21019t - 5.1986t^2 \quad (6.2)$$

Equation (6.2) has a high degree of adequacy: $R^2 = 0.977$.

The overall growth of the number of enterprises by years was driven mainly by small private companies. But small private enterprises, especially in the 90-ies, has not made a significant contribution to overall turnover and, respectively, to the country's GDP. Turnover was mainly due to large state or municipal enterprises.

Real turnover (taking into account the deflator of enterprises of all ownership forms (according to Rosstat data available for analysis) is shown on Fig. 6.7.

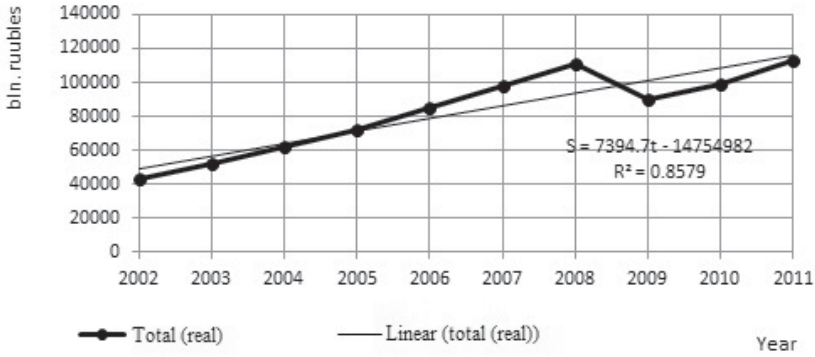

Fig. 6.7. The turnover of enterprises of all forms of ownership

As it can be seen from the dynamics of GDP (see Fig. 6.5) and the turnover of organizations (see Fig. 6.7), the character of their changes is similar, and therefore, these values must be fairly close correlation. The existence of this connection can be presented in the form of regression dependence, which would allow the turnover of enterprises to obtain an estimate of the GDP (see Fig. 6.5). As input (independent) value we will take the turnover of organizations (S) and as output (dependent) - GDP (g). The linear regression model:

$$g = b_0 + b_1 S = 18497 + 0.35674\, S \qquad (6.3)$$

Equation (6.3) has a fairly high degree of adequacy: $R^2 = 0.858$.

Since one of the main functions of STP is to support the process of the formation of small enterprises, so in this chain of the regression models the turnover of small enterprises is important, as part of the complex of enterprises. The statistical data on the turnover of small enterprises available for monitoring [98] is presented in Fig. 6.8, which also shows the turnover of all enterprises for comparison. Ibid (see right auxiliary scale) is given the relative share of turnover of small enterprises (SET) in the total turnover of all enterprises. The average size of this share for a reasonable period of observation is 15.6% (though according to some analytical reviews [33] the share of small business in GDP by the 1st of January, 2009, amounts to 21%). The model of growth of this share by year also can be build, although the crisis fluctuations of the turnover and the small size of the interval of observations do not allow to obtain a sufficient degree of adequacy of the linear regression model (is only $R^2 = 0.007$). Therefore, in future calculations we will consider the relative share of SET as a constant (d=0.156). Then the absolute value of this share (turnover of all SE) will be:

$$S_{SE} = d\, S \qquad (6.4)$$

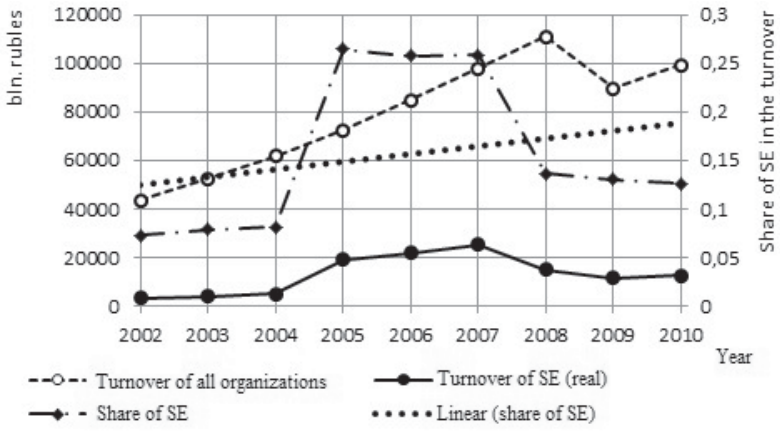

Fig. 6.8. The turnovers of all and the share of turnover of small enterprises

3. The features and parameters of the Russian small enterprises

To the group of small enterprises is usually attributed such business associations, in which the number of employees and turnover is not high. In the statistical data of Rosstat [98] there are the following levels:

- individual entrepreneurs (number of employees up to 5 people);
- micro-enterprises (number up to 16 people or revenues of up to 60 million rubles);
- small enterprises (number from 16 to 100 people, or revenues from 60 to 400 million rubles);
- medium-sized enterprises (number between 100 and 500 people or turnover above 400 million rubles). Some statistics on this group for 2011 is reflected in table 6.3 and Fig. 6.9.

Table 6.3. Statistical characteristics of small and medium enterprises (by 2011)

Characteristic	*Individual entrepreneurs*	*Micro-enterprises*	*Small enterprises*	*Medium-sized enterprises*	*Total*
The number of registered, thousand	2900	1400	229	25.7	4554.7
The number of operating, thousand	1900	1000	227	25.7	3152.7
The number of employees, million	5.3	3.9	7.2	2.6	19
Revenue, billion rubles	4500	5700	13300	7300	30800
Average revenue of the operating ones, million rubles	2.4	5.7	58.6	284.0	9.8
The average number (on the operating ones), people	3	4	32	101	6
The share of operating in registered ones, %	66	71	99	100	69
The share of the operating ones among all, %	60	32	7	1	100

Characteristic	*Individual entrepreneurs*	*Micro-enterprises*	*Small enterprises*	*Medium-sized enterprises*	*Total*
The share of revenue, %	15	19	43	24	100

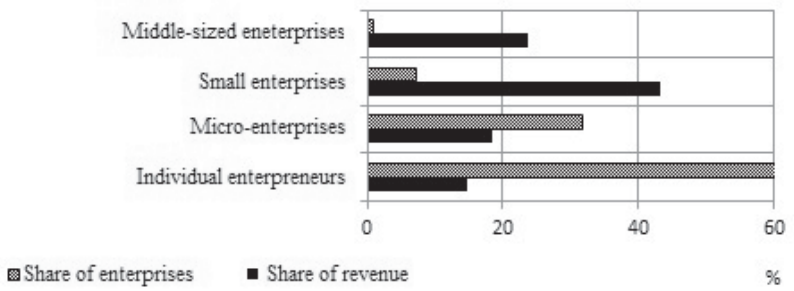

Fig. 6.9. The shares of enterprises by the types and volumes of their revenue (2011)

An important characteristic required for further analysis, is the average amount of revenue (AAR) of one company (S_{1SE}).). Analysis of the dynamics of AAR for several years between 2002 and 2010, according to Rosstat [98], shows that AAR is the indicator which substantially depends on the economic situation in the country. The character of its changes is similar with the indicator "Share of SE" shown in Fig. 6.8 (i.e. is very unstable). Therefore, in further calculations we will consider only the AAR for all the mentioned period, which is:

$$S_{1SE} = 3.5\ mln.rub. \quad (6.5)$$

As it can be seen from table 6.3, the AAR for small and medium enterprises in 2011 was:

$$S_{1SE\_2011} = 9.8\ mln.rub. \quad (6.6)$$

However, it should be noted that the vast majority of enterprises-residents of STP, as a rule, are not among medium enterprises, so the estimate of the AAR for all enterprises, except medium-sized ones, will be:

$$S_{1SE\_2011} = 7.5\ mln.rub \quad (6.7)$$

The values of revenue define the ranges of variation of AAR for SE. Although the concept of the enterprise's revenue (as the funds received from the sale of goods and/or services) is different from the concept of turnover (as the money equivalent to the volume of products shipped and services rendered), in the context of this study will be considered equivalent because of the considered processes for a number of years, which equates these indicators.

6.3.2 The estimation of the small enterprises' potential due to the factor of the science and technology parks

The main purpose of the STPs is to create conditions that support the formation and development of small innovative enterprises and other enterprises. In particular, this important function is performed by business incubators. The main effect of this support should be expressed in the increase of the share of the surviving enterprises after going through the first stages of their formation and development. As for today according to [98] the proportion of surviving enterprises without their staying as residents of the STP was 20-30% (the average figure k=0.25), while the number of enterprises, the formation of which was held in STP, and which survived was 80-90% (k=0.85). If without STP from 100 SEs (n=100) survived 25 SE ($n_0 = nk = 25$). But among the enterprises which went through the environment of STP, the number of survivors is 85 SEs ($n_0 = 85$). Considering this and knowing the number of operating SE (n_0), that was established in the conditions of almost complete absence of STPs in Russia, we can estimate their limiting number (n_0^{STP}), if they all went through the establishment in the environment STP:

$$n_0^{STP} = n_0 \frac{k+\beta}{k} \tag{6.8}$$

The effects of increased survival rate of startups in STP let us evaluate the contribution of the technoparks in the ultimate economic effects, particularly in the country's GDP. Let us show how it can be done. We shall not consider the dynamics of formation of STPs, but only the number of "survivors" among the SEs, and hence their contribution to GDP.

So the regression dependence of the GDP from the turnover of enterprises is represented by the expression (6.3). Then, taking into account the annual growth rate of SE-survivors, we obtain the expression for the value of GDP in every year:

$$g(\beta, t) = b_0 + b_1 \left((1-d)S(t) + S_{1SE}(t) n_0 \frac{k+\beta}{k} \right) \tag{6.9}$$

The calculation of GDP by the formula (6.9) for several values of β (from 0 to 0.75) and for a number of years of observation t (from 2002 to 2011) in real prices (taking into account the deflator by 2013) are presented in table 6.4 (fragment). In this process we were also taking into account the dynamics of the turnover of all enterprises (in the form of a regression of approximation (6.3)) and the dynamics of the average turnover of one SE (in the form (6.4)). The value of the original share of the SE-survivors was considered to be unchanged by year (k=0.25).

Table 6.4 The estimation of the increment of GDP, depending on the increase of the proportion of SE-survivors (in the environment of STP)

Year, t	2002	2003	...	2009	2010	2011	Average % of GDP growth (for $k = 0.25$)
$S_{1SE}(t)$, mln.rub.	2.228	2.527	...	4.322	4.621	4.920	
$S(t)$, bln.rub.	49252	56646	...	101015	108409	115804	
β	GDP, $g(\beta, t)$						
0	32922	36529	...	58171	61778	65385	0.0
0.05	33880	37616	...	60030	63765	67501	3.1
0.1	34839	38703	...	61889	65753	69617	6.2
0.15	35797	39790	...	63748	67741	71734	9.3
0.2	36756	40877	...	65607	69728	73850	12.4
0.25	37714	41964	...	67466	71716	75966	15.5
...	...	...	...	...	...	...	...
0.7	46340	51748	...	84197	89605	95013	43.5

0.75	47298	52835	. . .	86056	91593	97130	46.6

In this table for different years the average percentage of GDP growth did not differ significantly so the last column shows the average value over the years. The dependence of the average percentage of the GDP growth from parameter of growth of the SE-survivors ($\Delta g(\beta)$) is linear and can be represented by simple regression equation:

$$\Delta g(\beta) = \varepsilon\beta = 62.13\beta \quad (6.10)$$

This means that the increase in the number of the SE-survivors (due to their support in the STP) for 10% of the number of created ($\beta = 0.1$) against the existing share of survivors k=0.25, leads to growth of GDP on 6.213%. The maximum capacity of the GDP increment (in Russia) by ensuring of survival of all the SEs is about 47%.

The effect of 47% can be interpreted so that, if conditions in the country were such that all opened SEs was not closed, and would have continued their activities, GDP in each year of the reviewed period could be 47% higher than the actually achieved level.

Evaluation of growth of the medium percent of GDP $\Delta g(\beta)$ given in the last column of table 6.4, is obtained under assumption of existing today [98] fixed survival rate of SEs k=0.25. However, at different times, in different countries, this parameter may be different, and the value of k=0.25 requires a convincing ground and it seems reasonable to consider it as another variable.

Evaluation of the average increase of percent of GDP, as a function of two parameters $\Delta g(\beta, k)$, k), similar to that shown in the last column of table 6.4, calculated by the formula (6.9), are shown in table 6.5 and figures 6.10-6.14.

Table 6.5 The average rate of GDP growth, depending on the parameters k and β

k	*0.05*	*0.10*	*0.15*	*0.20*	*...*	*0.90*	*0.95*	*1.00*
β	*The average growth of GDP, %*							
0.00	0	0	0	0	...	0	0	0
0.05	16	8	5	4	...	1	1	1
0.10	31	16	10	8	...	2	2	2
0.15	47	23	16	12	...	3	2	2
0.20	62	31	21	16	...	3	3	3

k	*0.05*	*0.10*	*0.15*	*0.20*	...	*0.90*	*0.95*	*1.00*
β	*The average growth of GDP, %*							
0.25	78	39	26	19	...	4	4	4
...	...	...	...	...	...	...	...	...
0.80	249	124	83	62	...	14	13	12
0.85	264	132	88	66	...	15	14	13
0.90	280	140	93	70	...	16	15	14
0.95	295	148	98	74	...	16	16	15
1.00	311	155	104	78	...	17	16	16

Since the sum of the parameters k and β must not exceed 1 (because the number of SEs, which survived in natural way and with the support of the STP may not exceed 100%), then only those values of average percent of GDP growth, which are in the top triangle of the table (above the main diagonal, for them $k + \beta \leq 1$) make sense. In table 6.5, these values are in bold type.

The last line in table 6.5 presents rounded to integers factor ε (see equation (6.10)) for different values of the parameter k.

For a more visual representation and interpretation of calculated values of the parameter $\Delta g(\beta, k)$ let us will bring them in a graphical form. In figures 6.10 and 6.11 there are provided the families of dependencies of the percent of GDP, respectively, with the set valuations of initial shares of surviving SEs (k) and the share of the growth due to the STPs (β). The dependence on β is linear in the form (6.10), and dependence on k is nonlinear (hyperbolic).

Fig. 6.12 shows the dependence of the rate of growth simultaneously on two parameters (β, k) in the form of a 3D surface.

An important resulting characteristic of the SE potential, in terms of increasing of the proportion of SE-survivors, there is a graph shown in Fig. 6.13, reflecting the dependence of the maximum possible rate of growth of GDP due to the fact that the STP will let all the SEs survive. It should be noted that there were used all other necessary data related to the Russian economy. This graph, of course, depends on initial share of surviving SEs (without the effect of STP), and the higher the initial share of SEs (k), the less effective are the STPs in improving of the SEs survival. On this graph the point marked with the sign (+), corresponds to the current situation in the Russian economy (the level of survival SEs is k=0.25, and the maximum GDP growth by the STP factor is $\Delta g = 47\%$).

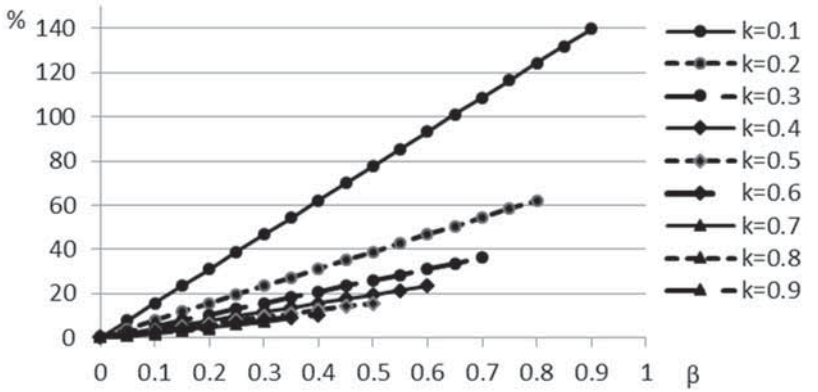

Fig. 6.10. The percentage of the GDP growth due to STP (parameter β) under different values of the initial shares of surviving SEs

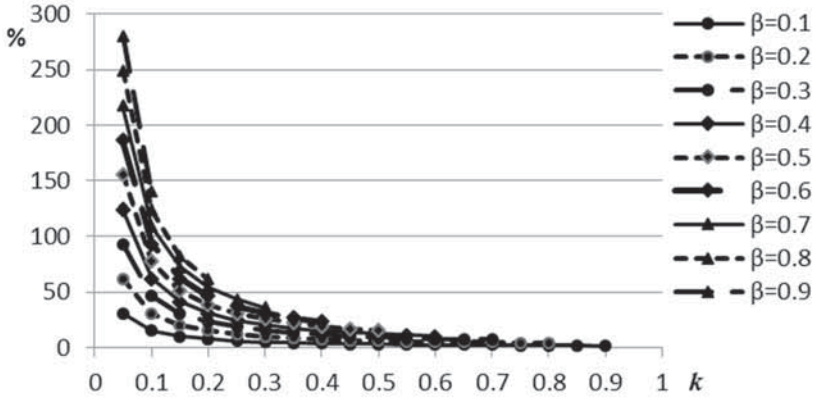

Fig. 6.11. The rate of the GDP growth depending on the initial share of surviving SEs under different values of the STP factor (parameter β)

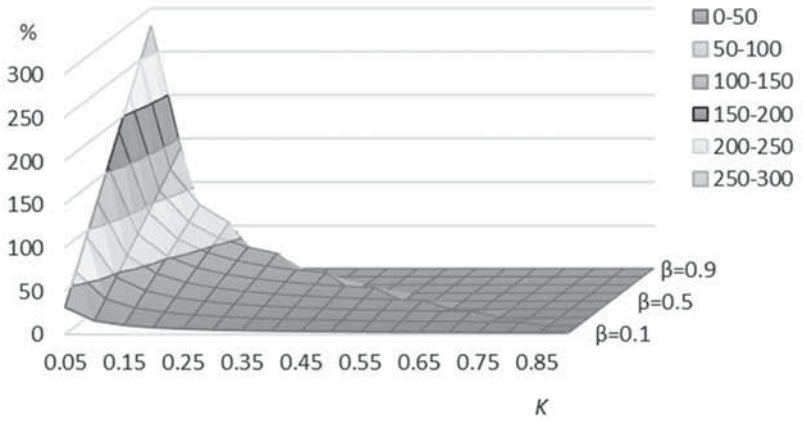

Fig. 6.12. The percentage of the GDP growth due to STP (parameter β) under different values of the initial shares of surviving SEs

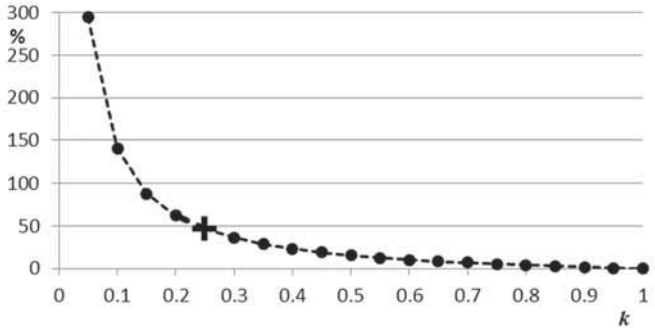

Fig. 6.13. The maximum percentage of the GDP growth depending on the initial shares of surviving SEs

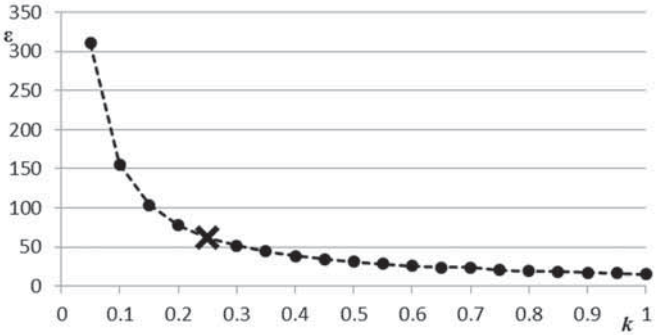

Fig. 6.14. The coefficient of the GDP growth in percent depending on the initial shares of surviving SEs

Figure 6.14 shows the values of the coefficient of the GDP growth in percent (ε) of model (6.10). By the nature of changes this model is similar to the previous one, but reflects the analytical dependence of the growth rate of GDP from the initial survival k. The current state of the Russian economy is marked with (x), corresponding to the value of $k = 0.25$ and $\varepsilon = 62$ (rounded to integers).

The above analysis based on official statistical data of Rosstat [98] showed the following:

During the main period of observations (2002-2011,) the rate of GDP growth due to such factor of STP as increasing the proportion of SE-survivors (among the registered ones), practically does not depend on the year, which allowed to consider the effect as the average volume of percentage of increase of GDP for every year of observation.

Such property factor of STP as creation of conditions for the survival of startups (SE) due to the presence of business-incubators, preferences and benefits for residents of STP, etc. in its environment, increases the proportion of SE-survivors. The property of increasing the share surviving SEs, as one of the effects of the STP is investigated for Russian conditions and there have been obtained estimates of the maximum possible values. This type of STP-effect is considered as if it appeared instantly ("what if ..."). Such approach allows to obtain maximum (limit) values of this effect, the consideration of additional factors and circumstances will only reduce the value of the estimates.

In this part of the work we are not considering the other effects of STP, for example, the very important one, as innovative effect of STP. Some STPs are being created only for this effect, for example, the project "SKOLKOVO" [75].

There haven't been considered the cost issues associated with the creation of STP, cost dynamics and dynamics of effects from the STPs creation.

6.4 CONCLUSIONS

Thus, the results of the study in this chapter allow to respond, for example, on the following questions:

What could be the possible Russia's GDP, for example, in 2010, if the STPs provided survival of all small enterprises, provided that without them the share of survivors is 25%, and the actual GDP amounted 61778 billion rubles (on the trend's average data)? Answer: 91593 billion rubles, which is about 147% from the actual.

What is Russia's GDP should be expected in 2015 without changing the situation with technology parks and in conditions of full maintenance with STP services for all SEs and startups? Answer: Without the STPs in 2015, Russia's GDP will amount to 74074 billion rubles, and in the presence of all spectrum of STP services for any enterprise - 108592 billion rubles, which also will be about 147% from the expected level without the effect of the STP.

In the previous question, what is the volume of the growth of Russia's GDP should we expect, if the environment of STP develop to such an extent that the proportion of SE-survivors rise on another 15% from 25% (i.e. it will be 40%)? Answer: the percentage of the GDP growth will be 9% (see the value for $k = 0.25$ and $\beta = 0.15$) that will be 80740 billion rubles, i.e. 109% of the GDP forecast for 2015, amounting 74074 billion rubles. And the net growth of GDP will be 6667 billion rubles that will allow the reasonable planning of budget funds for the development of the science and technology parks.

7 USING INNOVATIONS FOR RISING THE SMALL ENTERPRISES' SURVIVAL RATE

7.1 THE STRUCTURE OF TECHNOLOGIES FOR THE REGIONAL LEVEL

There is also a regional level in NIS of the Russian Federation, called the regional innovation system (RIS). For today as the successfully developing regions are usually mentioned [33, 71] the followings: RIS of Tatarstan, Tomsk and others. In this paper, the proposed approaches and methods are described on the material and example of RIS, but also for municipal innovation system (MIS) the scheme should, in our view, look similar.

The various elements of RIS for the support of survivability of small enterprises (SEs) in critical conditions, or to improve their competitiveness in a changing environment, and to ensure their smooth innovative development are merged into a single scheme shown in Fig. 7.1. Here is a brief description of the functional units of this scheme, and some of the most important features will be given the following sections of this chapter.

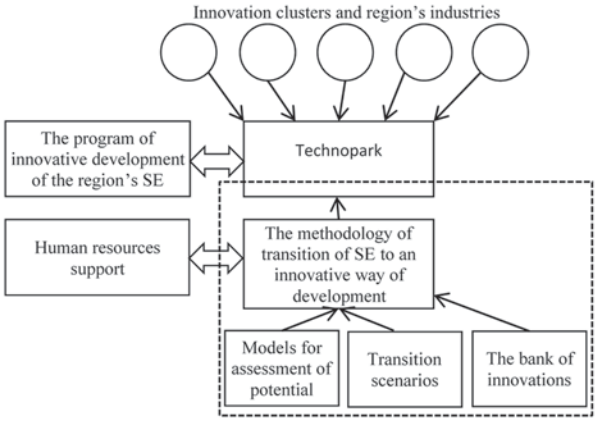

Fig. 7.1. The scheme of the mechanism of innovative development of the region's SE

The kernel of the provided mechanism is **technopark** (STP) (see chapters 2 and 3), as an infrastructure providing small enterprises with the necessary support in times of instability and/or during their development, upgrading, diversification of activities in the other circumstances. Technopark is an element of economic infrastructure, which increases the number of surviving SE, which ultimately contributes to the realization of the growth potential of the country's GDP, as shown in Chapter 6 of this work.

Innovative clusters and industries of the region spontaneously or purposefully (in the framework of programs of small business support [94] or other projects) ensure the completion of technoparks, designed to provide them with the necessary infrastructure for effective work and survival.

The program of innovative development of the SE in the region [97] is, as a rule, a separate or combined document, which contains all the components of the small business support and operation of such infrastructure formations as technoparks and/or contained in them the business-incubators and other elements.

Human resources support can be a branched system, elements of which are contained in the technopark, university or other educational institution. This unit plays a very important role in the training of employees of innovative companies, the business community the new knowledge in the field of new technologies and procedures of innovative development. In the modern innovative clusters the educational unit plays the role of one of the "springs" of innovative development. In the context of this scheme we are just going to mean that there is some entity, performing functions of training, exchange of knowledge and experience, helping the employees of small enterprises gain innovative experience and learn the technique of its use in practice.

Area, highlighted by the dotted line, conditionally reflects a set of functional blocks, which are implemented either directly by small enterprise (its management and/or staff) or run for it by outsourcing.

Models for assessment of potential can be quite diverse and targeted to different results. One of the variants of models of potential is given in Chapter 6 of this work and despite the fact that in the presented version is considered the levels of the country and region, this kind of model can be scaled also on the level of region, community and enterprise. In addition to models of potential reflecting survival, this block can use also the others, which are taking into account the factors of innovation (technological, organizational, managerial and others), and also factors of a different nature (e.g., mergers, acquisitions, diversification and so on). The role of all models of potential is prognostic evaluation, they show if there is a possibility of development in one direction or another. And if they show this possibility, then there can be used constructive mechanisms to ensure this development, i.e. to realize the existing potential. The functions of such mechanisms are performed by the following blocks.

The methodology of transition of SE to an innovative path of development, as described later in this Chapter, outlines the basic steps that should be taken, if an enterprise needs to develop or increase profits or just to survive. The technique is fairly general; however, it indicates the main directions of specifying actions for different types of enterprises and specifies the basic set of tools for work. The name of this unit should not be understood too literally, as "the transition to a new path once and for all", but more as technology innovation, if necessary, also in those moments when the need arises.

The scenarios of transition to an innovative way of development is one of the tools for scenario analysis that can be used within the part called "Methods of transition of the SE to the innovative way of development".

The bank of innovation is in fact the knowledge base, the arsenal, the palette from which the company can choose what is it more profitable or gives greater effect in the situation of choice. Such databases can be personal, formed exclusively on the enterprise, and can be shared or provided by the technopark infrastructure or training mode universities.

The mechanism of STP about the SE mostly as follows: feedback from residents (small enterprises and others) to science and technology parks is being accomplished in a form of making questionnaires and collecting opinions from residents, analyzing statistics on residents (including small enterprises), their needs and their indicators, trying to meet their needs, add new services and improving the quality of the ones already exist (can see on the example of EBN [7]).

7.2 PROCEDURE MANAGEMENT OF SURVIVAL AND DEVELOPMENT OF SMALL ENTERPRISES ON THE BASIS OF INNOVATIONS

The analysis of literary sources and current situation (in the methodological field and software) has shown that at present there is no constructive and adapted for practical use decisions for current support and organization of innovation activities in small enterprises.

In this chapter, there has been proposed a structured methodology that contains the algorithm of organization of activity of small enterprises, aimed at assessing the current status, resources and opportunities for the achievement of the operational goals of survival and/or increase the competitiveness. The algorithm (see Fig. 7.2) is a sequence of interrelated stages, each of which contains a specific set of activities, obtaining necessary assessments and making appropriate management decisions. The symbol “document” marked those units in which the analysis can be conducted on the basis of objectively existing documented data (for example, from the bases of accounting systems of enterprises), a symbol "face" indicates the units in which it is impossible to get data on the documents (or documents only), the assessment is being done by experts. The experts in the different stages of the algorithm can be business owners, managers and specialists of the enterprises and at some stages external experts on the basis of outsourcing can be invited.

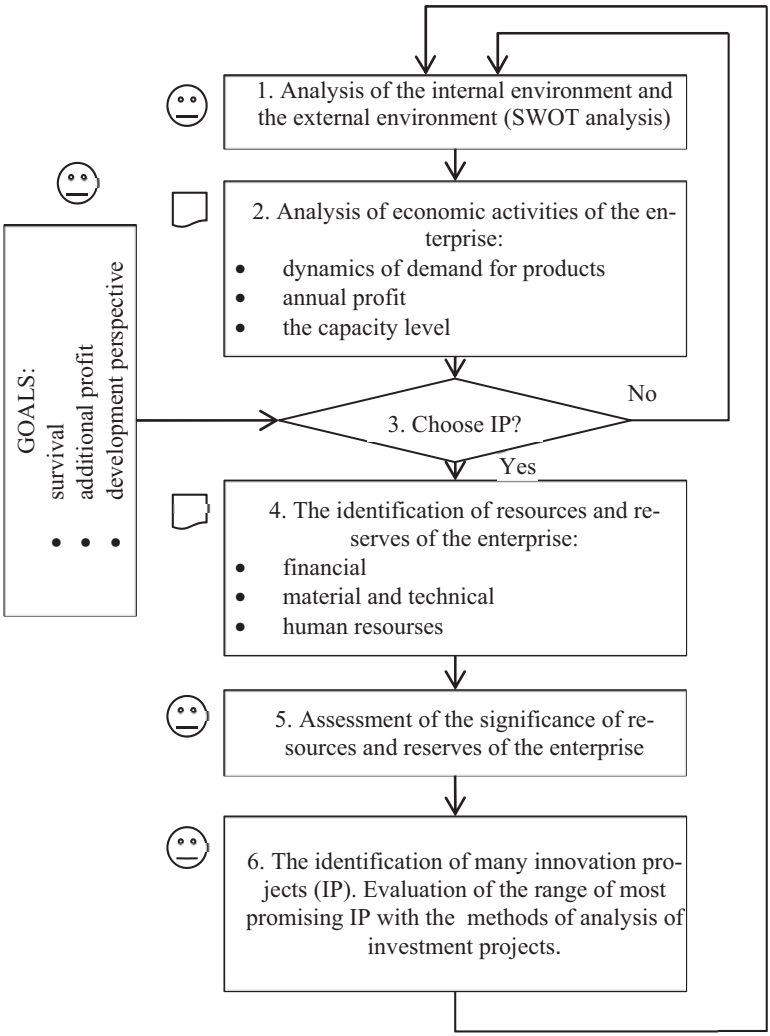

Fig. 7.2. The algorithm of transfer of the SE to the innovative way of development

The method is aimed at ensuring informed and targeted transition from traditional business based on purely intuitive behavior of top managers or owners, to innovational one.

As can be seen from the algorithm, the process of implementation of certain steps and/or action takes place continuously in appropriate management cycles. But the incentive for the implementation of the next cycle can be, for

example, one of the following (which are in turn a reflection of a goal, recorded in the company's mission or suddenly occurred):

- survival;
- obtaining additional profit;
- necessity of development.

The algorithm consists of six phases, usually being insured sequentially. However, the first two can run continuously (with some regularity) in monitoring the situation. Since it is assumed that the data necessary to obtain estimates can be obtained from experts (external, specially invited or employees) or from the database of the accounting systems of enterprises, then on the scheme of the algorithm near the blocks there are two types of icons that correspond to these two sources.

Let us focus on the content of each block of the algorithm. However, due to the huge variety of options of specific content of these blocks we will cite only the short version of that to illustrate the approach. Specific software and informational implementation of the methods may be different, that is defined by the industry SE is operating in and a large number of other circumstances. The eclectic version of software and informational support, based, for example, on a standard tools as MS Office, MS Project, etc. is also possible.

As the context example we will consider a small enterprise (based on a real prototype), providing services in the sphere of public utilities, for example, repair, replacement and installation of mains water and heat supply systems, repair and installation of appropriate equipment for the housing sector and industrial enterprises. The SE uses the infrastructure of technopark in one of the cities of the Moscow region. In its activities, the SE uses some advanced technologies of manufacture (has its own technological solutions, equipment and tools) that gives it in some cases competitive advantages in the market. The peculiarity of the market demand of this type of utility services is the high seasonal factor that in some cases complicates the works control, and in other situations makes the SE to search for orders, not quite corresponding to the main profile of it. Therefore, the task of management of the company contains many uncertainties that should be considered by its management in developing strategies, tactics and operational decisions.

Bringing innovation to solve current problems of the company can also be quite varied, but for the certainty of illustration of techniques we assume that the SE in a situation of increased flow of forthcoming works (as manifestations of the seasonal factor) is considering the possibility of using such management innovations as outsourcing, which the company has never used before.

The 1-st step of the algorithm is to analyze the internal and external environment of the enterprise on the basis of technology of the SWOT analysis. The table 7.1 presents a sample set of values of the key factors that should be considered when conducting a SWOT-analysis of activity of the SE, although the list each SE can be different.

Table 7.1. Key factors to be considered when conducting a SWOT analysis

№	Potential internal strengths (S):	№	Potential internal weaknesses (W):
S1	High competence of the staff	W1	Partial loss of the competencies
S2	Reliable financial sources	W2	Insufficient funding sources
S3	Competotion skills	W3	Weak skills in competition
S4	A good understanding with contractors, awareness of their needs and opportunities	W4	Poor knowledge of the needs of contractors
S5	The leading positions on the market	W5	Weak market position
S6	Having a strategy, adequate to opportunities and goal	W6	The absence of a clear strategy, the inconsistencies in its implementation
S7	Price advantage	W7	High prices on the market compared to key competitors
S8	Availability of own unique technologies and modern equipment	W8	Obsolete technologies and equipment
S9	Effective management	W9	Weak management
S10	Effective distribution network	W10	Weak distribution network
S11	Availability of effective R&D	W11	The lack of R&D
S12	Effective advertising	W12	Weak advertising
№	Potential external opportunities (O):	№	Potential external threats (T):
O1	The ability to operate on additional market segments	T1	Narrowing of the market
O2	The extension of possible range of services	T2	The emergence of a large number of alternative and replacing services
O3	Friendly behaviour of competitors	T3	Stiff competition

O4	The possibility of access to foreign markets	T4	The appearance of foreign competition with commodities of lower cost
O5	Favorable changes in currency exchange rates	T5	Unfavorable changes in currency exchange rates
O6	The abundance of resource providers	T6	The decline in the quality of delivered resources
O7	The weakening of legislative barriers of price regulation	T7	The tightening of legislative regulation of rates
O8	Increase of stability of business	T8	Increasing dependence on external destabilizing factors

Classic SWOT analysis [107] involves identifying strengths (S) and weaknesses (W) of the enterprise, potential external threats (T) and opportunities (O) and their evaluation in points. Important is the question of who shall be scoring. It is clear that such person (or group of people) must be competent professionals with accurate information about both the current situation in the analyzed SE, on the market of services and well-versed in the current legislation.

It should be noted that the accuracy of the estimates given by experts, depends on the quality of subsequent administrative decisions. Therefore, when conducting the SWOT analysis, it should be based on proven technologies and Toolkit of expert estimation [108]. If it would be expedient to attract a number of experts, estimates should be obtained by the methods of group expertise.

There can be many options of assessment. In practice, for the SWOT analysis, there are used, for example, the following options:

1. Experts put the value points regarding the average in the industry or in relation to the data of strategically important competitors;

2. Mutual (line relative to column) estimates for discrete, for example, a binary scale, i.e. if a factor of the line affects the factor of the column, then put a value of 1, otherwise 0. In the case of a larger number of discrete values, for example, on a 5-point scale, the selection of values is being made from a variety {-2; -1; 0; 1; 2}, i.e. valuation applied by the expert, can be any of the values from this set. It is also possible to make estimates on the 10-point, a 100-point or some other scale;

3. Mutual evaluation on a continuous scale, for example, from the interval [0; 1], then the assessment can be any of the values, for example, 0.37.

One of the options of the resulting matrix of SWOT analysis for the three factors in each group and for estimates put by experts on a five-point scale from -2 to +2, are presented in table 7.2. The positive values of ratings reflect

the potentially possible effect and a negative – the amount of possible losses or damages.

Table 7.2. The resulting matrix of SWOT analysis

	Mutual influence								
	Opportunities				Threats				
Strengths	O1	O2	O3	Total	T1	T2	T3	Total	TOTAL
S1	2	2	0	4	0	2	1	3	7
S2	1	0	1	2	0	2	0	2	4
S3	1	2	1	4	1	1	1	3	7
Total	4	4	2	10	1	5	2	8	18
Weaknesses	O1	O2	O3	Total	T1	T2	T3	Total	
W1	-1	0	-2	-3	-2	-2	-1	-5	-8
W2	-2	-1	0	-3	0	-1	0	-1	-4
W3	-2	-1	-2	-5	-1	-1	-2	-4	-9
Total	-5	-2	-4	-11	-3	-4	-3	-10	-21
TOTAL	-1	2	-2	-1	-2	1	-1	-2	-3

In the matrix at the intersection of rows Si, Wi with the columns Oj, Tj there are affixed the expert evaluation of impacts in points. The total amount of points in rows and columns shows the priority of consideration of certain factors in developing strategies.

According to the results of the SWOT analysis, i.e. depending on the interaction of factors and their importance in achieving the goal, there is the matrix of strategic activities is being made, in which:

- SiOj are the activities ensuring to use strengths for increasing the capabilities of the company;
- WiOj are the activities to overcome the weaknesses, using available resources;
- SiTj - these are activities that use strengths to prevent possible threats;
- WiTj are measures that minimize weaknesses to avoid threats.

The 2-nd step is the analysis and evaluation of activity of the enterprise in the following three groups of indicators:

- dynamics of demand for products/services;
- annual (quarterly, current) income;
- the degree of use of capacities of the enterprise and other resources.

The positive dynamics of demand for products testifies the absence of the urgent need to engage in new activities. A stable level of demand should put top-managers of the company on their guard and talks about the possibility of the organization to take efforts in case of reduction in demand, for example, to start to analyze the opportunities to innovate. Negative dynamics of demand indicates the need for the introduction of protective measures, in particular, in the direction of innovative activity.

If the annual income (or profit of another controlled interval) is below the industry average values and has a negative trend, the main goal of such company becomes a survival. If the profit is equal to the average value, the aim is to obtain additional profit. If the profit is higher than the industry average or planned by the company, the main target of such enterprise may be either the additional revenue or future development (new markets, new products, etc.).

The degree of usage of available resources and capacities of the enterprise is an important indicator of opportunities (potential) expansion, including through the use of innovations.

The 3-rd stage of the algorithm lies in making management decisions about the need for the enterprise innovative activity. Decisions are being made are based on the use of estimates of the groups of indicators of the previous stage (the dynamics of demand, annual earnings, degree of use of capacities of the enterprise).

The need for innovative activities may be due to the presence in the current version of the company's mission of at least one of the following purposes:

- the need for survival;
- the need for additional revenue;
- the need for perspective development.

The current goal is usually included in the mission of the enterprise, recorded in the strategic development plans of the enterprise, but for small business the goal can be very dynamic and determined solely by the business owner and/or small group of persons (top-managers, stakeholders, etc.).

The 4-th stage of the algorithm (if a decision is to engage in investment activity - see Fig. 7.2) includes evaluating the possibility of forming potential reserves and resources of the enterprise, including:

1) financial resources (Fig. 7.3) and the availability of its attraction (loans, subsidies, subventions, grants, investments and so on);
2) material and technical reserves of the company;
3) human resources.

Part of the resources and reserves may be established by the documents of the enterprise (on databases, information and accounting systems of the company), and some - on the basis of expert assessments.

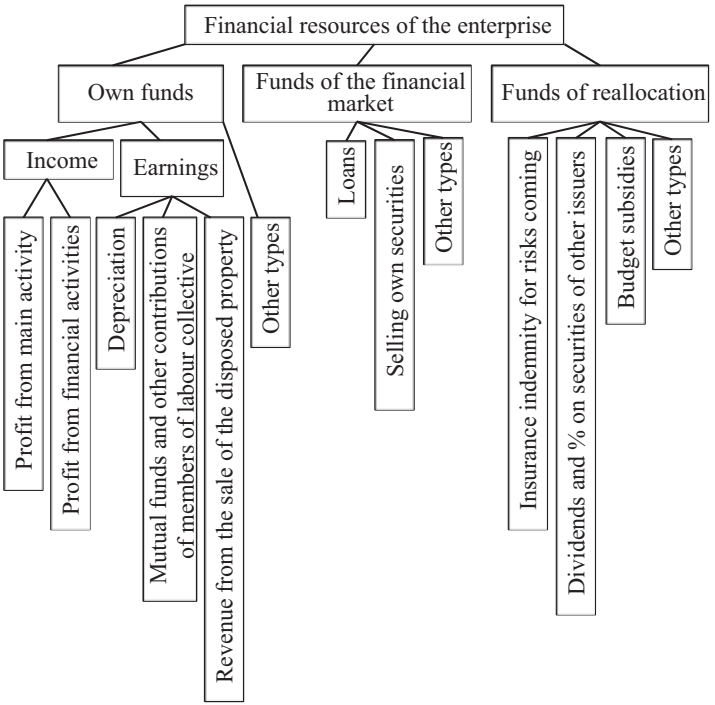

Fig. 7.3. Financial resources of the enterprise

The material and technical reserves of the company may include inventories and/or technical resources used by the company not in corpore, for example, land, production facilities, warehouses and office premises, machines, equipment, tools, raw materials, materials and other means. According the availability all material and technical resources can be divided into two groups:

1) free reserves;
2) not fully used resources.

To determine the existing level and possibilities of the use of the reserves of the first group the company needs to make an inventory and to consider their use in the enterprise. With the purpose of definition of the possibility of realization of provisions of the second group the company should examine the degree of utilization of production capacities and take a complex of measures on optimization of the production process, which will allow to release part of production premises, equipment, personnel.

Human resources is a set of skills, intellectual potential and expertise of employees who can be considered as one of the important assets of the en-

terprise, because the level of qualification and professionalism of the personnel will largely determine the effectiveness and efficiency of activity of the enterprise as a whole.

Analysis of human resources of the enterprise is carried out in two main groups of criteria:

1) the number of employees and their qualification;
2) the intellectual potential of the enterprise.

When determining **the number of personnel**, as a rule, the following parameters are being analyzed:

- the actual budget of workers' time;
- reasons inter-shift and daily losses of working time;
- coefficient of shift;
- level of personnel qualification.

The **intellectual potential** of the enterprise is usually understood as the ability of a group to create and share innovations. In real practice its analysis is difficult because there is no universally accepted way to measure the collective knowledge of the employees, their experience, intuition, intellectual reserve. In this regard, there are expert estimates [108] or indirect indicators often being used, such as:

- the share of the organization's employees with higher education;
- the share of the employees of organization of supreme and first category in the total number of specialists;
- the share of employees of organizations with scientific degrees;
- the share of funds (part of the costs) allocated for research and development performed by the company;
- the share of new products in total sales.

The result of the analysis of all types of reserves and resources of the enterprise is that it results in the unified register of enterprise resource (as soon as the reserves also have the meaning of resources, then both of these categories will be called resources).

The 5-th stage of the algorithm includes **evaluating the significance** of the identified reserves and resources of the company (resources of the enterprises) in terms of their further use.

Because its importance should reflect certain forecasted characteristics in the further effective use of the resource, then, taking into account the current objective of forecast uncertainty it can be done with the help of expertise. Each resource can be described in a specific application by a set of its individual indicators $L_1, L_2, \cdots, L_K$. Among them can be, for example, such as: level (index) of the price of resource, applicability (will/will not work), implementation (as accessibility, for example, of a bank loan or available, i.e. the remaining amount), etc.

The following interpretation of the indicators is possible:

- applicability of the resource may reflect the following properties:
- use only for a specific type of activity;
- use for a limited list of activities;

- use for any activities.
- feasibility of the resource may reflect the following properties:
- the lack of demand for this resource;
- limited demand for this resource;
- increased demand for this resource.

For convenience of work with private indicators and their compressions (options of combining in one indicator) one should use their modifications, reduced to a single scale, for example, continuous one, taking values in the interval [0; 1], with all individual indicators should be in the same direction, i.e. the value of 0 will correspond to the worst variant; and a value of 1 is the best option. Then as the index rates we can use the value, reverse to the price of the resource (the higher the price, the lower the index); applicability can been used as the probability of use (the fact that it will suit, may be involved) of this resource considered in this innovative project; feasibility also will be a probability that the resource will be available and that it can be get.

Some indicators can be compressed into one in different ways, but the most commonly used are:

1) additive (amount) form;
2) multiplicative form (represented as a product).

The choice of one or another of them depends on the meaning of the indicators and the task. If individual indicators can offset (replace each other), then should use the amount form, and if zeroing is one of the indicators makes senseless the others, then need to apply a multiplicative form. In our case we have the second option, because, for example, loss of use of the resource cannot be compensated with its low cost. This means, for any i-th resource its compression can be in the form of a simple multiplicative function of the following form:

$$L_i = \prod_{k=1}^{K} L_k \tag{7.1}$$

or the form of function of Cobb-Douglas type is also possible, involving a number of resource x_k:

$$L_i = \prod_{k=1}^{K} {x_k}^{L_k} \tag{7.2}$$

Setting a value of human resources coefficient according to a suggested formula is difficult because the same personnel for enterprises of various industries, as well as for various planned innovative works can have different values. However, we assume that the experts can give to all personnel of the company (related to backup human resource) the estimation, the value of which can also belongs to the interval from 0 to 1.

The results of the evaluation of each resource, made on the basis of the opinions of qualified experts (as a rule, managers of the enterprise or invited external reviewers), taking into account compressions of the form (7.1) or 7.2.), are tabulated and/or took to the method's relevant database.

Thus, the main and important result of the 5-th stage of the algorithm is the current "Bank of resources", with the corresponding integral indicators of their significance, which can match different ways of projects designed to ensure the achievement of one of the relevant goals (see Step 3 of the algorithm is to survive, to increase profits, to ensure growth and others). It should be noted that the resources of current “Bank of resources” should be stored not only with their aggregate indicators (compressions), but with constituents, moreover, for each resource should be stored the maximum possible set of its parameters (the number, timing, funding and expenditure on the existing needs/projects, etc.).

The calculations can content sufficiently wide range of resources and reserves, but in the selected (in the next step of the algorithm) type of the innovation activity it can be used one or other of its subsets. This means that the presence of even a very limited set of resources and reserves may lead to further innovation development, and thus improve the chances of survival of the company.

The 6-th stage of the algorithm lies in selecting of the most effective directions of innovation activity at the moment. This choice is based on the discovered reserves and resources of the company.

Selection of innovative idea depends on the goals of the enterprise:

- if the goal is survival, it is necessary to choose an innovative idea, which for a small period of time will give the maximum economic effect;
- if the goal is to obtain additional business profits, it is better to select innovative ideas which give maximum economic benefits in the coming years;
- if a goal is the formation of a technological reserve for the future and prepare platform for development, selected innovative ideas should be based on new technologies, which in future can become the basis for effective activity of the organization.

Search for innovative ideas can be implemented, for example, from such sources as:

- collection and analysis of scientific and technical information;
- analysis of unmet and potential demand of the population;
- identification of possible changes of parameters of manufactured products;
- and others.

Methods of analysis, generation, and search of ideas are quite different and described in the special literature. However, in the present scheme of the mechanism of support of innovative development of the SE (Fig. 7.1) assumes the existence of "the bank of innovations", which provides the options to be selected, which are potentially suitable for work. Depending on the resources and reserves available in the framework of the innovation development of the enterprise there are several innovative projects can be run simultaneously, the complex of them provides the necessary effect.

The procedure of innovation selection involves several steps:

1) Formation of innovative ideas (from the bank of innovations or independent generation).
2) assessment of the feasibility of selected ideas and/or innovative projects. Here is a comparison of the available resources (see step 5) with the spectrum of the resources necessary for the implementation of selected innovation, i.e. there is only the resource endowment of potential projects is being checked, the options which are not passing this selection are being rejected and excluded from further analysis.
3) evaluation of the potential effectiveness of innovation, selected at the previous stage. During the evaluation not only economic indicators can be taken into account, but also the others.

In cases when the company can use analytical systems, capable of performing complex assessment from the stages 2 and 3 of the procedure of innovation selection, these works can be executed in a single cycle.

7.3 SOME TOOLS FOR THE TECHNOLOGY OF SURVIVAL AND DEVELOPMENT OF SMALL ENTERPRISES

When talking about modern information and communication technologies (ICT), in recent time usually mean the communication component (Internet, telephony, navigation, multimedia and so on). Information component is usually considered as a certain self-evident content, which is then transmitted by means of communications.

However, in the ICT always invisibly present a variety of means for processing, compression, submission of raw data to the user, intended to ensure that he is going to use knowingly (or unknowingly/automatically) these data for monitoring, selection of variants of his actions, etc. These functions are performed by the part of the ICT called application software (AS). The peculiarity of the role of AS is that they, in addition to general training (usually corresponds to a level of the bachelor), require special, though not so significant, training and acquiring skills to apply them in practice. At the enterprises this software is usually being used (or should have) by the personnel performing functions of analysts. Or these functions are transferred to outsourcing external consulting/analytical companies.

The AS used by analysts, is usually necessary, in particular, for such purposes as:

- obtaining one or a set of estimates for the analysis of the current situation on the enterprise or processes in an external (for the company) environment;
- making the forecast of change of the characteristics of internal or external processes;
- determining the dependencies of an indicator of a certain option (or their combination) to determine the degree of their influence;

- combining some set of indicators into a single, integral index, which allows to obtain general evaluation of the option or the object;
- collection and subsequent processing of data from experts to ensure valid and reliable estimates of options, projections, etc.;
- simulation of the behavior of a certain process and/or object (i.e. presenting it in some logical, mathematical, simulation and other models) to obtain the necessary estimates.

Today among the number of software systems that can perform such an analysis (in varying degrees of completeness), the following can be mentioned:

1) Microsoft Office [109], and more so its analysis tool, Excel, containing standard add-in functions as "Data Analysis" and "Search for solutions".
2) Microsoft Project [110] which helps to analyze the work packages given their time and resource characteristics.
3) Project Expert and other products from the Expert Systems [111] company one of reputable group of effective analytical tools for modeling of work of the enterprises and their services, holding companies and other economic actors of micro level with a very developed system of study options for organizational structure, business processes, etc.
4) AnyLogic from AnyLogic Company [112] is a multi-approach system of simulation modeling that contains tools for the implementation of all existing technologies, simulation of processes and phenomena (discrete event, system dynamics and agent-based modeling).

These analytical software systems today sometimes are not available to small enterprises (which implement, for example, the methodology of innovative development presented in the previous subsection) due to their high cost, so it seems appropriate to have them as part of collective use services of the technology park, which will ensure wide access for startups and other small businesses. Using them in practice to assess options for innovative development is possible in different ways and in particular:

- providing comprehensive services, providing also the services of the experts able to assess options for requests of small enterprises;
- training the employees of small enterprises in the use of such analytical systems;
- providing small businesses with the opportunity to work with analytical systems in the remote access with flexible level of completeness of the provided services.

7.4 THE APPLICATION OF THE METHODOLOGY OF INNOVATIVE DEVELOPMENT OF SMALL ENTERPRISE ON THE BASIS OF SCENARIO ANALYSIS

In accordance with the methodology (see item 7.2) of the transition of small enterprises on innovative way of development or use innovation as a way to solve problems or achieve the goals, there are six successive stages

they should run. In the process of implementation of each of them there often is a large number of alternative options for further steps of the algorithm that creates uncertainty in the actions of the analyst. Therefore, an important element of the mechanism of innovative development of the SE can be a typical scenario of development.

Scenario modelling/planning [113, 114] is a powerful tool used by companies when planning, budgeting and forecasting.

Among the advantages of scenario modeling can be mentioned the following ones:

- Identification of factors that significantly affect the analyzed business processes;
- possibility of operation with real (actual) financial indicators, not a hypothetical initial data;
- the removal of uncertainties in the values of output indicators based on actual data;
- the possibility to check the impact of the implementation of the decisions within the probable adverse external conditions;
- more effective management of risk and uncertainty based on the simulation of scenarios that do not meet current trends;
- analysis of the possibilities that could be considered.

Scenario approach can be used not only in planning and managing the efficiency of the company based on including the scenarios in the process of business management, but also in risk management. This will provide additional competitive advantages, allowing faster use the emerging opportunities and make more informed decisions quickly within complex and uncertain conditions. The use of scripting libraries in management practices can be an additional effective tool of analysis and decision support.

In this subsection, we will use the example of the acting small enterprises LLC "Alpha-Stream" (hereinafter - SE Alpha) to analyze the situation where the causal motivation for innovations is a factor of instability in demand due to seasonality. The negative impact of seasonality in particular may be facilitated by the use of such managerial innovations as outsourcing.

The sphere of activity of the SE Alpha is communal services, where the company performs routine maintenance of the communal equipment (heat and water supply) of the population and enterprises. Work is being done on their own. Services on duty of SE Alpha provide troubleshooting and solving emergency situations at the request of clients, repair teams perform current repairs of mains. But due to the long-term plans of municipal authorities, in a certain period there was a need for a significant expansion of the scope of work for the planned replacement of overage pipelines. This raises the task of increasing the volume of work that can be done either by traditional increasing of the SE staff (with its subsequent dismissal) or using such managerial innovation as outsourcing. However, this choice is not easy, as it requires reliable calculations, estimates and modelling. Here are the main elements of the scenario of such a choice.

7.4.1 Characteristics of business processes

The heat supply system (HSS) is a complicated technological and social-economic complex, providing livelihoods of a vast number of consumers. HSS is a set of sources of thermal energy and heat-consuming installations, united in thermal systems, which are operated by heat supply organizations (HSO). The main task of the HSO is the proper provision of heat to consumers. Timely and quality maintenance of heat networks significantly reduces the probability of occurrence of emergencies and failures.

The main business processes of SE Alpha and other similar utilities profile companies include:

1) Repair and liquidation of accidental damage.
2) Technical support of core activities (procurement, transport, buildings, etc.).
3) Organizational support of the main activity (economic department, personnel, training, licensing).
4) Coordination of business processes (development of indicators, monitoring their dynamics, analysis, comparison of territorial units, and implementation of corporate policy and so on).
5) The generation of thermal energy and providing standards of water-chemical regimes.
6) Transportation and distribution of thermal energy to consumers.
7) Additional services.
8) Development.

Let us consider the basic core processes in more details.

Transportation and distribution of thermal energy. This is a basic business process; its content differs from the traditional procedures of transfer of finished goods from producer to consumer, and consists of the transportation of the heat-carrier on mains, bringing it into line with the requirements and current weather conditions and distribution of heat energy to consumers.

In accordance with the Federal law "On natural monopolies" transmission of thermal energy, on the one hand, belongs to the sphere of activities of natural monopolies, and on the other, should be performed in conditions of market relations with consumers, which implies dependence of demand on the quality of the goods/services.

The provision of additional services to clients (by additional agreements). An important principle for additional attraction of private households in the district heating is the consistency of customer service. The main goal in this field is to improve the competitiveness of district heating compared to the alternatives. In this field the heat supply companies can provide such additional services as:

- maintenance of heating units on the balance of consumers;
- maintenance of internal systems of water supply, heating and ventilation;

- maintenance, repair and installation of metering devices;
- operation of thermal networks on the balance of other organizations, including moulding, closing the gaps, adjustment, etc.

The absence of complaints from consumers on the whole complex of services is the main indicator of the competitiveness of district heating.

Development is the business process of continuous improvement of the existing system that allows to expand business, increase capitalization, profit, social and other indicators. Among the main tasks of the development are the followings:

- reduction of expenses;
- connection of new consumers;
- increase of labor productivity of the personnel;
- improvement of technological processes (also through the use of innovative technologies, tools, equipment, materials and methods of work);
- improvement of work organization and company management (also due to attraction of innovation management decisions).

The basic functions of the development service are the following:

1) The accession of developers (including active search for new clients):
2) Issuance of technical conditions;
3) Acceptance of the created assets on the balance sheet;
4) Charging for accession (according to the law 210-FZ) and use of it for the expansion of the centralized water supply system.
5) Joining the previously disconnected ones.
6) Development at the expense of internal resources (improvement of the system).
7) Comprehensive assessment of the improvement actions.
8) Participation in the budget process of construction of objects of a heat supply.
9) Interaction with investors.
10) Developing programs of complex development of systems of a heat supply together with the administrations.

Repair and emergency services are a separate auxiliary business processes, resulting in a properly functioning heating system, heater, chamber or other equipment. This business process is often considered to be auxiliary, although many enterprises direct the main resources on maintenance of heating networks in good condition, and repair works have a status, equal to the main activity which is the operation of equipment.

The purposes of this business process lie in increasing the resource of the heat networks, equipment and prevention of accidents.

7.4.2 Analysis and evaluation of scenarios

As noted above, in the activities of the SE Alpha in recent years have increasingly emerged the problems of survival, which appeared in low profit

with all the ensuing consequences (lack of working capital, delay and avoidance to increase salaries, etc.). The company's management used the above method to obtain constructive options to ensure survival in the short term (months) with further expansion efforts for getting a "safety margin", and the further development of the company.

To accomplish **the 1-st stage** of the method there was constructed the matrix of factors for the SWOT analysis of the SE Alpha, which is presented in the table. 7.3.

Table 7.3. The matrix of factors SWOT analysis company MP alpha

Potential strengths (S)	Potential opportunities (O)
- Stable financial indicators. - 14 years in the market. - High degree of compliance of the contract obligations, both in terms of subcontractors and in relation to end-users. - The company's positive image in public life (charity). - Have the experience and core competencies as: General contractor, customer, developer of the design documentation, technical maintenance of utility networks, emergency repair of the sanitary equipment, internal engineering networks of institutions of social sphere (education, culture, health, sport), and others. - Reasonable financial strategy. - Experience in participating in electronic auctions held in accordance	- Availability of new attractive geographic markets in the region. - Implementation of a complex project on reconstruction of dilapidated housing with the use of innovative technologies (LEGO). - Maintenance and repair of high-tech equipment in industry (based on the experience with the company "TetraPak"). - An opportunity of application of innovative technologies in construction.

with the legislation of the Russian Federation.	
Weaknesses (W)	Threats and risks (T)
- Low qualification of the employed labor force. - Loss of flexibility and depth of control. - Complicated organizational structure, which hinders effective management of different directions. - Lack of financial resources for the implementation of new activities (including innovative ones).	- High taxes. - The imperfection of the legal base regulating business activity. - An unstable currency exchange rate. - High competition in the construction market. - Decrease of profitability of the executed works by increasing costs. - The absence of standards for new technologies. - Shortage of specialists.

SWOT-analysis above, taking into account the current values of the SWOT factors, showed the possibility of transition of the organization from traditional entrepreneurship to the innovative one (with the use of modern technologies, materials and management procedures).

The 2-nd stage of the method is to obtain current estimates of the demand, profits and reserves. These works were performed by company's personnel. The results of the analysis are given in table.

Table 7.4 The results of the analysis of reserves and resources of the SE Alpha

№	*Group of indicators*	*Estimation*	*Conclusions*
1	The dynamics of demand	The demand is stable. There is a seasonal increase of demand.	The market situation is favorable. There is no acute need for diversification.
2	The annual profit	Slightly below average values in the industry.	Measures aimed at increasing profits are desirable.

№	*Group of indicators*	*Estimation*	*Conclusions*
3	The degree of resource use	Resources are being used almost completely. Management has reserves of time.	It is desirable to use the spare time of management to apply managerial or organizational innovation.

At **the 3-rd stage** of the method, taking into account the results of the second stage, the top management of the company SE Alpha states survival as the dominant goal, and the secondary purpose is to increase profits of the enterprise with the need of development in the nearest future.

At **the 4-th stage** there was built the company's reserves (resources) registry on the basis of the analysis of data from accounting systems and by the expert survey of leading experts (see table. 7.5).

Table 7.5. The registry of the reserves of the SE Alpha

№	*Type of the resource/reserve*	*Name*	*Availability*
1	Financial	Profit from main activity (1 997 thousand rubles)	Practically used
		Credit investments (opened a credit line of up to 15 000 rubles)	There are reserves of about 30%
		Venture capital (private investment to 25 000 rubles)	Available only 90%
2	Material and technical	Office space (book value 1816 thousand rubles, S=43.6 m2)	Available only 10%
		Instruments (book value 564 thousand rubles)	Available only 10%
3	Human resources	The proportion of staff with a higher education (80%)	There are reserves of about 20%
		The share of personnel of the highest and first categories in the total number of specialists (workers 20%)	No reserves

№	*Type of the resource/reserve*	*Name*	*Availability*
		The share of the organization's employees with academic degrees (10%)	There are reserves of about 50%
		The share of funds (in structure of costs) allocated for research and development performed by the company (0%)	No reserves

The subject of evaluation at **the 5-th stage** of the method is to determine the significance of the identified reserves and resources of the enterprise to further the fullest and most effective use. As the set of indicators for each of the resources there were taken the ones mentioned in the methodology:

- level (index) of rates of resource - L_1;
- applicability (will/will not work) - L_2;
- feasibility (like accessibility, for example, of a bank loan or available, i.e. the remaining amount) - L_3.

By the expert survey with further processing of the results of the group expertise there were provided estimates of these three indicators for each type of resource. The integral indicator was calculated as a multiplicative compression by the formula (7.1). The results are given in table 7.6.

Table 7.6. Factors of reserves' importance

№	*Name of reserve/resource*	L	L_1	L_2	L_3
1	Profit from main activity (1 997 thousand rubles)	0	0	1	0.5
2	Credit investments (opened a credit line of up to 15 000 rubles)	1	1	1	1
3	Venture capital (private investment to 25 000 rubles)	1	1	1	1
4	Office space (book value 1816 thousand rubles, S=43.6 m2)	0.12	0.5	0.5	0.5
5	Instruments (book value 564 thousand rubles)	0	0	0	0.5
6	The proportion of staff with a higher education (80%)	0	0	0.5	0.5

№	*Name of reserve/resource*	L	L_1	L_2	L_3
7	The share of personnel of the highest and first categories in the total number of specialists (workers 20%)	0	0	0	1
8	The share of the organization's employees with academic degrees (10%)	0	0	0.5	0.5
9	The share of funds (in structure of costs) allocated for research and development performed by the company (0%)	0	0	0	0
TOTAL: average index $L = 0.24$					

The analysis of this table shows that only credit and venture capital is real use in innovation. However, at the current stage of work of the enterprise, they may not be used due to the absence of ready to launch innovative investment projects. These resources can be included in the development program, which is scheduled to be activated as the purpose of the third phase (after ensuring a minimum level of survival of the company and achieve a minimum inventory of profit).

The 6-th stage of the algorithm is to select one or a group of innovative projects, able to ensure the achievement of the goals put forward by the management of the SE Alpha. At this stage, the analysis of reserves and resources, made at the fifth stage, suggests that the real resources that can be used for the survival of the company, are the own resources of time and personal experience of top management. This resource can be used mainly for the implementation of the organizational or managerial innovations, among which, according to international economic practice, the most promising is the outsourcing of services.

For effective outsourcing the necessary part is selection of works transferred to a third party for execution and the choice of the actual organization can perform them with the necessary quality. This part of the analysis and selection will be demonstrated using elements of scenario analysis [114].

As a rule, the upcoming repair and maintenance work on the heating networks and equipment have definite volume, capacity and can be estimated using common methods, in particular the methods of network planning and planning with the involvement of special computer programs. To illustrate that, here is a simplified version of the upcoming complex of works. In conditions of seasonal changes (increase) of volume of work, the planned work can be performed in different ways (different scenarios). For definiteness as alternative options will be considered the followings:

1) To perform work of the available forces and means.

2) To employ temporarily additional staff (with the subsequent dismissal after the work is done).
3) To draw a third party (by outsourcing), giving it a part of the forthcoming works for execution.

Typical complex of works is presented by the network diagram (see Fig. 7.4 and table 7.7).

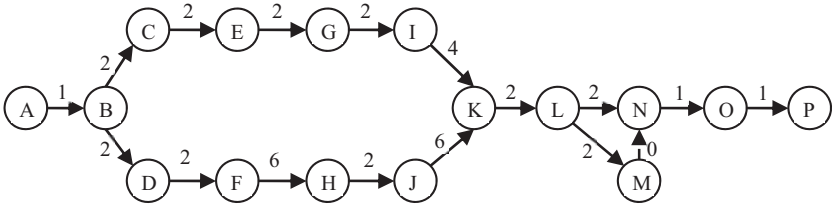

Fig. 7.4. Network diagram of a complex of works

To perform the calculations there were used software: MS Excel and Project Expert.

Table 7.7. Work content of network diagram

Work content	*Operation (Work)*	*Previous work*	*Follow-up work*	*Duration (days)*	*Labour force (persons)*
Shipping crews to object	A		B, C	1	1
Excavation the site №1	B	A	D	2	1
Excavation the site №2	C	A	E	2	1
Cleaning the site №1	D	B	F	2	1
Cleaning the site №2	E	C	I	2	1
Preparation of the damaged site (№1)	F	D	G	2	1
Stripping (on the site №2)	G	F	H	2	1
Welding works on removal of damages (on the site №1)	H	G	L	4	2
Dismantling of pipes (site №2)	I	E	J	6	2

Work content	*Operation (Work)*	*Previous work*	*Follow-up work*	*Duration (days)*	*Labour force (persons)*
Cleaning of tray (site №1)	J	I	K	2	1
Installation of new pipe (site №2)	K	J	L	6	2
Pressure testing of the entire plot	L	H, K	M, N	2	1
Isolation of the site №1	M	L	O	2	1
Isolation of the site №2	N	L	R	2	1
Filling the entire site	O	M, N	P	1	1
Garbage removal from the object	P	O		1	2

The use of the software complex Project Expert has allowed to simulate a large number of different variants of organization of works with different composition of the staff of SE Alpha, in the result there was chosen a scenario using such management innovations as outsourcing, which gave the company additional income and did not led to the need for subsequent dismissal of the hired employees.

Thus, the application of this method has allowed to provide the optimal choice of several different (in this case two) targets - profit and social stability, and as the result SE Alpha LTD., used the managerial innovation in the form of outsourcing of services on maintenance and repair of external engineering networks and power equipment. Assessment of economic efficiency of using this innovation, assuming average annual revenue from maintenance of external engineering networks and equipment in the amount of 8 million rubles, while expenditures connected with the implementation of this innovation in the amount of 6.35 million rubles, will be 1.65 million rubles, i.e. profitability is 26%.

7.5 CONCLUSIONS

After getting the result in the previous chapter (that increasing the survival rate of small enterprises can enlarge the country's GDP), in this one we made an analysis of the ways how to do it and used the example of one of such enterprises, made a SWOT-analysis for it, chose a type of innovation which can be effective for this particular company and counted the profit it can get.

8 ESTIMATION PERSPECTIVES OF INNOVATIONAL ECONOMIC DEVELOPMENT IN RUSSIA

Due to its special geographic place (one part of its territory is in Europe, another is in Asia) and quite special historical experience during the 90's of the last century and economic crisis just a couple of years before, Russia has to choose its own way, although in the modern globalizing world it's impossible to carry out the policy without taking into account the other players of the global market. The government needs to consider the other countries' experience, see their strong points and try to avoid the mistakes they have made. But also need to remember to take into account the special features of the Russian economy.

Analyzing the main directions of the economic policy of the most of the countries, or just comparing the list of the most successful economies in the world with the list of the most innovative countries we can clearly see that the vector of their efforts and expenditures proves the role of innovations as one of the most important, or even the most important factor in their policy.

The research provided in the previous chapters shows the content of the concept of innovation in the sphere of the national level – national innovation systems, their types and the trend of their evolution, analyzing the most significant examples of all types and the features most typical for the particular countries, the analysis of technology parks as one of the most efficient instrument for stimulating the innovations in the country and different types of it. Keeping in mind the experience of the other countries in the field of innovation policy and infrastructure and also the role of small enterprises in it, we analyzed Russia's innovation sphere.

On the basis of the previous analysis of the other countries' and Russia's national innovation system and its elements, we can make some conclusions and forecast about the future of the Russian economy in the field of innovations.

Despite of the negative effects of the economic crisis, problems with the population (some forecasts shows decreasing of the population by 17 million by 2025 and increasing the number of pensioners by 9 million people), Russia does have a chance. Taking into account the breakthrough R&D in the sphere of critical technologies in practically all the trends of the modern and future technological modes, Russia needs to focus its financial and administrative resources on the above priorities rather than spend efforts to develop trends in which it's too far behind today. Analysis showed some ambiguous effects, like the fact that the fields of the Russian research papers are published in, are not that popular in the world, and the world's most popular fields are not being studied by Russian scientist (as they are not publishing their works in these fields), but this can be a sign of the other effect – Russian researchers are choosing the fields in which Russia has greater potential, which can be implemented and will provide competitive advantages in its economic development in future.

It also worth to mention that the fields Russia is strong and has potential in future (the researchers estimate the possibility to occupy a significant share of 10-15% of the world market), i.e. the aircraft industry, nuclear power engineering, rocket and space systems and some segments of the nanotechnology market, in most of the cases don't suit to be published in the research papers, as it touches upon the national security, so it also can affect the conclusions to make on the basis of such an indicator as the amount of research papers published.

Although Russia started the current program of innovational development of the country only in 2006, but it has experienced some changes and corrections and will in the future improve the innovation policy for the changing environment. The legislative base created in 2006 are also being changed according to the situation in order to provide the more effective services for the one of the most important actors in the field of innovation sector – small and medium enterprises. There has been created the Association of Russian Technoparks, which provides the "one window" service for the participants and other services for the residents of the technoparks.

Russia had a long period of economy on the basis of plan, so the word "plan" sometimes has not such positive associations with something wrong from the past, but they need to be overcome, because today no effectively developing country does without planning while implementing its strategic tasks. The most impressive example is China and its speed growth not only in the field of the economy but also as a trend for becoming one of the innovation systems with the fastest development in the world. So Russia needs to put more attention on the clear planning of the results of its innovative development and improve its system of long-term forecasting and strategic planning, providing the cooperation of the Russian Academy of Science with all state academies, federal authorities and higher education science. That will help to make long-term forecast of Russia's socio-economic, scientific-technological and territorial development.

Russia needs to develop and spread more all over the ministries and other government bodies the effective and transparent system of monitoring and controlling the use of the budget funds within the ministries, which will help to stop the wrong usage of the state money.

Reduce the gap between the education and real business, for that there can be considered some elements of the "triple helix", described in the chapter 2, for example, let the universities create enterprises to give the students a chance to check the knowledge they getting on practice, getting the results and making conclusions, creating new knowledge, making it the main part of the educational process and not only the formal part as it is now in the form of the working practice in the end of the study period before graduation.

Increase the share of funding for the R&D sector making all the money received form the selling resources abroad work for the country's future development (trying not to get so the called Dutch disease Russia experiences in the early 2000's) improving the conditions for the researchers to create

new knowledge, by rising the salary level, providing good infrastructures not only within the science and technology parks, but also changing the instrument base of the laboratories in the academies and providing good infrastructure for the universities (providing the universities with the modern equipment).

Implementing the model of innovative partnership of the state, business and education. The state should primarily ensure the legislative support of the process, funding from the budget, tax stimulation and innovation climate. Business must undertake investment-innovation projects and finance accordingly the development of market niches. Education is the most important element and the base of the innovation economy, but it needs to be in a close connection with the current needs of the state and business, to be able to prepare the specialist needed for the country's economy. And that's the reason to develop the forecasting field because the many of the modern professions and work just didn't exist 10-20 years ago. Nowadays the forecasting prognoses are being made also by the Skolkovo project.

So, considering the efforts being made now in Russia by the government and the activity of the participants, involved in the sphere of innovations, we can conclude, that Russia has quite good chances to develop an effective innovation system and take a good place among the world's most effective innovative countries.

CONCLUSION

The phenomenon of small enterprises in the economies of different countries is used for a variety of purposes.

Small enterprises can be created quite easy if necessary, and also can be closed without significant losses and/or socio-economic impacts. This property of them often is the most significant for innovative startups, where the risk of inefficiency is very large, and therefore the damage from unsuccessful startups stop working is not essential, while the positive impact in case of successful development can be very significant.

In the economies of some countries, the share of small enterprises in GDP is quite big. In this process there are the effects of paralleling and decentralizing the creation of enterprises that work out, and also their high manageability, mobility and autonomy. And at the same time, the results of their economic activity are composing, leading to cumulative and synergetic effects. Unlike small ones, large enterprises are more slow, inertial and often less manageable, although, in contrast to small enterprises, have a number of other advantages.

In the area of innovation development of economy, small enterprises (in the form of startups) are the key element created for realization of venture projects, which, if effective, may be extended to the necessary sizes or join a large company.

The government structures in the majority of developed or developing countries, being aware of the extreme importance of the role of small enterprises in the innovative development, create a variety of favorable conditions for their formation and innovative development. Every positive (and negative) experience in this sphere is extremely important and must be accounted for and used by other countries, associations, companies. However, the analysis shows that the use of foreign experience in the area of innovation development, including all its components, i.e. generating new knowledge, R&D, production, support, and implementation, has a huge number of features, due both to the state of the economy, and mental-historical characteristics of the people of a particular country. Blind copying of innovative technologies often does not have the desired effect [115]. Therefore, it should be stated that the mechanisms of innovative development of different countries and technological structures rather more specific than general.

However, it should be noted that the schemes of innovative development of various countries and regions are largely similar, based on selection of the key directions and critical technologies development, which are being implemented, as a rule, by program-target methods. In this case besides the pure state support measures there also tools of private-state partnership are being applied.

One of the significant problems of efficient innovative development is the absence of effective tools of innovation management. The paper suggests two tools, the first of which is a set of models for assessment of potential of

small enterprises - can be used to monitor the potential, from the company level up to the state level. The second important proposed tool is the method of transition to the innovative way of development or bringing innovation to ensure own competitiveness, survival and development.

The complex of the models of potential assessment is based on data of the previous period of activity of an economic subject and takes into account the factor of increasing of survival rate of small enterprises through the creation of an enabling environment. Based on the data of Rosstat, the work presents the calculations for estimating the potential of small enterprises in Russia. The model allows monitoring the potential of small enterprises and allocating funds for their support more efficiently.

The method of transition of small enterprises to innovative activity, proposed in the work, contains a sequence of interrelated stages, each of which includes a specific set of activities and assessments. Part of the stages of the algorithm is performed on the basis of data of the accounting systems of the enterprise, and part - on the basis of expert assessments, where the experts are managers and specialists of the enterprise, and external analysts.

Using the proposed method there has been provided the scenario of transition to innovative development, built on the basis of the influence of the external environment (for seasonal growth of demand for the services provided).

As economical and mathematical tools in the work there were used the developments of the author and colleagues [116, 117, 118] and standard modern software tools for data analysis.

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