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Master's Thesis

THE ROLE OF SCIENCE TECHNOLOGY PARKS IN CREATION OF NETWORKING FRAMEWORK BETWEEN ELEMENTS OF NATIONAL INNOVATION SYSTEM AND BUSINESS IN RUSSIA

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ABSTRACT

Author: Anna Bogucharskaya **Subject:** The role of science technology parks in creation of networking framework between elements of national innovation system and business in Russia
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This master thesis paper investigates the National Innovation System (NIS) in Russia and examines the principles of functioning of science technology parks (STPs). The author describes the main theories of STPs' development and reflects their connection with all stakeholders of NIS. The implementation of innovations and functioning of NIS in Russia is investigated through the research of the "Technopark Strogino" and the "Technopolis Moscow" cases. The author conducts interviews in order to cover all possible issues concerning obstacles of innovation development in Russia and reflect perspectives of the National Innovation System. The results show the importance of STPs' cooperation with Government, Academia and Industry, the synergy of this cooperation and strategies for the effective creation of networking environment. The study shows a low level of interaction of NIS and its elements in Russia. This is due to the fact that existing STPs in Russia are of the first and second generations: these types of STPs employ conventional methods of work and rarely utilize modern digital solutions for the organizing interaction with Government, Academia and Industry, such as the creation of virtual technology parks and specialized platforms for the implementation of this interaction.

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LIST OF ABBREVIATIONS

BI	Business Incubator
NIS	National Innovation System
R & D	Research and Development
STP	Science technology park
SMEs	Small and medium-sized enterprises

1 INTRODUCTION

The chapter describes evidences of the topicality of the studied subject, presentation of theoretical background of the study, research questions and objectives.

1.1 Background of the study

Global economies in the last 20 years are characterized by significant changes in the structure of international competition and productivity (Bianchi and Labory, 2006). The globalization of the innovation of a large scale is reflected in the constant circulation of products and services.

Economic growth is stimulated by the achievement of political, financial and humanitarian goals through high quality and positive structural changes in the economy, and the development of innovative products (Brown et al., 2003). The development of countries determines the scaling up of production activities, revenue growth, reforming of economic systems of state structures. Furthermore, it accelerates scientific and technological progress, stimulates entrepreneurial development, and contributes to the economic growth (Deller, 2010). In order to increase the rate of economic growth of a country, it is crucial to concentrate on creation of conditions for innovative development and infrastructure for innovation. This, in turn, will facilitate development of favorable conditions for the increase of economic growth and the improvement of the quality of life. The key focus of the innovation policy in this case should be the encouragement of technology transfer and cooperation between small- and medium-sized enterprises (SMEs) and research and development companies (Marchese and Potter, 2010).

National Innovation System (NIS) is a complex of communications, which contribute to implementation of innovation into business and industry on a national scale (Godin, 2011). Three major stakeholders of NIS are Government, Academia and Industry. The NIS also involves interaction between these three main actors. The NIS interacts with public and private sectors of business. This collaboration includes joint research and exchange of resources, expertise and funding. Implementation of NIS at the national level is crucial for the development of innovations.

The development of innovation infrastructure is one of the primary tasks of modernization of innovation system (Radgina, 2010). Infrastructural support encompasses a variety of different institutions providing business services to entrepreneurs, such as consulting, R&D, investment support and others.

Representatives of business and industry, who support the development of infrastructure, address a number of critical issues that inhibit the establishment of new innovative enterprises (Mole et al., 2009). The institutions that provide such support try to co-locate a number of services in such a way that the enterprise can suit their needs. Miller et al. (2011) in turn distinguish four support areas for entrepreneurs: Consulting, Networking, Finance, Premises.

Science technology parks (STPs) play a key role in the development of NIS (Brcic et al., 2010; Uryupina, 2013). Among all the elements of the innovation infrastructure, they act as instruments of a governmental policy, providing the implementation of novel technologies into life (Hansson, 2007). Innovation is a powerful tool for stimulation of national economies. Governments therefore tend to foster innovation policy for knowledge transfer and university-industry cooperation development. Such measures can be monitored in all countries with the developed NIS. Currently, many countries consider STPs as the most common element of NIS. STPs are now present in the US, UK, France, Germany, China, Japan, Canada, Australia and many other countries. The experience gained by the leaders illustrates that STPs can act as effective structures of modern innovative production. Thus, STPs play a noticeable role in the use of knowledge, creation of new jobs and new business development, which all leads to stimulation of economic growth (Hansson, 2007). Considering all listed sources of support for innovation companies, it may be concluded that STPs have valuable sources for implementation of innovation and the development of infrastructure. Innovative companies address them in order to get connections to other enterprises and find required funding. They also engage SMEs into a system of monitoring and business assistance in order to help entrepreneurs develop their businesses. STPs contribute to strategic development of their tenants and provide a value-adding system of assistance that enables development of tenants' business capacities (Hackett and Dilts, 2004a). According to Brcic et al. (2010), STPs are a critical part of entrepreneurial supporting infrastructure, which foster development and growth of innovation companies.

There are many terms, which describe similar types of infrastructural support for innovation companies or entrepreneurs. There are two major groups of such terms. The first one includes such expressions as a science and technology park, technopark, technopolis, technopole, technology precinct, research park. The term “technology park” is mostly used in Germany and in Asia, the term “science park” in England, the term “research park” in the USA, the term “technopolis” in France, the term “technopark” in Russia (Link and Scott, 2007). In Russia, the terms “technopark” and “technopolis” are used more frequently than the “science park”.

According to the International Association of Science Parks (IASP), “a science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated business and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities”.

According to the Russian Federation Government Decree 10.3.2006 N 328-r “Approval of the state program “Establishment of Technoparks in High Technology Area in the Russian Federation” (as amended on 10 March 2009), a technopark (science park) is a territory of an innovation activity that accelerates interaction of high-tech companies within a certain sector due to the availability of infrastructure and provision of necessary services.

Meanwhile other innovative structures, such as an innovation technology center, innovation center, technology transfer center, and business incubator can also provide services for innovation start-ups similar to those that STPs do.

Some authors consider business incubator (BI) as a synonym to a science park (Dettwiler et al., 2005; Phan et al., 2005; Brcic et al., 2010) since both terms are defined as a part of entrepreneurial infrastructure, which promotes different services and facilities innovation technology companies’ development. Other authors claim that business incubators differ from science and technology parks in their relation to start-ups and early-stage companies. These researchers consider incubators as structures that focus on support of entrepreneurs and start-ups, while science parks mostly support mature firms (Radygina, 2010).

According to Wiggins and Gibson (2003) first incubators emerged in the USA due to three drivers:

- The government tried to use old, abandoned industrial buildings in distress regions by offering them to SMEs;
- The National Science Foundation financed innovations and entrepreneurial activities arising in universities;
- Successful entrepreneurs wanted to share their experience with innovative start-ups.

The concept of incubation and the term "incubator" is often used as an overall denomination for organizations that constitute or create a supportive environment that is conductive to "hatching" and development of new firms (Lindholm-Dahlstrand and Klofsten, 2002; Lyons and Li, 2003; Chan and Lau, 2005). According to Bergek and Norrman (2008, p.2) "business incubators are used as vitamin injections for "tired" regions and as contraction stimulators or painkillers in the birth of university spin-offs".

Aerts et al. (2007) claim that BIs stimulate growth processes, promote entrepreneurship, and contribute to innovation development by providing facilities and equipment, financial and consulting support. They found BIs to be one of the most effective instruments of innovation support and start-up development. Business incubators provide support in strategic development, offer value-adding intervention systems for monitoring, as well as business assistance services. BIs are also valuable for the development of certain business capacities for potential innovation entrepreneurs or SMEs (Hackett and Dilts, 2004).

By analyzing the information listed above, it is possible to say that STPs and BIs are perceived as business centers for innovative companies. They provide information, legal and technical support, access to communication systems and other logistical support. STPs and BIs are a part of the market framework, which integrates innovative companies within the economic framework (Uryupina, 2013). According to Brcic et al. (2010), STPs and BIs are a crucial part of the entrepreneurial supporting infrastructure, which fosters development and growth of innovation companies and start-ups. These structures unite science, innovation, research and business into effective practice.

In the present study, STPs and BIs are considered as similar structures with the same direction of work and objectives based on the views of authors who define them as types of innovation infrastructure for promoting a comfortable environment for innovative companies. Since both

terms have a similar definition, they will be addressed collectively and considered as the term 'STP' within the framework of this study.

The first STPs appeared in the USA in the beginning of 1950s. The main idea of STPs was to set industrial enterprises nearby large universities in order to strengthen the impact of science on technological innovation. This practice was highly successful and has evolved into the model of STPs, which is commonly spread today (Hansson, 2007).

Some authors distinguish three generations of STPs (Gyurkovics and Lukovics, 2014). Others outline four generations (Formica, 2009; Hardman and Berntsen, Next generation science parks). STPs has evolved from university based science parks to a science park as a network organizational structure for synergy of professional communities (Hansen et al., 2000; Bianchi and Labory, 2006). The main purpose of the first generation of STPs (later 40 - early 70s) was to lease premises and land on concessional terms for various companies. A distinctive feature of STPs of the second generation (the end of the 20th century) was the existence of a building intended for placement of SMEs in it. The presence of such buildings contributes to the formation of SMEs that use collective services. The third generation (the end of the 20th - beginning of the 21th century) is characterized by the application of the "cluster" system of location of enterprises. The STP is an established system of "growing" of small businesses by uniting market leaders and start-up companies under one-roof. The fourth generation (the beginning of the 21st century) is a "distributed" STP, which is focused on the provision of services for development of small innovative companies, without the provision of offices and premises for production of these companies. Such STPs were created for establishing the connection between users and providers of innovation process. Management teams of these STPs can develop this connection and create a business environment that integrates all stakeholders of innovation process (Haselmayer, 2004; Annerstendt, 2006; Bianchi and Labory, 2006; Formica, 2009; Hardman and Berntsen, Next generation science parks). A detailed description of STPs' generations is presented in the chapter 2.3.

Globalization and integration has made networking an important aspect for success (Ritter et al., 2004; Dhanaraj and Parkhe, 2006; Möller and Rajala, 2007; Ritala, et al., 2012). Companies integrated with STPs can benefit from communication with Government and Academia structures, can get the access to corporations and external funding. Tenants of STPs also receive technical expertise, consulting services, support from business mentors,

international business, suppliers and investors. Furthermore, clients of STPs obtain the opportunity to interact with other customers. All these aspects enable STPs to develop networking as a powerful tool for growth (Ritter et al., 2004). It is therefore crucial to create a sustainable network for effective STPs (Heikkinen and Tähtinen, 2006; OECD, 2010).

STPs play an important role in stimulation of innovation growth as they contribute to technology transfer and integration of the NIS elements in a single unit. This integration includes government, industry and university relations. The effectiveness of NIS is strongly dependent on the depth and quality of interaction between three elements: Government, Industry and Universities. One of the common approaches that describe NIS is the Triple Helix Model. This concept is presented in detail in the chapter 2.3.

It is worth noting that business support structures in Russian Federation are usually referred to STPs, however they do not provide a sufficient amount of services for clients. Such structures typically provide offices for rent without any collective services for innovative business development. STPs in Russia, which are often called “technoparks”, are mostly of the first and second generation, with the rare exception of the third. They provide a limited amount of services for SMEs, in most cases these are simply premises for rent and small range of collective services. STPs should create a sustainable business model with a key focus on the development of effective business structures and creation network framework rather than on provision of simple rental services.

The present study is designed to examine the system of relations between Russian STPs and University, Industry and Government, as well as to investigate STPs’ networks as an instrument for successful functioning of the NIS system and facilitation of innovation development. The research also focuses on the creation of recommendations for the building of strong connections between STPs and university, industry and government, and on defining the key elements involved in the process of creation of long lasting partnerships. The chapter 3 contains a detailed analysis of the links between STP and university, industry and government and their impact on innovation businesses.

1.2 Research aims and questions

Cooperation between all three elements of NIS is one of the main goals of creating comfortable conditions for innovation development. Organizations with a developed networking system, appropriate management and access to elements of innovation

infrastructure of STPs get valuable infrastructural support and foster innovation entrepreneurship development. This research provides the analysis of STPs' networks, outlines recommendations for networking development, and indicates links with each group of stakeholders, such as Government, Academia, and Industry.

The purpose of this study is to investigate the role of cooperation between STPs and other stakeholders, such as government, universities, financial institutions, industrial partners, and other organizations, which support young innovation companies. This research will also explore strategies that STPs typically use for creating and sustaining their networks, and also for determining the criteria for successful development of their tenants.

The research concentrates on networks of STPs, their partners and strategies. It also investigates activities, benefits and drawbacks of networking, as well as the influence of collaboration within a specific network on tenants' development. The study specifically focuses on the investigation of STPs in the Russian Federation. The geographical, political, social and economic aspects are taken into consideration while performing this study.

The main research question of this study is:

How do STPs interact with the elements of the National Innovation System in order to facilitate innovation development in Russia?

The author defines the following sub-questions:

1. How do STPs interact with Academy, Industry and Government in Russia at the moment?
2. Which strategies should be implemented for the development of Russian STPs in order to create an effective networking framework with elements of NIS?

1.3 Research structure

Structure of the study presented in Table 1.

Table 1: Research structure of the study

Input	Chapter	Output
Theoretical background, historical facts of NIS and innovation infrastructure development, STPs	Chapter 1 INTRODUCTION	The urgency of the problem under study, the structure and objectives of the research
Description of the functioning of NIS and its main elements for support of innovation among entrepreneurs in particular STPs	Chapter 2 SCIENCE TECHNOLOGY PARKS AS A PART OF NATIONAL INNOVATION SYSTEM	Representation of science technology parks development, descriptions of generations and further evolution
Literature and practical examples of network functioning in STPs	Chapter 3 NETWORKING BETWEEN SCIENCE TECHNOLOGY PARKS AND ELEMENTS OF NATIONAL INNOVATION SYSTEM	Understanding of existing linkages between STPs and University, Government and Business
Description of existing research methods and methodologies, case environment and data collection	Chapter 4 RESEARCH DESIGN AND METHODOLOGY	Description of basic approaches, presentation of methodology and interview questions

Statistics, reports Interviews' data, STPs' information, reports	Chapter 5 FUNCTIONING OF SCIENCE TECHNOLOGY PARKS IN RUSSIA. ANALYSIS OF CASES AND INTERVIEWS	Analysis of development and functioning of STPs in Russia. Cases of Technopolis "Moscow" and Technopark "Strogino".
Literature review and empirical findings	Chapter 6 DISCUSSION	Description of STPs' networking functioning with University, Government and Business Strategies for the future development on network coordination of STPs with University, Government and Business
Results and findings	Chapter 7 CONCLUSSION	Results summary and suggestions for further research

2 SCIENCE PARKS AND BUSSINESS INCUBATORS AS A PART OF NATIONAL INNOVATION SYSTEM

2.1 National innovation system and its main elements for support of innovation among entrepreneurs

The National Innovation System (NIS) is a structure, which is in charge of controlling the maintenance and growth of innovation and technological development. The development of both technology and innovation is the core of this structure, as they create a competitive advantage on the market. NIS, therefore, is an integral part of a country's economic growth strategy.

The NIS theory has been developed by Freeman, Lundvall and Nelson in 1980s. They have analyzed the growth of innovation activities in various countries, comparing values that lay in the core of innovations in various locations, and finally gave the definition to the concept of NIS. The findings of their research were based on studies of Schumpeter, Hayek, North, Solow, Romer and Lucas (Freeman, 1982; Lundvall, 1985; Freeman, 1995; Lundvall, 2007).

According to Freeman (1987, p. 1) NIS can be described as "The network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and diffuse new technologies".

Lundvall (1992, p. 12) characterized NIS as "… the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state."

Nelson (1993, p. 4) describes NIS as "... a set of institutions whose interactions determine the innovative performance ... of national firms."

Each of the authors offered their own definition of NIS, focusing on some of its elements and their position in the overall innovation infrastructure. As it can be understood from the definitions, the key advantage of NIS is an increase of production volume among new technologies.

At the same time, NIS follow general methodological principles, such as:

- Knowledge plays a special role in the economic development.

- The main factor of economic dynamics is the competition between entrepreneurs, which is based on innovation.
- Institutional context of innovation directly affects its content and structure.

Russian researchers (Ivanova, 2002; Katukova et. al., 2012; Molchanov and Molchanov, 2014) additionally outline the following characteristics of NIS:

- NIS has a systemic character;
- NIS is considered as a set of elements interacting in a special way;
- NIS has an institutional aspect;
- Dissemination of new knowledge and technology is the main function of NIS.

Structure and linkages of NIS are presented in the figure 1. This figure represents fundamental components and communications of NIS and shows collaboration through linkages between stakeholders (UNCTAD, 2013).

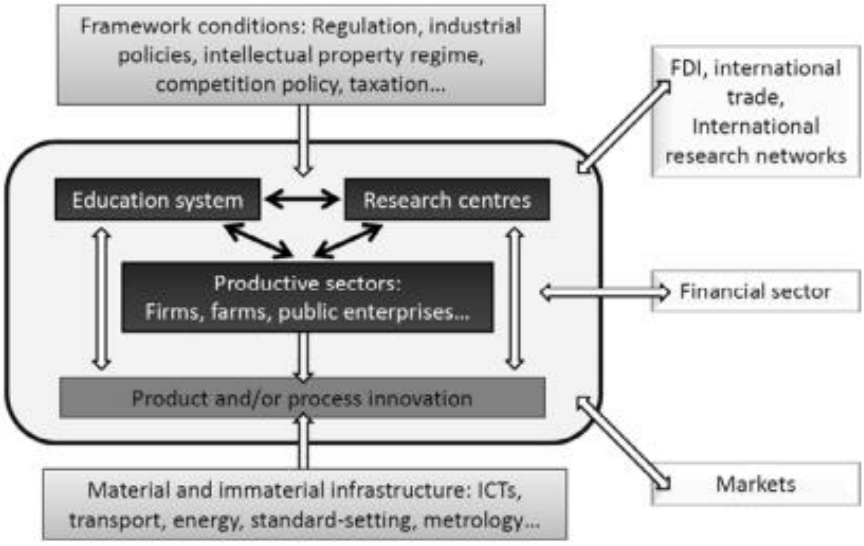

Figure 1: A systematic diagram of National Innovation System (UNCTAD, 2013)

Following the OECD classification (OECD, 1999), NIS includes government, research institutions, and industries. NIS works as the liaison between government, firms, universities, social institutions and other organizations.

NIS can be described as a structure within a national economy, which involves various participants, for example, organizations, associations and institutions. By communication

with each other, they create a framework for stimulation of innovations, foundation and growing of new firms (Balzat and Hannush, 2004).

2.2 Triple Helix concept

The effectiveness of NIS is strongly dependent on the depth and quality of interaction between the three elements: Government, Industry and Universities. Therefore, one of the common approaches that describe NIS is the Triple Helix Model. It has been developed by Etzkowitz and Leydersdorff L. in 1995. This concept involves three "spirals", which intertwine and interact with each other:

- Government - local and regional authorities;
- Industry / business;
- Universities.

Academia-Industry-Government relations are the main elements of the regional, national or multi-national innovation strategy (Etzkowitz and Leydersdorff, 1995). Figure 2 illustrates the Triple-Helix model of NIS.

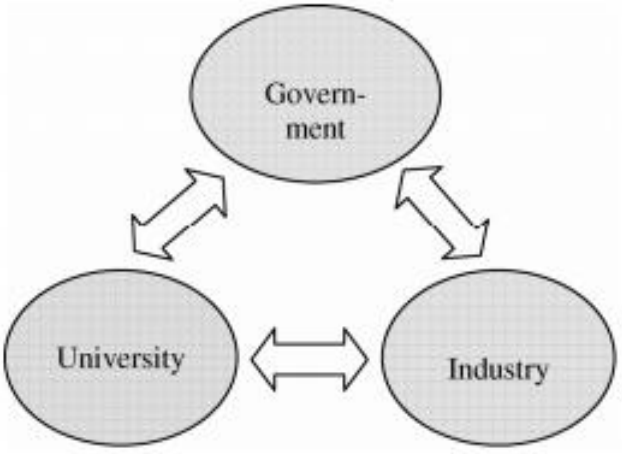

Figure 2: Triple-Helix model of University-Industry-Government relations (Adopted from Savitskaya and Torkkeli, 2011)

Each of the elements is independent and has its specific qualities and measurable parameters. The Triple Helix model examines how the interactions of these three spirals appear in a successful innovation system (Etzkowitz and Leydesdorff, 2000).

The Triple-Helix concept is based on the evolution of innovation systems. During the transformation of the interaction between the government, industry and academia, the forms of interaction also undergo several changes. The evolutionary development of the Triple-Helix configuration into the integrated form is shown in figures 3-5 below.

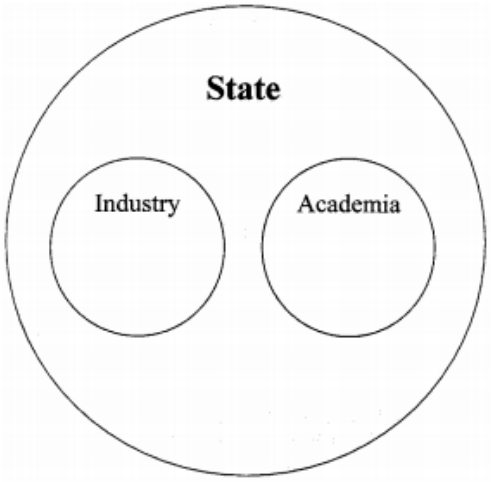

Figure 3: A statistic model of University–Industry–Government relations. (Adopted from Etzkowitz, and Leydesdorff, 2000; Etzkowitz 2008)

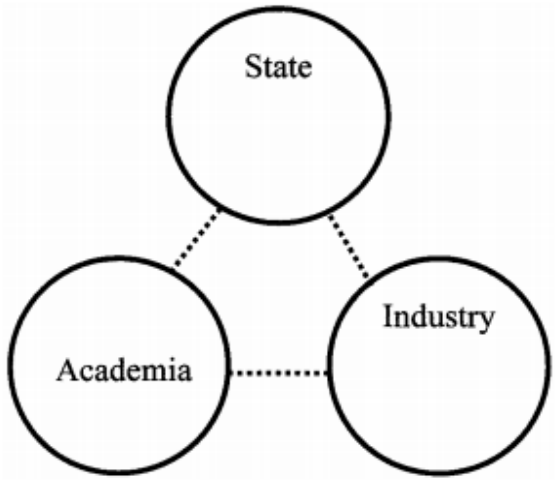

Figure 4: A "laissez-faire" model of university–industry–government relations. (Adopted from Etzkowitz, and Leydesdorff, 2000; Etzkowitz 2008)

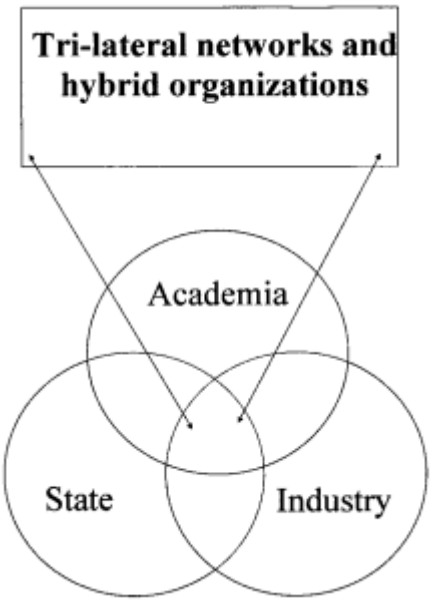

Figure 5: The Triple Helix Model of University–Industry–Government Relations. (Adopted from Etzkowitz, and Leydesdorff, 2000; Etzkowitz 2008)

The figure 3 depicts a static model or a model of administrative-command society. In this model the primary role is played by the government. There is no interaction between all three elements as industry and universities are state-controlled. An example of such a system is the innovation policy in the Soviet Union, where all three elements were unconditionally controlled by the state (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008). The main advantage of such a system is the clear innovation strategy, which is planned for years ahead. However, it has several sufficient drawbacks, such as low rates of innovation implementation and the resistance to change in large-scale enterprises.

The figure 4 illustrates a "laissez-faire" model of university–industry–government relations, also known as "the market model". In such configuration, all three elements are separated from each other and operate independently. In this situation universities provide only educational services and research results, while the industry is connected to other participants of the NIS by market relations (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008).One of the key benefits of this model lies in stimulation of entrepreneurial activity.

The figure 5 presents the Triple-Helix Model of University–Industry–Government Relations. The elements, in this case, not only perform their functions, but also interact with each other, and innovations appear in a place where overlapping of the elements occurs. As

a result, the Industry, State, and Academia acquire new functions in addition to existing ones (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008).

This concept includes the following three basic conclusions:

- The role of universities is greatly enhanced by the interaction with business and government institutions;
- Innovative products are not created by the initiative of the state. They are created by the interaction of the three major elements that seek to cooperate both in the generation of knowledge, technology transfer, and commercialization of innovation products.
- The NIS elements, in addition to implementation of its functions, acquire new ones.

2.3 Role and Development of Science technology parks

STPs play a key role in the development of NIS. According to the Innovation Association of Science Parks and Areas of Innovations (IASP) science, technology and research parks are the key elements of the countries' economic development. STPs create a dynamic framework and contribute to changes in innovation policies, activities and facilities, quality space and value-added services that stimulate innovation entrepreneurs' development.

The main goal of STPs is to reduce the timing of a new product development and decrease the introduction time of product to a consumer market. An STP acts as an intermediary, providing interaction and information exchange between innovators, innovation enterprises and Government structures, Institutions and Industry (Radygina, 2010).

The development of STPs was supported by the belief that they would act as a core institution of regional technical entrepreneurship (Van Dierdonck and Debackere, 1990). According to Monck (1988), STPs are considered as a property-based initiative, which includes the following features:

- It has formal and operational connections with a University, other Higher Education Institutions or Research Centers;
- It is designed in order to encourage the formation and growth of knowledge-based businesses and other organizations on site (science park's residents);

- It has a management function, which is actively engaged in the transfer of technology and business skills to the organizations on site.

According to Allen and McCluskey (1990), UKSPA (1996), Hackett and Dilts (2004a, b), Hansen et al. (2000), Link and Scott (2003), Wright et al. (2008), the concept of STPs includes the following characteristics for stimulation of growth of technology-based firms:

- Rent of offices and provision of services and activities;
- Professional mentoring and counseling;
- Creation of internal and external networking and establishment of partners' relations between elements of NIS.

Bellavista and Sanz (2009) analyze framework of STPs consists of eight main blocks. These blocks are shown on the Figure 6.

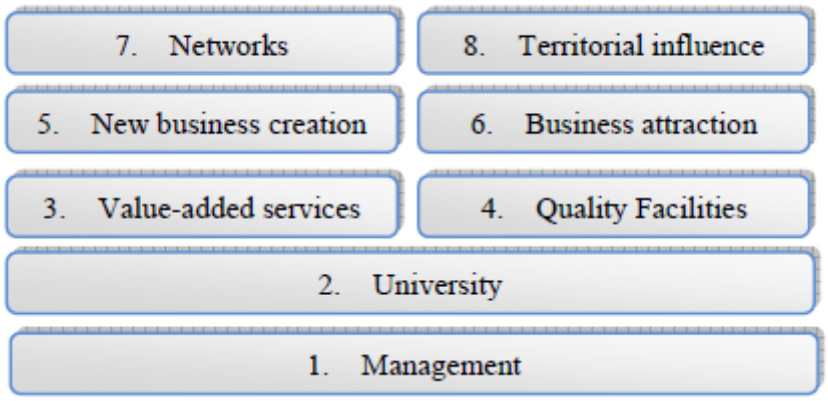

Figure 6: Eight main blocks of STPs' framework (Bellavista and Sanz, 2009)

Characteristics of STPs' framework blocks:

1. This element includes creation of a professional team, which can provide competent management and a supportive framework for the professional activities of tenants.
2. University is the next important element of Bellavista and Sanz model. Successful STPs commonly possess strong communication links with universities. An access to research databases of universities and research centers forms the basis of the scientific activity in the STPs.
3. STPs should provide professional value added services to its residents. Value added services involve all activities, services and facilities that management team of a

science park offers to its tenants. Typical services that contribute to residents' success are listed below:

- Provision of an access to sources of finance and investments, establishment of contacts with business angels and venture capital funds, universities and research institutes;
- Technology transfer and commercialization;
- Assistance in commercial contracts, and establishment of national and international contacts, including major corporations;
- Search of new possibilities for development of companies through joint ventures.
- Provision of common (joint) services;
- Tax reductions for residents;
- Premises rentals at preferential prices. It is one of the main reasons for the establishment of business incubators and science parks. Residents receive rent area at a discounted price.

4. Quality facilities involve not only business framework listed above, but also recreational facilities.
5. The next element is a new business creation. Growth of firms and creation of workplaces are one of the main targets that STPs have to accomplish.
6. Promotion of STPs.
7. Networking describes creation of interaction between tenants and other internal structures.
8. Territorial influence implies an outside expansion of developed STPs across its boundaries. (Bellavista and Sanz, 2009)

Incremental progress can be observed in the development of STPs. Every 15-20 years there is a change of STPs' formats which is caused by changing market trends, shifts in world economy and by transformation of society as a whole (Haselmayer, 2004; Bianchi and Labory, 2006). Now there is a change of global trends in technological development. It affects not only STPs' formats themselves, but also their role in society and economy. Competitiveness and profitability of the older generation of STPs is rapidly falling (Shpak, 2012). Nowadays Science Park's development is in an upward progress.

Development of science parks has three main generations (Haselmayer, 2004; Annerstendt, 2006; Bianchi and Labory, 2006), see table 2.

Table 2: Comparison of the generations of science parks (Adopted from Bianchi and Labory, 2006; Annerstedt, 2006).

Aspects	First generation	Second generation	Third generation
Aim	Broaden universities' economic opportunities	Support the creation and growth of innovation oriented businesses	Improve the welfare of the local community
Mechanism of operation	Economic utilization of the university's research results	Create technologies suitable for economic utilization, encourage university students to become entrepreneurs	Support Academia-Industry-Government relations and interactions, offer a broad portfolio of innovation services, develop a region's entrepreneurial culture
Location	In the immediate proximity of the university but not in a city center	Not in a city center	In bustling city centers
Started by	Mainly universities	Primarily business organizations, the minority by universities	Universities, businesses and local (municipal) government together
Management	An organization created by the university	A business created by a private sector	A business jointly owned by three sectors with a professional management team
Innovation approach	Science push	Market pull	Interactive, feedback-based

Some authors determined born of fourth generation (Formica, 2009; Hardman and Berntsen, Next generation science parks), (see. Figure 7, Table 3).

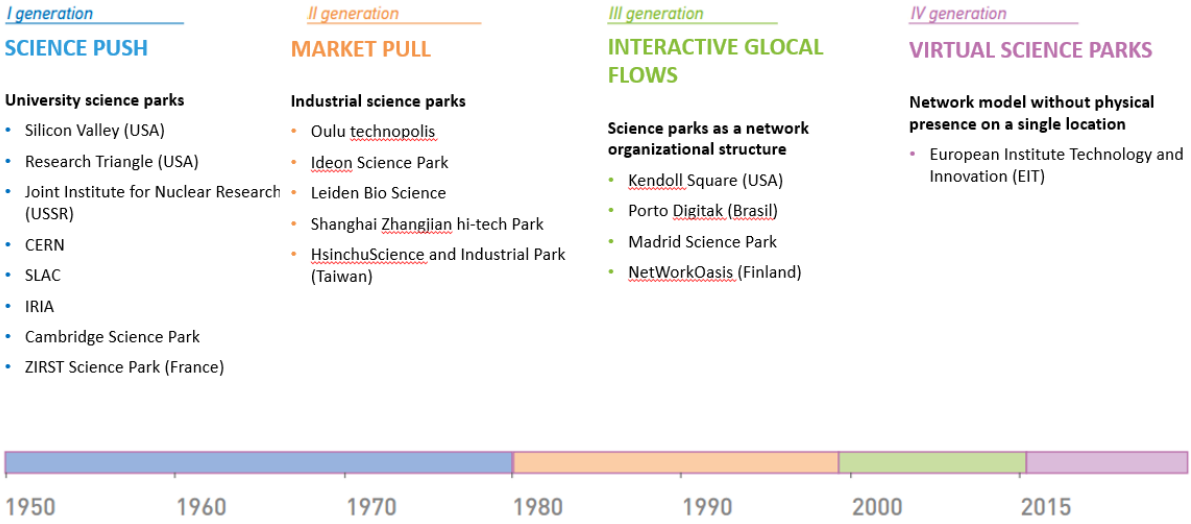

Figure 7: Science parks' generations (Edited by the author, based on Bianchi and Labory, 2006; Formica, 2009; Hardman and Berntsen, Next generation science parks)

Table 3: Science park generations and its main characteristics (Recourse: Edited by the author, based on Bianchi and Labory, 2006; Formica, 2009; Hardman and Berntsen, Next generation science parks)

Stage of science park development	I generation	II generation	III generation	IV generation
Period	**late 40s-early 70s**	**early 70s-mid 80s**	**mid 80s - early 2010s**	**early 2010s - future**
Type	University science parks	Industrial science parks	Science park as a network organizational structure	Network model without physical presence on a single location

Strategy type	Technology push	Market pull	Interactive glocal flows	Virtual science park
Base process	R&D	Commercialization of R&D	Creating a space for an exchange of information, creation of joint projects	Creation of an inter-cultural context of mobility and integration
Product	Innovation product	Technological solutions and technologies	Research potential	Global innovation power
Base services	Access to a knowledge source of universities or a source of practical problems	Favorable lease terms, other related services	Access to a professional community	Global networks, multiple stakeholders involved in STP communication

First generation of science technology parks

The first science park generation appeared in USA in the beginning of 1950s, in Europe they came in the beginning of 1960s. The first science parks in the US were created on the basis of Stanford University. Universities created science parks in order to implement ideas of local researchers into practice. This type of STPs represents the expansion of a university into a special zone for development of ideas by researchers (Bianchi and Labory, 2006). Main characteristics of the first generation science park involves the following (Gyurkovics and Lukovics, 2014):

- The location should be in proximity to a university;
- The park should be managed by a university;

- The main goal of the park is the economic development of universities and support of university's business activities;
- The research park is operated by the "science push" model of innovation;
- Obtaining of new scientific results has higher priority than satisfaction of market needs and practical utilization of innovative ideas.

Science parks of the first generation evolved due to a success in creation of agglomerations of innovative cities around the first industrial parks (such as Silicon Valley, covering cities such as Santa Clara, San Jose, Maung Ting View, Palo Alto, and others), as well as due to a high efficiency practice of creating scientific centers, such as Dubna, in the USSR. For instance, in 1959 Akademgorodok was founded in Novosibirsk where R&D activities specializing in different economy sectors were concentrated (Radygina, 2010).

Second generation of science technology parks

The development of the second generation STPs started in 1970s and 1980s. This type of STPs can also be characterized as belonging to universities, but in this case, STPs are not necessary located at university premises (Bianchi and Labory, 2006; Annerstedt 2006; Gyurkovics, Lukovics, 2014). The outcome of the appearance of such industrial parks' generation was the development of innovative products. It focuses on the process of introduction of scientific and technological development through commercialization of accumulated scientific knowledge of universities or companies (Radygina, 2010).

Hansson et al. (2005) define the difference between first and second generation of science parks in the following way: the aim of the first generation is to create opportunities for new businesses for economic utilization of economic results of their universities, the second-generation science parks focus on the creation of technologies appropriate for utilization and development of entrepreneurs. Second-generation STPs follows the "market pull" model (Annerstedt 2006; Bianchi and Labory, 2006).

In 1970s through 1980s, second-generation science parks started to acquire traits of a business lease. STPs commercialized research results, sold rental space and offered administrative services to the growing innovative companies. That period is characterized by a wide spread of technology business incubators (business incubators), as well as by the emergence of a large number of highly specialized science parks focused on individual

economy sectors. A technology was a main product of innovative companies at that period of time (Shpak, 2012).

Third-generation science technology parks

The development of the third-generation science parks began in 1990s. These STPs were located in urban regions. They integrate government, university and industry together (Annerstedt, 2006; Gyurkovics and Lukovics, 2014). Such STPs are perceived as territorial platforms for communication between various stakeholders within an innovation environment. The main aim of the third-generation science park is an economic growth through collaboration and integration of three elements of National Innovation System.

Third-generation science parks also promote services that focus on economic and cultural growth of a particular region. However, this focus began to shift towards the provision of communication services, which enable access for developers and researchers to a global market through communicating with various professional groups (investors, industry, etc.). Science parks became the structures for organization of various events for business innovation, which help to expand the capabilities of their virtual work. Third-generation science parks are not just centers for uniting professionals of a particular industry, they have become a platform for a free exchange of information and communication for researchers (Shpak, 2012).

Present time is characterized by impetuous changes of global trends in technological development. Conventional science parks' models cannot cope with fast changing conditions of the global market. As a result, in order to maintain a required level of competitiveness and profitability they have to switch to a new development paradigm (Buzás and Lukovics, 2014).

Traditional 'science push' concept was changed by a new interactive approach. First and second generation science parks, that were traditionally located close to universities, were replaced by the third generation of STPs, since they had more substantial benefits and favorable conditions to reveal an innovative potential of a particular region nearby. However, universities still remain the main players in the development of STPs. The new interactive model of STP's development requires strong cooperation between various players of innovation process. To sum up, the key philosophy of the third-generation science

parks is a combination of ‘science push’ and ‘market pull’ approaches (Buzás and Lukovics, 2014).

Fourth-generation science technology parks

The combination and integration of multiple stakeholders such as partners, suppliers, investors, experts, founders, competitors, and customers are crucial for the fourth generation of STPs. Such STPs were created for establishing the connection between users and providers of innovation process. Management teams of science parks can develop this connection and create a business environment that integrates all stakeholders of innovation process. (Formica, 2009; Hardman and Berntsen, Next generation science parks). In this context STPs are perceived as virtual global networks with multiple stakeholders involved in innovation process.

3 NETWORKING BETWEEN SCIENCE TECHNOLOGY PARKS AND ELEMENTS OF NATIONAL INNOVATION SYSTEM

This chapter provides a detailed overview of networking theories and describes the interaction of STPs with the elements of NIS.

3.1 Network linkages in National innovation system

Engaging partners in the innovation development process allows extending the vision of marketing interaction problems. Thorough consideration of marketing relationship's theory in 1990s confirmed the correctness of its development prospects. This view of market relationship includes not only consideration of customer relationship, but also covers a number of key relationships, partners and markets, fundamentally important for business survival and integration in the value chain. Such approach to transformation of marketing relationship used for formulation of general relationship strategy has led to the creation of the concept of "constellation" of values. (Reidenbach and McClung, 1999).

There has been a significant growth of number of network research recently; a lot of scientific studies were held around networks as well (Santoro et al., 2006). In the meantime, this research is much disseminated and has distinctions. Network definition is not yet completely settled; therefore, the term is utilized in various contexts and has several meanings.

The word "network" originally comes from the Latin word "retis" which means sort of web to catch small game or animals. Accordingly, a network is initially identified with catching something. In this way, systems can be seen additionally as instruments for asset, for example knowledge capture (Santoro et al., 2006).

The network can be defined as a set of entities that are involved in relationship allowing them to participate in the same activities that link their resources (Johannisson, 1994). The ability of the company to develop and successfully manage its relations with other firms may be considered as a core competency as well as a source of competitive advantage (Ritter et al., 2004).

Brass, et al. (2004, p. 795) define network as "a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes". According to the authors,

nodes can be represented as different actors, for instance, organizations, teams, individuals, etc. Network provide transfer of information that can achieve attitude similarity, imitation, generation of innovations, and intercede exchanges among associations and collaboration among people. In addition, they give differential access to resources and force. Networks offer companies aggregate advantages, for example, increase of productivity, as the division of tasks allows network part to concentrate on main competences. Additionally, networks can provide products and services or enable other value creation activities (Möller et al, 2005).

Some definitions of the National innovation system include the term "network". Freeman, for example, defines the national innovation system as a "network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and distribute new technologies" (Freeman, 1987, p. 1). He also considers knowledge system as a network of participants (Freeman, 1997). There are various statements about benefits of networks as a form of government in innovation systems. Economists refer to operational and organizational costs, arguing that markets create high transaction costs. Bureaucracy, in its turn, creates high organizational costs, while network optimizes both these types of costs. Sociologists, on the other hand, argue that innovation, including a large degree of tacit knowledge, depends on reliable communication between participants in the system, which may likely occur in the network structure than market or hierarchical relationships (Galli and Teubal, 1997; Godin, 2009).

In accordance with the OECD (1992), the national system of innovation includes a set of networks, figure 12 reflects this framework. According to OECD (1999), NIS foundations can be separated into five categories:

- Governments (national, regional, local) play important role in setting and regulation of policy directions;
- Intermediaries, e.g. research associations, which coordinate governments and industry;
- Private enterprises and the financing of research institutions;
- Knowledge and technology transfer in developing countries;
- Academia, such as Universities and research institutions that provide knowledge creation and skills development;

- Other organizations, which play important role in the national innovation system (joint research institutes, patent offices, public laboratories, training organizations etc.).

They are connected in such a way that the creation and dissemination of technologies and their transformation into commercial products depends as much on the viability of a complete set of linkages, as well as on individual performance of any element of the system (see Figure 7). Network cooperation plays an important role in the development of new technologies and countries' economic growth.

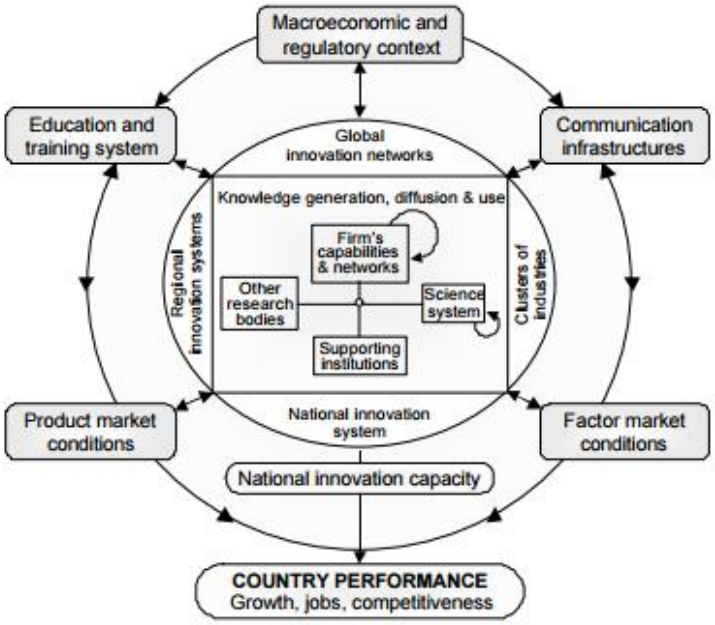

Figure 8: Actors and linkages in the innovation system. (OECD, 1999)

The NIS linkages describe absorptive capacity of the whole system. NIS Taxonomy of Schoser (1999, cited in Feinson. National Innovation Systems Overview and Country Cases) helps to describe the importance of informal knowledge flows for the system functioning (Figure 9). It represents formal and informal processes. First and second points describes formal processes that reflect NIS involvement in innovation process and its impact on creation of technological innovation. Third aspect indicates informal processes, describes how structures (such as research organizations, universities, and government) interact with each other. Fourth point shows informal processes of NIS, which includes historical and cultural factors that affect innovation process.

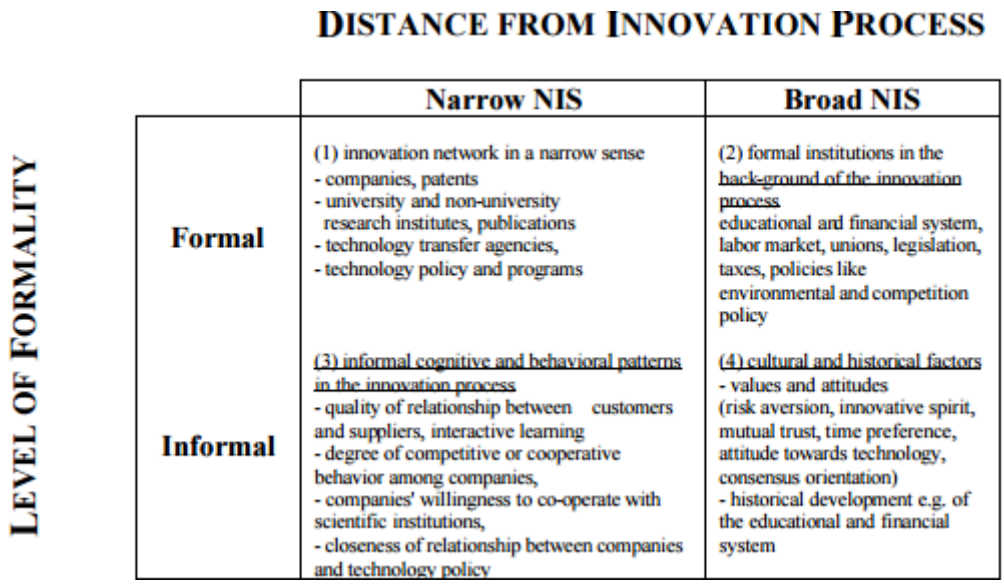

Figure 9: NIS Taxonomy. Adapted from Christof Schoser, 1999, p.5 cited in Feinson (National Innovation Systems Overview and Country Cases)

3.2 Role of networking cooperation for the development of STPs' tenants

Tenants of STPs are innovation businesses, which develop their ideas and try to commercialize new product or service.

Typically, SMEs possesses the following drawbacks:

- limited resources (financial, technical, human);
- great reliance on market supply and demand factors;
- low credibility;
- loads of industrial workers, etc. (Brunswicker and van de Vrande, 2014)

STPs should aim at solving these problems for SMEs. STPs integrate innovative companies, scientific organizations, design bureaus, educational institutions, innovative infrastructure organizations, manufacturing companies or their departments, research centers, business incubators and other support infrastructure for SMEs. These all create business network for developing innovations. The creation of a partners' network of STPs is the core element for sustainable development. These structures must obtain the support from a number of partners. The pool of stakeholders can include government, which is responsible for region or land development; the representatives of academia, such as universities and research

institutions that create value from their resources, and industry representatives as creators and consumers of new technologies.

According to Gordon and McCann (2000), STPs provide an environment that unites many interdependent organizations from governmental, academic and industry sectors. These structures integrate cross-sector and interdependent organizations, which have similar aims and perform in unified collaboration. This collaboration plays a role of intermediate, which has synergetic effect of integrating into different organizations and types of sectors (Bøllingtoft and Ulhøi, 2005).

Shane and Venkataraman (2000) define entrepreneurship as 'an activity that involves discovery, evaluation, and exploitation of opportunities to introduce new goods and services, ways of organizing, markets, processes, and raw materials through organizing efforts that previously have not existed'.

Level of tenants' interaction with partners is a factor that can enhance the company's innovative activity and contribute to the success of a new product or service. It is crucial to ensure an appropriate integration into an extensive organizational network that provides significant opportunities for training and contribute to innovation development. Thus, motivation and cooperation with collaborative partners become fundamental and vital for strategic and innovative development of a particular firm.

For SMEs, building network connections with the Academia, Government or Industry may be a challenging task due to lack of experience and resources. For SMEs, the cooperation with different partners is of utmost importance; they namely lack a certain amount of expertise, knowledge and experience (Sirec and Bradac, 2009). Strategic cooperation and networking allow SMEs to compete and produce innovations in a dynamic business environment. The SMEs success depends on collaboration with other organizations, which influence the creation and transfer of products or services (Valkokari and Helander, 2007).

Networks of SMEs are especially based on personal relationships, where small companies' networks overlap with entrepreneurs' networks. A challenge for SMEs is to use networks in a proper way and to profit from organizations within these networks. Networks of SMEs are constructed with the help of personal relationships while the firms' networks collaborate with entrepreneurs' networks (Biggiero, 2001). SMEs should use these networking linkages in a proper way and get profit from elements inside these networks (Sirec and Bradac, 2009).

In order to implement innovation, it is necessary to combine improved performance and search for ways to increase efficiency that can only be achieved by combining knowledge of the market and the ability to track the market needs with long-term planning. Thus, both external and internal stakeholders should be involved in determination of strategic priorities and introduction of innovations to market. Potential internal integration of a company also provides firms with benefits. This includes creation of market orientation in the course of interaction with company's partners, creation of internal mechanisms of an organization of marketing and cross-functional coordination, feedback from consumers, coordination of new product development process with partners' participation and taking into account different results of a network. In addition, joint innovation partnerships also enable creation of value chain and facilitate change of business models.

Möller and Svahn (2003) in their research describe framework, which synthesizes emerging business networks. This framework is presented in figure 10 below.

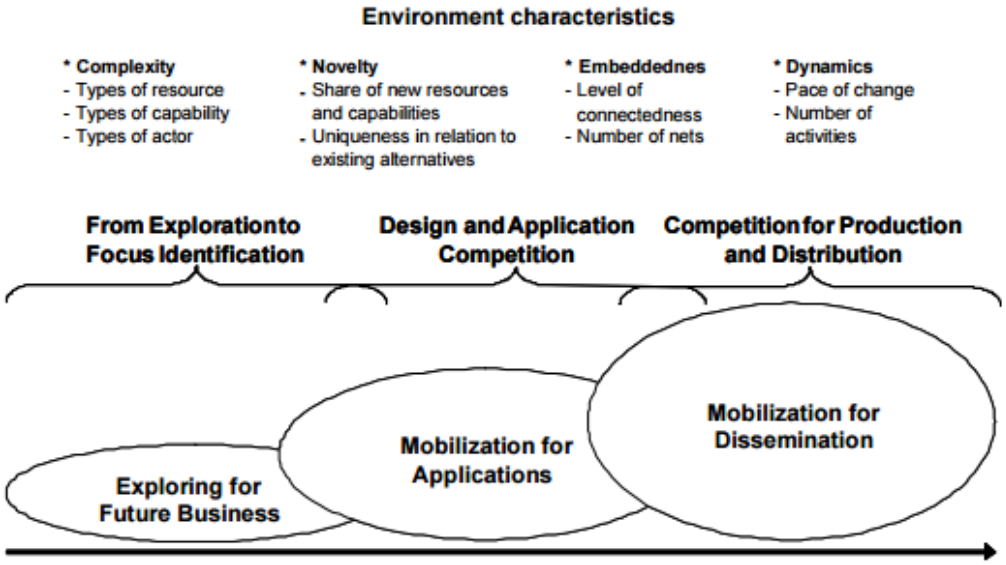

Figure 10: Landscape of Emerging Business Networks (Möller and Svahn, 2003)

The Exploration for Future Business phase shows competition between the actors and the coordination in the exploration of the application of potential for new technologies. The Mobilization for Applications phase concerns actors collaborating or competing in constructing dominant designs and applications. The Mobilization for Dissemination phase includes actors collaborating and competing in scaling up production and distribution networks in the competition to create markets. (Möller and Svahn, 2003)

Networking in SMEs varies in different dimensions that could be classified as follows (O'Donnell, 2004):

- levels of networking,
- strength of ties,
- networking proactivity.

Complete STPs is formed, when all the elements of the "triple helix" start working: Government, Academia and Business (Lewontin, 2000). Government, universities and other higher education institutions, research and design institutions are the stakeholders of STPs. Industrial companies are also interested in the creation of STPs in order to solve their issues concerning the manufacturing of goods. Most Russian STPs do not meet this criterion. The cornerstone in the Russian Federation is a small contribution of large businesses in development of STPs' activities and low level of state support of innovation processes (Molchanov and Molchanov, 2014).

Engel (2015) defined key components for developing high-potential entrepreneurial ventures: entrepreneurs, venture capital investors, mature corporations and strategic investors, universities, government, R&D centers, and specialized service providers and management (see Figure 11).

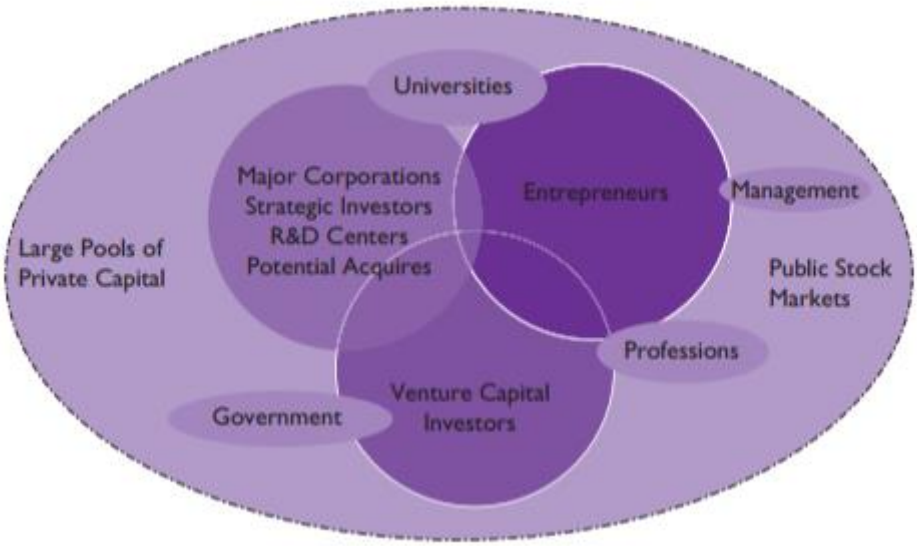

Figure 11: The Innovation Engine of Clusters of Innovation. (Elgar, 2014)

It is needed to create a community, where all these elements come together. This will pull innovation from the bottom, giving start-ups personnel, capital, support and sustainability of development. The role of the government is very high, it is often not appreciated, but the state creates a context, law and order, protection of intellectual property, rules on which it then works. Depending on the industry, the roles may vary, for example, in some industries, venture capital plays a major role, in others it may be corporations large corporations. As for the developing countries, the role of the state is of critical importance here. It is very important that these components interact with each other.

3.3 Linkages between STPs and the elements of NIS

This chapter reflects the linkages between STPs', STPs' tenant and the elements of NIS: University, Industry and Government.

According to Guy K. E. et al (1996), STPs seek to facilitate and promote linkages of various types of coordination, for instance, research links, technology transfer between park tenants and academia. Evaluation of the connections of STPs is difficult to perform due to frequent-arising informal links. The authors claim that the concept of linkages is fundamental in STPs' development and growth. Functioning of STPs is based on the knowledge transfer, shared resources, effective support of SMEs, and the synergistic benefits, which are provided for tenants. If STPs do not possess these linkages, they offer little or no added value. Without these linkages, STPs will not have complete set of benefits for local and regional economies.

Linkages can take many forms and integrate together people, data, knowledge and technology, technology goods or services, etc. In some cases, linkages can be evident, for instance, exchanging human resources. In other situations, it can be hard to track them e.g. in case of information transfers. (Guy K. E. et al, 1996)

For example, Guy K. E. et al (1996) define the following types of links:

- Park tenant – university
- Park tenant - park tenant
- Park tenant - other firms/divisions of a certain firm, located outside of a park

It is necessary to analyze in more detail the types of connections between STPs and each element of NIS.

3.3.1 Linkages between STPs and University

Universities and research institutions are an important source of gathering of scientific knowledge. These linkages contribute to the technology development of companies and creation of values. Enterprises can obtain access to scientific knowledge by creating formal and informal connections with higher education institutes, which promote innovation and production development (OECD, 1981, 1993; Westhead and Storey, 1994; Lofsten and Lindelof, 2001). Therefore, creation and building of academia links is directly connected to development innovation and production (Westhead and Storey, 1994).

Lofsten and Lindelof (2001) indicate that companies, which are located within the STPs are more likely to have links to research institutions and universities than companies that are not engaged with science parks. Monck et al. (1988) claim that Industry-Universities cooperation includes the following characteristics:

- knowledge transfer;
- human resources transfer, which includes employment of founders or members of innovation firms, staff and key strategic personnel;
- access to university services, capabilities and facilities;
- access to development, analysis, design, evaluation, testing, equipment;
- research in universities by researchers or students on sponsoring or contract conditions;
- free integration and interchange with universities that provide access to essential research findings.

Based on analyses of the Surrey Research Park Vedovello (1997) have identified various linkages, which could appear between STPs and Academia:

- Informal links: access to professional literature, university department, university equipment, academic staff, seminars and conferences, training programs etc.
- Human resources links: recruitment of students, involvement in projects, access to expertise in science and engineering, formally organized training of companies' personnel at the university;
- Formal links: establishment of joint research, research contacts, analysis and testing, counseling academic staff (Typology taken from Löwegren, 2003, pp. 41-42).

Firms can get an access to scientific knowledge by creating formal and informal connections with higher educational institutions, as a result this cooperation promote development of production and innovation (Westhead and Storey, 1994; Löfsten and Lindelöf, 2001).

Siegel et al. (2003) suggest that enterprises located in university STPs, have higher research productivity than companies that are not based in these STPs. Löfsten and Lindelöf (2001) analyze differences in benefits of academic new technology based firms in SPs and the private sector. According to authors, STPs provide an important resource network for new technology based firms. Local authorities in Sweden stimulate economic initiatives enabling technology transfer from universities and its diffusion into industry. Lorenzoni and Ornati (1988) claim that firms located in STPs are more capable to obtain information from external sources such as universities, consultants, enterprises and entrepreneurs and then other companies.

3.3.2 Linkages between STPs and Government

Based on the NIS descriptions provided above, it is possible to conclude that government has a major role in the structure of NIS. The government defines rules for the functioning and interaction of innovation process participants through the formation of framework conditions. NIS includes the subjects of innovation activity, such as organizations and individuals, which are involved in the creation and promotion of innovations, and infrastructural organizations, that facilitate implementation of innovations. (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2008)

STPs are an important element of regional and national innovation policy. Government is usually involved in ownership and financing of STPs. Around 55 per cent of STPs in the European Union are publicly owned. Mixed public–private ownership is less common, approximately about 30%. These types of STPs usually include universities and private firms. Privately owned parks represent over 14 per cent in the European Union STPs in most cases receive the bulk of funding directly from the state: in England, the share of state funding is 62%, in Germany - 78%, in France - 50%, in Belgium - almost 100%. (UNCTAD, 2015).

Public administration and complex funding of STPs provides full participation of the state in creation of industrial park including formation of concepts and statute of parks. For

example, the government can cover costs for provision of preferential lease terms to residents, granting tax privileges, etc. (Basile, 2010). Thus, the Government can participate in residents' selection, formation and approval of services provided by STPs, control choice of management team of STPs etc. Other methods of supporting are presented below:

- tax benefits for tenants;
- direct financial assistance to tenants within the competition of innovative projects;
- providing property, located in the municipal property on favorable lease terms;
- presentation of the project at international and regional exhibitions;
- support in media, etc. (Link and Scott, 2007)

In addition, Government may finance establishment of a branch of an existing STPs in its territory or one of its facilities (laboratories, production site, a permanent exhibition of products of technology companies, and others.).

3.3.3 Linkages between STPs and Industry

STPs join Academy, Government and Industry through development of innovative entrepreneurship and support of innovative companies. In addition, STPs can integrate a pool of companies involved in providing services to residents, corporations and big businesses for technology transfer.

The task of STPs is that they have maximum release of tenants from non-core solutions for their problems. In this case, it is not enough only to provide laboratory equipment for tenant' use. For such structures, it is much easier and more efficient if they help professional partners using their equipment. There are three models of organization of such services in STPs:

- all services are physically represented in the areas of STPs;
- distributed model (STPs have no equipment on their territory, thus it is required to attract external contractors);
- "combined model" (something in its own territory, but something is outsourced). (Narasimhalu, 2003)

Some services may be kept under organization of STPs, for example, information, visa and migration, rental support, own post office, video-conference. Legal, accounting and

personnel services, housing services may be provided to tenants by partners. In any case, the services provided by partners for tenants are less costly. (Tskhadaya et. al., 2016)

STPs can be a platform for cooperation between resident and potential partners from different areas, providing opportunities for professional collaborations and meetings of scientists and businesses, organizing joint training programs and organizing workshops for student and academic projects providing equipment and technical expertise. Thus, STPs promotes future development of a resident; makes a long-term investment in their own development in order to form a stream of promising projects. (Tskhadaya et. al., 2016)

4 RESEARCH DESIGN AND METHODOLOGY

The key to a successful research work is a systematic and comprehensive approach to solving a given research problem. According to Saunders et al. (2009), the research philosophy describes the development of knowledge and analysis of its nature. The key aspects of research development are shown on the figure 12.

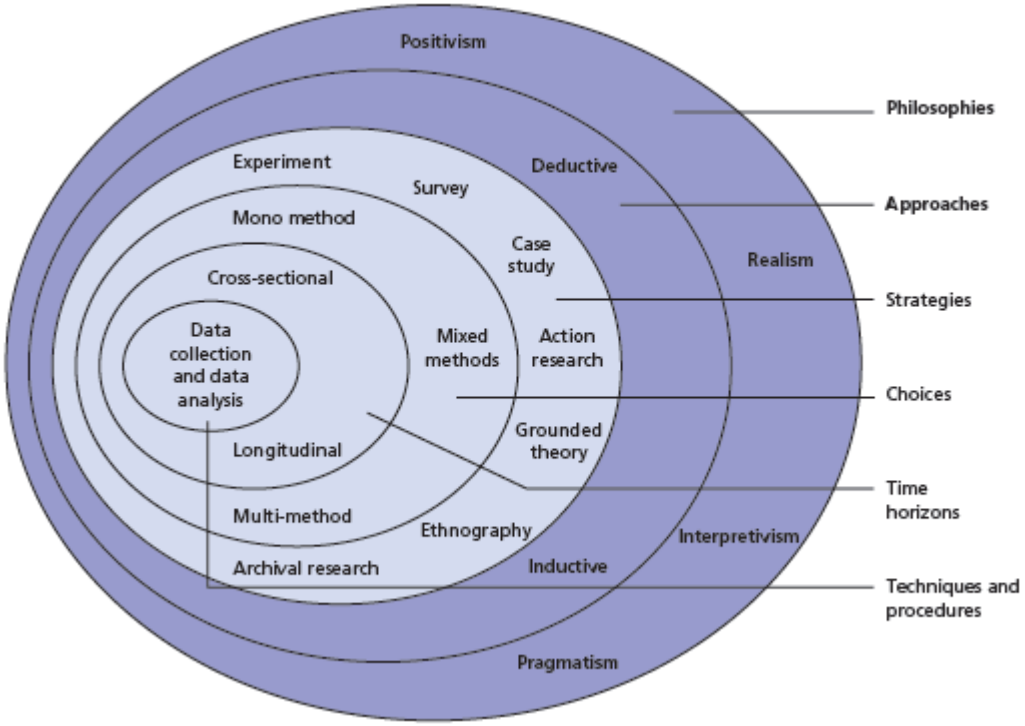

Figure 12: The research 'onion' (Source: Saunders et al., 2008)

The research philosophy of this study is interpretivism. Interpretivism is based on the assumption that subjective values play a key role in social activities. Its purpose is to identify the main interpretations and values shared by individuals and social groups (Saunders, et al., 2009).

The approach to this study is inductive. According to Saunders et al. (2009) inductive considerations start with individual observations, which are made based on general conclusions.

This research is exploratory. The purpose of this study is to see “what is happening; to seek new insights; to ask questions and to assess phenomena in a new light” (Robson, 2002).

According to Saunders et al. (2009), a choice of research strategy is guided by research questions and objectives, by the extent of existing knowledge, by amount of time and other resources which are available, as well as by philosophical underpinnings of researcher. Seven research strategies exist. The typology includes purely theoretical approaches (such as archival research or a case study) as well as practical methods (survey or experiment). The following research is based on the results of the investigated case study. Consequently, this thesis will answer the stated research questions based on a single case study as a strategy of analysis.

The following research is based on the results of the investigated case study.

The method of case study was first used at Harvard Business School in the XX century (McNair, 1954). Robson (2002) defines case study as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence”. Case study is a common research strategy in business, political science, psychology, sociology, and planning (Yin, 1983).

Case study strategies can be divided by:

- single case v. multiple case;
- holistic case v. embedded case. (Saunders et al., 2009)

Consequently, this thesis will answer the stated research questions based on a multiple case study as a strategy of analysis. The empirical basis of the research consists of the “Technopark Strogino” and the “Technopolis Moscow” cases. This study investigates the main system of functional operations and cooperation of the above-mentioned STPs with their stakeholders. The research also examines the network coordination of network of both STPs and concentrates on a particular unit of analysis.

4.1 Case environment

Case environment of this study is National innovation system in Russia and STPs in Russia. It is necessary to consider the development of NIS and STPs in Russian Federation, their main characteristics and features.

In the Strategy for Innovative Development of the Russian Federation for the period up to 2020 (2011), the formation of the fundamentals of the NIS is considered as one of the key objectives of the country's development strategy. According to the Strategy for Innovative Development of the Russian Federation for the period up to 2020 (2011), the infrastructure of the innovation system is understood as a set of innovation subjects that contribute to the implementation of innovation activities, including the provision of services for the creation and sale of innovative products.

The NIS in Russia has several peculiarities due to geographical, social and economic aspects of the development of the country (Turina and Ippolitova, 2013). First of all, there is no established governmental policy for innovations and the involvement of innovation into the industry so far. Consequently, the implementation of innovations is occasional and the innovation politics is somewhat decentralized. However, due to a high level of education and academic standards, the drive for innovation is highly appreciated. It is claimed that the main priority of the innovation policy is to shift the focus from Academia, which is supported and funded by the Government, towards the Industry, where it can be implemented immediately (Nepesov, 2013; Przhedetskaya, 2016).

Furthermore, the NIS in Russia is oriented on the cutting-edge technologies, leaving low-technology sectors of the Industry without valuable attention. Many industry sectors, therefore, have to be considered and investigated in the NIS. It is also known that innovation policy is mostly developed for large-scale enterprises, while SMEs implement innovations regardless of the national policy (Nepesov, 2013; Przhedetskaya, 2016).

Additionally, the Russian NIS is characterized by relatively slow rates of innovation implementation due to a low productivity in the industry sector, the disunity between the industry and academia, and fragmentation of the national innovation policy (Nepesov, 2013; Przhedetskaya, 2016).

All these factors influence the formation and development of the national innovation system and the transformation of Russia into an innovative country. Therefore, it is necessary to transfer the best world practices and implement them methodically (Przhedetskaya, 2016).

In Russia, STPs began to form in the late 1980s mainly as structural units of universities, reflecting the necessity of cooperation development between science and manufacture. In 1990, the first STP was established in Tomsk. Early 1990s showed a rapid growth in the number of STPs in Russia from 2 in 1990 up to 43 in 1993. The first STPs were launched in Moscow, Tomsk and Zelenograd. STPs that appeared in the mid-90s were organized on the bases of state scientific centers, in academic towns and science cities (Technoparks and Clusters Association, 2017; Radygina S., 2015).

However, the subsequent slowdown in development of STPs occurred due to the lack of a coherent government strategy in the creation and development of technology parks, weak material and financial base of technology parks, as well as dependence on universities. Most of technology parks were structural units of universities and were not aimed at extracting commercial profits through the introduction of the results of scientific and technical developments in the economy (Technoparks and Clusters Association, 2017).

The second stage of large-scale creation and development of STPs in Russia began in 2006. This stage is associated with the implementation of a targeted state policy on the formation of a national innovation system as well as with the implementation of development programs for technology parks on the federal level. In order to ensure the accelerated development of high-tech sectors of the economy in accordance with the priority directions of its modernization and turning them into one of the main driving forces of economic growth, a comprehensive program “Creation of high-tech technology parks in the Russian Federation” was approved (Technoparks and Clusters Association, 2017).

Despite the obvious progress in the development of STPs in the early 2010s, most of the mistakes made by the executive authorities during the first stage of development of STPs were not taken into account in terms of creating a legislative framework that defines the goals, objectives and principles of functioning of STPs in the national innovation system. Since 2013, there has been a steady trend towards the harmonization of Russian legislation in terms of building uniform requirements and criteria for technology parks and their management companies, as well as measures of state support for these facilities (Technoparks and Clusters Association, 2017).

There are about 125 STPs in Russia, including already existing ones and those that are under construction in 44 regions in Russia (Technoparks and Clusters Association, 2017) (see Figure 13).

Figure 13: Distribution of STPs in Russia (Technoparks and Clusters Association, 2017)

Analytical studies show that modern domestic STPs can be systematized depending on their specialization (see Table 4). (RVC and Ernst & Young, 2014)

Table 4: Specialization of STPs in Russia

Types of Specialization	The share of STPs in total
Information Technology	50%
High-tech	36%
Other specialization	14%

The organization can get the IT specialization if more than two thirds of its residents conduct activities of such kind. If more than 50% of STPs' residents work in the field of high-tech (in such areas as instrumentation, nanotechnology, biotechnology, laser technology, etc.), the organization can be classified as a high-tech focused one.

It should be noted that the development of most of STPs in Russia is initiated by government and universities (see Tables 5). The development of STPs is mainly supported by the government as it finances their activities. (RVC and Ernst & Young, 2014)

Table 5: Types of the owners of STPs in Russia

Types of Owners	The share of STPs in total
Regional administration	39%
Municipal administration	13%
University Administration	26%
Individual or company	22%

Most of STPs provide office space, as well as co-working facilities for negotiations and conferences. Many of them have community space and catering facilities, which potentially contribute to more active interaction of residents and further development of ecosystems. About half of STPs are equipped with specialized research laboratories for collective use.

The significant part of STPs, both private and public, provide premises at a rental rate below the market level. The absence of high market rates may indicate legislative limitations and high competition between them.

Based on the above mentioned analysis of Russian STPs, we can conclude that the majority of STPs in Russia are of the first and second generation, the third generation is very rarely presented. The activities of Russian STPs may also be limited as they depend on functioning of small industries, in most cases residents of such kind simply rent out premises and provide a small range of collective services. It should be noted, however, that the current level of support for the operation of STPs in Russia will not yet allow us to demonstrate satisfactory results of its activities.

A lot of authors (Technoparks and Clusters Association, 2017; Radygina S., 2015; RVC and Ernst & Young, 2014; Savzikhanova S., 2015) highlight main problems of STPs in Russia:

1. Lack of space

   More than half of the incubators do not have public zones for informal communication, some STPs are underfunded by laboratories, production and storage facilities, which negatively affect the activities of high-tech companies.
2. Lack of services required for residents

It is difficult to provide all necessary services and expensive equipment for startups, since it requires huge financial costs.

3. Lack of specialists

   STPs are forced to provide the significant part of educational and consulting services with the help of their own employees who do not have sufficient entrepreneurial or business experience. The shortage of personnel and its high cost limit the number of new start-ups and ability of residents of incubators and STPs to hire personnel for further development.

4. Absence of highly qualified specialists

   The professional training of managerial personnel of STPs directly affects its functioning. It is crucial to constantly improve personnel skill level and learn the best world practices.

5. Absence of relationship with investors and government funding programs.

4.2 Data collection

There are two types of research methods: qualitative and quantitative (Saunders et al., 2009). The qualitative data is described as "all non-numeric data or data that have not been quantified and can be a product of all research strategies"; quantitative data is "numerical data or data that have been quantified". The two types of the research methods are presented in Table 6.

Table 6: Distinctions between qualitative and quantitative data (retrieved from Saunders et al., 2009)

Quantitative data	Qualitative data
• Based on meanings derived from numbers	• Based on meanings expressed through words
• Collection results in numerical and standardised data	• Collection results in non-standardised data requiring classification into categories
• Analysis conducted through the use of diagrams and statistics	• Analysis conducted through the use of conceptualisation

This study is based on qualitative research methods. Research interview is one of the most important qualitative data collection methods. The interview describes an information exchange between two or more individuals allowing researcher to assemble valid and relevant information that is important to research question (Saunders et al., 2009).

Interviews is the most frequently applied method when case studies are conducted (Yin, 1994). Saunders et. al. (2009) defines the following types of interviews:

- Structured interviews
  - Include questionnaires and quantitative research interview;
  - Utilize standardized set of questions.
- Semi-structured interviews
  - The list of covered questions can be changed during interview.
- Unstructured interviews
  - Meeting are informal, organized spontaneously and casually directed;
  - Interviewer does not have a preliminary developed list of questions or topics for discussion.

The data was collected using semi-structured interviews with management teams and tenants of both Technopark "Strogino" and Technopolis "Moscow". A semi-formalized interview was chosen as a survey method, since it allows getting more detailed information about the functioning of STPs. Such interviews have less rigid structure allowing the interviewer to utilize only a list of main issues, and the obtained information, in this case, serves to formulate hypotheses in order to identify social problems that need to be more systematically analyzed. Direct communication with a respondent and psychological relations that arise during the interviews create many advantages for obtaining information, which seems to be inaccessible when using strictly formalized interviews (Saunders et al., 2009).

The interviewer must be able to ask questions during the conversation, which interest him in this research, but in such a manner, that they do not violate the general course of the conversation, organically and naturally fit questions into the story as a clarification. Interviewing requires organizational training, which involves the choice of location and time of the interview. In any case, the place where the interview is held must be calm and sensitive, without the presence of unauthorized individuals, at a convenient time for the respondent (Saunders et al., 2009).

Discussion topics were designed in order to address the main research question and topic of this study:

- The way STPs act within the network between elements of the National Innovation System, such as Government, Academia and Industry;
- Influence of the STPs' networking environment on further development of tenants.

Semi-structures interview guide can be found in the Appendix 1.

In total five interviews were held with STPs' managers and five with tenants, table 7 contains detailed information about interviewees. The age of interviewees is different; the average age is 31 years old. The interviews were conducted as a one-to-one interaction by the Internet (via Skype). Received data was summarized and used to create a situational network cooperation between stakeholders. The study of the interview questions and the interview itself was conducted in Russian, because the author of this study is a native speaker of the Russian language, as well as the participants of the interview.

Table 7: Characteristics of the interviewees

Number	Name of the respondent	Place of work	Position	Duration of the interview
1	Talaeva Galina	Management company of Technopark Strogino	Chief specialist – Residents Cooperation	35 minutes
2	Meisner Mariia	Management company of Technopark Strogino	Chief specialist – Residents Cooperation	55 minutes
3	Leonova Anna	Management company of Technopark Strogino	Chief specialist – Residents Cooperation	45 minutes
4	Laktionv Aleksandr	Loga Group, service company of Technopark Strogino	Executive director	35 minutes
5	Alexander Khanin	Vision Labs, resident of Technopark Strogino	General director	35 minutes
6	Alexei Evtukhin	101 XP Lab, resident of Technopark Strogino	Project manager	35 minutes
7	Migalnikova Natalia	Management company of	Chief specialist – Residents Cooperation	35 minutes

		Technopolis Mocsow		
8	Groshev Vladimir	Avrora Robotics Lab, resident of Technopolis Mocsow	Advisor to Director General	35 minutes
9	Polina Federova	Management company of Technopolis Mocsow	Advisor to Director General	35 minutes
10	Mezhenkova Anna	Management company of Technopolis Moscow	Deputy Director for Cooperation with Residents	35 minutes

The following objectives were achieved:

- Extensive information on the topic was obtained;
- In-depth network coordination with stakeholders of science park was investigated;
- The gaps in the interactions were revealed;
- Recommendations for further development were designed.

This Study also uses for the analysis the secondary data. This data includes the report of RVC and Ernst & Young (2014), articles, newspapers, magazines and web sites, companies' reports, published interviews. Structure of methodology and expected research results are shown on the Figure 14.

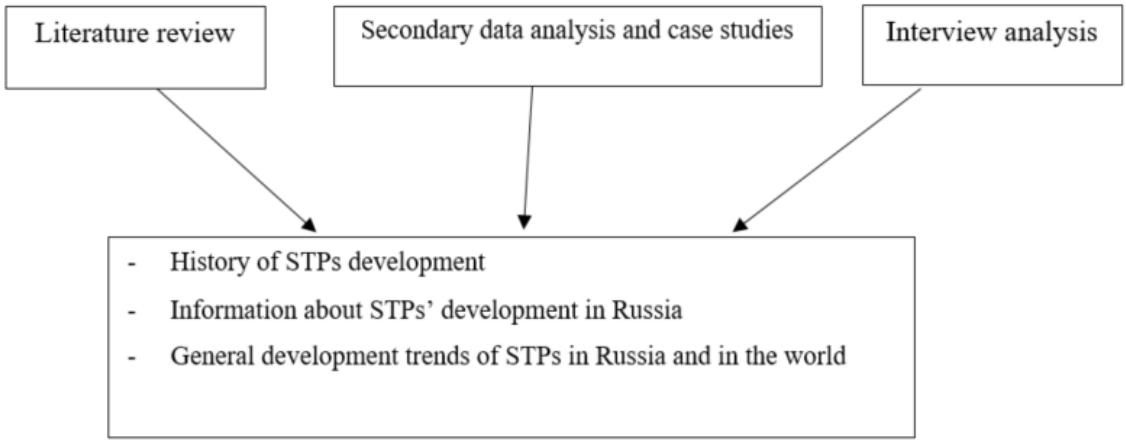

Figure 16: Structure of methodology and expected research results

5 FUNCTIONING AND NETWORK FRAMEWORK OF SCIENCE TECHNOLOGY PARKS. ANALYSIS OF CASES AND INTERVIEWS

This study examines two STPs that were created with the active support of the Moscow Government - Technopolis “Moscow” and Technopark “Strogino”. The Moscow government invest more than 5 billion rubles in the creation of Technopolis “Moscow”, and more than 700 million rubles in Technopark “Strogino”. The activity of these STPs is carried out in close cooperation with the Department of Science, Industrial Policy and Entrepreneurship and the Department of City Property of Moscow. The purpose of creation of these STPs is related to the importance of creating an innovative ecosystem of the city by providing the most favorable conditions for the placement of Russian and foreign high-tech companies. Technopolis “Moscow” (4th place in the ranking of the Association of Clusters and Technoparks) is the flagship project of the Moscow Government aimed at creation of the infrastructure for the development of high-tech industries. Technopark “STROGINO” took the 5th place in the rating of the Association of Clusters and Technoparks. Full cycle of project support is established in this STP (Association of Clusters and Technoparks, 2016).

It is also worth noting that the author of the study has two-years’ experience of work in the Technopark “Strogino”, as well as close experience of interaction with the management company and residents of the Technopolis “Moscow”.

5.1 The technopark “Strogino” case

The Technopark “Strogino” (hereinafter – “the Technopark”) was conceived as a STP, where a full cycle of project support can be realized starting from an idea up to product development, manufacturing and market entry (Figure 7.1). According to the management company, the Technopark provides infrastructure and a set of services required for each stage of project development, including:

- Coworking facilities, where innovators can start implementing their projects which are at the initial idea stage;
- Prototyping center that allows to make and test a prototype;
- Business-incubator, which supports promising innovative business ideas and transform them into high-quality, attractive investment projects;

- Technopark allows to organize production and get tax benefits.

All these structures allow not only to develop successful projects, but also to ensure their sustainable functioning after the ‘graduation’ (after they leave the technopark and start working independently).

At the moment, the list of basic services of the Technopark is as follows:

- lease of office and warehouse premises;
- coworking services;
- consulting services in the field of financial management, crediting, accounting, civil, corporate and tax law;
- provision of meeting rooms and equipped halls for lectures and seminars;
- services for maintenance of office equipment, office equipment and access to the Internet;
- marketing services (assistance in conducting marketing research);
- organization of participation in Russian and international exhibitions;
- dissemination of information about products produced by SMEs at seminars, conferences, exhibitions, etc.;
- collective secretariat services (reception of telephone calls, faxes, reception and sending of mail correspondence and others);
- provision of office equipment (color printer, scanner, fax, multifunction copier) and furniture for use;
- cleaning services and services for operation and maintenance of engineering and technological systems of the Technopark;
- catering services;
- provision of parking space (Technopark "Strogino" official web-site)

It is necessary to analyze the Helix model of Academia-Industry-Government relations.

Government

The Technopark performs its activities in collaboration with the Department of Science, Industrial Policy and Entrepreneurship of Moscow, Moscow City Property Department, Prefecture of Nord-West Administrative District of Moscow, and other bodies of executive power of Moscow (Technopark "Strogino" official web-site).

The management company provides consulting services on obtaining state subsidies, and interacting with public authorities. Executives of the management company consider the following: “Technopark "Strogino” was created with the support of the Government of Moscow with the participation of the Ministry of Economic Development of Russia in 2007, therefore this interaction is the strongest.”

Industry

The main focus is on the organization of comfortable working environment. The management company of the Technopark conducts business meetings, seminars, as well as an annual conference with thematic round tables for the development of business communication within the Technopark and ensures coordination with invited companies, investors, government officials, etc. **Anna Leonova said:** “Business breakfasts are often organized in the Technopark, seminars and an annual conference with thematic round tables are held, at all these events companies in similar industries can interact with each other.”

The Technopark uses the IASP business network for international cooperation, it can reach any international technology park, organization or network with the help of IASP. **Maria Meisner said:** “At the request of the resident company, through the international IASP network, we can reach a technopark or international company, form a request to a company for any work.”

The management company of the Technopark, as well as residents, believe that the development of a network of relationships is a top priority. **Galina Talaeva said:** “Of course, the communication that the Technopark is trying to build between our residents and various structures, both state, educational, and business representatives greatly influence their (residents') development and facilitates a faster exchange of information.”

Academia

The Technopark has a strong cooperation with educational institutions. Every year students of Moscow Railway State University in the specialty “Management of Innovation” successfully pass pre-diploma practice in resident companies of the Technopark. Moscow State University and Moscow State Institute of International Relations also participate in various activities of the Technopark. The residents and the management company of the Technopark are involved in the analysis of the students' dissertations. Some residents carry

out research activities together with universities. However, the Technopark does not carry out a full-fledged work on interaction with universities, such as research work, systematic selection of employees for resident companies and so on.

In 2017, the management company conducted a survey aimed at analyzing the residents' satisfaction with the services of the Technopark. This survey revealed the following problems in project development:

- Inaccessible lending, bank guarantees;
- decrease in the volume of the market;
- reduction of financing programs;
- shortage of professional staff;
- lack of interest of state organizations and bureaucratic restrictions;
- sales problems;
- lack of administrative resources;
- lack of working capital.

Many residents noted the necessity of additional support from the Technopark:

- Assistance in promoting products in Moscow and certain regions;
- Participation in exhibitions on preferential terms;
- Certification and registration of new technologies on preferential terms;
- Financial support, attracting infrastructures and finding partners;
- Media coverage;
- Assistance with communication with authorities and state bodies;
- Assistance in preparation of materials for subsidizing, concessional lending, etc.;
- Reduction of rent and communal payments;
- Patent processing services, patent search services,
- Translation of documentation from English, Chinese;
- Organization of non-formal meetings in the format of business breakfast or organization of similar meetings with the use of webinars;
- Educational events, congress and exhibition facilities;
- Specific inquiries, for instance, searching for children's audience of 2-8 years to test new application for children.

Residents also noted that they are interested in cooperation with regional or international technology parks and business incubators in:

- CIS countries;
- Asia, Middle East Countries;
- Europe and the USA.

Based on the types of the services for residents we can conclude that the Technopark can be classified as a technological park of the second type.

If the Technopark seeks to develop its business model, it has to unite representatives of Academy, Industry and Government in one system on its territory. It provides a lot of opportunities for residents, for instance, they get access to the city administration to promote and position their projects in state bodies, to financial and investment companies to accelerate full-fledged development of their businesses.

For the structured analysis of the information received, criteria that characterize the STPs' interaction with each of the NIS elements: Government, Academia, and Industry were used:

- High (STP has strong linkages with elements)
- Medium (STP has some linkages with elements, but linkages need improvement)
- Weak (STP has weak, undeveloped linkages with elements)

The table 8 shows a summary analysis of the interaction of the Technopark with Academy, Government and Industry.

Table 8: Analysis of Academy, Industry and Government linkages in the Technopark "Strogino"

Name of STPs	Government	Academia	Industry
Technopark "Strogino"	This interaction has the strongest character, as the Technopark was created by the government of Moscow, which in turn requires the annual report on activities from the	Students of Moscow Railway State University undergo pre-diploma practice in the Technopark and resident companies, some of them are employed in resident companies.	The Technopark organizes comfortable communication among residents, as well as possible coordination within the framework of events with business representatives. However, there is no

	technopark and full coordination with the government.		cooperation with large companies and state corporations.
Analysis	**High degree of interaction**	**Weak degree of interaction.** The Technopark needs to develop deeper interaction with universities, colleges and other educational organizations.	**Medium degree of interaction**

5.2 The Technopolis "Moscow" case

The Technopolis "Moscow" (hereinafter – "the Technopolis") is a specialized area for the development of high-tech industries, located close to the center of Moscow. The purpose of the Technopolis development is the formation of an innovative city ecosystem by providing the most favorable conditions for the deployment of Russian and foreign high-tech companies. More than 60 resident companies operate on the territory of the Technopolis, including such leaders of the Russian and international high-tech industries as Holding Company Composite, Crocus Nanoelectronics, American company NeoPhotonics, Dutch company Mapper, French company Schneider Electric. At present Technopolis "Moscow" includes over 335,000 sq. m. of production facilities with the necessary engineering infrastructure, its own customs post and congress center. The Technopolis offers long-term lease of production areas with all necessary communications (electricity, heating, water supply, communications, security systems), and scientific and innovative customs post. The Technopolis provides special facilities with sterilized and isolated rooms for companies engaged in microelectronics and biotechnology. (Technopolis "Moscow" official web-site)

The main focus of the Technopolis is the creation of conditions for the organization of high-tech production:

- Long-term lease agreement (5-20 years);
- Significant available power capacities;

- Simplified procedure for obtaining permission to adapt premises for technology tenants and issuing technical conditions;
- Free connection to engineering and communication networks;
- Specialized customs post;
- The preferential rate for income tax is 15,5% (instead of 20%) for anchor residents;
- Preferential rate for property tax is 0% for anchor residents. (Technopolis "Moscow" official web-site)

It is important to analyze the Academia-Industry-Government relations of The Technopolis.

Government

The Technopolis was created with the support of the Department of Science, Industrial Policy and Entrepreneurship of Moscow. **Natalia Migalnikova**, chief specialist for residents' coordination, said: "It is important to understand that in addition to benefits, it is also crucial for our residents to know that they have Moscow government support and the ability to solve urgent issues as quickly as possible."

Academy

The Technopolis and State budgetary professional educational institution for secondary vocational education "Moscow state educational complex" (hereinafter – "Complex") had signed an agreement on personnel training in 2016. The purpose of this collaboration is the training of professionals in high-tech competencies in order to form the innovative ecosystem of Moscow. The Basic Department of the Complex was created on the territory of the Technopolis in February 2018. The Basic Department provides a well-equipped training and production site in the area of more than 1300 sq. m. The Department promotes development of professionalism, enhance the prestige of highly qualified personnel and demonstrate the importance of competences for industrial growth in Moscow and Russia. The Basic Department is a powerful platform for personnel training in the TOP-50 modern in-demand professions, required for Russian and foreign high-tech companies. One of the main goals of the Department creation is training and production adaptation of mid-level professionals to the activities of enterprises, which is performed on the basis of an object-oriented approach to the formation of professional, personal and social competencies with subsequent guaranteed employment (MGOK official website).

The participants of the agreement cooperate in the following areas and activities:

- Traineeship and internships of all kind at the Technopolis and at residents' companies;
- Preparation of graduation theses on topics related to the activities of the Technopolis and its residents;
- Development of vocational training and further vocational education' courses for students in high-tech occupations, taking into account the needs of the Technopolis residents;
- Organization of competitive selection of innovative projects of employees and students of the Complex and their subsequent implementation in the Technopolis and its residents' companies;
- Organization of research laboratories and centers for collective use in the Technopolis;
- Assistance in carrying out of joint research and development, pilot product development, preparation of production launch;
- Identification of requirements of potential employers-residents of the Technopolis for students and graduates of the Complex, creation of a competences profile of an employee;
- Involvement of representatives of the Technopolis and its residents in the scientific and educational process of the Complex by forming joint working groups, assisting in the development of actual programs of vocational training and further vocational education;
- Agreed joint participation of the Parties in expert meetings, exhibitions, conferences, advertising campaigns, etc.

The Technopolis "Moscow" also promotes career guidance activities for children and youth. Children's technopark was opened within the framework of the Technopolis at the end of September 2016. The Technopolis provides scientific, technical and engineering facilities with advanced equipment as well as practical hi-tech workshops, the area of the technopark is more than 1100 sq. m. Children's technoparks are created in order to find talented children and prepare personnel for high-tech and innovative production (Technopolis "Moscow" official web-site).

Industry

High-tech manufacturing companies are at the heart of the Technopolis, these are large companies such as Schneider Electric, ABB, and medium-sized innovative companies. The management company of the Technopolis is engaged in attracting SMEs to provide large companies with the necessary services (possibly by locating them on the territory of the STP or by linking to the partner network platform). The Technopolis unites companies from various industries, some of them cooperate and create joint projects. Since 2012, the residents have implemented more than five common initiatives. This year the residents of the Technopolis "Radius Group" and "Goodwin" with the participation of outside investors have become the technology partners of the project "Russian Miner Coin's".

The financial results of the Technopolis in 2017 year are presented below:

- The revenue is 778 million rubles, which is 20% more than in 2016;
- EBITDA – 252 million rubles;
- Tax deductions to the federal, regional and extra-budgetary funds - 1,333 million rubles, including:
- on the management company – 140 million rubles;
- for tenants – 1,193 million rubles.
- Investments of residents of Technopolis "Moscow" – more than 20 billion rubles;
- Technopolis "Moscow" is the only STP at the moment, which reimbursed the costs of creating infrastructure. The expected return of funds from the federal budget to the regional budget will be 163 million rubles;
- Technopolis "Moscow" continues to create new jobs, currently employs more than 3,000 people, an increase over the previous year is amounted to 870 jobs.
- In 2017, 19 new companies became residents of Technopolis "Moscow", the total number of residents of the site is more than 80;
- In 2017, Technopolis "Moscow" received the status of a special economic zone (SEZ). According to the calculations of the Department of Economic Policy and Development of Moscow, the status of the resident of the SEZ reduces the regional tax burden up to 47%. In addition, the Special Economic Zone is subject to the regime of the "Free Customs Zone", that means, exemption from payment of the import customs duty and value-added tax. Technopolis Moscow has its own customs post,

more than 1300 declarations were filed in 2017, which is 40% more than in the previous year;

- The State Unitary Enterprise “Stroyexprom” became the Joint Stock Company of Technopolis "Moscow”. “We set ourselves the task for the next few years to become a valuable asset that will attract institutional investors with private capital, since the called capital for now is 100% owned by the city”, commented the Technopolis executives (Technopolis “Moscow” official web-site).

It is worth noting that the Technopolis implements the “My Account” program. It is an innovative service for communication of residents with a management company. Previously, management of the STP received applications for equipment placement, parking, and other services by calls or e-mails. When the number of residents and tenants began to grow, manual collection of applications became simply impossible and ineffective. The developed service allows managers to automatically distribute tasks to different departments, and to monitor their execution in real time. The idea of the service is to provide tenants with a tool that structures application process for any commercial or non-commercial service and to ensure prompt execution of orders and requests, even if the number of tenants has already exceeded several dozens, and the number of their employees has exceeded several thousands. According to chief specialist for work with residents, **Natalia Migalnikova**: “This platform unites management of the Technopolis, its contractors, other STPs and institutions, and facilitate their interaction. As a result, the execution time of orders, requests and applications, for example, ordering of passes, catering or cleaning services, was reduced significantly.”

Polina Fedorova, advisor to Director General, said: “Also, at the moment, the specially developed information resource “My Account” simplifies the interaction of the management company with residents, and we hope that in the near future a community will be formed on its basis for the rapid exchange of information on the Internet site.”

Vladimir Groshev, resident representative of the Technopolis Moscow, estimated the interaction with the three components as follows: “The Technopolis is a state property, therefore, interaction with state structures is well developed here, with universities – on a poor level, with medium-sized industry – on an average level”. According to **Polina Fedorova**: “One of the main advantages of the Technopolis is networking and almost

unlimited opportunities for cooperation among residents. Modern business involves mobility, flexibility and the use of resources from different partners."

Technopolis Moscow belongs to the third generation of STPs. the Technopolis has a pool of experts and partners and actively develops the program "My Account", which can later become the basis for the development of interregional and intercountry interaction with ex-traders, partners and market players.

The table 9 shows a summary analysis of the interaction of the Technopolis with Academy, Government and Industry.

Table 9: Analysis of Academy, Industry and Government linkages in the Technopolis "Moscow"

Name of STPs	**Government**	**Academia**	**Industry**
Technopolis Moscow	A high degree of interaction with the state allows the residents to contact the authorities for strategic issues.	Technopolis "Moscow" managed to build the multi-level educational platform for future engineers. There is a children's technopark for middle school students, the Basic Department is engaged in education of senior students. Residents of the Technopolis enter into deferred employment contracts with prospective students.	There is a large set of privileges for residents in the Technopolis. New development strategies help attract large players of the market, which guarantees further successful development, attracting new partners and financing.
Analysis	**High degree of interaction**	**Medium degree of interaction**	**High degree of interaction**

6 DISCUSSION

Findings and results of this study will be analyzed in this chapter. The discussion addresses three independent topics of this research paper:

1. STPs as main elements of NIS for the innovation economy development;
2. Summary results about analysis of linkages between STPs and main elements of NIS in Russia;
3. New directions of STPs development, which facilitate the effective networking management of NIS.

Most of the industrialized countries in the world consider innovation to be their guarantee of national security and economic stability, and therefore fully supports the development of science and the introduction of innovations into the economy. The development of innovation infrastructure is one of the primary tasks aimed at achieving the goal of economic modernization. STPs are rightfully becoming the key elements of the infrastructure of innovation support and development. They are the ones who are able to support innovators at all stages of the innovation process from the moment when an innovation idea was born to its commercialization. Creation and development of an STP is a powerful tool for implementation of innovations and stimulation of activities of innovation and technology-based SMEs, which, in turn, are highly important for a stable economy.

At its core, a STP act as an intermediary, providing interaction and information exchange between innovators, financial institutions and enterprises implementing innovative developments on their premises. STPs offer various ways of cooperation with teams of innovative leaders in order to promote new ideas and bring them to life (Peters et al., 2004, Aerts, Matthyssens and Vandenbempt, 2007; Brcic et al, 2010; Radygina S., 2015). As a rule, STPs do not directly participate in sale process of innovative products and technologies, but they influence on the process of innovation exchange, create favorable conditions and services for innovation and technology-based SMEs.

From the literature analysis, it becomes clear that government structures, universities, research institutes, industrial enterprises and different business structures play a key role in the development of STPs and their tenants (Shane and Venkataraman, 2000; Biggiero, 2001; Sirec and Bradac, 2009). Analyses of linkages between STPs and the elements of NIS allows

presenting Government-Academia-Industry cooperation and linkages between STP and its tenants, Figure 15.

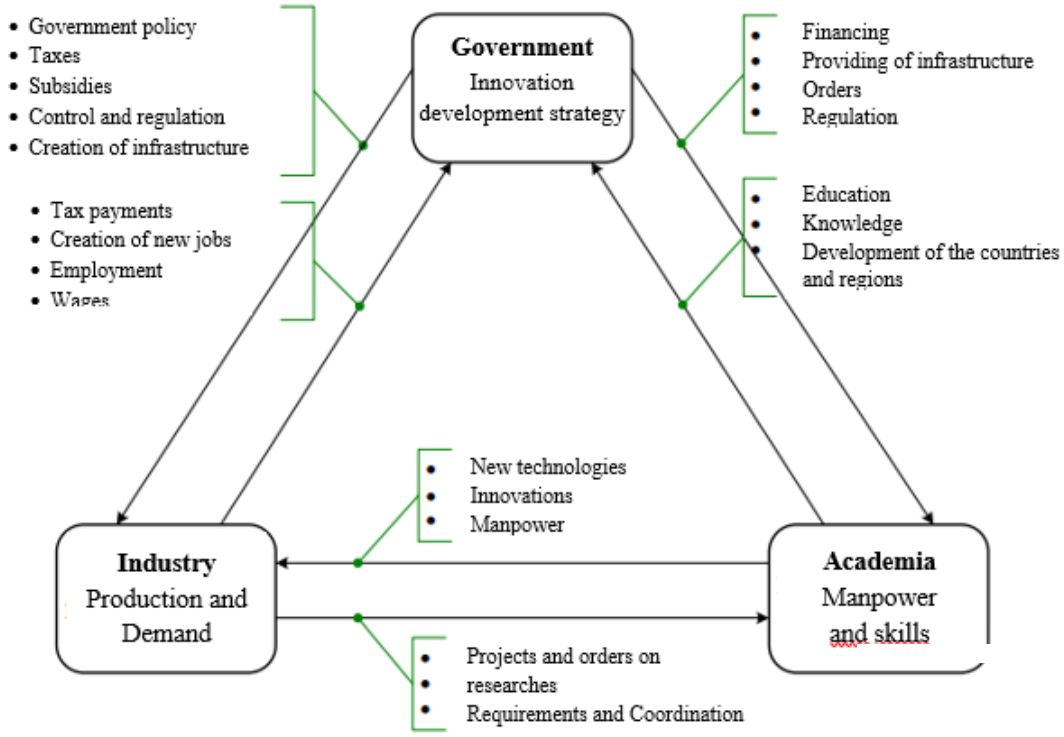

Figure 15: Government-Academia-Industry cooperation. Resource: author's own elaboration

Government

Government institutions are in charge of formation of an innovative system. Government provides the following functions in relation to the Industry:

- Formation of the state policy in the field of innovation;
- Monitoring and regulation of innovative system development;
- Determination of taxes and subsidies,
- Creation of innovative infrastructure.

In relation to universities, the Government provides the following:

- Provision of educational and scientific infrastructure and other resources;
- Government orders for supply and procurement;
- Coordination of the development of the research and education system in general.

Industry ensures the production of innovative products, formation of consumer demand on new innovative technologies and demand on new researches. Industry pays taxes to the budget, stimulates creation of new jobs and employment.

Industry

The Industry ensures the following tasks:

- Implementation of innovative projects;
- Ensuring orders for research and development;
- Ensuring the employability;
- Financing;
- Taxes;
- Formation of requirements for educational programs.

University

Universities provide training and generate scientific data on various subjects. In relation to Industry, Universities create new technologies, develop innovations and train staff for new research activities, such as graduate students. According to the Government, the Academia is responsible for providing education, generation of new ideas and concepts, and the stimulation of development of a national economy. Governments may attempt to create a novel and promising innovation system through the formation of supporting entities. The infrastructure of innovation is aimed at enhancing the cooperation between resources of Academia and the connection to the Industry.

The analysis showed that STPs create the interaction between Government, Science and Industry and provide their tenants easier access to these links with elements of NIS, figure 16. This collaboration create networking framework, which can stimulate development of innovations and new technologies. (Gordon and McCann, 2000; Bøllingtoft and Ulhøi, 2005).

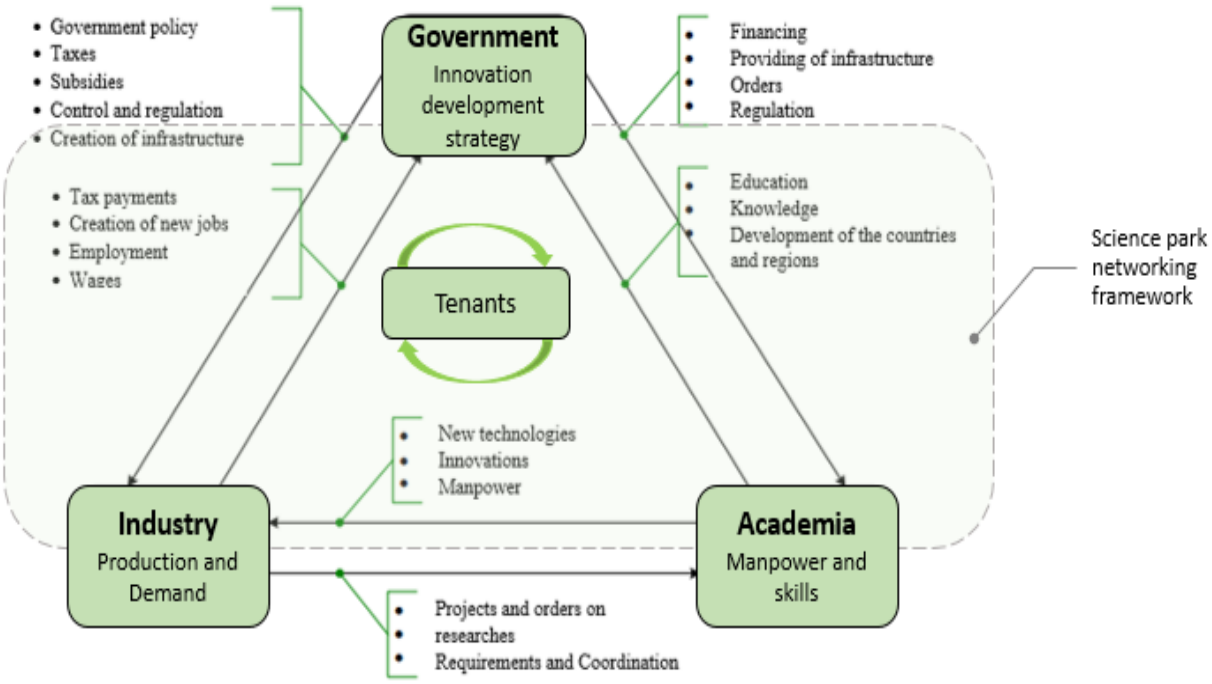

Figure 16: Networking framework of STP. Resource: author's own elaboration

Case study shows that linkages between "Technopolis "Moscow" and "Technopark "Strogino" with the elements of NIS have an average character. In connection with the deep participation of the **Government** in the creation and functioning of STPs in Russia, we can note the close relationship of STPs with the Government. Government can participate in the support of innovative business through the provision of tax incentives, financing, compensates for certain types of expenses, and so on. Linkages with **Academia** can be characterized as below the average. For example, "Technopolis "Moscow" has medium connection with Universities, participates in the formation of educational programs, and other similar projects. Nevertheless, based on an analysis of the literature, it is worth noting that in Russia, universities do not fully interact with STPs, as an example, universities do not often participate in the development of R&D in cooperation with innovative business. Interaction with the **Industry** can also be described as above average, but much depends on the specifics of the STPs. STPs are trying to attract big business, financial structures and establish interaction with tenants.

The analysis of the conducted research revealed a set of the key problems of Russian STPs. A lot of STPs in Russia are not very efficient and do not have significant impact on economic

and innovative development of the country and certain regions. Experts consider that the existing STPs in Russia do not fully ensure the fulfillment of the existing intellectual potential of residents. STPs should not only provide office space and production area, but also ensure consulting support and establish an effective system of interaction with external and internal networks being the driver of business development. Crucial services for resident companies (business acceleration, mentoring, assistance in attracting investments, etc.) are also of limited use (RVC and Ernst & Young, 2014; Radygina S., 2015; Savzikhanova S., 2015).

Based on the analysis, full-fledged STP can only be created if all elements of the triple helix matrix, namely the Government, Academia and Business, function with fully and collectively. Because of this, in Russia, STPs should act as a platform for coordinating NIS elements.

Based on the analyses of STPs generations and case studies, we can draw conclusion than the world is resolutely moving away from any hierarchical structures, since the systems led by the control center do not cope with the increased flow of information and are increasingly being replaced by network systems. The advent of the Internet, the development of electronic business and other information and communication technologies led to the creation of a new model of STPs. The global interaction in the world goes online. This trend involve various elements in the communities, clusters, networks where is important the pooling of resources, ideas, coordination of action and plans and collaborative relationships.

Because of these trends, the next stages of development of STP can be virtual STPs, which offers different types of IT services and infrastructure facilities for networking of Academia, Business and Industry, allowing them to collaborate in a joint space and thus realize technology transfer. With the formation of this type of STPs, there is no need to build transport infrastructure, huge amount of housing and communications, as well as to work on improvement of a vast territory. Virtual STPs can only have an office space and generally dispense with production site. However, STPs that have distributed production areas in various organizations and regions remain still quite relevant. Creation of new generation STPs can save substantial resources of enterprises, universities, research institutions, as well as state funds that are typically spent on creation of STP's infrastructure and maintenance of its innovation environment. (Bianchi and Labory, 2006; Formica, 2009; Hardman and Berntsen, Next generation science parks)

7 CONCLUSION

The main focus of the study was put on the analysis of networking framework between STPs and the main elements of the National Innovation System.

7.1 Final conclusion

The main research question of this study is:

How do STPs interact with the elements of the National Innovation System in order to facilitate innovation development in Russia?

There is can be defined the following sub-questions:

1. How do STPs interact with Academy, Industry and Government in Russia at the moment?

2. Which strategies should be implemented for the development of Russian STPs in order to create an effective networking framework with elements of NIS?

In order to answer these questions, the author conducted deep literature analysis, examined the theoretical base of the subject of the innovation system, conducted several interviews and case studies of the two Russian STPs. The following conclusions are formulated:

1. For the effective implementation of public policy instruments in the development of innovation technology, it is necessary to create network framework between STPs and three elements of the National Innovation System - Government, Academia, Business on the basis of the triple-helix model. The development of an effective innovation infrastructure, which involves bringing together three main parts of the National Innovation System, quite commonly, faces various obstacles due to economic, geographic and social factors. Without creation of this fully and collectively network framework innovation infrastructure cannot be considered successful.

   The degree of interactions between STPs and NIS elements in Russia is as follows:

- The degree of STPs' interaction with **Government** is considered as strong. **Government** is deeply involved into the process of creation and functioning of STPs in Russia, supports innovative business through the provision of tax incentives, financing, compensates for certain types of expenses, etc.

- The degree of STPs' interaction with **Academia** can be characterized as below the average. STPs are engaged in the development and update of educational programs, organization of scientific conferences and labor fairs. They actively support various educational projects. Nevertheless, it is worth noting that in Russia, universities do not fully interact with STPs, for instance, they rarely participate in R&D activities in cooperation with innovative business.
- The level of STPs' interaction with **Industry** is considered as above average, however the degree of interaction also depends on the STPs' specifics. STPs attempt to attract corporations, financial structures and establish interaction with tenants.

Based on the research results we can conclude that the interaction between STPs and the elements of NIS is not full-fledged. The problem of Russian policy for the development of STPs lies in the development of traditional STPs, which are based on the experience of STPs created in developed countries in the last century. Such STPs prevail in Russia nowadays while more complex networking structures or virtual organizations are not that common. It is necessary to elaborate the main directions of the state policy on stimulating innovation activity and interaction between Russian manufacturing enterprises, science and innovations. The main goal of the Russian innovation policy is to create a system of interaction between Government, Academia and Business for creation more comfortable and modern conditions for the successful functioning on innovation businesses. The answer to this problem lies in creating network cooperation between elements of NIS. The network interaction has become a highly effective innovative approach that allows innovative organizations to develop dynamically. It is important to note that network interaction not only facilitates innovation diffusion, but also contributes to the development of innovation processes. STPs as main elements of innovation infrastructure can create network environment between Government, Academia and Business. STPs employ collective thinking, synergy and a knowledge-based partnership.

2. Overcoming existing problems, contradictions, drawbacks and low efficiency of domestic STPs will make possible a global competitiveness improvement of the Russian economy. Currently, there is a change in trends in global technological development. Not only the formats of STPs are changing, but also their role in socio-economic

development. The main goal of STPs in Russia is overcoming of the gap between technology generations and the demands of the time. It is crucial to create new forms of STPs or communication networks for STPs that will become a communication platform for the development of international contacts between innovators. At the current stage of the development of information and communication technologies, the creation of STPs' structures using outdated communications is meaningless. One of the actual ways of innovation infrastructure development in Russia can be creation of virtual STPs, universities, government structures, industry representatives and other structures located not only in a particular city, but in different regions and even abroad, on a single platform, and provide a large variety of accessible services for residents.

Creation of a model of virtual STPs of the fourth generation as a structure that fully meets modern requirements for development and operation of the innovation infrastructure can be considered as one of suggestions for further research. The STPs, based on network technologies, is a structure capable of organizing an effective innovation process with the rational use of innovative opportunities of regions through information exchange between them. Modern network information technologies make it possible to organize operation of STPs by involving contractors for the implementation of certain stages of innovation process. This makes it possible to integrate disparate innovative resources of regions into a single innovation infrastructure and to ensure interaction with any organizations on the territory of the Russian Federation and beyond.

7.2 Limitations of the research

This study has several limitations. First one is related to the research base. This research conducts only two case studies of innovative infrastructure, e.g. Technopolis “Moscow” and Technopark “Strogino”, including five interviews on each of the cases. In order to get broader understanding of the topic it is recommended to conduct more interviews and involve more research objects into the investigation. Approbation of this technique on a larger number of STPs can get even more viable, detailed and reliable information on the subject of research.

This study includes only qualitative analysis of information through semi-structured interviews with the Management Company and residents. The next recommendation for further research is the usage of both research methods: quantitative and qualitative studies.

This research examines network coordination between STPs and main elements of NIS (Academia, Government, Business), including investigation of only STPs’ residents and management companies. Future research should address this limitation by including more actors of NIS such as research institutions, corporations, invest funds, government structures and others in addition to STPs residents’ and management companies.

Moreover, the study focuses on the investigation of two STPs (Technopolis “Moscow” and Technopark “Strogino”) which are based in Russia. This study did not address the analysis of the functioning of similar structures in other countries and, therefore, did not reflect experience of other countries. It is highly recommended to consider best world practices as well as best cases of innovation infrastructure development.

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APPENDCES

APPENDIX 1: INTERVIEW GUIDE (ENGLISH VERSION)

Interaction of STP with NIS (National Innovation System):

1. Which elements form the STP network? Who is included in this network? For example, stakeholders, partners, etc.

2. How is the relationship with these structures built? Describe the mechanisms for the formation of relationships; what role personal ties play; Are these relationships usually long-term or short-term? What kind of interaction are they directed at? (For example, information / financial / exchange of other resources / strategic)
3. What role does the government play in the functioning of the STP?
4. What role does Science play (universities, research institutes, etc.) play in the functioning of the STP?
5. What role does the Business Park (business, large corporations, SMEs, financial structures) play in the functioning of the STP?

Consider issues 3-4-5:

- How does each element (Business, Science, State) interact with the STPs?
- Name the weaknesses and strengths of the existing interaction.
- How do you consider the strategic importance of such cooperation for the STPs?
- How satisfied are you with the existing mechanisms of interaction and what are the opportunities for improvement?

6. Is STP interested in developing its business network?
7. Can you single out other structures that interact with the STP (intermediaries)?
8. Does the STP interact with other subjects of the innovation infrastructure (other technology parks, business incubators, etc.)?
9. What are the strengths and weaknesses in the organization of the relationship of the STP. What are the biggest challenges and opportunities in building a network?
10. Can you determine the development trends of STP's network?

11. What are the features of the organization of the STP business network, which in your opinion are of little use and are of great importance?

Influence of the STP Network on the Development of Resident Companies

12. How do residents interact with elements of the national innovation system (science, government, business)? Give examples.
13. Does the existing network have all the necessary resources to organize the development of residents?
14. Is it possible for STP residents to exploit the partner network of the STP? Give examples of how the technology park provides similar requests to residents? STP provides these requests on its own or by recruiting intermediaries?
15. How does STP provide access to a network of partners? Describe the process by example. For example, a resident company needs to enter the international market with its project, get venture financing, patent a product, gain access to certain equipment, or find product consumers.
16. How do residents interact with each other?
17. How is the assessment of interaction with residents carried out? Is there any polls or reports in the STP?
18. Please give an example of how STP helps start-ups to obtain critical resources for business development?
19. What is the value of the existing business network of the STP for resident companies?
20. Is there an online interaction in the STP? (specialized online programs, chats and stuff)
21. Do you have any comments, suggestions or comments on this survey?

APPENDIX 2: INTERVIEW QUESTIONS (RUSSIAN VERSION)

Взаимодействие Технопарка с НИС (Национальная инновационная система)

1. Какие элементы формируют сеть Технопарка? Кто входит в эту сеть? Например, стейкхолдеры, партнер и др.
2. Как строится взаимоотношения с этими структурами? Опишите механизмы формирования взаимоотношений; какую роль играют личные связи; Эти связи обычно долгосрочные или краткосрочные? На какое взаимодействие они направлены? (Например, информационные/финансовые/обмен другими ресурсами/стратегические)
3. Какую роль государство играет в функционировании Технопарка?
4. Какую роль играет Наука (университеты, исследовательские институты и др.) играет в функционировании Технопарка?
5. Какую роль играет в функционировании Технопарка Бизнес (бизнес, крупные корпорации, малый и средний бизнес, финансовые структуры)?

Рассмотреть в вопросах 3-4-5:

- Как каждый элемент (Бизнес, Наука, Государство) взаимодействует с Технопарком?
- Назовите слабые и сильные стороны существующего взаимодействия.
- Как Вы считаете насколько стратегически важна такая кооперация для технопарка?
- Насколько Вы довольны существующими механизмами взаимодействия и какие есть возможности для улучшения?

6. Заинтересован ли Технопарк в развитии своей бизнес-сети?
7. Можете ли Вы выделить другие структуры, которые взаимодействуют с Технопарком (посредники)?
8. Взаимодействует ли Технопарк с другими субъектами инновационной инфраструктуры (другие технопарки, бизнес-инкубаторы и тд.)?

9. Назовите сильные и слабые стороны в области организации взаимоотношений Технопарка. Каковы самые большие проблемы и возможности в построении сети?
10. Можете ли вы определить тенденции развития сети Технопарка?
11. Назовите особенности организации бизнес-сети Технопарка, которые по вашему мнению, мало где применимы и играют большое значение.

Влияние сети технопарка на развитие Компаний-резидентов

12. Как резиденты взаимодействуют с элементами национальной инновационной системы (наука, государство, бизнес)? Приведите примеры.
13. Имеются ли в имеющейся сети все необходимые ресурсы для организации развития резидентов?
14. Предоставляется ли резидентам Технопарка возможность эксплуатировать партнёрскую сеть технопарка? Приведите примеры, каким образом технопарк обеспечивает подобные запросы резидентов? Технопарк обеспечивает данные запросы своими силами или привлекая посредников?
15. Как Технопарк оказывает доступ к сети партнеров? Опишите процесс на примере. Например, компании-резиденту необходимо выйти на международный рынок со своим проектом, получить венчурное финансирование, запатентовать продукт, получить доступ к определенному оборудованию или же найти потребителей продукции.
16. Как резиденты взаимодействуют друг с другом?
17. Как проводится оценка взаимодействия с резидентами? Существует ли в технопарке какие-либо опросы или отчеты?
18. Пожалуйста, приведите пример того, как Технопарк помогает стартапам получить критически важные ресурсы для развития бизнеса?
19. Какую ценность составляют имеющаяся бизнес-сеть Технопарка для компаний-резидентов?
20. Осуществлено ли в технопарке онлайн-взаимодействие? (специализированные онлайн-программы, чаты и прочее)
21. Есть ли у Вас какие-нибудь замечания, предложения или комментарии по данному опросу?