# ECONOMICS OF INNOVATIVE ACTIVITY OF ENTERPRISE

# ЭКОНОМИКА ИННОВАЦИОННОЙ ДЕЯТЕЛЬНОСТИ ПРЕДПРИЯТИЯ

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В пособии рассматриваются вопросы организации и управления инновационной деятельностью предприятия в рыночных условиях. Рассмотрены стратегии и формы государственного регулирования инновационных процессов, коммерциализация интеллектуальной собственности, особенности финансирования инновационных проектов. Особое внимание уделяется современным формам организационной деятельности – венчурным фирмам, инновационной инфраструктуре, кластерам и др. Представлены подходы к оценке экономической эффективности инновационных проектов.

Предназначено для студентов магистратуры, обучающихся по направлению «Экономика».

The textbook addresses the issues of organization and management of enterprise's innovative activities in market conditions. The strategies and forms of state regulation of innovation processes, the intellectual property commercialization, the specificity of innovative projects financing are considered. Particular attention is paid to modern organizational forms of innovation – venture firms, innovation infrastructure, clusters, etc. Approaches to assessing the economic efficiency of innovative projects are presented.

For master program students in the field of Economics.

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## Contents

**Introduction** **5**

**Chapter 1. Essence and dynamics of innovative process** **8**
1.1. Properties, features and components of innovations 8
1.2. Rates of innovative process 13
1.3. Types of innovations, their development and intensity 16
1.4. Participants of innovative process and forms of their interaction 19
1.5. Assessment of the level of innovative development 30

**Chapter 2. State regulation of innovative activities** **36**
2.1. The state role in the development of innovation economy 36
2.2. The strategy for innovative development of the Russian Federation 41
2.3. State policy to stimulate innovation in the Russian Federation 48

**Chapter 3. Clusters and innovative activities of enterprises** **59**
3.1. The concept and the basic characteristics of clusters 59
3.2. International experience in the implementation of cluster policy 64
3.3. Cluster policy in the Russian Federation 68

**Chapter 4. Intellectual property: protection, evaluation and commercialization** **82**
4.1. The concept of intellectual property 82
4.2. Legal protection of intellectual property rights 85
4.3. Intellectual property valuation 91
4.4. Commercialization of intellectual property in Russia 95

**Chapter 5. Innovative activity of enterprises** **100**
5.1. Innovative company 100
5.2. Organizational forms of innovation 111
5.3. Scientific and business structures in innovative activities of enterprises 127
5.4. Innovation business strategies of companies 136

**Chapter 6. Funding innovation** **141**
6.1. Sources of innovation financing: equity, debt and raised funds 141
6.2. Public financing of innovative activities 151
6.3. Venture financing of innovation 159

**Chapter 7. Innovative projects: efficiency and risks** **167**
7.1. Innovative project and its main participants 167
7.2. Specific features of innovative projects efficiency evaluation 170
7.3. Analysis of innovative projects under risk 177
7.4. Risk management practices in innovative companies 183

**References** **186**

## Introduction

Now the economy of the most developed countries is oriented to knowledge, new ideas, high technologies, scientific achievements in all industries and spheres. The traditional sources of economic growth based on raw material and energy resources, cheap labor power and new territories nowadays to some extent yield their positions to the new factors of economic growth — scientific and creative achievements of people, which become the most important driver of economic development. The economy becomes "intellectual", "innovative". Development and effective, timely implementation of innovations as results of intellectual activities becomes an important and actual task of modern economies.

Many scientists, both foreign, and domestic[1] believe that in modern conditions the level of development of the innovation oriented economy contributes to the world economic superiority of the country. The innovation economy becomes the new economic mode, which gradually replaces industrial economy.

Innovations exist in various forms — product, service, technology, etc. The innovative activities, which need incessant updating and effective usage in the conditions of the competitive market, require creation of certain conditions. These conditions, on the one hand, stimulate innovations, and, on the other hand, create special requirements to the companies and institutes. These are the following conditions:

1. *The acceleration of rates of the latest technologies release* caused by the need to use the new knowledge quickly given the continuous release of new products (goods, services, technologies, etc.) by competitors.

2. *The inter-company cooperation and development of network organizational structures* caused by the need of companies to conduct high-quality and large-scale research for the development and marketing of new products.

[1] See works by Toffler E, Bell D., F.Fukuyama, Yakovets Yu., Glaziev S., Ivanter V., etc.

3. *The functional integration and cooperation within the enterprise* which promote fast development and successful marketing of new products.

4. *Cooperation of enterprises with centers of knowledge production*, namely establishment of interrelations with the state and private research universities, the scientific and educational centers, laboratories, etc.

5. *The increase of the services' share and the role of knowledge transfer* connected with the formation of new methods of the economic activity of an organization, and change of the existing business models.

To develop innovative activities and promote the economic growth of the country, creation of favorable conditions to accelerate the transfer of progressive technologies is needed. At the same time, during the organization of research, development and marketing of new technologies, it is necessary to take into consideration needs and interests of all participants of innovative process (researchers, producers, investors, buyers of new technologies, goods, services, etc.).

Authors of this textbook discuss the economic essence and dynamics of innovative process, analyze the properties and components and types of innovations, the intensity of innovation development and interaction of innovative process participants.

In the textbook authors discuss the role of the state in development of innovative sector of economy, specific features of the state policy for innovations' stimulation, as well as the strategy for the innovative development in the Russian Federation.

Authors consider domestic and foreign experience of cluster policy as modern approach to stimulate innovative activities of enterprises and increase the efficiency of national economy.

In modern conditions protection of intellectual activities results, guaranteeing author's rights and the property rights to the received results, stimulates the development of new ideas, knowledge, and contributes to activation

of technological and socio-economic development of the states. The effective system for protection of intellectual activities results promotes creation of favorable environment for accumulation of investment and transfer of new technologies. In this connection the authors have paid special attention to the problems of protection, valuation and commercialization of intellectual property.

In this textbook authors also examine development of various elements of innovative infrastructure, such as science and technology parks, scientific parks, technological platforms, business incubators; organizational forms of enterprises' innovative activities, innovation business strategies of companies, and specifics of innovative activities financing.

Considerable attention is paid to methods of evaluation of innovative projects efficiency and approaches to minimization of innovative projects risks which are used in practice.

Development of competitive high-technology production, improvement of export structure through increase of high-technology products share, and vice-versa decrease of the raw materials share, improvement of the country's status in the world technology market is one of priority tasks of the Russian Federation. In this context the research and the analysis of problems and prospects for development of enterprises' innovative activities, formation of the innovation oriented economy acquire special relevance.

## Chapter 1. Essence and dynamics of innovative process

### 1.1. Properties, features and components of innovations

Nowadays the economy of the most developed countries is oriented to knowledge, new ideas, high technologies, scientific achievements in various industries and spheres. The traditional sources of economic growth based on the usage of raw material and energy resources, cheap labor power, new territories gradually lose their relevance. Scientific and creative achievements of people become the major resource, driving factor of economic growth. The economy becomes "intellectual", "innovative". At the same time, both development and effective and timely implementation of innovations based on the results of intellectual activities become an important and actual task of modern economies.

The concept "innovation" for the first time appeared in scientific research papers in the second half of the 19th century. However, in economic discussions this term was introduced by the Austrian and American economist Josef Schumpeter in 1934 in his paper "The Theory of Economic Development". On the basis of the analysis of "innovative combinations" and changes in development of various economic systems Schumpeter has determined an economic innovation as the scientific and organizational combination of production factors motivated by entrepreneurial spirit[2].

There are various definitions of the concept "innovation". In general, it is possible to distinguish two main approaches to defining of the "innovation" concept when the innovation is considered:

1. as a result of creative process;
2. as a process of innovations' introduction.

The standard modern international definition is formulated in the "Frascati Manual" and "Oslo Manual".

[2] Shumpeter, Y.A. (2007) *Theory of economic development. Capitalism, socialism and democracy*. Moscow: Eksmo [Russian].

"Frascati Manual" became the first document devoted to the methodology of science and innovations, including recommendations about gathering, handling and the analysis of information on science and innovations. The "Frascati Manual" was developed and adopted in 1963 in the Italian city of Frascati by the group of national science and technology experts working for the Organization for Economic Cooperation and Development (OECD). The last edition of the Manual (in 1993) became the major international standard.

The "Oslo Manual", which contains recommendations about gathering and analyzing data on innovations, became the next document promoting formation of unified approach to the concept "innovations". The Oslo Manual has been developed jointly by Eurostat and OECD and it was adopted in 1992.

Now the concept "innovations" defined in the specified documents is a reference point for both theorists and practitioners in the sphere of science, technologies and their managements and it serves as a basis for the development of legal documentation, concepts, programs, and other strategic documents devoted to innovations.

According to the accepted international standard, *the innovation* is understood as a creation and introduction to the use of a new or significantly improved product (goods or service) or process, a new marketing method or a new organizational method in business practice, workplace organization or external relations. In the Oslo Manual it is noted that "*innovative activities* are all scientific, technological, organizational, financial and commercial activities, which actually (or are intended to) lead to the implementation of innovations. Some innovation activities are themselves innovative, others are not, but they are necessary for the implementation of innovations. Innovation activities also include R&D which is not directly related to the development of a specific innovation"[3].

The *innovation* is recognized as innovation only after it has really been used by an enterprise, and / or marketed, i.e. a new or advanced product has entered the

[3] Oslo Manual (2005) *Guidelines for collecting and interpreting innovation data*. OECD and Eurostat (Paris: OECD). - P. 47.

consumption. In other words, the developed new idea described in detail, with graphical presentation, etc., which is not used in industry, does not have the consumer, though it represents the result of creative activity, that is *novelty*, not an innovation.

Therefore, as innovation we will determine the result of implementation of new ideas, methods, processes developed for practical use (implementation), for achievement of significant cost efficiency in production or consumption of a product.

From here the main *properties (criteria) of an innovation* are the following:

1. novelty (scientific and technical, methodological, organizational, etc.);

2. implementation (embodiment) in practical activities, in new products or processes, use in various fields of activity (the industry, agricultural industry, health care, science and education, etc.);

3. high efficiency in production or consumption of a product.

These criteria are interconnected and complement each other. Since a new idea (a method, process) is implemented in real objects, processes, its orientation to high cost efficiency and meeting needs of people acts as the integral criterion of an innovation. And vice versa.

It is possible to distinguish the following types of innovations:

1. *The technological innovations* represent the end result of innovative activities embodied in the form of a new or improved product or service introduced to the market, new or upgraded process or method of production (transfer) of the services used in practical activities. The innovation is assumed to occur when it is introduced to the market or to the manufacturing process. Both product and process innovations are included into the group of technological innovations:

• *product innovations* cover development and introduction in production of technologically new and considerably upgraded products. A technologically new product – a product, which technical characteristics or intended use are essentially new or significantly differ from the similar products produced earlier by the

enterprise. A technologically advanced product is an existing product with improved quality characteristics, higher economic efficiency due to the use of more effective components or materials, and partial change of one or more technical subsystems;

• process innovations include development and implementation of technologically new or considerably upgraded production methods, including methods of transfer of products (production methods in logistics, deliveries of goods and services, and also in auxiliary types of activity).

2. The *non-technological innovations* include:

• *organizational innovations* the realized new business methods, the new organization of workplaces, the new external relations;

• *marketing innovations* the new or improved marketing methods including new sales methods and presentations of products (goods, services), their introduction and promotion on the markets, and new price setting strategies , etc.;

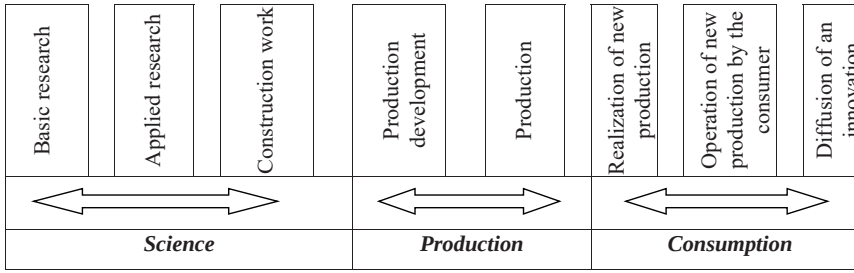
• *ecological innovations* the innovations promoting increase of an ecological safety, decrease or prevention of negative impact on environment, performed together with technological, organizational or marketing innovations.

The concept “innovation” is the cornerstone of the innovative process representing creative process of development and transformation of scientific knowledge to the new products recognized by consumers.

The simplest model of innovative process is the innovative chain which includes the complete research and production cycles consisting of rather independent stages (Table. 1.1).

Table 1.1.

**Stages of innovative process**




Innovative process can be provided as a set of results presented in the Table 1.2.

Table 1.2.

**Main components of innovative process**

| | |
|---|---|
| Novelty - updating, new idea, new knowledge | Result of the finished scientific research (fundamental and applied), R&D, and other scientific and technical achievements.<br>New ideas can have the form of discovery, concepts, techniques, instructions, etc. |
| Innovation (from Latin innovatio – in the direction of changes) | Result of new knowledge development, its implementation in new or upgraded products sold in the market or in new or upgraded engineering methods used in practical activities. |
| Diffusion of an innovation | Distribution of the innovation already mastered, i.e. application of innovative products, services, technologies in new places and conditions.<br>The form and speed of this process depend on the structure and capacity of communication channels, ability of economic agents to react quickly to innovations. |

Speed of diffusion depends on the type of innovation (tab. 1.3).

Table 1.3.

**The factors determining the speed of innovation diffusion**

| Factors | Contents |
|---|---|
| Comparative advantage | Superiority of innovation in comparison with the available analogs (for example, increase of accuracy of measurement by the device, increase in the number of device functions, etc.) |
| Complexity | Complexity as internal component of new ideas or goods. High level of complexity means the higher costs of consumer for training. |

| | |
|---|---|
| Compatibility | Degree of an innovation compatibility with the established practice of potential users. If consumers change the habitual operations procedure, there are costs for switching or adaptation, and the speed of diffusion of an innovation decreases. If new goods are completely compatible to purchasing habits, acceptance can happen very quickly. |
| Communicativeness | Simplicity of the explanation of the innovation essence to potential users. Some benefits are readily visible - goods "show up" themselves (cars, phones, etc.). In the case of goods with " postponed" benefits, it is more difficult to market them, and, therefore, diffusion happens more slowly. |
| Possibility of approbation | An opportunity to preliminary testing the sample of a new item. |

It is necessary to emphasize that the innovation is not only the component of innovative process, which represents the result of implementation of a new idea or an advanced product, methods, the processes into practice, but innovation is also itself good, being the end result of creative activity. So, for example, an innovative product being the result of R&D, at the same time contains a set of knowledge, information about this product, its features, and properties.

Thus, speaking about an innovative process, we come to a conclusion that it is a consecutive chain of modifications, starting from the emergence of new idea to its practical embodiment in a specific product, technology, including distribution of already mastered innovation in new places and conditions.

## 1.2. Rates of innovative process

Innovative process is dynamic and, taking into account escalating rates of the scientific and technical progress which has affected practically all spheres of human activities, it acquires the characteristic features which are shown in: 1. reduction of a time lapse between the emergence of a new idea, its development, and implementation; 2. sequential change of technological modes, which become shorter. The time of novelty conversion into innovation, which includes a number of stages, has been reduced.

The main phases of the life cycle of technological mode of production are presented in Figure 1.1.

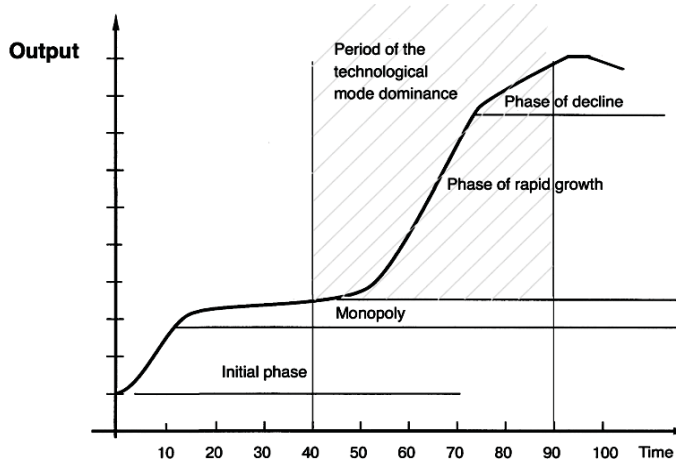



Fig. 1.1. Life cycle of technological mode of production.

Technological modes of production in their development go through three phases. Usually the technological mode of production lasts around 70-100 years.

The first phase is a phase of emergence and formation in the economy of a new technological mode of production. The second phase represents a phase of rapid growth, when the new technological mode becomes dominant. This phase lasts about 50 years. During the third phase the technological mode gradually becomes obsolete and disappears. A new technological mode gradually steps in.

It is considered that starting from the industrial revolution there were 5 technological modes in the world, the sixth one is coming at the moment.

Each technological mode is connected with specific scientific and technical discovery which has made the significant contribution to the industry and become driver of economic development. These discoveries are listed in tab. 1.4.

Characterizing the technological mode of production we distinguish: periods of their dominance (about 50 years); core of technological mode; key factor of technological mode; formation of a new technological mode core.

Table 1.4.

**Technological modes of production**

| № TLC | Beginning, year | Name of the technological mode of production | Event/factor |
|---|---|---|---|
| I | 1772 | Beginning of the First industrial revolution | Creation of the spinning car by Arkrayt R. and construction of the first cotton factory |
| II | 1825 | Steam era | Creation of a steam-engine, construction of the railroad |
| III | 1875. | Beginning of the second industrial revolution / Steel era | The invention of Bessemer process, construction of plant for usage of Bessemer convertor |
| IV | 1908 | Energy era / Oil era | The belt conveyer at Ford's enterprise. Internal combustion engine, wire telecommunication, automotive industry, construction of aircrafts |
| V | 1971 | Scientific and technical revolution / Information and communication era | Achievements in the field of microelectronics, informatics, biotechnologies, genetic engineering, new types of energy, materials, space exploration. Production of the first Intel 4004 microprocessor |
| VI | 2010s | Era of nanotechnologies | Decrease in power and material intensity of production. Creation of high-tech products based on nanotechnologies, cellular technologies |

In various cases the interval between scientific novelty and its practical implementation could be long, or could be short, that depended on the availability of the consumer demand. So, for example, it took almost 100 years from the moment of discovery in 1854 of valuable chemical element aluminum to its practical use, when after the World War II it was used as alloys for production of house ware, window frames, wings of planes, etc.

For laser it took 44 years from the moment of its discovery to the practical use. Laser has become one of the main components in the optical communication, medicine, research of space, etc.

In the case with X-rays the time lapse was minimal. X-rays, discovered by V.K.Rentgen in 1895, in several years were used in medicine and optics.

However, the described situations arise in exceptional cases. The time lapse between the discovery and its practical application is usually long, commensurable in duration to the main stages of innovative process.

## 1.3. Types of innovations, their development and intensity

Based on various criteria the multifaceted concept of 'innovation" can be grouped into different classifications with their features and distinctive properties.

There are various approaches to the classification of innovations. In the Table 1.5. we will consider the distinctive features that are in the basis of different innovations' classification.

Table 1.5.

**Main classification signs of innovation group**

| № | Classification sign | Group |
|---|---|---|
| 1 | Significance | Basic, improving, pseudo-innovations |
| 2 | The relation to the current operating system | Replacing, rationalizing, expanding, opening |
| 3 | Place of realization | Branch where the innovation was produced, branch where it was applied, branch where it was consumed |
| 4 | Depth of change | Change of initial properties of system or product; updating of the existing functions; adaptive changes; development and implementation of new generations, new types, etc. |
| 5 | Developer / creator | Own, internal, in-house innovations (developed and produced by own means), joint, external, purchased from outside sources |
| 6 | Term of development and realization | Long-term, medium-term, short-term |
| 7 | Financing | State budget, off-budget, own, private |
| 8 | Scale of diffusion | Local, specific industry, global |
| 9 | The place in the production chain | The main product and technology chains, supplementary product and technology chains |
| 10 | Nature of the needs met | New requirements, the existing requirements |
| 11 | Degree of novelty | Innovation based on a new discovery, based on a new method of application of already known phenomena |
| 12 | Timing of entry to the market | Innovations-leaders, innovations- followers |
| 13 | Costs | Large-, average-, low-cost |
| 14 | Degree of risk | High, average, low |
| 15 | Origin | Adapting, strategic |
| 16 | Application area | Technical, technological, organizational, managerial, information, social, etc. |

We will consider several groups in more details. So, according to the **importance criterion** we consider:

- the *basic innovations* (or *radical innovations*) which are based on a large discovery or the invention, are directed to development of absolutely new products, methods, technologies (for example, a CD player for laser disks was a basic innovation in comparison with the sound-reproducing equipment working as "a magnetic head  a magnetic film");
- the *improving innovations* (or *incremental innovation*), directed to improvement of properties and parameters of already made and used products, services and technologies (for example, production of the cassette tape recorder after bobbin tape recorder: the principle of reproduction remained the same  "a magnetic head  a magnetic film", however, the exterior changed considerably, the product became more compact, convenient and practical);
- the *pseudo-innovations* oriented to partial improvement of obsolete generations of equipment and technologies (color, form, finishing, etc.).

One can observe transition from innovations from lower level to higher level, according to the **depth of the changes** and effects produced by innovation:

1. reproduction of initial properties of a production system or product, preserving and updating of the existing functions;

2. change of quantitative properties of system, a regrouping of system components for the purpose of its functioning improvement;

3. adaptive changes of production system elements for the purpose of better fitting to each other;

4. new option  the elementary qualitative change which is beyond simple adaptive changes;

5. new generation  change of the majority of properties of the system, but the basic concept still remains;

6. new type  qualitative change of initial properties of the system and the initial concept, without change of the functional principle;

7. new sort  the highest change in functional properties of the system which changes its functional principle;

8. radical (basic);

9. improving;

10. modification.[4]

Classifying innovations in accordance with the **scale of diffusion**, we pay attention to their features. So *local innovations* assume the use of experience of one enterprise by another economic entity (for example, in the sphere of resource-saving, work incentives, work with suppliers, etc.).; *industry innovations* represent the innovations which were not used earlier by enterprises of this industry; *global innovations* are applied in all industries and assume essentially new types of products, technologies, new methods of management which do not have analogs in world practice.

Depending on the **degree of novelty** innovations are divided on: *innovations created on the basis of a new discovery or invention; innovations created on the basis of a new method applied to already known phenomena*. Considering innovations from the point of view of the degree of novelty, they can also be classified according to their novelty for the market. With respect to these criteria we distinguish: *new to given enterprise / company; new to specific industry; new industries / directions to the country; new industries / directions to the world*.

According to K. Christensen's model[5], significant influence of new technologies on activities of companies goes through so called "*disruptive innovations*". Their essence is that as soon as new technology appears in the market and finds the buyer for whom the new properties are necessary, the technology begins to justify its name: volumes of production are growing promptly and as a result the new technology replaces the previous one. It has happened to such innovations as phone (which replaced the telegraph), a steamship (replaced sailing ships), e-mail (instead of traditional mail), etc. "Disruptive innovations", in

[4] For more detail see: Agarkov, S.A., Kuznetsova E. S., Gryaznova M. O. (2011) *Innovative management and state innovative policy.* M.: Academy of Natural Sciences publishing house [Russian].

[5] Christensen, C.M. (1997) *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business School Press.

fact, lead to change of a ratio of values in the market since the product/technology existed earlier becomes noncompetitive, and the value of the main properties of old technologies/products is lost.

The German researcher G. Mensh has proposed his classification of innovations - he has distinguished the *basic, improving innovations* which promote formation of new industries and new markets and the *pseudo-innovations*, which improve the product or technology quality or slightly change elements of engineering process.[6]

The Russian scientist Yu.V.Yakovets, in addition to basic, improving and pseudo-innovations, has suggested to distinguish the micro-innovations, which improve certain parameters of equipment and applied technologies on the basis of small inventions that contributes to more effective production of these models or their more effective use.[7]

### 1.4. Participants of innovative process and forms of their interaction

For the dynamic development of scientific and high-tech business professional approach to creation of communication between knowledge carriers (scientific community, educational institutions), entrepreneurs and the state is needed. The world system of institutes of interaction between government institutions, business and science is based on the system of the managed communications which allows investment planning, channeling funds to the most successful directions and creation of effective practice –oriented programs.

Schematically the interaction of innovative process participants can be presented as follows:

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[6] Mensch, G (1976) *Gemischtwirtschaftliche Innovationspraxis: Alternative Organisationsformen der staatlichen Forschungs- und Technologiepolitik*. Göttingen.

[7] Yakovets Yu.V. (1988) *Acceleration of scientific and technical progress: theory and economic mechanism*. Moscow: Ekonomika [Russian].

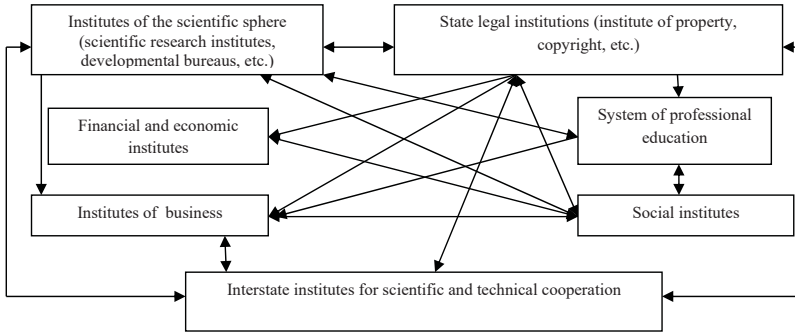


Fig. 1.2. Interaction of innovative process participants

*Triple Helix Model and its transformation*

Considering relations of innovative process participants, experts mainly speak about interaction between its three main participants – the state, science and innovative business. Analysis of their interaction is in the core of the so-called "Triple Helix" concept the model of strategic innovative networks.

Triple Helix model was developed in England and Holland at the beginning of the 21st century by professor of Newcastle University Henry Etzkowitz and professor of Amsterdam University Loet Leydesdorff[8]. The Triple Helix symbolizes the cooperation between the power (state), business (industry) and university (science) which are crucial elements of innovative system of any country. The Triple Helix Model studies how various institutes interact at each stage of an innovative product creation. At the initial stage - knowledge generation, the power and university interact with each other, then during a transfer of technologies the university cooperates with business, and, the result an innovative product, is brought to the market jointly by the power and business.

According to the concept, the dominant position in the system of innovative development is held by the institutes responsible for creation of new knowledge.

[8] Etzkowitz, H., Leydesdorff, L.(2000) *The Dynamic of Innovations: from National System and "Mode 2" to a Triple Helix of University-Industry-Government Relations*. Research Policy 29.

The key reason for the ongoing transformation is the development of science which gives a rise to numerous synthetic directions, both fundamental and applied interdisciplinary research. In these areas the formation of "clusters" takes place. In clusters the future potential of innovative development (bio-, nanotechnologies, information technologies, etc.) is under development, and connections between scientists, technologists and users become qualitatively deeper, as well as the functions carried out by various participants.

Transition to the economy of knowledge, innovative economy, and globalization are a consequence of transformation of conditions, external to science. As a result of social and economic changes, the state does not play the dominant role in innovative development anymore, since it is not capable to create knowledge. However, to the extent to which the knowledge is a public good, the state bears responsibility for the organization of its production.

Therefore, the new model of innovative system, different from the model of national innovative system, where the main engine of innovations were firms[9], and from the J. Sabato's model[10] with an omnipotent role of the state in the course of innovative development, is forming now.

Functions and forms of interaction among innovative process participants at each historical stage underwent changes due to the fact that independent activity of each of them did not yield effective result.

The economic theories of industrial society considered development of economy, in fact, on the basis of "a double spiral". So, the theory of political economy studied the interaction of a private capital with the state, and the state's influence on the market. In the evolutionary theory the interrelation of technologies and market was discussed. At the same time the big part of feedbacks between participants was not considered. It was necessary to include the innovative process

[9] Lundvall, B.A. (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Printer Publishers; Nelson R. (1993) *National Innovation Systems: A Comparative Analysis.* Oxford: Oxford Univ. Press.

[10] Sabato, J. (1979) *Technology and the Productive Structure*. Instituto Latinoamericano de Estudios Transnacionales.

into explanation of economic dynamics. It has led to transformation of relations both between private sector and the state, and between the state and scientific community. Recently a characteristic tendency in developed countries is the high level of innovations financing by the business sector.

It is possible to distinguish the **following forms of interaction of innovative process participants**:

*1. The state support institute* (the key participant is the state).

*1.1. Direct and mediated* (through the government organizations) *allocation of budgetary funds to research organizations, provision of grants, placement of state orders for accomplishment of R & Ds.*

In the majority of countries, the state is the main investor in new knowledge and technologies. Its share in internal expenses on R & D is presented in the Table 1.6.

Table 1.6.

**Share of state expenses, % GDP[11]**

| Country | Education | Health | R & D | Defence |
|---|---|---|---|---|
| Denmark | 7,5 | 9,7 | 0,97 | 1,5 |
| USA | 5,4 | 9,5 | 1,03 | 4,8 |
| France | 5,9 | 9,3 | 0,84 | 2,3 |
| Germany | 4,6 | 9,0 | 0,93 | 1,4 |
| Great Britain | 5,6 | 8,1 | 0,83 | 2,6 |
| Canada | 4,8 | 8,0 | 0,62 | 1,5 |
| Japan | 3,8 | 7,8 | 0,74 | 1,0 |
| Portugal | 5,0 | 7,5 | 1,02 | 2,1 |
| Italy | 4,7 | 7,4 | 0,61 | 1,7 |
| Sweden | 6,6 | 6,8 | 0,89 | 1,3 |
| Finland | 6,3 | 6,7 | 1,15 | 1,4 |
| Australia | 5,1 | 5,9 | 0,91 | 1,9 |
| Brazil | 5,7 | 4,2 | 1,1* | 1,6 |
| South Korea | 5,0 | 4,1 | 1,02 | 2,7 |
| South Africa | 6,0 | 3,9 | 0,9* | 1,3 |
| *Russia* | *4,1* | *3,2* | *0,91* | *3,9* |
| China | н.д. | 2,7 | 1,7* | 2,1 |
| India | 3,1 | 1,2 | 0,8* | 2,7 |

* all expenses on R & D.

[11] Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World. UNDP, 2013.

It is worth mentioning that the financial crisis of 2008-2009 which shook the world economy, did not lead to the cut of the budget support for innovation programs, but on the contrary, it gave strong stimulus for their further expansion considerable amount of expenses on innovations was included in a stabilization program for economy (Tab. 1.7).

Table 1.7.

**Structure of the public expenditures in stabilization program during the crisis of 2008-2009, % to GDP[12]**

| Country | Infrastructure | Education | «Green technologies» | Research and development |
|---|---|---|---|---|
| USA | 0,70 | 0,58 | 0,48 | 0,11 |
| Germany | 0,50 | 0,60 | 0,20 | 0,10 |
| France | 0,24 | 0,04 | 0,00 | 0,00 |
| Finland | 0,48 | 0,02 | 0,02 | 0,01 |
| Sweden | 0,27 | 0,02 | 0,06 | 0,29 |
| Canada | 1,27 | 0,12 | 0,28 | 0,05 |
| Australia | 0,82 | 1,40 | 0,48 | 0,25 |
| Poland | 0,07 | н.д. | 0,00 | 0,01 |

*1.2. Provision of various tax incentives to enterprises engaged in research and development.*

The experience of Western countries demonstrates the considerable use of tax incentives in the financial policies. Companies are allowed to deduct from the tax base more than 100% of their expenses on R & D. For example, Australian companies can deduct 150% or more of their R & D expenses from taxable income. Ireland, India, China, Israel, Taiwan granted unprecedented tax privileges to their companies carrying out activity in innovative sphere, which had a positive impact on economic growth and significantly modernized structures of their economies. Also, it worth mentioning such a measure as a 50% reduction of the profit tax rate from the sale of high-tech goods and services. The implementation of this measure is a good example of Belarus for other countries, including Russia. An interesting tax incentives for innovative activities in several developed

[12] Eroshkin, A.(2011) *Mechanisms of the state support of innovations: foreign experience.* World economy and international relations, №10. - P.21 [Russian].

countries has recently been a reduction in the profit tax rate for patented products. This practice has already been used by seven European states and China and is known as "patent window". Unlike most widespread R & D incentives that are aimed at creating more favorable conditions at the initial stages of the innovation process, reducing the cost of ongoing R & D, the "patent window" creates tax incentives for the successful commercialization of the results of innovation. As a rule, these incentives consist in lower rate of profit taxation. This encourages successful innovation, and stimulates economic growth, competitiveness and job creation. Some countries have set the upper limits of tax benefits available to companies within the "patent window". In Ireland, this is 5 million euros, in Spain - six times the cost of income-generating R & D. In China, after company receives the benefits worth 5 million yuan, its profits are taxed at 50% reduced profit tax rate.[13]

1.3. *Investment of budgetary funds into the equity of the venture funds and other specialized financial institutions participating in implementation of innovative projects.*

Practically in all leading countries nowadays there are budget programs for establishment of new venture funds and for strengthening of resource base of existing venture funds. So, in the USA the federal program for creation of the small business investment companies (Small Business Investment Companies - SBICs) has already been functioning for many years. It invests in new high-tech firms. Within this program supported by the Administration of small business of the USA, several hundreds of SBICs with the total capital over 20 billion dollars have been founded, that, according to experts, has made the significant contribution to formation of the American venture industry[14].

In many countries (Spain, Canada, Finland, Sweden) the creation of state venture funds managed by governmental agencies was widespread at the initial

[13] Tretyakova Yu.N., Filatova II Tax stimulation of innovation activity in the Russian Federation // Young Scientist. - 2015. - № 7. - P. 499-502 [Russian]. .
[14] The Small Business Investment Company (SBIC) Program. URL: https://www.sba.gov/sbic

stage of the national venture industry formation. However, later it became less popular because of, on the one hand, the rapid growth of private venture capital markets allowing to involve non-state investors in creation of hybrid funds, and on the other – lower performance of state funds in comparison with institutes with mixed equity managed by professionals.

1.4. *Allocation of concessional state loans and credit guarantees to subjects of innovative activities*

These transactions can be performed within general national programs for small and medium business support. However, recently the increasing number of the states creates special programs oriented to the venture entities (tab. 1.8).

Table 1.8.

**State programs on provision of concessional loans and guarantees to the small and medium innovative scale enterprises**

| Country | Program | Main requirements of the program |
|---|---|---|
| Great Britain | *Enterprise Finance Guarantee*. It is realized by the agency *Capital for Enterprise Limited*[15] | Provision of credit guarantees worth 1 million pounds for up to 10 years to companies with the annual turnover up to 25 million pounds . Guarantees cover up to 75% of a loan and are paid by the companies at interest rate of 2% . |
| Germany | *ERP Innovation Programme* implemented by the Bank *KfW Mittelstandsbank*[16] | Provision to small firms of soft credits and subordinated loans with exemption of interest and principal debt payments from 2 to 7 years, issue of guarantees on bank loans and investments of venture funds. |
| France | *OSEO* agency programs[17] | Provision of concessional loans to start-up companies, and guarantees on bank loans, investments of venture funds and business angels as much as 70% of invested amounts. |
| Spain | Programs of agency *Centro para el Desarrollo* | Provision to the perspective technological companies of long-term non-interest loans at the amount from 150 thousand to 3 million euros, but no more than 60% of the project cost. |

[15] The Enterprise Finance Guarantee (EFG). URL: https://www.gov.uk/guidance/understanding-the-enterprise-finance-guarantee

[16] Country Review Germany. URL: http://ec.europa.eu/invest-in-research/pdf/download_en/germany.pdf

[17] OSEO garantie. URL: www.oseo.fr

| | | |
|---|---|---|
| | *Tecnologico Industrial*[18] | |
| Netherlands | *SME Credit Guarantee Scheme*[19] | Provision to small and medium-sized enterprises of partial guarantees on bank loans up to 1 million euros for up to 6 years. Guarantees cover from 2 to 3.6% of loan amount. |
| India | Programs of bank *SIDBI* and guarantee fund *CGTMSE*[20] | Provision of soft credits, issue of guarantees on unsecured loans. Guarantees cover from 1 to 1.5% of loan amount. |

*1.5. Implementation of targeted public procurements of innovative products and services.*

In Russia public procurements have not become significant instrument of innovative activity stimulation (according to specialists' estimation, 70-90% of all public procurements in Russia are carried out with different violations) while in the world practice government procurements are an important instrument for creation of demand for innovations.

Expenses on public procurements in the majority of the Western countries are covered from the state or territorial budgets, special government and off-budget funds are created at the expense of tax and other revenues, including profits of state entities.

China is a special case. According to the national program adopted in 2006, state bodies are obliged to allocate a certain share of the expenses on products of the innovative Chinese companies irrespective of profitability of these purchases. According to new rules, state bodies can buy foreign products, only if there is no similar domestic production.

*1.6. Financing of business incubators and technopark structures*

In countries that are leaders in the sphere of high technologies and innovations, the state has made a crucial contribution to construction of national networks of business incubators and science and technology parks. It provided

[18] Centro para el Desarrollo Tecnologico Industrial (CDTI). URL: http://www.cdti.es/
[19] SME Credit Guarantee Scheme (CGS). URL: http://sbci.gov.ie/sme-credit-guarantee-scheme-cgs
[20] Industrial Development Bank of India (IDBI bank). URL: https://www.idbi.com/index.asp

necessary financial resources and real estate objects, as well as rendered administrative assistance. So, according to estimations provided by the National association of business incubators, in the USA in the mid-2000th about 50% of 1500 operating entities got 100% financing from the governmental agencies and another 15% got partial financing. In the EU countries nearly half of 1000 organizations used budgetary financing, and another 40% - got mixed private-public investment[21].

*1.7. Grants.*

Every year in many foreign countries actively use grant financing as an instrument of support to the small innovative companies at early stages of their development. Grant programs in the innovative sphere work in many countries, especially in the United States. The biggest program with financing around 2 billion dollars per year is The Small Business Innovation Research (SBIR). SBIR provides phased grants in the amount of up to $ 850 thousand to innovative companies with less than 500 employees[22].

Generally, the following list of the measures promoting efficiency of grant support to innovations is developed in the international practice: involvement of leading research organizations in examination of grant requirements; phased provision of grants, during the implementation of R & D and determination of financed projects perspectives; co-financing by grantee of the costs (to 20-30%) that increases his interest in the final result of works.

2. *Programs of support to integration of the higher education and fundamental science*

Education institutions and scientific community are the major participants of innovative process in addition to the state; there is a mediated communication of science and business entities through the innovative infrastructure created around universities.

[21] UNECE (2009) *Enhancing the Innovative Performance of Firms: Policy Options and Practical Instruments*. Geneva and New York.

[22] The Small Business Innovation Research (SBIR) program. URL: https://www.sbir.gov/about/about-sbir

Experience of the leading foreign countries demonstrates strengthening of universities contribution to innovations development and economic growth. Public financing of researches in higher education institutions is guided by the specific social and economic purposes and depends on final results.

*2.1. National programs.*

Analyzing experience of foreign countries, we will emphasize national programs of China directed to support and development of science, education and production, as well as their integration. In 1986 the state program "Program 863" for development of science and the high technologies was adopted. The program has determined the following priority industries: microelectronics, informatics, space, fiber-optic technologies, genetic engineering, biotechnologies, energy-saving technologies and medicine. After two years China has started implementation of the research and production Torch program oriented to commercialization and industrialization of high technologies. In 1988 the State Council of China has established the first science and technology park — the Experimental Beijing zone of high technologies development (later the Scientific and technological zone Zhongguancun, or Z-park ).

Z-park has been placed in the northwest of Beijing on purpose. More than hundred scientific and technical institutes and laboratories, and also the strongest higher education institutions of China such as Peking University and Tsinghua University are located there. They became basic elements of science and technology park: universities provided both scientific developments, the companies which commercialized them, and qualified personnel for high-technology business.

It is known that there are three main models of creation of universities, or scientific centers of the world level. The first model consists in selection of the best universities from already existing and their further development. The second is based on merging of several institutes to achieve a synergy. The third is a creation of a modern university from scratch. China has chosen the first option. The Peking University and Tsinghua University, which have had the privilege to select the best

students from each province, have achieved the highest levels through these aid programs. The Code of Recommendations on the development of higher education (1993) foresaw the establishment of 100 high-class universities. As a result of carried-out reforms at the Chinese universities, a favorable environment for work and development of the academic talents and science has been created; updated capacities necessary for research work have been provided; modern curricula and programs have been developed. Talented students went through improved system of preparation - from 1 million students and the researchers, who went to study abroad, about 200 thousand returned to China. These universities conduct world-class research and establish innovative enterprises managed by universities.

*2.2. International programs.*

In many countries there are programs for interaction of representatives of science and education from various countries. One of the largest and well known programs in Europe is the French national center of scientific research (CNRS)[23] founded in 1939 with assistance of the Government of France. One of its main activities is the support of researches, development of joint programs and projects, creation of joint laboratories in cooperation with universities, the research and business organizations in France and abroad. At the moment 392 international programs for scientific cooperation (PICS) and joint research operations (PRC), 172 international joint laboratories (LIA), 101 international research networks (GDRI), 35 international joint associations (UMI) and 26 joint associations with the French research institutions abroad (UMIFRE) are functioning by the medium of CNRS[24].

[23] The National Center for Scientific Research (CNRS). URL: http://www.cnrs.fr/en/aboutcnrs/overview.htm

[24] International policy // The National Center for Scientific Research (CNRS). URL:http://www.cnrs.fr/en/workingwith/international-policy.htm

*2.3. Scientific and Educational Centers (SEC).*

Scientific and Educational Centers were initially focused on integrated development of key components - education, research activities, development of communications with scientific, educational, industrial and other entities in Russia and abroad. Each SEC is based on specific platform: education, research, corporate or program platform. Each center develops its strategy and organizes work according to its own priorities, goals, objectives, research programs (nanotechnology, medicine, biotechnology, energy, electronics, etc.).

*International cooperation in scientific and technological sphere* is performed through bilateral and multilateral programs, as well as cooperation through the foreign and international organizations and funds. According to the Ministry of Education and Science, Russia has agreements and contracts for a sci-tech cooperation with 88 countries.

## 1.5. Assessment of innovative development level

The majority of developed countries assessed the level of innovative development of national economy long time ago. For more than 25 years they have been trying to assess all relevant factors affecting innovative development.[25] Distinctions in indexes value obtained for various countries are explained by different set of explanatory variables and the particular features of method of index calculation of innovative development, as far as each index is constructed for certain analytical and managerial tasks.

In general, in innovative development of national economy one can select *external or internal contours. An external contour* is the macroeconomic environment characterized by macroeconomic indicators of national innovative systems, suitable for the inter-country analysis of a global innovative system. *An*

[25] Bruno Lanvin. Innovation, knowledge competitiveness and development. The World Bank, Trieste, 11 May 2007. URL: http://g8forum.ictp.it/multimedia/slides/Lanvin.pdf

*internal contour* is the internal environment of national innovative system within the territory of the state.

The following indicators refer to the *external contour*:

I. Macroeconomic indicators for inter-country comparisons:

1. National wealth of the country per capita, thousand $ USA;
2. GDP per capita, thousand $ USA;
3. Expenses on scientific R & D, as % of GDP;
4. Patent requests;
5. Intellectual property: payments for and revenues from intellectual property, mln $ USA;
6. Share of high-tech export in production export of the country, %.

II. General indexes.

7 main indexes are used to characterize the global innovative system nowadays:

1. Human development index, HDI[26];
2. Knowledge economy index, KEI[27];
3. Global competitiveness index, GCI[28];
4. ICT development index, IDI[29];
5. Global innovation index, GII_INSEAD[30];
6. International innovation index, IntII_BCG[31];
7. Innovation capacity index, ICI[32];
8. Knowledge Economy Index, KEI[33].

[26] Human Development Index [e-resource]. URL: http://hdr.undp.org/en/statistics/hdi
[27] World Bank Group official site . URL: http://worldbank.org
[28] World Economic Forum official site URL: www.weforum.org/
[29] International Telecommunication Union (ITU) URL: www.itu.int/en/ITU-D/Statistics/Pages/default.aspx
[30]The Global Innovation Index, Cornell University. URL: www.globalinnovationindex.org/content.aspx?page=GII-Home
[31] The Innovation Imperative in Manufacturing // The Manufacturing Institute 2009. URL: www.themanufacturinginstitute.org
[32] Lopez-Claros, A., Yasmina N. Mata. The Innovation Capacity Index: Factors, Policies, and Institutions Driving Country Innovation. URL: www.augustolopez-claros.net/docs/IDR2010_ICI_LopezClaros_Mata.pdf

*Human development index* is a method of measurement of country's living standards by consolidation of indicators of remaining life expectancy, the education level and the population income. The index is calculated within the Development program of the UN (PROON). For the first time, the report on human development was prepared by the PROON in 1990.

*Knowledge economy index* is a complex indicator characterizing the level of development of the knowledge-based economy. This index was developed by the World Bank Group for assessment of countries capability to create, accept and disseminate knowledge. The index is computed irregularly, now the World Bank provides information for 1995, 2000 and 2012. The Russian Federation positions in this rating are: the 59th place in 1995, the 64th place in 2000, and the 55th place in 2012.

*Index of information and communication technologies development* is an indicator characterizing the level of information and communication technologies development.

*Innovation capacity index* characterizes capability of a country to create the environment stimulating production and diffusion of innovations. In this index 5 categories are assessed: the economic and legal environment, human capital, education and social integration level, quality of a regulatory framework, research activities, implementation of information and communication technologies. The index is computed for 131 countries and territories.

*Global competitiveness index* characterizes ability of a country and its institutes to ensure stable rates of economic growth in the medium run. Leading positions according to the global competitiveness index in 2015-2016 were taken by Switzerland, Singapore and USA[34].

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[33] Knowledge Economy-Index URL: http://gtmarket.ru/ratings/knowledge-economy-index/knowledge-economy-index-info

[34] The Global Competitiveness Report 2015–2016 Full Data Edition // World Economic Forum. URL: http://reports.weforum.org/global-competitiveness-report-2015-2016/competitiveness-rankings/

*Global innovation index* is based on recognition of innovation key role which is a driving force of economic growth and prosperity of the country. Computation of this index started in 2007 and at the moment represents the most full range of innovative development indicators in various countries. In 2014 the research covered 143 countries. Russia's positions - 62nd place in 2013 and the 43th place in 2016.

Table 1.9.

**Global innovation index, 2016[35]**

| Rating general | Country | Index | Rating in region | Region |
|---|---|---|---|---|
| 1 | Switzerland | 66,28 | 1 | Europe |
| 2 | Sweden | 63,57 | 2 | Europe |
| 3 | Great Britain | 61,93 | 3 | Europe |
| 4 | USA | 61,40 | 1 | North America |
| 5 | Finland | 59,90 | 4 | Europe |
| 6 | Singapore | 59,16 | 1 | South-East Asia, East Asia and Oceania |
| 25 | China | 50,57 | 7 | South-East Asia, East Asia and Oceania |
| 43 | Russia | 38,50 | 29 | Europe |
| 66 | India | 33,61 | 1 | Central and South Asia |
| 69 | Brazil | 33,19 | 7 | Latin America and Caribbean |

In an *internal contour* internal processes of the open national innovative system are analyzed and measured by the following indicators:

• total quantity of enterprises and organizations conducting R & D (according to the forms of ownership);

• dispersion of enterprises conducting R & D over the territory of Russia;

• the number of personnel conducting R & D in different sectors;

• trade of technologies with foreign countries.

Experts try to develop an integral indicator which would reflect the quantity of the resources used for innovations and the value added created as a result of innovative activities (for more detail see Chapter 7).

Research of enterprises innovative activities should provide the objective information about what actually firms undertake to boost their innovative activity

[35] The Global Innovation Index 2016: The Local Dynamics of Innovation - www.globalinnovationindex.org

and what its dynamics is. Openness and close cooperation of the state and private sectors are of great importance. Innovative environment greatly depends on the regulatory framework in the state.

For exact assessment it is necessary to consider the impact of the legislation on innovations' development. Regulatory measures can give direct support to innovative activities, for example, the state grants, others can create additional obstacles, such as, lack of preferential system of taxation for innovative enterprises.

Not all data on innovations can be measured quantitatively. Besides that, dynamic computation of indicators, monitoring of new information is important for evaluation of investment impact and other support activities for innovations on national economy. Analysis of time series is needed. Assessment of both short and long term innovations is needed to understand the total impact of innovations on national economy.[36].

Collection of exact data is far from simple. Innovative activities are not always limited to activities of one firm companies interact among themselves, they interact with universities and research laboratories, firms buy and sell intellectual property rights, outsource part of their operations. Quite often interaction in innovative activities takes place at the interregional, cross-industry or international levels. Thus, the clear and detailed picture of innovative process is needed to assess the effective impact of innovative activities in the economic growth of the country.

***Questions for discussion:***

1. Technological and non-technological innovation.
2. Types of innovation, their development and intensity.
3. The pace of the innovation process.

[36] Council of Competitiveness. Innovate America. National initiative summit and report, 2005. URL: www.compete.org/images/uploads/File/PDF%20Files/NII_Innovate_America.pdf.

4. Participants in the innovation process and the forms of their interaction.

5. Statistics of innovations: statistics of the OECD countries and the Russian innovation index.

6. Indicators of innovation activity of national economy and enterprises: indicators of innovation costs; indicators of innovative activity mechanisms; indicators of innovation performance of enterprises.

7. The level of innovation activity of Russian enterprises.

8. Structure and dynamics of costs for innovation in Russia.

9. Statistical measurement of innovation processes.

10. The current level of innovative development of the Russian economy.

## Chapter 2. State regulation of innovative activities

### 2.1. The state role in the development of the innovation economy

*The main reasons for the government involvement in the innovation process*

The main driving force behind the innovative economy is the innovator who creates innovative product and brings it to the market. International experience shows that in successfully developing innovative economies the state creates entire ecosystem favorable to the vigorous activity of innovators. It is done through development institutes and governments, regional authorities in the first place, by funding technology parks and business incubators, by providing grants for development and other activities. In addition to the development of the proper innovation infrastructure, the state aims to provide general favorable conditions for businesses not only in business incubators, but in any part of the country during expansions, and especially in times of crisis.[37]

From the point of view of modern economic theory, government intervention into economic affairs in a developed market economy beyond traditional property rights protection and law enforcement, is permissible and justified in case of so called "market failures".

The state makes up for the lack of efficiency of the private sector: 1. It commissions production of so-called *public goods*, such as national defense, public order protection, street lighting, flood and earthquake protection, etc.; 2. the state entities commission production of *goods with positive externalities,* such as health services, education, etc.; 3. through antitrust regulation the state controls monopolization trends in different industries.

[37] http://economy.gov.ru/minec/about/structure/depino/20151113

The positions of countries in the global economy are largely determined by the competitiveness of their economies. Enhancing national competitiveness is a complex task, and the success depends on accumulation of human capital, the development of economic institutions, using and strengthening of existing competitive advantages of the country, the creation of new competitive advantages via the diversification of the economy and the strengthening of scientific and technological potential of the country.

Success of innovative development largely depends on the formation of a globally competitive *national innovation system*, which transforms new knowledge into products and services demanded by society. For its creation, it is necessary to increase the demand for innovation from most sectors of the economy, improve the efficiency of generating knowledge fundamental and applied science, and develop innovative infrastructure.

The private sector alone cannot develop an efficient national innovation system. There are specific "failures" of the market in this area, and the state should step in and fill these gaps. As we know breakthrough radical innovations are based on the results of fundamental and applied science. The private sector, with rare exceptions, is not interested in financing basic research, because the probability of getting a sound forecast of the result is low and the foreseen commercial effect is vague. Funding of fundamental research in almost all developed countries is primarily the responsibility of the state for example, in the United States the financing is organized through a system of research funds the National Science Foundation in the first place[38]. Applied research to some extent is also financed by the state in partnership with the private sector, because the private sector financing of fundamental and applied science, R & D, which form the foundation of high-tech modern economy, is insufficient.

Certain “market failures” are observed in the limited flow of private capital into innovative companies in new high-tech projects. In the USA, it took 20-30

[38] For more details about National Science Foundation, USA, see http://www.nsf.org

years for the state to serve as a catalyst in attracting private capital to high-tech companies until the flow of private funds there became self-sustainable. And even in that case the state does not cease supporting innovative sectors of the economy.

In transition economies the active role of the state in developing the science and research sector and direct promotion of the innovation process is due to additional "market failures" inherent to them. The main economic rationale for the state intervention in the innovation sector of economy is the desire to improve the competitiveness of the national economy in the system of international division of labor. In a number of countries, including Russia, besides the economic reasons to support innovation, there are also political reasons related to security capabilities, preservation and development of national culture, and the maintenance of national prestige.

Analysis of international experience shows that the national government is deeply involved in the formation of *national innovation systems*. The main objective of the government in this area consists in filling-in the missing elements in science and innovation funding, establishing of a mechanism of "continuous investment" for the implementation of efficient scientific and technical projects and, thereby, eliminating existing gaps in the "science - technology - production – market" chain.

National innovation system consists of the following elements:

- Tertiary education –education at college or university level;
- R & D sector (organizational structure, financing, human resources, results - publications, patents, licenses);
- The business sector (innovation activity in the high-tech and other industries, innovation in the services sector);
- Innovation infrastructure (informational, organizational and financial infrastructure, an infrastructure of small innovative business support.

The state innovation policy is added to these elements of the national innovation system.

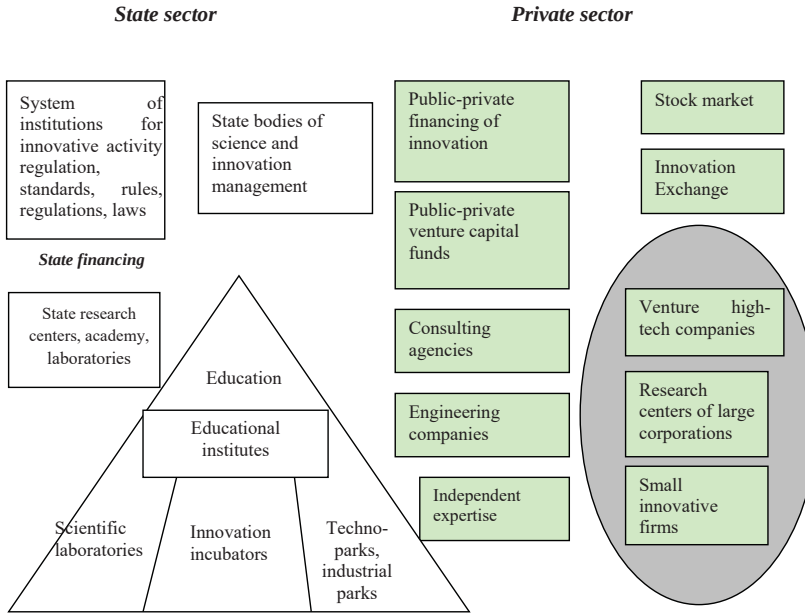


Fig. 2.1. The structure of the national innovation system [39]

Almost in all developed countries, the state through various state programs and funds financially supports small hi-tech companies at the early stages of development. Support is provided in the form of earmarked financing and funding on a strictly competitive basis. The state helps young technology companies to seek the necessary financial resources in a system of seed and start-up funds and produce and promote innovative goods to the market. State support is provided also to the protection of national intellectual property, and to promotion of national innovative products to competitive international markets. In general, the state through targeted programs, innovation infrastructure, and research and

[39] Tychinskii A. (2006) *Management of innovative activity companies: modern approaches, algorithms, experience.* Taganrog: TRTU [Russian].. Available from: www.aup.ru/books/m87/3_3.htm

innovation funds provides support for innovation at various stages from basic fundamental and applied research and development to creation of young high-tech businesses and channeling innovative products to the national and international markets.

State participation in the development of innovative economy goes along the following directions:

*1. The State defines the national development priorities in innovation sector.*

Policy documents in this field, such as "The Strategy of innovative development of the Russian Federation up to 2020", are based on foresight. The goals of development to be achieved and the course of action, including the public sector support for innovative projects from federal and regional programs are defined in these programs.

*2. The state allocates state budget funds for financing of research and organization of innovation activities*.

Public funding of science, technology and innovation policy in the Russian Federation is carried out in the following forms:

• allocation of funds of the state budget for fundamental and applied research in the sections "General state issues", "National defense" and other;

• targeted funding through the federal target programs (FTPs);

• financing through the system of science, technology and innovation public funds and through extra-budgetary funds;

• financing through the system of “seed”, start-up, venture capital and private equity funds.

*3. The state ensures legal regulation of innovation activity and protects intellectual property rights.*[40]

The state develops regulatory framework for innovative activities in the following areas:

[40] For more details see Chapter 4

- development and enactment of laws, as well as control over compliance with laws and regulations that create transparent and equal conditions for all participants of the innovation system;
- protection of rights and interests of subjects of innovation activity;
- protection of intellectual property rights.

4. *The state develops education and promote training, retraining and advanced training of personnel for innovation activities.* The State creates favorable conditions for investment in human capital, which is the most important factor for innovative growth. Investment by the state in human capital can be compared to the creation of goods with positive externalities.
5. *The State is working on the formation of a coherent innovation infrastructure.*[41] The state establishes and develops so-called "development institutions", technology parks, technology platforms, special economic zones. It creates information, consulting, and financial networks for innovative activity.
6. *The state regulates the international aspects of innovative processes*. The state creates the legal basis for international cooperation in the field of innovation activity and provides legal protection for national innovative companies.

## 2.2. The strategy for innovative development of the Russian Federation

The objectives and main directions for modernization and innovative development of the Russian economy are defined in the "The strategy for innovative development of the Russian Federation 2020", adopted in 2011. In this document the transition to the innovative socially-oriented development, as well as modernization of traditional sectors (such as metallurgy, chemistry, agriculture, and construction industry), development of new transport infrastructure and competitive "new economy" branches, such as science, engineering, education and health services were analyzed.

[41] For more details see Chapters 3 and 5.

The long-term objective of economic development of Russia is to ensure a high level of welfare of the population and to find a sustainable and economically viable place in the international division of labor. The only possible way to achieve these goals is the transition of the Russian economy towards the innovative socially-oriented development. Only this transition would allow in the next decade significantly increase the share of the high-tech sector in GDP, to increase five- six fold the share of innovative products in industrial output, and enlarge the share of innovation active enterprises up to 40-50%.

The complexity of the current state of the Russian economy, which relies on massive export of energy resources to international markets, is the fact that real competitors in innovation are not only the leading countries, but also many of developing countries, including CIS countries. Countries leaders in economic development, gradually pass to the sixth technological mode of production, while in the Russian economy nowadays elements of the third, fourth and fifth technological orders coexist oddly. The technological revolution in resource saving and alternative energy takes place: innovators develop cost-effective hydrocarbon production technologies from new sources such as shale, tar sands, and others.
This can lead to a fall in demand and prices for key commodities of Russian export, and reduce export revenues needed to stabilize the economic growth in Russia.

Globally, we observe the growing competition for the factors that determine the countries' competitiveness, primarily for skilled labor and investment in new knowledge and technology, which move among countries. For Russia, these movements represent a threat of the "drain" of the country's remaining competitive resources – skilled specialists, technologies, ideas and capital. To respond to these challenges, Russia must radically strengthen its innovation system, and try to more harmoniously participate in the global innovation system.

In the strategy the general conclusion on the current state of innovative development of Russia has been done, which says that despite all efforts of the Government of the RF, the innovative behavior of business has not been formed yet. Critical issue for innovative development today is motivation of all actors of the economy to innovate and the deepening of their cooperation with the research sector and innovative infrastructure.

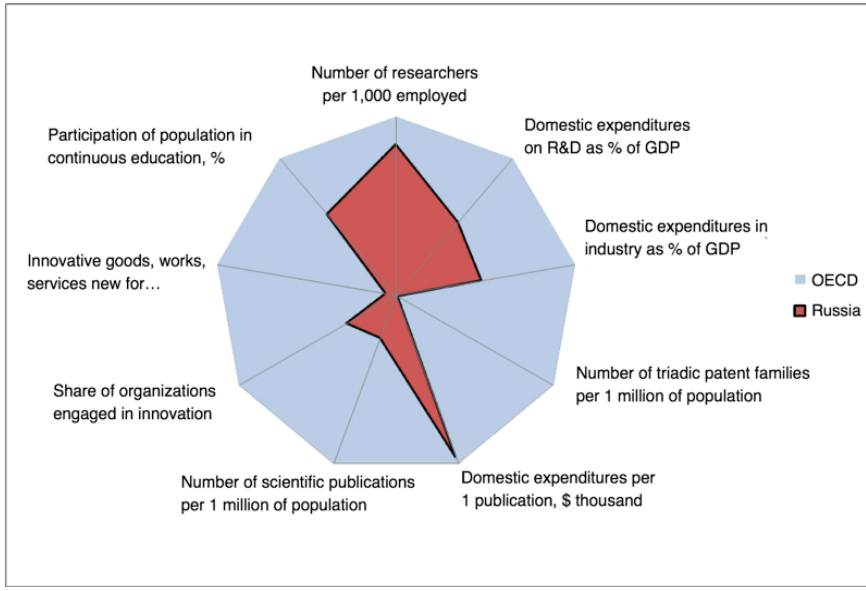


Fig. 2.2. Russia's position in the international comparison of science and innovation development. OECD - 100%.[42]

The data describing the positions of the RF in the science and innovation field in comparison with the average OECD level are presented in Fig. 2.2.

The purpose of the innovation strategy is to transfer the Russian economy to the innovative path of development. The figures to be achieved by 2020 are defined in detail. The Strategy also identifies the key tasks:

[42] The strategy for innovative development of the Russian Federation 2020. [Russian]. Available from http://innovation.gov.ru

1) Building human capacity in science, education, technology and innovation areas. Innovative economy needs “innovative people” who are able to take full advantage of scientific and technological achievements, create innovation, and distribute them in all spheres of public life.

2) A sharp, fold increase in innovative activity of businesses and rapid growth of new innovative companies.

3) Upgrading of “innovation” characteristics of the state  the widest possible penetration of modern innovative technologies in activities of the government; the formation of “electronic government”; transfer of the majority of public services to digital technologies; the use of the state commissions system to promote innovation.

4) Development of a sustainable R & D sector, which has an efficient institutional structure that supports enhanced reproduction of internationally competitive knowledge; radical improvement of efficiency of the  infrastructure for commercialization of research results.

5) Finding the proper place for the Russian innovation businesses in international cooperation in creation and use of innovations, given all constraints and challenges of the last decade.

Three possible options for the Russian innovative development are discussed in the strategy: 1. The option of inertial import-oriented technological development; 2. The option of catch-up development and local technological competitiveness; 3. The option of leadership in selected scientific and technical sectors, and fundamental research.

According to the authors of the Strategy, in modern conditions the optimal strategy of innovative development for Russia is a mixed strategy, which combines elements of the *strategy of leadership* in some segments, which already have or can quickly create competitive advantages, with the implementation of the *catch-up strategy* in many sectors of economy.

Implementation of a *mixed strategy* presumes an emphasis on setting priorities for the state, both financial and organizational, to support selected innovation areas and to form the necessary common incentives for large-scale modernization and investment in a quality human capital needed to succeed in implementation of *leadership* and *catch-up* strategies.

In 2011-2012, the search for more efficient integration of the Russian economy in the global economy has intensified. Innovative technological development today has become the main driver of economic growth in the developed countries. Unfortunately, the existing nowadays participation of the Russian economy in the international division of labor, which has developed over the past decades, is extremely volatile and carries a large number of risks, primarily due to the dependence of the Russian economy from the external conjuncture.

A lot of attention is paid in The Innovation Strategy 2020 to the problem of a more sustainable and cost-effective participation of Russia in the global innovation system. There is a complete understanding of the fact that the underdevelopment of the Russian business, the lack of ability to work in a highly competitive international market conditions, impede production of the Russian high-tech products and penetration to the foreign markets.

It is well known also that modern innovative high-tech products market produced in open economies require the global, not national markets. Therefore, the inability to enter the global market undermines the possibility of production of these products on the Russian territory.

In The Innovation Strategy 2020 the following key areas for the development of international cooperation in innovation are identified:

1. The development in Russia of high-tech industries and research centers of international companies and attraction of foreign direct investment;
2. Support for Russian high-tech companies activities in the world markets, simplification of control procedures in foreign trade of high-tech products;

3. The normalization and intensification of international scientific and technological cooperation.

Regarding the first of these areas, the research centers of multinational companies in Russia have been created and placed in innovative clusters, primarily in Skolkovo: research centers of international Intel Company, representative offices of Oracle, Novartis Pharma, Berlin Chemie; AstraZeneca Industries, Ford, Boeing, Microsoft and others. First-class Russian professionals work in these research centers.

At the moment, the main mechanisms of attraction of foreign investors are provision of land for construction on favorable terms, demand guarantees, agreements with Russian companies on the purchase of innovative products and services (so-called offset requirements)

The current model of Russia's participation in the global economy is rather vulnerable. For the international community, Russia is predominantly hydrocarbon supplier and sales market. But Russia is a developed country with highly educated, by international standards, population and relatively high standards of living. Russian experts agree that Russia should try to integrate into the global economy at all stages of the value added creation.

One example of the successful integration of the Russian economy into the global chain of high-tech added value is the work of Russian programmers who participate in production of goods by transnational corporations for global markets. In many foreign goods, such as mobile phones, for example, elements of value were added by the Russian programmers, who work in Russia. Part of the value added in the production of mobile phones returns to the Russian economy in the form of programmers' wages. But it is only a small part of the value created in the chain "ideas - prototypes - mass production - marketing and sales of products in the global markets organized by high-tech businesses. The bulk of the profits goes to companies that own and control the entire value chain.

There are successful examples of Russian innovative companies, established in Russia from scratch, that successfully operate in the global market – for example, Yandex.ru and Mail.ru. However, these examples are rare to date. Russian companies have not been able yet to create sufficient number of high-tech businesses with stable sales in the global competitive market.

Experts recommend to develop and implement the policy of "Open Innovation of Russia" which will allow more harmonious embedding of Russia into the global innovation system. For that purpose it is necessary to create in Russia centers for applied research and development, and engineering centers. As additional requirements to foreign investors, the creation of joint ventures with Russian producers and the transfer of relevant know-how and intellectual property rights to Russian partners may be proposed.

The Strategy seeks to maximize the production localization in Russia, and to attract foreign direct investment to the development of high-tech industries on the Russian territory. The potential of all Russian research and engineering centers, Skolkovo, science villages, technology development special economic zones, innovative clusters, development institutions and technology platforms should be used.

*Development of the Strategy for Socioeconomic Development of the Russian Federation for the period up to 2030*.

In 2015, the Russian government started the updating of The Strategy for Socio-Economic Development of the Russian Federation until 2030. According to the Ministry of Economic Development, The Strategy 2030 is a long term strategy; it must be based on a hypothetical, but informed expert vision of the future and should cover all areas where development and transformation are needed. The new long-term strategy "in addition to the socio-economic issues should include issues related to defense, security, law enforcement and legal systems, and other, so that it

was possible in a single document to balance all the challenges the country faces."[43]

First of all, it is necessary to form rough idea about how the world will look like in 2030 and what, from the experts' point of view, the desirable and achievable place of Russia in this world might be (foresight). Experts currently explore the directions of a possible breakthrough of Russia in some technology areas. Futurologists and experts in the field of innovation predict that new technologies will restart entire sectors: some industries may disappear, but many new industries may appear. The task is to embed the Russian economy in the future technological world framework. It will affect the economic policy of the country, the federal budget structure, the direction of fiscal policy, macroeconomics, etc.

Key objectives of the renewed block in the Strategy dedicated to innovation proposals for the restructuring of development institutions in the field of innovation, rebooting of innovative development programs of companies with state participation. One of the ideas is that large companies with state participation should interact with the Corporation of SMEs in public procurement issues. Public procurement should be oriented not only to small companies, but also to small innovative companies, to development and implementation of new technologies. State support for regional innovation clusters as well as participation in the national technological initiative will be continued, and a single body for intellectual property issues on the basis of Rospatent will be established.[44]

### 2.3. State policy to stimulate innovation in the Russian Federation

Over the last years, fostering innovation in the Russian Federation was conducted in the following areas[45]:

[43] http://economy.gov.ru/minec/about/structure/depino/20151113
[44] http://economy.gov.ru/minec/press/news/2016020203
[45] For more details see http://economy.gov.ru/minec/activity/sections/innovations/

1. *Direct funding of science and innovative activities at the state budget expense.* First of all, it is financing of fundamental science and applied research of young innovative companies, which is performed through the mechanism of federal innovative programs, state scientific and technical programs, through the state science funds, targeted budget funds (The Russian Foundation for Basic Research, Foundation to Promote Innovation and through so-called development institutes in the innovative sphere.

Over the past few years, Russia has created a modern system *of development institutions* in the field of innovation, which includes the following Russian institutes:

1. “Bank for Development and Foreign Economic Affairs (Vnesheconombank)”;
2. State Corporation “Russian Corporation of Nanotechnologies”;
3. JSC “Russian Venture Company”;
4. JSC “Russian Bank for Development”;
5. “Foundation to Promote Innovation”;
6. Scientific Centre for Development and Commercialization of New Technologies Foundation “Skolkovo”;
7. “The Russian Venture Capital Association”;
8. “Moscow Interbank Currency Exchange”;
9. “SUPPORT OF RUSSIA”, and others.

The development institutions are the instruments of the state policy for stimulation of innovation processes and the development of infrastructure through public-private partnership mechanisms. The main objective of development institutions is to overcome "market failure" to support sustainable economic growth and diversification of the economy, which cannot be optimally implemented by purely market mechanisms. The development institutions act as a catalyst for channeling private investment to priority sectors and industries and creating conditions for building infrastructure, providing to priority sectors enterprises access to the necessary financial and information resources.

The main objectives of development institutions are: enhancement of the economic and social infrastructure; development of innovation sphere; promotion of foreign economic activity; support for small and medium-sized businesses.

The largest Russian development institutions in innovation area include Vnesheconombank, State Corporation "Russian Corporation of Nanotechnologies", OJSC "Russian Venture Company. They support projects through financing of business projects and R&D, as well as providing infrastructure support.

In addition, in various regions of Russia more than 200 organizations have been created, which also can be considered development institutions. The key activities of regional development institutions are support to small and medium-sized businesses, promotion of innovation development, and the elimination of technological backwardness in the regions. The regional development institutions are created mainly in the form of support funds, the regional venture capital funds and business incubators.

In most areas mentioned above, the development institutions successfully engage funds and business skills of private investors in the development of innovative enterprises. Development institutions jointly develop common approaches to the selection, expertise, structuring and implementation of innovative projects, search for promising innovative projects, provide financial support for innovative projects of small and medium-sized enterprises; attract private investment in projects. Good results have been achieved: a unified database of prospective projects has been created, a transparent and logical system of redirection of the projects to the relevant levels of the support system and their further transfer to higher levels of the technological chain. Thus, the declared idea of creating an effective "*innovation lift"* gradually takes shape.

In this context, very indicative is the activity of one of the most successful development institutions – *the Foundation to Promote Innovation (the Bortnik Fund, Promotion Fund*).

*Promotion Fund*, a state non-profit organization, has been created in February 1994. The main objective of the Fund is to conduct public policy for development and support of small enterprises in scientific and technical sphere. Any small innovative business needs the same support that the small businesses in general - the initial investment and favorable business climate. But in addition, specific measures are needed as well – access to technological equipment and prototyping centers, interaction with investors, access to pre-seed and seed funding for finalization of ideas and products. Therefore, in many countries innovation activity of SMEs is supported by the state.[46]

The main objective of the Promotion Fund is to develop in Russia infrastructure to support small innovative entrepreneurship, facilitate new jobs creation for scientific and technical specialists. The Promotion Fund on a competitive basis provides direct financial, informational and other assistance to small innovative enterprises, which develop new high-tech products mainly on their own technologies. Also, The Promotion Fund by investing public funds in small enterprises must attract private investments to small innovative business. One more objective of the Fund is the training and involvement of young researches in innovative activities. According to the research and innovation community The Promotion Fund is a successful organization, which honestly and creatively solves the challenges it faces.

2. The state support of innovations also goes through activities of the *Russian technological platforms*.

Technology Platforms (TP) is an association of representatives of government, business, science and education around a common vision of technological development and common approaches to the development of relevant technologies. This novelty has been largely inspired by the experience of European countries. Innovation activity in Europe has traditionally concentrated in large industrial companies while the pre-commercial stage of research in the state

[46] http://economy.gov.ru/minec/about/structure/depino/20151113

scientific and educational institutions. Leading institutions of the European Community over the years have tried to find new and effective mechanisms for the active involvement of industrial companies in the R & D process to combine their efforts with those of public research institutions, not only at commercial, but also at pre-commercial stage.

Technology platforms have been recognized as an instrument for cooperation between European states, their business, science and education, which should solve the problem of Europe's technological independence. While continuing cooperation with the United States, Europe demonstrated the desire to ensure its technological sovereignty. A total of 36 European Technology Platforms have been created by 2008 (ETPs).

In 2010, the new European development institution was noticed in Russia. In 2011, by the decision of the Government Commission on High Technology and Innovation a list of 28 technology platforms was approved. [47]

In Russia Technology Platforms are considered as a communication tool, aimed at development of advanced commercial technologies, new products and services, and attracting of additional resources to R&D from all stakeholders (business, science, government, civil society), as well as improvement of the legal framework in the field of science, technology and innovation.

As priority the following Technology Platforms have been approved: *Medical and bio-technology* (1. Medicine of the Future, 2. Bio-industry and Bio-resources - BioTeh2030, 3. Bio-energy); *Photonics* (Innovative laser, optical and optoelectronic technologies - Photonics); *Energy* (15. Environmentally friendly high efficiency thermal power, 16. Promising renewable energy technologies, 17. Small distributed power); *Metallurgy and new materials technology* (21. Materials and metallurgy technology); *Extraction of natural resources and oil and gas processing* (22 .Solid minerals, 23. Technologies of hydrocarbon production and usage, 24. Deep processing of hydrocarbon resources); *Electronics and*

[47] The list of 28 platforms is available from http://www.economy.gov.ru

*Mechanical Engineering* (27. Ocean exploration); *Environmental Development* (28. Technologies of Environmental Development).

This tool has been created in Russia recently, but now it is used by large companies with state participation, by the development institutions mentioned above, by RVC and the Association of innovative regions of Russia.

3. A special form of financing is the state co-financing of *innovative development programs* of large companies with state participation.

In 2012, by the order of the Government 60 large companies with state participation have developed their *programs of innovation development* (PIDs).[48] According to these PIDs, companies should seek, find and create innovations that allow improving their technological processes, reducing energy consumption, increasing productivity, and establishing cooperation with innovative SMEs.

PID's effectiveness largely depends on the development of innovation clusters, where the leading state-owned companies, institutions and participants of technology platforms are located.

Companies have planned significant increase in expenses on R&D 60% of this growth is at the expense of federal budget, and 40% from extra-budgetary funds raised by companies. The most impressive growth in R & D spending in the coming years is scheduled in electricity, in general mechanical engineering companies, in transport and infrastructure companies, in nuclear industry companies, and high-tech companies (aviation, space, shipbuilding, electronic systems, defense industry).

Significant growth of a number of patents obtained by the companies is expected. Production, meeting the European environmental standards, will

[48] The list includes such companies as Rosatom, Russian Technologies, RusHydro, Federal Grid Company of Unified Energy System, Rosneft, Gazprom, Transneft, Aeroflot - Russian airlines, United Aircraft Corporation, Sovcomflot, Tactical Missiles, AVTOVAZ, Rocket and Space Corporation Energia, Rostelecom, Alrosa, Zarubezhneft, Gazpromneft, KAMAZ, Crystal, NPO Energomash and others.

increase. As a result of PID's accomplishment the growth of labor productivity and energy efficiency is expected to be higher, than in average in economy.

Companies are going to actively cooperate with development institutions, universities and small businesses. They plan to search for new technological solutions in small and medium-sized enterprises.

A number of companies, such as Rosneft, Rostelecom, Rostekhnologii, Gazprom, etc., in partnership with the development institutions and outside investors are planning the creation of corporate venture funds. These funds will invest in capital of small and medium-sized enterprises, which carry out innovative projects.

The PIR of large companies also include plans to create subsidiary small and medium-sized businesses (*"spin-off" companies*), where the companies plan to develop research and commercialize new technologies. Some companies are also planning to establish their own *corporate parks and business incubators*, where small businesses, implementing projects for large companies, could be placed on favorable terms.

Large companies in their PIRs plan to actively *cooperate with scientific organizations and universities* both in research and education, in particular to upgrade the skills of their employees.

Companies in their PIRs plan to *participate in technology platforms*. TPs provide companies and educational organizations conduct research, joint development of technologies, as well as share laboratory equipment. Cooperation with TPs allows identifying business interest in emerging technologies, and attracting financing from private sources. It is expected that the interaction with TP will strengthen the innovative component in the company's activities. Many companies are planning to enter into a *cooperation agreement with the "Skolkovo" center*, and *establish subsidiaries* at the Skolkovo premises.

The PIR Companies in their PIRs have planned improvement of their competitiveness and *growth of production for export*.

Experts expect that in the next 3-5 years, the “forcing" of large state-owned companies to innovate, will lead to modernization and increased competitiveness.

4. The state makes efforts to *stimulate research and innovative activities in the higher education* of the Russian Federation.

In recent years 57 higher education institutions have got a financial support for developed innovative programs. 29 universities on a competitive basis have got the status of *the national research universities* with targeted funding for research and infrastructure development. The law allowing the budget organizations of science and education to create the *small innovative enterprises* has been adopted. During the first year about 1,000 small innovative enterprises at universities and research institutions have been created. One third of them are working successfully. Also formation of *national research centers* has begun the first center has been created at the Kurchatov institute.

5. The state pursues an active policy for the development of innovation infrastructure – the *special technology development economic zones*, which provide considerable privileges to innovative companies; science and technology parks; business incubators at universities; the centers of technology transfer and collective use of the unique equipment, etc.

New Russian *territory of innovation Skolkovo* situated near Moscow with unprecedented legal regime, which minimizes administrative barriers and tax burden for the resident companies is under development now. Through managing organization of the Skolkovo project and the Industrial Development Fund the *co-financing system of innovation projects of private companies by the state* has been created.

6. The state continues stimulation of innovative activities through support to *territorial innovative clusters*.[49]

[49] For more details on innovative clusters see Chapter 3.

In 2012 government agencies on a strictly competitive basis have selected development programs of 25 innovative territorial clusters which later have received financial and other support.

Innovative territorial cluster  a combination of enterprises and organizations, cluster members, placed in a limited area, which is characterized by: 1. research and production chain which connects cluster members; 2.mechanism of coordination and cooperation of cluster members; 3. synergies expressed in improving economic efficiency and effectiveness of each company due to their high degree of concentration.

In the USA, Singapore, Israel, Germany, France, China and South Korea there are examples of very successful development of innovation clusters. Besides that innovation infrastructure  technology parks, business incubators, industrial sites, special economic zone of technology-innovative type has been created in clusters, there is another important element of success - the existence of a favorable environment for business development.

According to expert estimates in Russia the favorable business climate has not been created yet, although Russian *DoingBusiness* rating has risen to 51 place in 2015.[50]

The program of state support to territorial innovation clusters in Russia has been quite successful and its continuation has been planned. Expected results are R & D growth, development of productive capacity and industrial cooperation as well as investment activity in clusters.

7. The state plays an important role in stimulation of innovative activity of companies by *improving the tax regime for innovative activities - tax privileges* for scientific researches and innovative activities have already been introduced.

Tax exemptions on sales of exclusive rights for inventions, utility models, industrial designs, computer programs, databases, integrated circuits, trade secrets (know-how) have been introduced. Certain tax benefits have been provided to R &

[50] http://economy.gov.ru/minec/about/structure/depino/20151113

D activities. The list of targeted scientific foundations exempt from taxation has been expanded. For scientific and technical activities the coefficient of accelerated depreciation for fixed assets has been introduced.

Expenditure on R & D and patenting may be deducted from the tax base of taxpayers applying the simplified taxation system. At present, in Skolkovo the government applies a special regime of low taxation of residents of the area and plans to extend this special regime to innovation clusters mentioned above.

*8. Developments in the field of intellectual property law.*

The Russian legislation on intellectual property rights (IP) has been harmonized with the Agreement on Trade-Related Aspects of IP Rights (TRIPS Agreement) in connection with Russia's WTO accession. The Russian government has always paid great attention to regulation of IP rights, including those created at the expense of the budget. The Russian state has been and remains one of the key R &D funding sources.

The basic principle of the developed legal model is maintaining the balance of interests of the State, source of funding, the immediate creators of intellectual property (researchers), research organizations and industrial structures.

While working for state or municipal contract, the rule who gets the intellectual property rights on the product produced, is set in the contract. If case of defense or security technology, funded by the state, the right to technology belongs to the Russian Federation. In all other cases the rights to results of intellectual activity belong to the organization producer. The state reserves the right to free non-exclusive license for public use.

Improving the intellectual property rights regulation may affect the administrative and budgetary legislation, the law on NGOs, the law on commercial companies, the law on accounting, and tax legislation.

***Questions for discussion:***

1. The main reasons for the state participation in the innovation process.
2. Directions of state participation in the innovative economy development in foreign countries.
3. The main objectives of innovative development in the “Strategy for Innovative Development of the Russian Federation for the period until 2020” and “Strategy 2030”.
4. What kind of innovation development strategy do domestic experts recommend for the Russian Federation?
5. The main directions of the state policy of stimulating innovation in the Russian Federation.
6. Russian innovation economy “development institutes”.
7. The main tasks facing “development institutes” of innovative economy in Russia.
8. Technological platforms in Russia.
9. The main state foundations working with innovative companies in Russia.
10. The main objectives of state co-financing of innovative programs implemented by large companies with state participation. Results achieved.

## Chapter 3. Clusters and innovative activities of enterprises

### 3.1. The concept and the basic characteristics of clusters

The cluster approach as a way to improve the efficiency of the national economy began in the 80s of the 20th century. The appearance of the term "industrial-innovation cluster" as one of the most effective options for the development of companies and industries associated with the concept of Michael Porter – the author of the theory of competitive advantage.

Michael Porter has identified the causes of the country's success in international competition in a particular industry with the help of four indicators - determinants – *the competitive rhombus*.[51]

The competitive rhombus consists of a system of indicators: factor conditions, domestic demand conditions, related and supporting industries, the structure and strategy of the firm, intra-industry competition. (Fig. 3.1).

M. Porter has included the following items to the list of factor conditions:

1) Human resources;

2) Natural resources;

3) Capital;

4) Scientific and information potential;

5) Infrastructure.

The main idea of M. Porter is that the main factors for the competitiveness of the country are not inherited, but created. And essential is the effectiveness of their use.

M. Porter has determines the effect of competition from clusters in three ways:

-it can increase the company's performance in the cluster;

[51] M. Porter. *Competition.* Moscow: Williams, 2010 [Russian].

-it can stimulate innovation;

-it can stimulate new business processes.

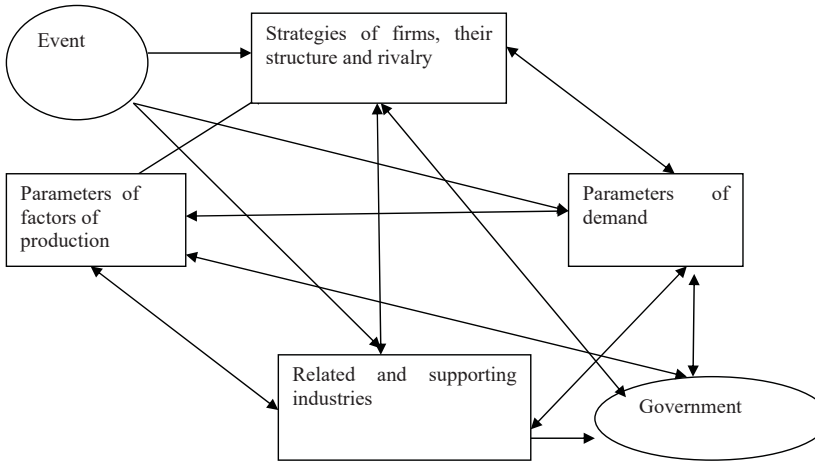


Fig. 3.1. ”Competitive rhombus” by M. Porter

M. Porter has undertook a study of the most successful companies on a global scale, and found that with some regularity company of one or more countries achieve much greater results than their competitors. This was the beginning of the theory of industrial clusters. He has given the following definition of clusters:[52]

Cluster is a geographically concentrated group of interconnected companies, specialized suppliers, service providers, firms in related industries, as well as other organizations associated with them (e.g. universities, agencies, standardization, trade associations), competing, and at the same time, leading work together ( see Fig. 3.2.).[53]

[52] M.Porter. *International competition*. *Competitive advantages of countries*.\ M.: Alpina Publisher 2017 [Russian]

[53] Methodological recommendations for realization of cluster policy in regions of Russian Federation. Ministry of Economic Development of the Russian Federation. 2011 [Russian]

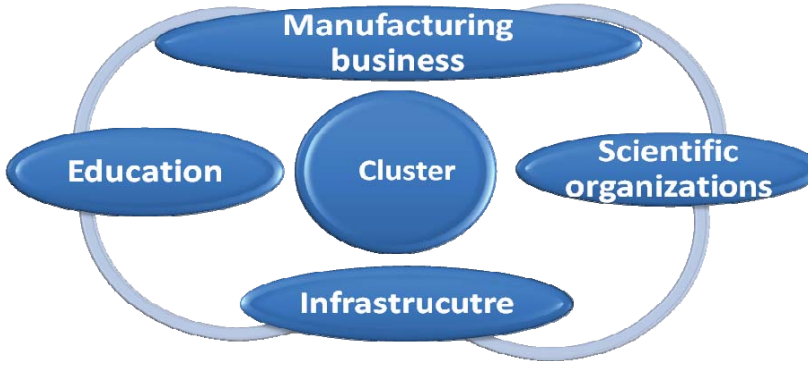


Fig. 3.2. Structure of innovative territorial cluster

*Characteristic properties of clusters*

Characteristic features of clusters are shown in Fig.3.3.

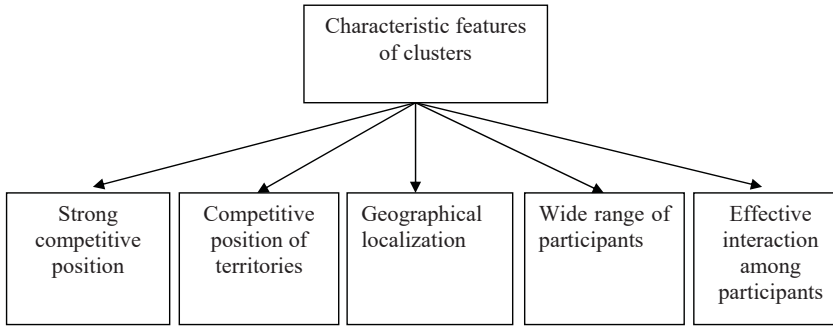


Fig. 3.3. Characteristic features of clusters

The efficient cluster possesses the following properties:

1. Strong competitive position on the national and / or international market and high export potential of cluster members. Indicators of competitiveness here can be: high level of multifactor productivity; high level of goods and services exports, and / or a high level of supply outside the region.

2. Availability of competitive advantages for the development of clusters, such as: an advantageous geographical location; the access to raw materials,

availability of specialized human resources; the availability of suppliers and related services, the availability of specialized educational institutions and research organizations; the availability of infrastructure and other factors.

3. Geographical concentration and proximity of enterprises and organizations in the cluster, which provides opportunities for active interaction.

4. A wide range of participants, which originate synergy in their interaction.

5. An effective interaction among the cluster members. The main categories of cluster residents are: enterprises (organizations) specializing in core activities; enterprises (organizations) supplying products or providing services to specialized companies; service enterprises (organizations), including transport, energy, engineering, environmental, information and telecommunications infrastructure; organizations of market infrastructure auditing, consulting, credit, insurance and leasing services, logistics, trade, real estate; scientific research and educational organizations; the non-profit and community organizations, business associations, chambers of commerce; organization of innovation infrastructure: business incubators, technology parks, industrial parks, venture capital funds, technology transfer centers, centers for the development of design, energy conservation centers, support centers; centers and business development and investment agencies to support exporting of goods; state and municipal funds to support entrepreneurship, etc.

*Types of clusters*

The Ministry for Economic Development of the Russian Federation proposes the following industry-specific classification of clusters (see Figure 3.4.)[54]

[54] Methodological recommendations for realization of cluster policy in regions of Russian Federation, op.cit.

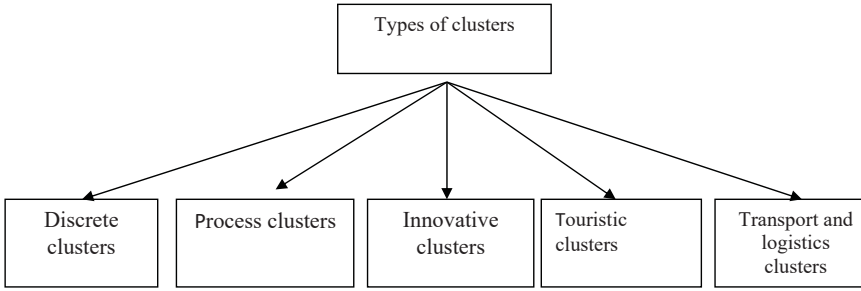


Fig. 3.4. Types of clusters

1. *Discrete clusters* include companies that produce products (and related services), consisting of discrete components, including automobile companies, the aviation industry, shipbuilding, engine building, and other branches mechanical engineering, as well as the organization of the construction industry and production of construction materials. As a rule, these clusters include small and medium-sized companies suppliers, developed around the assembly plants and construction companies.

2. *Process clusters* are formed by enterprises belonging to the so-called process-industries, such as chemical, pulp and paper, metallurgical industry as well as agriculture, food industry and others.

3. *Innovative clusters* are developed in so-called "new sectors", such as information technology, biotechnology, new materials, as well as in services related to the implementation of creative activities. Innovative clusters include a large number of new companies that arise in the process of commercialization of technologies and R&D carried out at universities and research organizations.

4. *Tourism clusters* are formed based on the regional tourism possibilities and assets and consist of companies, such as tour operators, hotels and catering companies, souvenir manufacturers, transport companies and other enterprises.

5. *Transportation and logistics clusters* include a range of infrastructure and companies specializing in the storage, maintenance and delivery of goods and passengers. The cluster may also include companies serving port infrastructure,

companies specializing in the sea, river, land, air transportation, logistics centers and others. These clusters are developing in regions with a significant transit potential.

*Clusters of mixed types* can combine features of several types of clusters.

Implementation of cluster development projects allows effectively coping with various "bottlenecks" and barriers hindering the development of companies and organizations - residents of the cluster.

Innovation clusters include a large number of new companies emerging in the process of commercialization of technologies as result of scientific activities carried out at the universities and research organizations.

*Problems of innovative clusters development*

Innovative clusters face many difficulties in their development, the most typical of them are:

• Insufficient intensity of research activities in the key specialization areas of clusters, including an educational component;
• Low efficiency of technology commercialization;
• Difficulties with access to financing for the development of new technology companies;
• Low availability of specialized services for the development of hi-tech startups;
• Inefficient regulation of economic sectors in innovative cluster.

### 3.2. International experience in the implementation of cluster policy

**Cluster policy in the United States**. Industrial and innovation clusters as territorial concentration of enterprises, research centers, research organizations, specialized suppliers and manufacturers which form the technological chain, have been established in the United States in the last few decades.[55] So far in the United

[55] Survey of foreign innovation clusters. Ministry of Economic Development of the Russian Federation. 2011 [Russian]

States there is no any single model that allows defining all necessary characteristics of the cluster. According to the Institute for Regional Studies of the USA (Regional Research Institute), nowadays, there are 20 clusters in the country. Almost all experts have recognized that the leading center is the “Silicon Valley”, which accounts for a third of all venture capital investments in the United States. This territory has a high density of high-tech companies involved in the development and manufacture of microprocessors, software, mobile devices and other products of information technologies.

Other major US innovation clusters are clusters in Seattle, Tacoma, Olympia (Wash.) aerospace engineering, information technology; Minneapolis (Minn.), Jacksonville (Fla.) medical equipment; Pittsburgh, Akron, Cleveland (Ohio and Pennsylvania) technology "clean" energy; Kansas City (Kan.) biotechnology and modern chemistry; Boston (Mass.) biotechnology; Austin, Dallas (Tex.) - semiconductors; et al.

The US administration is considering the development of regional industrial and innovation clusters as one of the most important factors in promoting the competitiveness of the US economy. The law “America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education and Science”, Chapter IV is devoted to the issues of innovation and their support in regions. Thus, in particular, a program of federal support for innovation at the regional level, as well as a regional program of innovative research and dissemination of information to support innovative strategies, innovative clusters, scientific and research parks has been adopted. Support is provided through the provision of grants on a competitive basis to improve the innovative infrastructure in the regions, including the mechanisms for the dissemination of information to attract attention of the potential consumers of innovations. The information barriers between innovation clusters at the regional and federal level should be overcome. The annual funding in this area in the period of 2011-2013 was allocated a total of $ 100 million.

The emergence of clusters in the United States without government interference occurs on the initiative of large and medium-sized businesses, the state is connected to the support of existing clusters funding through grants for the development of infrastructure projects clusters.

Cluster policy in the United States can be characterized as follows clusters emerge without the intervention of the state, at the initiative of large and medium-sized businesses. The state gets connected to already existing clusters through grant financing of infrastructure development projects.

**Cluster policy in China.** The term *innovation clusters* in China refers to the mechanism of strategic cooperation between enterprises, research institutions, universities, venture capital funds and other intermediaries, which creates a synergy effect of mutual support to the production of new innovative products and services.[56]

In accordance with the concept of the Ministry of Science and Technology of China, promulgated in 2001, the creation of innovation clusters in China should be carried out primarily through the development of existing industrial clusters, successful zones of technical and economic development, techno-parks, high-tech area, etc.

According to the document, China is at the initial stage of the creation of innovative clusters. Industrial clusters to date have already achieved high results in production and play a significant role in the industrial development of the regions. At this stage, the problem consists in transforming the "traditional" industrial clusters in innovation clusters:

1. Innovation clusters should produce not just competitive, but radically new goods;

2. Innovation clusters are designed to accumulate scientific and industrial potential of various companies and organizations to create a unified chain of innovation goods production;

[56] Survey of foreign innovation clusters, op.cit.

3. The purpose of innovation clusters is not only the creation of the production chain on the basis of traditional ties and resources, but also entering into a global production network based on new technologies;

4. Innovation clusters are the main points of the rapid growth of various industries in the surrounding region.

China intends to focus on the development of the following sectors of the national economy:

1. Energy efficiency (development and introduction of equipment with high efficiency and the ability to regenerate natural resources to protect environment);

2. A new information technology equipment (next generation of mobile communication, broadband access, internet equipment, security systems of telecommunication networks, integrated circuits, new types of monitors, software, servers, etc.).

3. Biotechnology (development and production of drugs for epidemiological and other serious diseases, pharmaceutical and chemical preparations of traditional Chinese medicine, medical equipment and new materials, “green” agricultural products, marine biotechnology, and other);

4. Production of high-tech equipment (mainline and regional aircrafts, aviation infrastructure construction, the establishment of satellite communication systems, passenger and urban rail transport equipment, development of infrastructure for exploration of marine resources, and others.);

5. New sources of energy (development and introduction of new types of equipment for nuclear, solar, and wind power);

6. New materials;

7. Cars on alternative energy sources (innovative types of batteries, hybrid cars).

China's approach is the opposite of the US approach clusters are created at the initiative of the state inside of the existing special economic zones, industrial parks, and investors are attracted to already existing platforms.

**Cluster policy in the European Union.** Indispensable condition for the existence of successful clusters in Europe is participation in the network

connections. European cluster networks bring together clusters similar in purposes of creating, the industry, region, and the country.[57]

The network is usually created for the exchange of successful experiences, promotion of know-how and for sharing information. In addition, authorities, responsible for cluster development in a country or region, monitor clusters through the network. In Europe there are many national and pan-European networks. In 2009 the European Cluster Observatory has been established to improve the efficiency of cluster management and strengthen the international cluster cooperation. The European Cluster Observatory is an online platform for co-operation of organizations, clusters and their members, developed at the initiative of the European Union.

The European cluster approach can be viewed as a compromise between the American and the Chinese approaches, and cluster associations can be established both at the initiative of the state and companies. In the latter case, the state provides preferential treatment to the cluster residents.

### 3.3. Cluster policy in the Russian Federation

In the Russian Federation the state agency responsible for implementation of the cluster policy is the Ministry of Economic Development.

*The main goal of the cluster policy* is to ensure high rates of economic growth and diversification of the economy on the basis of improving the competitiveness of enterprises, their suppliers, research and educational organizations, and other entities which form territorial industrial clusters.

The implementation of cluster policy contributes to the growth of competitiveness of businesses through organization of effective interaction of cluster participants which are located in close proximity. Clusters provide the access to innovations, technologies, "know-how", specialized services and highly qualified personnel. The interactions within cluster decrease transaction costs,

[57] Survey of foreign innovation clusters, op.cit.

create the prerequisites for the implementation of joint projects and intensify productive competition.

The formation and development of clusters are effective mechanisms to attract foreign direct investment and encourage foreign cooperation. Inclusion of the local clusters in the global value chain can significantly upgrade the level of national technological base; contribute to the quality of economic growth and increase the international competitiveness of enterprises, cluster residents. Interaction of different companies and organizations within the cluster contributes to:

- acquisition and deployment of critical technologies and modern equipment;
- access for enterprises to new management techniques and expertise;
- access for enterprises to highly competitive international markets.

The development of clusters can also improve position of domestic enterprises in industrial value chains, deepen processing of raw materials, substitute imports, increase the assembly plants localization, and increase the non-price competitiveness of domestic goods and services.

The main tasks of cluster policies are (Fig. 3.4)[58]:

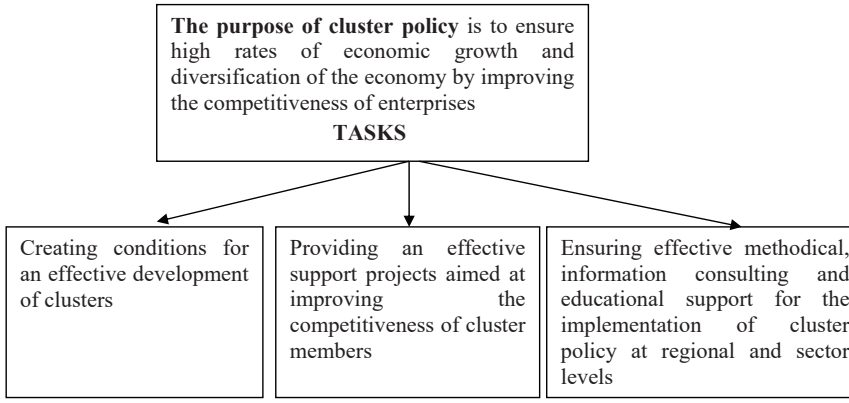


Fig. 3.4. The main objectives of the cluster policy

[58] Methodological recommendations for realization of cluster policy in regions of Russian Federation, op.cit.

The cluster policy in the Russian Federation aims at:[59]

1. Promotion of institutional development of clusters, which includes support to the creation of clusters, assistance in strategic planning of cluster development, support with effective communication among the cluster residents and their cooperation.

2. Development of mechanisms to support projects which seek to improve the competitiveness of enterprises and effectiveness of their interaction. It is expected that the support to the projects will be provided regardless of the membership of companies in respective clusters.

The main tasks of the cluster projects include: improvement of the quality of company management in the cluster; the competitiveness and quality of production of the enterprises and their suppliers; and development of subcontracting arrangements. Besides that, clusters should contribute to stimulation of technology commercialization; cooperation between research groups and companies; marketing of cluster enterprises output, and investment capital raising.

Cluster policy in Russia envisages improvement of the professional training system, promotion of cooperation between enterprises and educational institutions; upgrading of housing on the cluster territory, engineering and transport infrastructure; tax relief and reduction of administrative barriers for businesses-residents of respective clusters. Development of clusters in Russia is one of the major instruments for increasing the competitiveness of the domestic economy and intensifying of the public-private partnership. The building of engineering, transport, social, and other innovative infrastructure for the residents of the special economic zones is paid by the federal budget of the Russian Federation.

*Promoting organizational development of clusters*

In this area the authorities plan to support implementation of the following activities by the cluster residents:

[59] Methodological recommendations for realization of cluster policy in regions of Russian Federation, op.cit.

1. Formation of a specialized organization for the development of the cluster and organization of its residents;

2. Development of the strategy for the cluster development and the plan of actions for its implementation, including: the development of cluster projects and measures aimed at creating favorable conditions for the development of the cluster, based on the analysis of cluster threats and opportunities;

3. Establishment of effective communication between members of the cluster;

4. The implementation of measures to promote cooperation between members of the cluster: the organization of conferences, seminars, working groups, specialized Internet resources, electronic mailing lists, etc.

*Promote the implementation of projects aimed at improving the competitiveness and efficiency of interaction between enterprises and organizations.*

In this area it is expected to develop in the Russian Federation the mechanisms to promote the competitiveness of enterprises and the effectiveness of their interactions, which can be used in cluster projects.

Cluster projects usually include at least 3-8 companies and the priorities of projects are defined as follows:

1. Improving the quality of management in enterprises;

2. Promoting the entry of enterprises to foreign markets and the implementation of collective marketing projects;

3. Promoting the innovation, the development of cluster cooperation in R&D and developing the mechanisms of technology commercialization.

The main priorities of the cluster development policy innovation are:

*Formation of favorable conditions for the cluster development*

1. Improving the efficiency of professional and continuing education system;

2. Creation of industrial parks, techno-parks for the development of clusters;

3. Targeted investments in the development of engineering and transport infrastructure, and housing, in accordance with the plans of cluster development;

4. Implementation of tax control measures for cluster members;

5. Reduction of administrative barriers.

*The system of measures for the implementation of cluster policy*

The implementation of cluster policy needs the effective interaction between the federal, regional and local executive authorities and business associations.

Strategies of cluster development implemented at the regional and municipal levels pay attention to priorities of regional and local programs for socio-economic development, including transport and engineering infrastructure projects, housing construction, as well as support to small and medium-sized enterprises. Also regional and municipal authorities take care of policies to promote technology and education development, as well as policies of investment capital raising, exports promotion, and industrial development.

At the federal level the main attention is given to the improvement of the financial mechanisms, as well as to the provision of information, consulting and educational support to the cluster development.

*The main results of the implementation of the cluster policy*

World experience shows that the cluster approach is one of the most effective tools for the development of innovation and improvement of competitiveness of individual companies, sectors of economy and the national economy as a whole.

Implementation of cluster policy will allow: 1. to ensure the growth of non-price competitiveness of domestic enterprises; 2. to support production of processed goods and exports of goods and services; 3. to simulate the growth of small and medium-sized enterprises; 4. to ensure the accelerated development of innovative sector of the economy; 5. to improve the efficiency of the training system for the needs of the economy; 6. to stimulate investment capital raising; 7. to promote socio-economic development of regions based clusters.

Currently in Russia 25 regional innovative territorial clusters get support from the federal budget according to the state program of pilot innovative cluster development. Some of them are listed below:

1. Kaluga region, Obninsk pharmaceutical, biotechnology, biomedicine, and radiation technology cluster;

2. Moscow, cluster "Zelenograd" - information and communication technology, electronics;

3. Moscow, Troitsk new materials, laser and radiation technology cluster;

4. Moscow region, Dubna nuclear physics and nanotechnology cluster;

5. The Moscow region, Pushchino biotechnological innovation cluster;

6. The Moscow region cluster "Fiztech XXI", Dolgoprudny, Khimki new materials, medicine and pharmaceuticals, information and communication technologies;

7. Arkhangelsk region innovative shipbuilding cluster;

8. St. Petersburg information technology, electronics, instrumentation, communications, and telecommunications cluster;

9. St. Petersburg, Leningrad region medical, pharmaceutical, and radiation technologies cluster.

The most striking example is the implementation of the cluster policy activities of Zelenograd cluster in Moscow.[60]

**Innovative territorial cluster Zelenograd**

- Geographic localization - ZelAO in Moscow
- Area - 3720 hectares
- Population - 221.7 thousand people
- The working population with higher education - 44%
- The number of enterprises-residents of the cluster - 150
- Total revenue of cluster members (2011) – RUB 24.7 Bn.
- The share of exports of cluster members (2011) - 28%

[60] City internet portal zelenograd.ru

- The share of small and medium-sized companies in the economy of the cluster - 21%
- The share of innovative products and services - 84%
- Expenditure on research and development (2011) – RUB 4.9 Bn.
- The volume of investments for the period up to 2017 – RUB 153 Bn.

**Industry specialization**

- Micro and nano-electronics (electronic component base)
- Electronic devices and equipment
- Complex technical IT-based systems of electronic devices and equipment

**Key participants of the cluster**

**Business:** The core of the cluster - about 20 companies, including companies Micron, Angstrem, Zelenograd ITC, Zelenograd Nanotechnology Center, Elvis, Plant components, Plastic Logic, NTC ELINS, NT MDT, and other.

**Education:** Engineering education: MIET (Moscow Institute of Electronic Technology) - the leading Russian university in microelectronics, the eighth place in the ranking of technical universities in Russia in terms of commercialization. Business education: MGADA (Moscow State Academy of Business Administration), IBE (International Institute of Business Education).

**Science:** State Research Technology Center, and other.

**Infrastructure:** Special economic zone Zelenograd, Zelenograd innovation and technology center, Zelenograd nanotechnology center, Techno park Zelenograd, Special area for small business, Business incubator and enterprise development center.

**Power:** The Moscow city government (department of science, industrial policy and entrepreneurship), prefecture of Moscow ZelAO.

**Media:** City internet portal zelenograd.ru

**Key projects of cluster Zelenograd:**

1. Establishment of a shared physical infrastructure for the development of basic industries of nano- and microelectronic technologies by cluster members.
2. Creation of a specialized diagnostic and metrological center for shared services in research, diagnostics, measurements including in the nanometer range.
3. Organization of Zelenograd open center prototyping for innovative products.
4. Establishment of a business incubator for medical technology start-ups the infrastructure company that provides services in business planning, development of prototypes and pilot batches of medical technology, expertise and commercialization of medical devices.

5. Development of targeted training for the requirements of cluster participants.

6. Creation of specialized infrastructure for open city Youth Innovation Center.

7. Reconstruction and repair of the MIET hostel to organize additional 300 units to accommodate non-resident students, undergraduates, postgraduates and doctoral students.

8. Establishment of the Center for the Coordination of development of the territory (the executive management of the cluster) and the implementation of projects of soft infrastructure for the cluster.

**Targets for the cluster activities for year 2017:**

• Increasing the share of the "civil" sector in the total output of Zelenograd industries from 30% to 50%;

• Sustained growth of the output of the civil sector by 30% per year;

• 1.5 times increase of the export share of the civil output of Zelenograd companies;

• Development of investment-friendly business environment in the city;

• Organization in Zelenograd of annual international forum and exhibition SEMICON Russia;

• Establishment of 50 high-tech start-ups per year according to the cluster profile;

• Creation of brands "Designed in "Zelenograd" and "Made in Zelenograd".[61]

The Zelenograd innovation zone focuses on the following key industries: micro-electronics; Information technology; Navigation and guidance systems; nanotechnology; laser and plasma technologies; biotechnologies, life support and human security systems; renewable energy technologies.

The special economic zone Zelenograd will include the following specialized clusters, which are currently being shaped:[62]

- The biopharmaceutics cluster (BioCity) sponsored by Binnopharm;
- The IT cluster sponsored by Cisco System Solutions and ELAR;
- The nanotechnology cluster sponsored by Nanotechnology-MTD, NT-Active, and Sitronics-NT;

[61] City internet portal zelenograd.ru

[62] http://eng.russez.ru/oez/innovation/moscow/zelenograd/

- The microelectronics cluster sponsored by ZITC and Komponent Research Institute;
- The energy-saving technology cluster sponsored by LED Technologies OOO and Soyuz Design Centre;
- Design Centre.

*The objectives of Zelenograd zone development are:*

- Development of innovative infrastructure;
- Creation of breakthrough technologies and products able to compete in the domestic and international markets;
- Promotion of domestic and foreign investment in Zelenograd's science and technology-intensive industries;
- Upgrading of Zelenograd's manufacturing sector;
- Commercialization of innovative products developed by Zelenograd's companies.

Zelenograd SEZ currently has 35 resident investors. Their total committed investment is RUB 83.7 Bn. Their total committed investment is RUB 83.7 Bn.

Resident investors enjoy the following incentives and preferences: land tax exemption; property tax exemption; VAT exemption; corporate income tax reduced to 15.5%; social insurance contributions reduced to 14%; free customs area.

Table 3.1.

**Tax, customs and infrastructure benefits in Zelenograd cluster for residents of the special economic zone**

| **Types of Taxes** | **Preferential tax rate** | **Terms of eligibility** |
|---|---|---|
| **Corporate income tax** | 15,5% | until 01.01.2018 |

| | | |
|---|---|---|
| Other benefits for corporate income tax for a period of a special economic zone (20 years): expenditure on R&D activities (including with negative results) are recognized in the reporting (tax) period in which they were incurred in the amount of actual costs. | | |
| **Property Tax** | 0% | 5 years from the date of property registration |
| **Transport tax** | 0% | 5 years from the date of registration of the vehicle |
| **Tax on land** | 0% | 5 years from the date of ownership |
| **VAT (value added tax)** | - 0% for purchase of cleared imported goods in the customs-free zone<br>-0% for implementation of R&D financed by state budget and RFBR, the Russian Foundation for Technological Development and other. | For the special economic zone lifespan |
| **Excises** | - 0% for purchase of cleared imported goods in the customs-free zone<br>-0% for import of goods from Russia to free customs zone with customs clearance in the customs-free zone | For the SEZ lifespan |
| **Customs dues** | - 0% for purchase of cleared imported goods in the customs-free zone<br>- 0% import of goods from Russia to free customs zone with customs clearance in the customs-free zone | For the SEZ lifespan |

Other preferences for the Zelenograd Zone's residents include:

- Preferential rental rates for land, offices, etc.;
- Favourable administrative environment;
- Access to financing: private equity funds, venture funds, banks;
- Governmental funding (including interest-free).

The case of “Zelenograd” cluster, which is a form of the public-private partnership in special economic zone, shows that not all of the stated goals have been achieved, some of them have been accomplished with a lag, but the overall effect for the national economy is definitely significant.

Zelenograd has already become a strong knowledge-intensive cluster with specialization in electronics. Cluster activity is characterized by high share of innovative products and services which reaches 84% of the cluster’ output. In addition, one of the important features of the cluster is the emphasis on the development of start-ups and small innovative companies: their share in the economic output is 21%. Investment attractive business environment is under construction in Zelenograd.

**Achievements of companies-residents of Zelenograd cluster**

- Creation products of microelectronics, microsystems technology, IT systems and electronic equipment;

- Development and implementation of “System solutions” for the organization and operation of data-and call-center, creating conditions for the development of innovative technologies;

- Development of advanced electronic engineering technology, creation and implementation of a new generation of laser and vacuum ion-plasma processing equipment;

-Development of technology and the establishment of production of cylinders with the base cut from artificial sapphire, as well as on its base plate;

- Development of new technologies and specialized equipment for the creation and use of databases and information resources;

- Development of software and hardware complex “Quint-7” designed for the construction of automated process control systems (PCS) and a set of specialized tools of a new generation of measurement and control of process parameters;

- Research, development and implementation of automated multi-level intelligent system for monitoring and management of telecommunication networks;

-Development and expansion of devices and systems for production control, measurement and diagnostics. Formation of scientific and industrial infrastructure in this area;

- Development and implementation of innovative security technologies;

- Development of modern microprocessor-based variable frequency drives;

-Creating on-board radio systems for spacecrafts;

- Development of microwave component base, receiving and transmitting modules for radars of different bases, modernization and expansion of the functional characteristics of radar an “echo-defendants” type “Signal-H”, transfer of the developed products to manufacturing. “Development and implementation of microwave electronics”. Creating on-board radio systems for spacecrafts;

- Development and pilot production of micro-electro-mechanical systems based on the physical quantities sensors, as well as devices and systems based on them;

- Creating a modern methodology of design and development of integrated circuits with design rules 180-130 nm for production on a new technological line of “Mikron”;

-Technology development of microcontrollers and system-on-chip based on its own IP blocks;

- Development and pilot production of a new generation of instruments and electrical equipment on the basis of domestic electronic components;

- Development and production of telecommunication systems for next-generation communications networks;

- Development and introduction of systems of the human environment protection;

- Development and maintenance of systems for the processing and storage of large volumes of data and digital depositories;

- Establishment of the Innovation and Innovation Center for Applied Nanotechnology for the military-industrial complex at the Institute of Applied Nanotechnology;

- Development and introduction of new technologies in the field of renewable energy sources and environment-friendly organization for pilot production of thin-film photovoltaic solar modules based on amorphous silicon;

- Research and development for commercialization of a wide range of new generation competitive high-tech products;

- Introduction of intelligent lighting control systems, the development and subsequent implementation of new equipment to measure the adhesion strength of coatings in the oil and gas industries;

- Development and implementation of energy-saving lamps LED. Creating innovative center in the SEZ TV project “Shining City”;

- Development and widespread adoption of advanced technologies and equipment on the basis of repetitively pulsed solid-state lasers;

- Development and implementation of energy-saving environment-friendly durable lighting products through solid state semiconductor light sources (high-brightness light-emitting diodes) to replace traditional light sources;

- Development of microelectronics products and organization of pilot production of integrated circuits on wafers 300 mm in diameter with 65-45 nm design rules;

- Development of complex electronic engineering technology, manufacturing, integration and aggregation of a new generation of electronic equipment;

- Creating scientific and industrial complex for the development and implementation of innovative biotech drugs;

- Development of technology for ion polishing of intraocular lenses, drug carriers and hydrophilic coating;

- Development and promotion of information security tools for automated information systems;

- Development and production of electronic measuring instruments, systems and technical means of measurement of temperature and mass flow. Establishment of the in-house research and production infrastructure;

- Development and production of individual kits for testing self-glucose and glycated hemoglobin in the biological fluid with monitoring indicators and remote access. Innovative development and organization of production of individual oncology compact testers for detecting of tumor markers in bioliquids;

- Development of integrated information systems with the use of industrial software and methods of virtualization and cloud computing;

- Development and transfer to industrial use installation of complex non-destructive inspection and laser scanning of industrial plants;

- Establishment of the Research Institute for the development of basic microelectronics technology on the basis of JSC "NIIME", the development of chip production level 65GP-45 nm technology, the development of chip-level technologies 45-28 nanometers and lower;

- Development of advanced large-scale production of microelectronics at the JSC "Micron", the development of 65GP-45 nm manufacturing technology, 45-28 nm and lower, design and development of industrial production of new chips for industrial and special destination.

Therefore, the cluster approach is one of the most effective tools for the development of innovations and upgrading of competitiveness of individual companies, groups of companies and the national economy as a whole. Progress in innovation activities in the leading world economies, such as the United States, European Union, and People's Republic of China is largely determined by the successful implementation of the cluster policy.

In the Russian Federation innovation activity faces many obstacles, such as shortage of qualified personnel, the underdevelopment of engineering and transport infrastructure, the heavy tax load on innovative business, high administrative barriers, etc. It is expected that the implementation of cluster policy in the Russian Federation will be able to help overcome barriers to innovation. Multilateral support to innovative clusters, which function mainly in special economic zones and science cities and intensively use resources of local research centers and universities, is the current trend in the Russian Federation.

***Questions for discussion:***

1. Definition of cluster.
2. Main characteristics of clusters.
3. Classification of clusters.
4. Specifics of cluster policy in the United States.
5. Specifics of cluster policy in the European Union.
6. Specifics of cluster policy in China.
7. Main objectives of cluster policy in Russia.
8. Examples of tax benefits for clusters in the Special Economic Zones.
9. Examples of customs benefits for clusters in the Special Economic Zones.
10. Examples of innovation clusters in Russia.

# Chapter 4. Intellectual property: protection, evaluation and commercialization

## 4.1. The concept of intellectual property

Enterprises for their business operations use various assets, including those created in result of intellectual activity (RIA). This *intellectual property (IP)* is especially important for innovative enterprises. These assets are mainly *intangible assets*, which exist in the form of inventions and utility models, industrial designs and know-how, computer programs, etc.

*Intellectual property* (IP) is a collective term that means rights over results of intellectual creative activity of the person in any field scientific, industrial, literary, artistic, etc., as well as rights over means of individualization of a legal entity, goods, works or services. Classification of intellectual property objects is given in the Table 4.1

Table 4.1

**Classification of intellectual property**

<table>
<tr><td colspan="4">Intellectual property objects (IPO)</td></tr>
<tr><td colspan="3">IPO in scientific, technical and industrial sphere</td><td>IPO in humanitarian sphere</td></tr>
<tr><td>Industrial property:<br>• Inventions<br>• Utility models<br>• Designs<br>• Trademarks<br>• Selection achievements<br>• The right to stop unfair competition[63]</td><td>Secrets (know-how)</td><td>Objects of copyright:<br>• Computer programs<br>• Topologies of integrated microcircuits<br>• Scientific publications</td><td>Objects of copyright:<br>• Literary works<br>• Musical works<br>• Works of art</td></tr>
</table>

[63] The right to stop unfair competition is included into the category of industrial property because unfair competition often violates industrial property rights.

The concept of IP was introduced in 1967 by the Convention which has established the World Intellectual Property Organization (WIPO). WIPO has stated that the objects of intellectual property rights include inventions in all fields of human endeavor: scientific discoveries, scientific works, inventions in all fields of human activity, industrial designs, trade secrets (know-how), trademarks, service marks and trade names and commercial designations, the suppression of unfair competition and some other objects.[64] This list can also be complemented by the respective national legislation.[65]

Intellectual property rights in the WTO members are regulated by the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), an international agreement that sets minimum standards for the recognition and protection of the main objects of intellectual property. The agreement was signed during the Uruguay Round of GATT in 1994. The TRIPS Agreement allows using efficient mechanisms of dispute resolution available in the WTO.

Intellectual property (IP) as an asset of an enterprise is very specific – unlike other assets, IP assets do not disappear and do not wear and tear during the production process as other factors of production, but they may become obsolete.

Possession, management and use of intellectual property in economic activity are regulated by several branches of law: 1. The patent law; 2. Copyrights; 3. The legal regime of secrecy (know-how); 4. The right to the means of individualization.

Each of these legal regimes defines the document that confirms the possession of respective rights, the criteria of patentability and the term of validity

[64] Currently, this list is expanded: in accordance with the Agreement on Trade Related Aspects of Intellectual Property Rights of the World Trade Organization (TRIPS Agreement) - the new elements "topologies of integrated circuits" and "protection of closed information" were added.
[65] In Russia, the rules of IP protection are set forth in the Part IV of the Civil Code of the Russian Federation "Rights to the results of intellectual activity and means of individualization", adopted in December 2006.

of the document. Table 4.2. provides information on the legal protection of IP objects under the Civil Code of the Russian Federation.

Table 4.2

**Information on the legal protection of intellectual property rights under the Civil Code of the Russian Federation[66]**

| Intellectual property objects | Confirmation of Eligibility | Criteria for eligibility | Duration of the document |
|---|---|---|---|
| 1.The invention[67] | Patent for the invention | Novelty, inventive level, industrial applicability | 20 years |
| 2. A utility model[68] | Patent for utility model | Novelty, industrial applicability | 10 years |
| 3. Sample of industrial design | Patent | Novelty, originality, industrial applicability | 15 years |
| 4. Selection achievements | Patent for selection achievements | Novelty, distinctness, uniformity, stability, | 30 years, 35 years for the grapes, woody ornamental, fruit and forest trees |
| 5. The secret (know-how) | Documents that Organization keeps the regime of secrecy of information | The presence of commercial value, the lack of free access to information, regime of secrecy | The term set by the order or the confidentiality agreement. |
| 6. Topographies of integrated circuits | The existence of a material form, proof of voluntary registration | Creative character, originality | Property rights for 10 years. Non-property rights are perpetual. |
| 7. The works of science, literature and art | The existence of a material form, proof of voluntary registration | Creative character, originality | Property rights over the life of the author, then 70 years more. Non-property rights are perpetual. |
| 8. Computer Programs | Same | Same | Property rights in the life of the author, then 70 years more. Non-property rights are perpetual. |
| 9. Databases | Same | Same | Property rights over the life of the author, then 70 years more. Non-property rights |

[66] Source: Bovin A.A., Cherednikova L.E., Jakimovich V.A. (2011). *Managing innovations in the organization*. M : Publishing house "Omega-L" [Russian]

[67] The invention – is a new and significantly different technical solution in any industry, that a positive effect.

[68] A utility model is a new solution to a technical problem relating to the device.

| | | | |
|---|---|---|---|
| | | | are perpetual. The exclusive right of database arises from the moment of its completion and is valid for 15 years. |
| 10. The integrated circuit topology | Same | Same | Property rights for 10 years. Non-property rights are perpetual. |
| 11. Trademarks and service marks[69] | Certificate | Distinctiveness of the means of individualization of goods and services rendered | 10 years. |
| 12. Commercial designations | Are not subject to mandatory inclusion in the Unified State Register of Legal Entities | Distinctiveness of means of identification | Exclusive right of enterprise to commercial designation is terminated, if the owner does not use it continuously through the year. |
| 13. An appellation of origin | Certificate | Distinctiveness means of individualization of goods | 10 years. |
| 14. Brand names[70] | included in the Unified State Register of Legal Entities | Distinctiveness of means of individualization of legal entities | Are valid from the date of the state registration of legal entities until exclusion of the brand name from the list of registration. |

## 4.2. Legal protection of intellectual property rights

Part of intellectual property rights is governed by the copyright, the second part is under the protection of the exclusive property rights, and the third is governed by the regime of secrecy. Intellectual property is protected by patents, registration certificates, documents of the regime of secrecy of information.

1. *Copyright* : the author's rights to the intellectual property include such rights as the right of authorship, the right to a name, the right to publish, the right

[69] Trademarks and service marks – is a designation that can distinguish the goods and services of one producer of similar goods and services from other manufacturers.
[70] Brand name refers to the name of the legal entity that allows individualizing specific company in economic life.

to integrity of the work. This is the inalienable right of the author. *Copyright* protects works of art and scientific papers.

2. *Exclusive property rights - patent law and the means of individualization* - regulate the commercial use of IP. Exclusive right is the right of the owner of IP object to use it, as well as to allow or forbid to do it to someone else. Exclusive right is alienable and its owner can be any physical or legal person who by law or contract possesses this right.

There are certain common features of property rights which refer to various types of IP:

• Rights are of limited validity and territory;

• Rights are absolute, i.e., they do not have any conditions or restrictions other than those stated in the legislation;

•Rights are exclusive in relation to all others;

• IP can be freely used for non-commercial purposes, for example, for research, for individual needs in emergency situations;

• Rights to use the IP object can be transferred to other person through a special agreement, for example a *license agreement*. The only exception is the name of the place of origin, the rights to which are not transferred.

By agreement the exclusive right may belong to one or several persons jointly. Each of them can use the IP object in its sole discretion, and income from the joint use of this IP shall be distributed equally among them, unless the agreement provides otherwise.

If IP financing was done from multiple sources, including the state budget, funds of private domestic and foreign investors, the intellectual property rights (IPR) belong to all financers together. Revenues from IP commercialization are divided among the parties according to their share in financing, unless their agreement states otherwise.

Especially important for production is *industrial property*. Industrial property includes inventions, industrial designs, utility models, know-how,

topologies of integrated circuits, trademarks, service marks, names of the place of origin, trade names, as well as suppression of unfair competition. Industrial property plays an important role in innovation processes in any organization.

New, i.e. unknown from the prior art inventions, industrial designs, utility models are granted legal protection on the basis of a *patent. Patent* is a certificate issued by the competent public authority which certifies the recognition of technical solutions, the priority of the invention, the authorship and the exclusive right of the patentee to the invention within the territory of the country, where the patent was issued, for the time defined by the laws of this country.

*Patent* is an exclusive right given to the patentee, allowing him to control the use of his invention for a limited period of time. Issuance of a patent creates a temporary monopoly as a reward for intellectual activity and serves as important stimulus for promotion of inventive activity among individual inventors or small firms. Not all ideas of inventors, researchers, authors, are patentable. To meet the criteria for patentability the invention/ model, etc. should be 1. new, i.e. not known from the prior art, 2. non-obvious, i.e. contain certain level of inventiveness and 3. applicable in production. The most stringent criteria of novelty is its absolute world novelty, i.e. such solutions do not exist anywhere else in the world. The novelty of the IP object may be challenged. Criteria of novelty and non-obviousness of IP object is reviewed on the date of filling of the application. The patent system in many countries is based on the principle that the invention belongs to the person who first registers the patent.

The patent for the invention means that anyone who wishes to use this invention must obtain permission from the patent holder. Using patented IP objects without such permission is illegal. Rights and protection mechanisms are defined in the patent law of the country, where the patent was issued. In most countries, the patent protects the IP rights during 10-30 years. Thus, a balance of interests between the patentee and the public is achieved. Patent laws of all countries provide for special cases when the patented invention can be used without the

permission of the patent holder, for example, in emergency situations. Norms of the exclusive property rights apply to the means of individualization of participants of economic turnover and their products, works and services.

3. *The regime of secrecy* applies to "know-how". This term refers to important information, omitted on purpose by the applicant in the patent specification, without which it is practically impossible to use the invention. Until now, the inventors try not to disclose in application materials their “know-how”, because it is impossible to apply the invention in production without this knowledge.

Even though in most countries – the United States, Russia, Britain, Austria, Belgium, Greece, and many others, the Act stipulates that the invention description in the patent specification should be detailed and complete, so that invention could be used in production, in practice the disclosure of information is incomplete. Thus the know-how, i.e. un-disclosed information, related to the invention, is extremely valuable for practical purposes. Know-how may represent specific managerial knowledge, for example, information about effective structures and management techniques, simple and reliable structural connection, clear allocation of responsibilities, etc. Know-how may consist in commercial strategies in sales, data on the state of the market, data on the experienced and efficient marketing firms, on the best marketing techniques, organization of advertising, etc.

Usually know-how is transferred via a license agreement. Protection of rights on know-how is organized as follows the state guarantees to the know-how holder protection from illegal use of this information by third parties, provided that this information has actual or potential commercial value, not freely accessible and is not known to the third parties. In his turn the owner of the information should take appropriate measures to protect confidentiality of know-how.

*Commercialization of innovation*

Innovation goods can be produced only when IPRs are transferred to the sphere of production. Technology transfer occurs on a non-profit or commercial basis.

*Non-profit technology transfer* is done through publishing of scientific literature, through open data banks, scientific communication of professionals at conferences, exhibitions, symposiums, through training, academic exchanges, etc. *Transfer of technologies on commercial basis* is carried out mainly through the sale of licenses and patents. When a patent is sold all rights are transferred to the acquirer of the patent. The new patent owner is required to maintain the patent in force and may issue a license to use it to others. The trade of intellectual industrial property is effectuated through the license trading. Buyers of license use it to produce and sell innovative products and acquire new markets, and the patent holder receives additional profit. These deals can be extremely beneficial for those individuals and companies, who conducted similar research and understand the substance of technologies. Sale of patents is also beneficial for those patent holders who do not have own financial means to organize production.

Some countries purchase foreign patents and licenses to foster their innovative development. For example, after the Second World War, this strategy of innovative development was used by Japan, which did not have its own research base, purchased and used foreign patents and licenses, and finally became the leader of the scientific-technical progress.

*License agreement* is a permission to use invention, technology, production experience, trade secrets, trademarks or other information for a certain period of time to other legal and physical persons for certain remuneration. The licensor and the licensee are two parts involved in the sale of the license. Inventions, know-how, right to industrial or commercial use of the inventions, right of commercial use of trademarks – all these items can be subjects of Licensing agreement. The license may also be issued for just one operation – only for production or for sale only.

The licenses differ in terms of nature and scope of the rights, modes of transfer and conditions of use. According to the volume of transferred rights, licenses are divided into non-exclusive and exclusive licenses, full licenses and

sub-licenses. Selecting the type of license to issue depends on the size of the market, the nature of the product and the economic situation.

Under a *non-exclusive license*, the licensor while selling licenses reserves all the rights on the patent, including the right to grant licenses to the third parties. As a rule, non-exclusive license is used when goods for sale are of a short life cycle, the market is large, and several manufacturers - licensees produce goods to meet the existing demand.

When an *exclusive license* is sold, licensee acquires the exclusive right to use the object of industrial property within the limits specified by the contract, keeping the licensor the right to use the remaining rights which were not transferred to the licensee. It makes sense to sell exclusive licenses in countries with small domestic market and products with slow depreciation.

Under the so-called *full license* all rights are transferred to licensee for the duration of the contract, and licensor cannot use the subject of the license. Such transactions are made when the owner of the patent has no financial means to use the invention on its own and prefers to concede rights to beneficial purchasers. There are also deals with *sub-license* and *patron licenses*.

The very process of negotiating deals with licenses is far from simple. In discussing the transfer of technical or commercial information, transaction parties behave with extreme caution: the owner of the know-how does not want to disclose it before the contract is signed, while the buyer insists on testing know-how or the invention to understand how good they are in practice.

All essential elements of the transaction are stipulated in the licensing contract. All terms used in the contract are carefully determined in the contract, as well as the subject of the contract. The list if technical documentation transmitted is included in the contract, as well as guarantees and responsibilities of both parties. Contract also contains information on payments, taxes and fees, conditions for the termination of the contract, consequences of agreement termination and the

procedure for the disputes settlement. Often, upon expiry of the main license agreement, the parties agree to cooperate in the future.

### 4.3. Intellectual property valuation

Intellectual property rights, which belong to the firm, constitute its intangible assets and are put on the firm's balance sheet. Owner of intellectual property rights would like to sell the maximum number of copies, since the cost of replicating is low. Licensor maximizes its income when using so-called discriminatory prices, i.e. different prices for different categories of customers, designated according to their ability to pay. This approach to set different prices to different categories of customers, for example, is frequently used in the market of information and statistical software.

The price of the license is influenced by many factors, including the nature of the use of the invention, the pace of moral depreciation of innovation, as well as the velocity of innovation diffusion and technological progress in a particular industry.

The license price is the result of bargaining and depends on the relative power of the licensor and the licensee. In general, the price of exclusive license is a monopoly price and it does not depend on the cost of technology production. It is related to the additional revenue from the sale of products manufactured under license.

Industrial and commercial risks from possible underproduction and difficulties in market sales affect revenues obtained by the licensee.

Several approaches are used for determining the price of the license. Every license is unique and determination of the license price is one of the most difficult questions of the license agreement. Sometimes, the licensee buys a license to continue his own research on the innovation topic, which allows him to become a

leader in the production of innovation goods. The licensor may also have its own specific objectives in mind which are not clear at the time of the transaction.

Clear common methodology for determining the price of a license does not exist. Each party defines the license price in its own way, and then the process of bargaining begins. The result of the bargaining ultimately depends on the relative strength of the contracting parties.

*Types of royalties*

Two main forms of payment for the license used in practice are: 1. *Royalties* – regular, annual payments by licensee of a certain fixed interest rate; 2. *The lump-sum payment* single payment for the license, the amount of which is clearly agreed upon in negotiations and does not depend on future sales of licensed products.

Different bases can be chosen to calculate royalties:

1. Revenues from the sale of licensed products;
2. Gross profit from the sales of licensed products;
3. Cost of the licensed products;
4. Fixed rate per unit of production;
5. Special base.

Royalties are part of income obtained by licensee from the use of the license, paid to the licensor. For example, the licensee regularly pays 30% of profit from the sale of licensed products to the licensor.

The royalty rate as stipulated in the license may be fixed during the term of the contract or may vary, according to the market situation. The so-called *combined form* of payment is often used in practice: first, the *down payment* covering expenses of the licensor on arranging a deal, and second, *royalty* payments after sales of licensed products.

The amount of the *lump sum payment* is established on the basis of expected volume of sales for the duration of the license. If sales exceed the agreed volume the extra profit it fully retained by the licensee.

The lump-sum payment may be based on several variables:
1. Total discounted expected revenue from the sales obtained during the license agreement;
2. Licensor's expenses on legal protection of the license;

The license price can be calculated as discounted value of future royalty payments agreed upon between the licensor and licensee:

$$P_L = \sum_{i=1}^{T} V_i \times R_i \times P_i \times D_{di} \ ,$$

where $P_L$ – the price of the license on the royalties basis;

$T$ - number of years of the license agreement;

$V_i$ - the volume of production under the license agreement in the i-th year;

$R_i$ - royalty rate in the i-th year;

$P_i$ - unit price in the i-th year (if calculation base is the volume of sales);

$D_{di}$ - the discount factor.

The license price can also be calculated as certain percentage of expected discounted profits from the sale of licensed products for the duration of the license. There may be other variants, but in any case the license price is a certain part of the expected additional profits from the sale of licensed products.

*Methods for royalties' calculation.*

The royalty rate for a particular license agreement can be determined using information about the industry average royalties prevailing in deals with similar and interchangeable products, as well as information on previously signed license agreements. To calculate royalties the so-called rule of 25%, the "cost" approach, the "general business approach" and other can be used.

In the case of royalties based on *industry's average royalty rate* prevailing on similar and interchangeable products, the information on royalty's rates in various sectors is used. For example, royalties are calculated as percentage of the balance sheet profit on the license. The royalty rates vary by industry and by country.

The average royalty value in the same industry varies considerably by country. So, for the pharmaceutical industry in the USA the range of royalties is 3-10% of the profits, the average in Germany – 10.2%, the average in France - 5.4%, which naturally affects royalties for each specific license transaction. Nevertheless, the average amount of royalty rates is just a pure reference tool, which does not take into account the type and specifics of every particular license.

The royalty rate for an exclusive license must be different from the price of a non-exclusive license. The royalty for the technology, which can be easily modified to bypass the patent in no way suits for the evaluation of a patent for a pioneer innovation. However, average rates still reflect the situation in the industry. High royalty rate in the pharmaceutical industry is explained by the time consuming way of a new product to the market, stringent requirements of state control, continuous improvements in medical treatments and aggressive activities of generics producers. In this case, the high level of royalties is needed to offset the high costs incurred, and to stimulate further research and development[71].

If licensor or licensee has data on royalty rates in the real licensing deals, they can use this information for setting royalties in their specific deals.

Another possible approach to determine the value of a license - is to use the "25% rule", when licensee agrees to pay the licensor 25% of the expected gross profit from sales of licensed products.

There is also a *cost approach* to license pricing, which focuses on assessment of the total cost of R & D, production and finishing of the prototype for the patent holder. Then the price of exclusive license centers towards the cost of recovery plus some normal profit, and the price of non-exclusive license depends on the number of licenses sold. The desire of the licensor through the sale of licenses to reimburse expenses and make a profit is quite clear, but in practice it often happens that the price of the license covers only 10-20% of the R & D costs.

[71] in the chemical industry 2-5%, in the pharmaceutical - 10-15%, in the production of consumer goods – 2-3% of the gross volume of sales of licensed products, in the production of non-durable consumer goods of mass consumption - 0.2 - 1.5%

When buying a license, the licensee expects a possible future stream of payments, and does not think about the past costs incurred by the licensor. However, in determining the license price the cost accounting is useful as a kind of reference guide.

When the market prospects for the new technologies are unclear, and inventors do not have sufficient financial resources, large companies often buy up promising ideas from inventors at prices well below costs. These prices do not relate to the expected future profits from the sale of licensed products. Many large companies have established special departments for searching and purchasing of promising scientific developments from the market, since it is often a cost effective way to obtain resources for future innovative productions.

Recently the approach to determine the price of patents and licenses from the *general business profile* became popular. It is based on expectations of professionals regarding the future product line of certain company or business in general, and not only on expectations about the impact of a separate license transaction. The purpose of the licenses and patents sale from the standpoint of a company is to cover total R & D expenses of the company as a whole.

In practice, the final price depends on many unpredictable economic factors, so the contracting parties use a very balanced and flexible approach to the harmonization of the license price.

Payments for licenses may take many different forms: in addition to the usual monetary form; it can be a payment in the form of licensed products; or supply of components to the licensor for the production of goods; payment with shares, when the licensor becomes co-owner of the licensee' company and others.

### 4.4. Commercialization of intellectual property in Russia

It is extremely important to be able to commercialize the R&D results and intellectual property to increase production of innovative products. In Russia this

problem is very acute. In 2003, the Ministry of Industry of the Russian Federation has developed the "Concept of the venture capital industry in Russia", where was suggested to organize Technology Transfer Centers, TTCs, on the basis of universities and academic institutions. These TTCs should engage research results in the commercialization. TTCs which have been established over the past 10 year, are designed to create new high-tech businesses based on research results of academic institutions and universities.

The idea to commercialize scientific potential is not new. In Western countries, the infrastructure for creation of new products and new business out of scientific ideas successfully functions for decades. For Russia this is a relatively new phenomenon, which develops quite successfully. TTCs are designed to produce from fundamental and applied R&D a stream of patents and licenses and, going further, to create companies that could produce innovation goods. Therefore, the aim is to create efficient models for TTCs for commercialization of intellectual property and innovation  from idea to product on the market. To do this, TTCs help inventors, young companies and other professionals to assess commercial potential of their developments, to conduct market research, to form business concepts, to attract investment, to develop the scheme of technology transfer and help to promote the products to the market.

Many TTCs have already been created in the Russian Federation. Tomsk Technology Transfer Center is one of highly successful consulting companies. This center can be viewed as a model TT center. It offers the following services: marketing research; development of business projects and fundraising; products promotion; provision of services for scientific organizations; training seminars. To assess the commercial potential of developments the Tomsk TTC works with authors of these developments. TTC looks for specific competitive advantages for consumers, conducts primary research to determine the demand for technology or product.  Tomsk TTC has developed its unique methodology for assessment of the commercial potential of the technology. Tomsk TTC also offers its clients the

optimal technology of commercialization: TTC defines groups of potential customers and organizes initial negotiations, reveals consumer preferences for future products. Tomsk TTC assists in the sale of intellectual property licenses. To do this, TTC is looking for potential buyers, organizes negotiations, assists in signing of license agreements and controls the timely receipt of payments.

An important activity of TTC is a development of a business project.

TTC renders the following services:

1. Development of the concept of the product;
2. Conducting comprehensive market research;
3. Building effective business - model;
4. Protection of intellectual property;
5. Risk assessment study;
6. Calculation of financial indicators of the project.

To attract investment Tomsk TTC helps to identify the most appropriate type and source of funding and searches for appropriate partners.

Post-investment support to the project aims at reducing the risks to investor and helps companies achieve the planned performance.

The most important final stage of TTC work is to promote innovative products to market. TTC uses its own call-center to promote innovation products by direct selling, i.e. conducts telephone conversations directly with potential consumers.

Tomsk TTC is successful in promotion of medical equipment; navigation equipment; consumer goods; products for the oil and gas industry; laboratory equipment; laser equipment; measuring and analytical equipment.

There are many other TTCs which effectively participate in commercialization of innovations in Russia. The process of replicating the best samples of innovation transfer is underway.

Findings*:* The most important feature of intellectual property is its uniqueness. Protection and evaluation of intellectual property is needed to apply it

in production of innovation goods. This protection nowadays is done by means of the state registration and patenting. Not all objects of intellectual property are patentable. Industrial property objects, such as inventions, utility models, industrial designs and others represent intangible assets of the company, which, when put on the balance sheet, can significantly increase the value of the firm.

In Russia, the results of intellectual activity have become a new kind of commercial products. An institute of patent attorneys is established in the country, they should carry out patent and licensing activities in accordance with the international standards.

Intellectual property, such as research reports, inventions, design documentation, software, business plans, etc. are very peculiar assets that are transferred to manufacturing firms on a non-profit and/or commercial basis. Technology transfer is mainly done through the licensing agreements.

There are different types of licenses – exclusive and non-exclusive licenses, full license, sub-license, patron licenses, and other. Production of licensed products, its price, markets, types of license fees, and other details are defined in the license agreements. One of the most difficult issues is negotiation of the license price. In the market of scientific and technical products the system of monopoly discriminatory pricing dominates. In general, the license price is the result of bargaining and reflects the relative bargaining power of the licensor and licensee.

Licenses payments can take different forms, for example, the royalty payments, the lump-sum payments and the combined payments. Different approaches are used for determining royalty rates: industry average royalties, royalties on the basis of earlier agreements, the cost approach, the rule of "twenty-five percent", etc.

Many entities participate in the world market of scientific and technical products  individual inventors, small innovative companies, large industrial companies. The main role in production of innovation products still belongs to large firms, which have a strong research and production base.

A fairly efficient institutional mechanism for servicing the market of scientific and technical products exists nowadays. It is represented by companies-intermediaries, divisions that search for necessary technologies and deal with licenses' sales and acquisitions, organize exhibitions and fairs. An important element of the innovation infrastructure of modern economies is technology transfer centers that facilitate the transformation of innovation into innovative products sold on the market.

***Questions for discussion:***

1. The composition of intellectual property.
2. The concept of industrial property.
3. The concept and meaning of "know-how" for innovation.
4. The need to protect intellectual property.
5. Ways of intellectual property protection.
6. Market method of intellectual property valuation.
7. Profit-based method for intellectual property valuation.
8. Cost-based method for intellectual property valuation.
9. Importance of technology commercialization for creation of innovation.
10. The tasks and activities of technology transfer centers.

## Chapter 5. Innovative activity of enterprises

### 5.1. Innovative company

Austrian economist Joseph Schumpeter, the founder of the theory of innovation, praised the entrepreneur and innovator, who is not limited to the improvement only of the technical side of the production, but also uses managerial, marketing and other innovations to create a new benefit, which will win the market.[72]

According to the definition of Oslo Manual (1992), innovation is the final outcome of innovation activity, which is embodied in the form of 1. a new or improved product or service that is embedded in the market, 2. a new or improved technological process used in practice; 3. or a new approach to social services.[73]

Innovative entrepreneurship, along with the creation and implementation of technological innovation, also includes marketing, organizational and environmental innovation. In this context, any firm which contributes to the creation, dissemination and application of innovation in the economy is an innovative firm.[74]

Statistics counts company as an innovative company if it has introduced some innovation over the observation period. According to statistics, innovative activity of enterprises includes: research and development (R&D), carried out independently or commissioned to the third party; purchase of machinery and equipment related to technological innovation; acquisition of new technologies; purchase of software; industrial design; education and training related to innovation; marketing research and other.[75]

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[72] Schumpeter J. (1982) *Theory of Economic Development*. Moscow: Progress. P.159 [Russian]
[73] *Russian Innovation Index (2011)* .Ed. Gokhberg L. Moscow*:* National Research University "Higher School of Economics", P.10 [Russian]
[74] Yudanov A. *What is an innovative compan*y (2007). Problems of Economics. 2007, №7 [Russian]
[75] *Russian Innovation Index (2011),* op.cit, P.10 [Russian]

Innovation is assumed to occur when it is demanded by the market or introduced in the manufacturing process. Innovations are diverse.

*Innovative activity* consists in participation of enterprise in creation of innovations during certain period of time.

There is a gradation of enterprises according to their level of technological development. The criteria for inclusion of enterprise to *high-tech industry* is the high level of its technological development, supported by the high R & D to the gross output value ratio. It is believed that in high-tech industries this figure should be 1.2-1.5 times more than the average ratio for the manufacturing industry in average. The criterion for inclusion of enterprise into the high-tech industry is the ratio of people with a high level of professional education among the manufacturing industry workers.[76]

In the world practice there are several distinct classifications of high-tech, knowledge-based industries. In 1990s, experts in some countries highlighted so called "leading edge" technologies and “high-level” technologies. According to the Standard International Trade Classification (SITC), “leading edge technology” group consists of 16 science - intense types of products such as: radioactive materials, pharmaceutical products, equipment for automated data processing, semiconductor devices, etc. The group of “high level” technology includes 41 products that are designed primarily to market conditions and the mass consumer.[77]

In manufacturing industries the high-tech, medium-tech (high end), medium-tech (low end) and low-tech industries are distinguished according to the "technicality" criterion.[78]

In Russia the *high-tech* industry (according to R & D / sales ratio) includes the production of : pharmaceutical products, office machinery and computers, manufacturing of radio devices, television and communication devices,

[76]Available from: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/en/htec_esms.htm
[77]Available from:http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2014_sti_outlook-2014-en
[78] *Russian Innovation Index*, op.cit., P.11 [Russian]

manufacture of medical equipment, measuring instruments, optical instruments, watches and manufacture of aircrafts and spacecrafts. The medium-tech (high end) technology industries include: chemical industry, production of machinery and equipment, manufacture of electrical machinery and apparatus, manufacture of motor vehicles, trailers and semi-trailers, manufacture of other transport equipment.

*Medium-tech* (low end) branches in Russia include: the production of coke and petroleum products, manufacture of rubber and plastic products, manufacture of other non-metallic mineral products, metallurgy, and production of metal products, construction and repair of ships.

*Low-tech* industries are those producing food, beverages, tobacco, textiles, clothing; furs, leather goods, footwear, pulp, paper, books, furniture, etc.

This terminology is quite deceptive - a company of low-tech industries, such as textiles, for example, can be equipped with the newest technology and produce innovative fabrics, but formally it refers to low-tech industries, since company expenses on R & D are small, and sophisticated equipment used in production is qualified as “borrowed technology”.

Technological innovation activity is one of the key indicators characterizing the potential for technological modernization and innovative development of the economy. It would be a mistake to underestimate the innovative potential of enterprises that refer to the medium- and low-tech industries. Employers in these sectors may not conduct their own R&D, but they can borrow technologies developed by other organizations, including technologies embodied in the modern equipment to produce innovative products.

Innovative companies are also those firms that design and implement new marketing, organizational and environmental ideas. Their contribution to the innovative development of the national economy is very significant.

The need for innovation is caused by the need of companies to survive. During the economic crisis many companies activate their search for ways to

create competitive advantages by upgrading technologies and products that will secure their positions in the market and attract new customers. Failure to innovate leads to the reduction of companies' customer base.

The innovation process in companies must comply with cycles, which determine the state of the economy, industry and company itself. Investment in innovation is needed when the market is ready to accept offered products. Large successful companies apply the tactics of open innovation based on the use of a wide range of external sources of innovation, while exploring at maximum the innovators potential within the company.

Innovative activities are carried out in all branches of the economy, including the low-tech, and we can say that innovations are created by enterprises of all technological levels.

Recognizing this fact, however, experts start studying innovative behavior of enterprises primarily with technological innovation, which, as a rule, are based on the results of the conducted R&D.

A study of innovation activities of enterprises, conducted in OECD countries in 2015[79], revealed a number of trends, characteristic for the development of innovative firms in developed economies at the moment.

1. R & D of private innovative firms

In OECD countries, the private sector has been carrying out the major part of R & D during the last 10 years, and it also bears more than 60% of their costs. Nevertheless, the state remains the main entity, which finances R & D in the higher education sector and, to a large extent, in the private sector (see. Fig. 5.1).

The data indicates a high concentration of R & D in a limited number of mainly large companies. But the overall picture is quite diverse. In some countries (Iceland, New Zealand), more than 60% of R & D accounts for small and medium-sized enterprises (SMEs), while in the United States and Germany less than 15%,

[79] OECD Science, Technology and Industry Scoreboard 2015. Innovation for Growth and Society. Available from: www.oecd.org

and in Japan less than 5%. In some countries Estonia, Slovakia, Korea and Finland, SMEs receive a significant proportion of funding from the government for R & D.

In the UK and USA, SMEs receive less state financing for R & D than the money companies spend on this R & D. There is a tendency of concentration of R & D of private sector in a limited number of industries. These are, above all, the chemical industry (including pharmaceuticals, fuel, chemicals, and minerals), ICT and transport equipment.

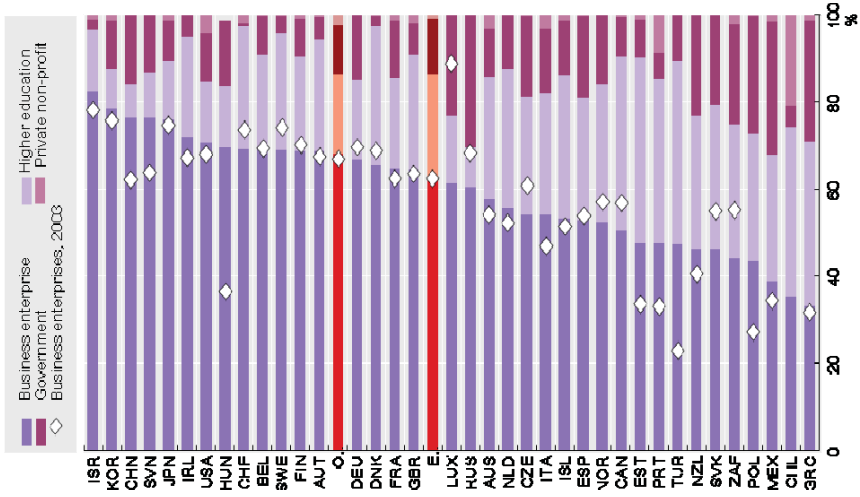


Figure 5.1 Expenditure on R & D financing of enterprises, government, universities, private non-profit organizations, 2013 (in% of total R & D expenditures)

*Source:* OECD, *Main Science and Technology Indicators Database*. Available from: www.oecd.org/sti/msti.htm, June 2015, p. 156

*2. Major R & D actors*

Two thousand companies in the world carry out more than 90% of all R & D and own 66% of all patents issued by five largest intellectual property offices in the world. These companies are global players in the field of technology.

*3. Information and communication technologies (ICT) and innovation*

ICT industry occupies a special place in the innovation sector. ICT expenditure on R & D amounts up to 25% of all private sector spending for R & D (0.2% - 0.4% of GDP) and in Finland, Israel, Korea and the US – up to 40-50% (0.6% -1.8 % of GDP). If R & D spending is an investment, the result is the patents obtained. During the period 2003-2013 the number of patents obtained by the ICT sector firms increased by 66%.

Innovative firms improve their competitiveness through the production of new and improved products and services, as well as more effective ways of marketing and sales. In the ICT sector the share of innovative companies is substantially higher than in other manufacturing industries (71% compared to 51% according to the 2012 Community Innovation Survey). And in the service sector the share of innovative ICT firms is higher than the share of firms that provide other innovative services (63% compared to 47%).

4. Different types of innovation

Company data shows that firms simultaneously carry out various types of innovation: the most innovative of them, both large and small, implement product and process innovations as well as new marketing and organizational methods (Figure 5.2.). The data shows that the share of large companies engaged in innovation is higher than the share of innovative SMEs in all SMEs. The behavior of large firms in different countries is similar, but there are differences in behavior among SMEs.

The most active innovative SMEs are in Germany, Luxembourg, Australia and Switzerland. In general, there is a significant gap in the intensity of innovation activities of large and small/medium firms. The largest gap is observed in Poland and Spain. The intensity of technological innovation of companies from the service sector is slightly lower than that of firms from the manufacturing sector (Fig. 5.2).

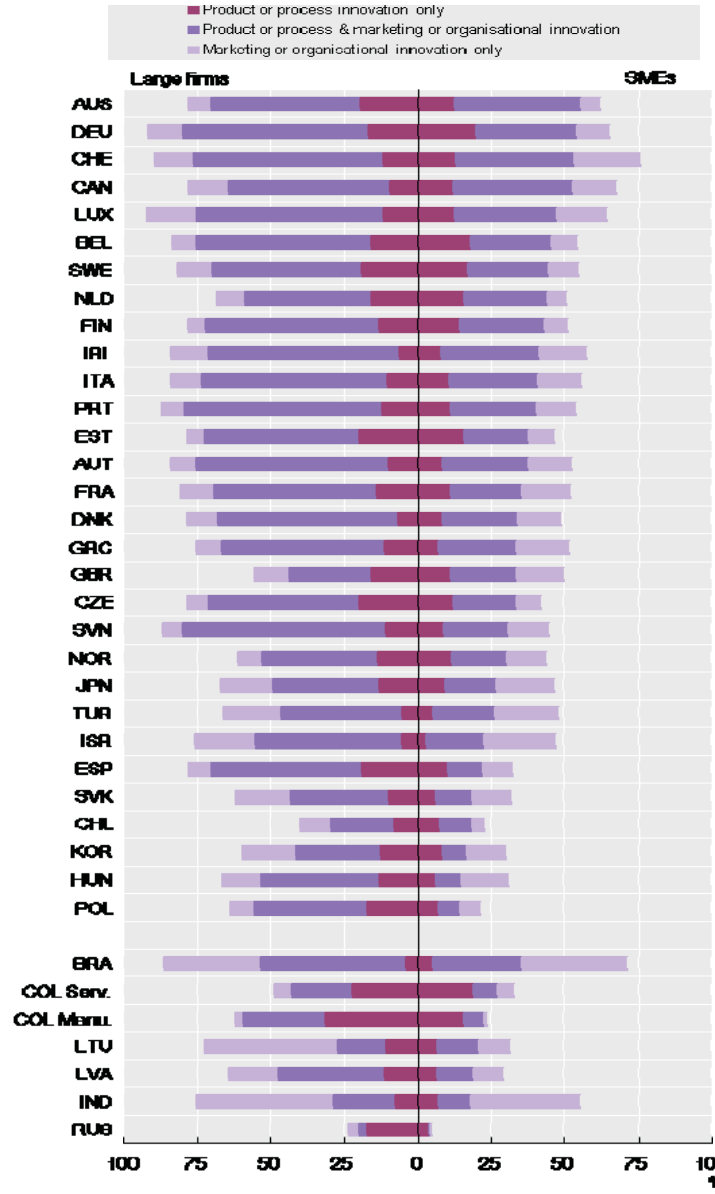


Fig. 5.2 Types of innovation in both large and small / medium-sized companies (as % of large companies and SMEs in the survey), 2010-12
*Source:* OECD, *Main Science and Technology Indicators Database*.
Available from: *www.oecd.org/sti/msti.htm*, June 2015, P. 162

5. Innovation new to the market

Conducting of R & D by firms increases the likelihood, but does not guarantee the creation of innovative products. At the same time, not all innovative companies conduct R & D. Data for OECD countries shows that, for example, 20% of firms in Germany and 30% of firms in Australia do not conduct R & D, but, nevertheless, they produce technological innovation (in case of high technology firms, which conduct their own R & D, this figure amounts to 80% (Fig. 5.3)).

At the same time, the majority of firms in the economy do not conduct their own R&D, but they set the average level of innovation in the economy. The level of novelty of innovative products offered by companies is different. The data reported by companies regarding their innovative products that are "new to the market", shows the following: 1. companies from the manufacturing industries report about new products created for the market more often than in the services sector (in Germany twice as likely); 2. large firms produce significantly more new products for the market than SMEs.

6. Demand on innovation and innovation support

Innovations produced by private firms depend on the demand on innovations and their offers. Statistical surveys study markets where the firms operate. In small economies, such as Slovenia, Latvia, Belgium, innovative firms work for the international market. Recently, attention has been paid to the fact that private firms are working on government contracts. In the OECD countries, Austria, Finland and France show the highest rates of private firms working on state contracts. Large innovative firms demonstrate higher rates of working for international markets and on government contracts. Non-innovative firms and SMEs are much less represented in these markets.

Government aid to private firms in the creation of innovations includes providing them with government contracts for production of innovative goods, as well as reduced costs and risks through tax credits, deductions, grants,

concessional loans and loan guarantees for innovative production. Statistics show that large innovative firms are more likely to get the state support, than SMEs.

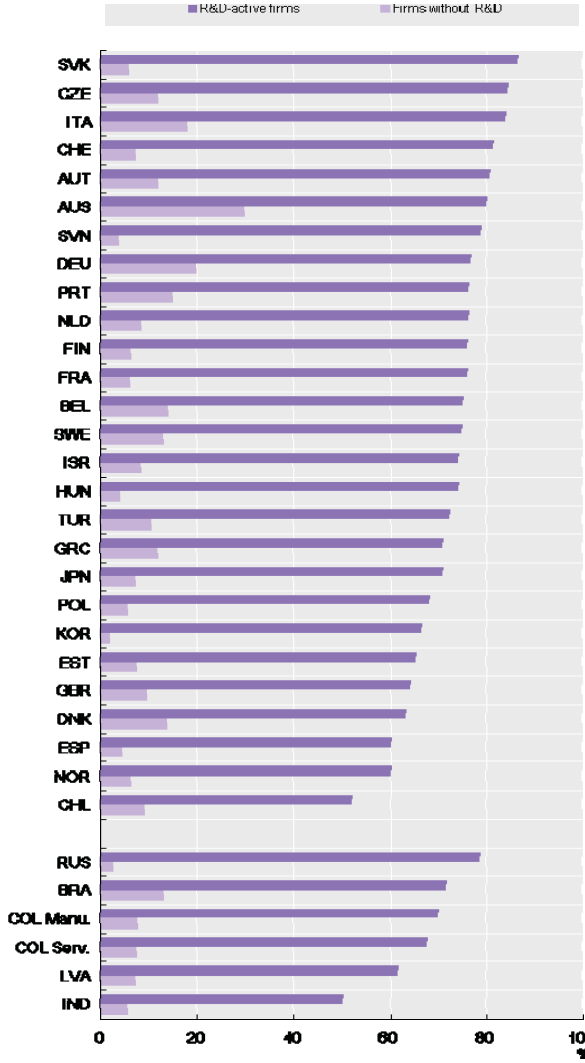


Fig. 5.3 Product innovation in firms, conducting and not conducting R & D, 2010-12 (as % of firms with product innovations, conducting and not conducting R & D in the total number of firms in the survey)

*Source:* OECD, *Main Science and Technology Indicators Database*. Available from: *www.oecd.org/sti/msti.htm*, June 2015, P. 164

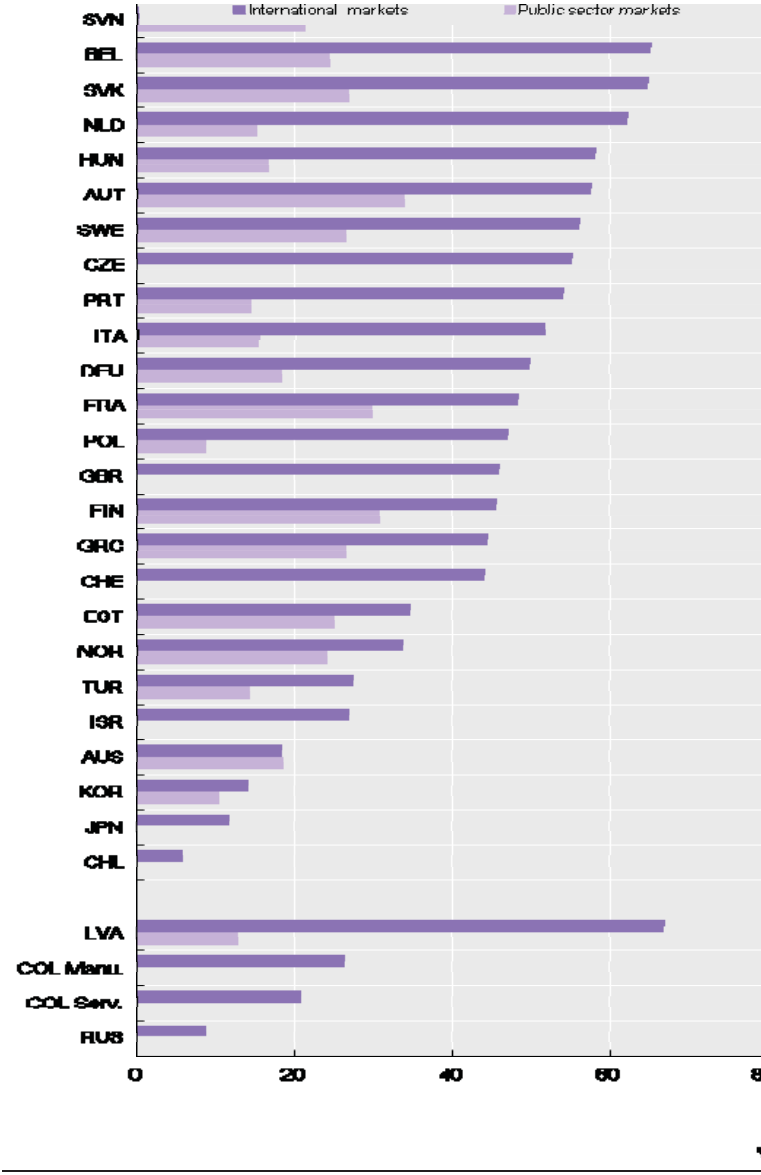


Figure 5.4 Enterprises operating in the international and state markets, 2010-12 (as % of all firms in the survey)

*Source:* OECD, *Main Science and Technology Indicators Database*.
Available from: *www.oecd.org/sti/msti.htm*, June 2015, P. 172

7. Business climate for innovation

The political climate plays an important role in the creation of new firms and promoting healthy competition in the economy. Reduced bans and barriers contribute to the creation of new businesses, and, thoughtful circumspect methods of firms prevention of financial insolvency reduce the risk of bankruptcy of companies and individual entrepreneurs that help them to take risks and innovate. Young innovative firms are critically important for economic growth and employment development, especially after the crisis recovery. However, these firms have great difficulty in finding funding, because they usually cannot provide neither collateral nor good credit history. It is difficult for forms to get funding for a seed and early stages of development as far as the prospects for young innovative firms development and the probability of being profitable is uncertain.

The economic crisis has negatively affected the industry of venture capital financing. Thus, the financing of seed and early stages remains better than the financing of the later stages. *Venture capital* is a private equity provided by specialized companies that act as intermediaries between the primary sources of finance (insurance funds, pension funds, banks, etc.) and private start-ups and fast growing companies whose shares are not traded in the stock market.

Currently, pre-seed and seed venture financing makes up a significant part of the venture capital in Denmark, Israel, Japan, Portugal and Slovenia.

Effective regulation of markets facilitates access to the market and the businesses creation. Over the past 10 years, the barriers[80] for entrepreneurs have been reduced in nearly all OECD countries.

Taxes and tax policy, in particular, the value of major taxes (personal income tax, corporate tax, capital gains tax and social security contributions) as

[80] Indicator "Barriers to Entrepreneurship" measures the standards that affect the business on a scale from 0 to 6. The index includes the administrative burden for the creation of new firms, their legal and regulatory protection (legal barriers, antitrust exemption, barriers in network sectors), as well as the complexity of the regulatory procedures (licenses, permits, simplification of procedures).

well as special tax regimes (tax incentives for start-ups and young companies, SMEs) largely affect the decision to start a new business.

## 5.2. Organizational forms of innovation

Innovation activity of companies is carried out in different organizational forms (see. Fig. 5. 5).

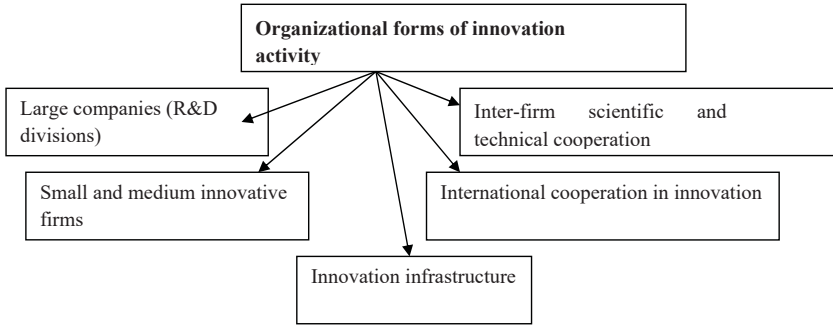


Fig. 5.5. The organizational forms of innovation activity

***Large companies***

Statistical data shows that in economically developed countries innovations are created by large and small and medium-sized companies in the high-tech as well as in the medium and even low-tech industries. And yet, large firms have a special place in the creation of innovation and play a crucial role in this process.[81]

By absolute size the spending of large companies on innovation significantly exceeds SMEs' expenditures on these purposes, while the R & D costs / sales ratio for large companies can be very low, since the amount of their revenue is very high. Virtually all successful big companies are innovative: they create

[81] Matthews J. *The innovation cycle in large companies*. Open Innovation for large companies (2011).Moscow: The Skolkovo Moscow School. P.12 [Russian]

technological, organizational, marketing and environmental innovations. In 2010, the largest R&D expenditures were recorded in the Swiss company «Roche» (pharmaceuticals) € 7.2 billion, the American company «Pfizer» (pharmaceuticals) € 7 billion, the American company «Microsoft» (programming). € 6.7 billion, the Japanese company «Toyota Motor» (automotive) € 6.7 billion, the American company «Merck US» (Pharmaceuticals) € 6.4 billion.[82]

Large companies manage their innovation projects in accordance with the cyclical development of the economy. In times of recession these companies are actively engaged in innovation, since innovations enable a company to successfully survive in times of crisis, prepare for the arrival of the upward phase of the cycle and stay ahead of their competitors when the market is to recover.

Large companies produce their own innovations of different types, and also actively borrow technologies from other companies. To this end, specialized units of companies actively seek technologies in their fields, buy patents and licenses, carry out joint R&D with other companies and, by doing this, carry out so-called *open innovations*.

Companies under certain conditions can also transfer their innovative developments to other companies. Frequently the large companies "create" small innovative companies (so called *spin-off companies*), which continue working on the most promising and risky R & D. The former parent company maintains a mutually beneficial relationship with spin-off companies and, in the case of successful developments, buys and uses them in its production.

*Sources of innovation*.[83] Companies - leaders in innovation find ideas for their innovative projects in different sources both within the company and outside it. Companies with low innovation edge typically use significantly fewer sources.

[82] R&D ranking of the top 1000 non-EU companies, Available from: http://iri.jrc.ec.europa.eu/research/docs/2011/vol_II_4.pdf
[83] Matthews J.*(*2011), op.cit., P.12 [Russian]

There is a big difference between strategy of *closed innovation*, when the focus is done on ideas developed in-house, and *open innovation* strategy, which relies on both internal and external sources of innovation. Whereas in the past major companies with extensive in-house innovation closed for competitors successfully worked in the chemical, pharmaceutical, electronics industries, nowadays, all successful large companies in this or that way use the tactics of open innovation.

External sources of innovation for companies are the local, national and global resources, universities, science and technology companies, and small and medium-size companies, even firms-competitors [84]. In some countries, there are active companies intermediaries that organize the interaction of large companies with suppliers and consumers for efficient use of the available intellectual and technological resources. For example, the Korean Trade Organization KOTRA implements "GAPS program" partnership within the global alliance that helps small and large Korean companies and universities to establish contacts with major companies such as Dow Chemical, Johnson & Johnson and GE. There are also "technology exchanges", where the private, non-profit and in some cases state-supported organizations serve as an intermediary between entities, owners of ideas or technologies, and companies interested in solutions. In Russia the Gate2RuBin website provides a link between Russian companies and the European Enterprise Support Network.

The most important source of innovation of the company is its own personnel and intellectual property, which the company possesses. In order to use effectively these intellectual resources, large companies conduct regular inventories of their intellectual property.

Large companies develop innovation programs with different planning horizons (short-, medium-, and long-term) and determine what structure units are responsible for implementing innovation plans. Often the most risky new projects

[84] Matthews J.(2011), op.cit., P.13 [Russian]

are placed into special units (e.g., R & D division, a division of “Innovative Projects” and others), with delegated powers and allocated finances. This allows the company to better control cash flows and manage the profitable part of traditional production. And the risks, uncertainties and possible financial losses under this setup are concentrated in separate divisions of the company. These units, engaged in innovative projects, use not only the internal innovation potential of the company, but also actively seek and use external sources of innovative ideas. In some cases, the development of technologies and products is transferred to spin-off companies or even third-party companies.

Typically, large companies at any given point of time implement several innovative projects. There are practical methods to assess expected efficiency of innovative projects. Integral performance indicator of innovation efficiency is based on the assessment of the success of new products and projects, which is defined as the ratio of expected profits to the total volume of invested funds (for details, see chap. 7).

Companies develop certain formal project management procedures with target reference points and decision points. Companies constantly monitor market situation in their segments and get information primarily from customers.

There is a connection between the intensity of innovation activities of large companies and the degree of competition in the markets where they operate: if competition in the market is weakened and the monopolistic tendencies are strengthening, then the large companies-monopolists significantly reduce their innovative activity.

For example, in Russia, some large companies are natural monopolies in their fields. In these cases, experts point out to the deficit of breakthrough innovation projects: innovation priorities of large Russian companies are so-called modifying or catching innovations. Many of the projects carried out by large companies in Russia, could be more correctly called “modernized” rather than “innovative”, because they are designed to strengthen existing competitive

advantages or reduce the technological gap with foreign competitors, rather than to occupy a new market niche or to create new markets[85].

Microsoft is the successful large high-tech company, which actively produce innovation in a highly competitive market.

**Microsoft: the company's innovation activities in a highly competitive market**

Microsoft Corporation was founded by Paul Allen and Bill Gates in 1975. The Company has developed from a technology start-up to the largest multinational technology company. The initial public offering of shares of the company took place in 1986, and in November 2014 Microsoft became the second in the world after Apple Inc. with capitalization of 410 billion dollars. Since the 1990s, Microsoft conducted a series of corporate acquisitions, and in May 2011, Microsoft acquired Skype Technologies for $ 8.5 billion.

The company develops, manufactures, licenses, supports and sells software, consumer electronics and personal computers and services. Its the most well-known software products are Microsoft Windows, Microsoft Office, Internet Explorer, Xbox game consoles, Microsoft Surface.

The innovation strategy of the company, which brings stable and impressive innovative results, is studied by many experts. One of the cornerstones of the company is investment in R&D. "The biggest mistake you can do cut back on science and development expenses. Then you will definitely never have a second chance "(Craig Mundie, Microsoft Director for research and strategy). Even in times of crisis, Microsoft never cut spending on R&D, and on the contrary, increased it in both absolute and relative terms. The company believes that despite their impressive financial results, an enviable stability and leading position in several segments of the market of information technologies, the Microsoft does not have "natural" defense to protect its positions.

The company does not control the sources of resources and supply chains, and the loyalty of its customers lasts only as long as there is no better offer in the market. In such circumstances, the only possible strategy is to continually stay ahead of competitors in the improvement of products and maintain the most attractive balance for customers between the cost of ownership and efficiency (TCO and ROI).

In addition, the society demands change and for the company to lead innovation, while maintaining commercial viability, is getting more and more difficult. Microsoft has strong competitors like IBM, Apple, Google and CISCO. Highly competitive market requires from the company constant maximum efforts to preserve its market position. Neither big nor small companies from whatever industry can survive without innovation.

The company Microsoft established “a scale of levels of innovation threat” to the corporate welfare, where the highest level orange corresponds to the situation “competitors are close to us it's time to accelerate”, and the highest red – “we have the last chance – put all forces

[85] Innovation activity of large business. (2011). Expert. Available from: http://www.raexpert.ru/researches/expert-inno/part1/ [Russian]

for a breakthrough." Even under the best circumstances, Microsoft operates in accordance with the upper limit of the orange level. These are the imperatives of the competitive market.

To increase the level of innovation maturity of the company, Microsoft implemented difficult organizational changes and changed attitude patterns of leading employees. Now the company is practicing a broad co-operation with partners and has a qualified innovation portfolio management. It also motivates employees to contribute to the innovation process.

*Extremely interesting is the very philosophy of innovations of Microsoft, as articulated in the brief statements:*

• The culture of innovation starts at the top, but valuable idea may come to every brain.
• Playing managers work in an innovative company.
• It should be easy and enjoyable to offer innovations.
• The errors need to be frequent, quick and cheap.
• Do not be afraid of success, i.e. change, but you need to weigh the risks: everything is not as it seems to be at first glance.
• Starting from some level of responsibility (and pay!) every Microsoft employee is involved in the expert evaluation of innovative proposals.
• Ideas are a valuable asset. It is important not to lose them, but to cherish, and to encourage their authors.
• Innovation management requires tools to ensure teamwork, intelligent search, knowledge management, competence management, process management, project and portfolio management.

Product groups are responsible for the development and marketing of specific products software and Microsoft services in accordance with the "road map", which inform consumers about the products to be issued in 2-3 years.

Microsoft Research Unit (MSR) is engaged mainly in fundamental research, the practical results of their work usually will appear in 5-10 years. The company believes that without fundamental science there can be neither new products nor serious improvement of people's lives through technology.

Now more than 900 researchers work for MSR. They are specialists of the highest level, including the winners of the awards, and promising young people. MSR conducts research in more than fifty areas, starting from the theory of algorithms and mathematical linguistics to computer medicine. It is possible only through broad cooperation with leading research centers, which invite students and young scientists to training in MSR, and provide grants for joint projects.

Microsoft Labs provide cooperation of the scientific research conducted in the MSR with the practice of product groups, i.e. the connection between the science and manufacturing. This temporary creativity groups bring together scientists, developers and marketers. Their traditional planning horizon is 3-5 years. Laboratories should prevent valuable ideas from "dying" on the way to consumer, and at the same time stop "raw" solution.

The company employs 90 thousand people. This is enormous creative and intellectual potential. The company has built an effective system for collecting proposals and decisions. Important tools to support innovation at Microsoft are ThinkWeek, ThinkSpace, Garage. These devices allow the company to maximize the use of the creative possibilities of specialists at all levels and secure the company's position in a highly competitive market.

*Source*: Shershulsky B.( 2011) *Innovation Management at Microsoft: From Idea to Product*. Open innovation for large companies. Moscow: The Skolkovo Moscow School, P. 117 [Russian]

***Small and medium-sized innovative companies***

Statistical surveys define small businesses in most industries as companies employing up to 100 people with an annual turnover up to US $ 25 mln. in the US, up to $ 5.2 mln. in the EU and up to 400 mln. rubles in the Russian Federation. The category of medium-sized enterprises includes enterprises with the average number of employees from 101 to 250 and turnover of up to 1 bn. rubles (the Russian Federation).[86] According to statistics, innovatively active portion of SMEs is generally smaller than in the category of large enterprises engaged in innovative activities (see. Fig. 5.2). The absolute value of the SMEs' R & D expenditures is also incomparably lower than that of large companies. However, SMEs play a vital role in the innovation process. Particular attention in this context should be given to medium-sized growing companies, so-called "gazelles", and a group of small high-tech enterprises.

Special emphasis should be given to so-called "gazelles" fast-growing sustainable medium-sized enterprises. The term "gazelle" was introduced by E. Burch in the 1980s to refer to firms showing a steady rapid growth.[87] These companies growing by 20-30% per year for 5 years or more can be found in various sectors of the economy in the high-tech, medium- and even low-tech industries.

Gazelles play a special role in the creation of innovations. The very fact of rapid and sustained growth over the years, even during the crisis years, means that these firms find markets and stable demand for their products and services. This in most cases means that the company offers to the market product which is much

[86] Federal Law of the RF (22.07.2008) # 556-FZ "On the limit values of goods (works, services) sales revenues for each category of small and medium-sized businesses" [Russian]
[87] Birch D., Medoff J. (1994). *Gazelles*. Labor Markets, Employment Policy and Job Creation L. C. Solomon, A. R. Levenson (eds.). Boulder, Co.: Westview Press. PP. 159-168.

better than that of competitors' new goods or significantly improved, i.e., innovative. Studies show that many gazelle firms are working in medium and low-tech industries, but are also found in high-tech industries.

If a firm works in medium or low-tech sectors and, as a rule, does not deal with their own R & D, for the production of an innovative product / service it uses R & D performed by other companies, or "borrowed technology" by buying modern equipment, which is an innovative product of firms equipment manufacturers. Thus, the effective demand for end products of gazelles ensures their demand for high-tech equipment and technology produced by suppliers from high-tech industries. Thus, gazelles' activities for the production of innovative products create demand for innovation down the production chain. And this is the positive external effect for the innovative economy.

As in other countries, in the Russian economy there is a complex problem of limited demand for innovation: the capacity of the domestic consumer market is limited, access to foreign markets is difficult because of the high competition and, in most cases, integration of domestic products in the value chain under the auspices of powerful international companies is needed.

If we consider the intermediate demand for innovation of large domestic companies with state participation, we find it very limited, although in recent years the state purposefully "persuading" them to innovate through commitment to develop Programs of innovative development. The demand for innovation by small businesses is relatively small. There is government support of demand for innovation in the form of government contracts, commissions, grants, issued through a system of matching funds. In Russia, this government support is quite well developed. And, nevertheless, demand for innovation remains limited, which hampers the development of innovative companies.

In this context, the activity of gazelles, both technological and conventional, is extremely important, because private firms take on the organization of cooperation with firms – suppliers, with cooperation partners and are able to

effectively create demand for their end products both due to the fact of working in the markets with an unsaturated demand, and through the use of innovative marketing.

The ability of gazelles to create new jobs in expanding enterprises and keep them in times of crisis is also extremely important for the economy. In addition to creating demand for innovation for suppliers and own production innovations, gazelles function as integrators of firms initiating and building cooperative links between firms needed to manufacture products[88].

In some countries, such as Russia, there is an increased proportion of gazelles in the economy, and we can assume that this is due to the presence of un-met demand in the economy and unoccupied markets unemployed which gazelles explore actively. The process of demand creation for innovation and organization of cooperative links can be demonstrated by the example of Russia's gazelle from medium-tech sector JSC “Interskol”.

**Russian gazelle Interskol**

JSC "Interskol" a Russian company engaged in the manufacture, sale and service maintenance of power tools. Power tools sector is considered to be a high end of medium technology. The company was founded in 1991 on the basis of the All-Russian Research Institute of Constructive Mechanized hand tools and building-finishing machines, VNIISMI the main Soviet Institute for electricity and vibration instrument. In 2002 “Interskol” built a factory of a full cycle for power tools production (BEZ) in Bykovo, Moscow region. In 2009 “Interskol” purchased the Italian company ”Felisatti” one of the world leaders in the segment of professional equipment for woodworking. In order to optimize production resources, “Interskol” transferred Felisatti production from the Italian city of Ferrara to the Bykovsky plant in the Moscow regions. “Interskol” installed Italian five-axis robotic processing center, so expensive and complicated that it required 24-hours online monitoring by the producer in the factory in Bykovo. In this processing center “Interskol” manufactures tools of original Russian design, which are in great demand, since in terms of precision these tools outperform production of famous company Bosch, and the price are similar to Chinese counterparts. In addition, “Interskol” is first to introduce into production of power tools a revolutionary valve engine developed by scientists of the Novosibirsk State University and produced at the Izhevsk

[88] Vinkov A., Yudanov A., Ruban A., Gurova T. *Future creators – gazelles with monkey brains* (2011). Expert 2011 № 10. Available from: www.expert.ru [Russian]

Mechanical Plant. Kaluga “Litform”, the supplier of cast aluminum blanks for "Interskol", has installed the ultramodern equipment to cope with orders of “Interskol”. At the same time, "Interskol" considers the opportunity to put the miracle incisors of cubic boron (including nano-versions) of the Russian company “Microbor” and fiber lasers produced by the US-Russian "IRE-Polus". A whole galaxy of Russian and foreign manufacturers of high-tech products obtains benefits through demand for innovation from “Interskol”.

*Source:* Vinkov A., Yudanov A., Ruban A., Gurova T. *Future creators – gazelles with monkey brains.* Expert 2011 № 10. Available from: www.expert.ru [Russian]

***Small innovative companies***

Small innovative entrepreneurship in science and technology arises at the intersection of small businesses and high-tech (innovative) business concepts. It is characterized by extreme dynamism and ingenuity. According to the British economist G. Bannock, half of 70 most important inventions of the XX century were made by small businesses or independent inventors. Small businesses have been created the electronic tube TVs, air conditioning systems, electrostatic copiers, transistors, mixers and even a jet engine, not to mention such trifles as ballpoint pen, zipper, vacuum cleaners, toasters and many others.[89]

Many large corporations, whose activities are related to new sectors of the economy, grew from small firms, for example, Microsoft, Cisco Systems, Dolby Laboratories, eBay, Google, Hewlett-Packard, Instagram, LinkedIn, Logitech, Silicon Graphics, Sun Microsystems, SunPower Corp. Small innovative firm is a small mobile team of professionals working on their own or as part of a large organization in areas subject to permanent change. Founders of small innovative firms are scientists, engineers, inventors seeking to realize the latest achievements of science and technology and get material benefit. The initial capital of such firms may be personal savings of founders, and further small firms have to find external sources of financing, in particular, grants, business angel capital, venture capital specialized funds, loans, etc. (for more about it see Chapter 6).

[89] Bannock G. (1981). *The economics of small firms*. Oxford.

Small innovative business is presented by small firms established by individual entrepreneurs, who have certain potential for innovation, small firms created by large companies; companies created in technopark structures, and enterprises established at universities and research institutes.

Small innovative business is the main driver of economic growth in the advanced countries. High innovative activity of small business in the advanced countries is determined by a combination of factors. Researchers identify the following advantages of small innovative companies[90]:

- Small business has the most favorable conditions for creativity. Creative activity is by nature alien to excessive discipline, hierarchy typical for large enterprises, it requires freedom, which is an important condition for the achievement of expected results;
- In small businesses, inventor, owner and manager is often one person, which almost completely removes the potential conflict between owners and managers in corporations;
- New information technologies create favorable operating conditions for small businesses that were previously available only to large companies.

In countries with developed market economies, the economic role of small innovative firms is very significant. For example, in Germany, the ratio of small innovative companies in the total amount of industrial enterprises is 62%, in Norway 49%, in France 38%. The highest percentage of innovative companies among industrial companies is recorded in Ireland 75%.

According to the National Science Foundation, among high-tech companies the proportion of small businesses is 89%. Small businesses account for 98% of firms in the field of software development, 97% in the field of photonics and optics, 96% in knowledge-intensive services as well as in the sphere of test and measurement operations. In the US electronic industry small businesses account

[90]. *Recommendations for strengthening the role of small and medium innovative enterprises in the CIS countries.* WIPO. Available from: http://ictt.by/rus/Portals/ [Russian]

for about 90% of the total number of operating companies. Given the relatively limited volumes of its own R & D (see. Figure 5.2), a small business is making a significant contribution to the creation of new products and technologies, being a source of up to 50% of innovations and as licensor for almost the same number of innovations embodied in various goods sold in the global market.

In terms of innovation performance, small companies in some sense are far ahead of large corporations. For example, small business creates in average 13-14 times more patents than large corporations. According to the National Science Foundation, 1 dollar invested in R & D by enterprise employing up to 100 people provides 4 times more innovations than firms with 1000-10000 employees and 24 times more than the company, which employs more than 10 thousand people. The return on investment in innovations in small business is about 2.5 times higher than that of large enterprises. Small businesses often spend fewer resources on a new design than large enterprises. If for the innovation implementation large enterprises need three to five years, a small company can do it all in one year and at a lower cost.[91]

Among small innovative companies, American scientists distinguish a special group of so-called serial innovators (their number does not exceed 10%) for their special success, constant innovation and orientation towards advanced technologies. These innovators are concentrated on industries where technological innovation and the patent protection of products are highly important biotechnologies, pharmaceuticals and semiconductors. In the US small innovative firms patent their results more actively than large companies.[92]

[91] *Prospects for the development of the resource potential of small business for the period up to 2020: the theory, methodology, practice* (2012)**,** Moscow, P.372 –Available from: http://www.fasie.ru [Russian]

[92] *Small Serial Innovators: the Small Firm Contribution to Technological Change* (2003).CHI Research, Inc., (Springfield, Va: National Technical Information Service), released Feb. 27, 2003.

As mentioned above, a wide range of different organizations are involved in creation of innovation. However, the immediate creators are manufacturing companies: large, small and medium-sized.

***Interaction of large businesses and small innovative businesses***

One of the most important factors of intensive development and high performance of small innovative businesses in the advanced countries is its close cooperation with large businesses. Large corporate structures, in contrast to small firms, possess huge material and financial means for the development of basic, strategic innovation, based on fundamental and applied research. They account for the vast majority of research and development carried out in the private sector in advanced countries.

Large corporations cooperate with small business in an attempt to use its innovation potential and because of difficulties with their own innovation. The development of partnerships with small innovative enterprises allows large corporations, on the one hand, to reduce their R & D costs, and on the other to reduce risks associated with development of innovative products.

In some cases, small innovative enterprises spin off from large companies and become independent companies, but as a rule, they continue to interact with the parent company. Economic interaction between small and large businesses in innovation activity takes place in the following areas: 1. Cooperation in research activities; 2. Co-production; 3. Technology transfer; 4. Implementation of venture projects.

***State support for small innovative business***

In developed countries state support is provided within the framework of the state innovation policy, which is aimed at creating favorable conditions for innovative activity of small firms. The support of the state can be divided into institutional and resource support.

The *institutional support* to small innovative businesses consists in: 1. The improvement of the legislation governing, supporting and protecting of small

business activities; 2. The development of infrastructure for small innovative businesses; 3. The removal of administrative barriers to the small innovative businesses development.

*The resource support* of the state presumes provision of financial assistance to small business firms. In different countries, this support takes various forms [93]. As part of government programs small businesses can obtain financial resources on commercial or preferential terms from various sources sponsored by government, including governmental, public and private foundations; public and private banks; public and private venture capital funds, etc. The main forms of financing are grants, subsidies, subventions, commercial and preferential loans, loan guarantees, the purchase of shares. The intensity of the state aid to small innovative firms varies considerably across countries.

In Russia, small innovative business could potentially be an important factor in development of innovative entrepreneurship. Experts identified a number of strategies for the development of small innovative companies that could be successful in Russia[94]:

*1. The strategy of company's partner network development*: company seeks to fully control all stages of product development and commercialization: from product development and manufacturing to distribution in commodity markets, including control over the trademark. The company will focus only on the conduct of some of the key R & D stages, while the remaining work will be carried out by outside partners.

*2. License distribution strategy:* company exercises complete control over the R & D stage and licenses production of new products.

*3. Strategy of specialization on R&D:* the company is focusing its efforts on certain types of R & D and provides R & D services for other companies.

[93] For more details see: *Prospects for the development of the resource potential of small business for the period up to 2020: the theory, methodology, practice*, op.cit. [Russian]
[94] For more detail see Baranov M., op. cit. [Russian]

4. *Strategy of participation in a global network:* company focuses on the production of high-tech modules that are part of more complex products, and on supply of these modules to manufacturers of various high-tech products and services, thus entering the supply chain.

***Small innovative companies at universities and research institutes***

The process of small innovative companies (SIFs) establishment at universities and research institutes has begun in some countries (USA, Israel, Finland) several decades ago, and now we can see growing belt of innovative businesses around universities and research centers. In Russia, this movement has begun relatively recently and promising results in the production of innovative goods and services are observed mainly at SIFs created at engineering universities which managed to preserve their scientific and research potential from the Soviet times.

The theoretical basis of this process is the "Triple Helix" theory, proposed by famous Stanford University professor Henry Etzkowitz in his book "The Triple Helix. Universities - Enterprises - State. Innovation in Action ".[95]

The model is based on the assertion that in modern society university is the core of innovation activity. University enters into close cooperation with business, and in many ways takes on the functions of R & D implementation, and thus becomes a major center for the application of government efforts in innovation promotion. Classical university turns into an entrepreneurial one, while retaining its academic components.

The State, besides the fact that it, as always, establishes laws and manages the society, now performs one more function it provides necessary resources to promote research and innovation at universities, while industrial enterprises, in addition to the traditional manufacturing of goods, now place their structural units in science parks of entrepreneurial universities.

[95] Etzkowitz H. (2010). *Triple Helix. Universities - Enterprises - State. Innovation in Action.* Translation from English. Ed. Uvarova A. Tomsk: TUSUR Publishing, 2010. -238 c. [Russian]

This allows businesses to contact closely with academic research groups and gives more opportunities to develop new products, to hire the right employees and to monitor scientific discoveries that have commercial application. The main argument in favor of this orientation in development of universities is that they have every necessary asset, even more than what the research institutes or R&D departments of companies possess. Because the university a place through which human capital flows, thousands of students with new ideas that can be tested and brought to commercialization. Stanford University, USA, and Tomsk State University of Control Systems and Radio Electronics, Russia are two universities, among many others, that actively conduct research and create innovative products.

**Stanford University, USA**

***Research***

**S**tanford research is remarkable in both its breadth and depth. Stanford research programs reflect the expertise, creativity and initiative of the faculty which sets the research agenda. There are more than 5,500 externally sponsored projects throughout the university, with the total budget for sponsored projects at $1.22 billion during 2015–16, including the SLAC National Accelerator Laboratory (SLAC). The federal government sponsors approximately 81% of these projects, including SLAC. In addition, nearly $260 million are invested by non-federal funding sources. SLAC National Accelerator Laboratory is a U.S. Department of Energy national laboratory operated by Stanford. Research at SLAC addresses questions in materials and energy science, biology, chemistry, particle physics, astrophysics, cosmology, advanced accelerator development and other fields. Nearly 3,400 scientists worldwide use the lab's facilities each year, and more than 1,000 scientific papers are published annually based on research at SLAC, earning Nobel prizes for six scientists.

**Technology Licensing**

Stanford's Office of Technology Licensing (OTL) brings technology created at Stanford to the market. In 2014–15, Stanford received more than $95 million from royalty revenue on 695 technologies. Thirty-nine of the inventions generated $100,000 or more in royalties. Eight inventions generated $1 million or more. In 2014–15, OTL concluded 112 new licenses.

**Innovation**

A 2012 study estimated that companies formed by Stanford entrepreneurs generate world revenues of $2.7 trillion annually and have created 5.4 million jobs since the 1930s. Stanford alumni and faculty have created 39,900 companies since the 1930s, which, if gathered collectively into an independent nation, would constitute the world's 10th largest economy. Frederick Terman, provost from 1955 to 1965, is called the "academic architect" of the high-technology region known as Silicon Valley. Among the companies Stanford faculty and alumni have helped create: Atheros, Communications, Charles Schwab &Company, Cisco Systems, Cypress, Semiconductor, Dolby Laboratories, eBay, E*Trade, Electronic Arts, Gap, Goodreads, Google, Hewlett-Packard Company, IDEO, Instagram, Intuit, Intuitive Surgical, , LinkedIn, Logitech, Netflix, Nike, Orbitz, Rambus, Silicon Graphics, StubHub, Sun Microsystems, SunPower Corp., Tesla Motors, Varian, VMware, Whole Earth, Catalog, Yahoo.

*Source: http://facts.stanford.edu/StanfordFacts_2016.pdf*

**Tomsk State University of Control Systems and Radioelectronics, Russia**

Scientists and administration of the Tomsk State University of Control Systems and Radio Electronics (TUSUR) several years ago began to apply the "Triple Helix" model in practice. TUSUR became very successful in the creation of cooperation between higher education and business. TUSUR graduates have founded most of the large innovative companies of Tomsk. By 2010, graduates of the university have established 198 companies, all from scratch. In 2015 they produced goods and services worth 15.2 billion rubles. About 400 companies producing high-tech products operate in Tomsk. The share of innovative products in 2008 in the total volume of industrial regional production was about 20%.

*Source: http://www.tusur.ru* [Russian]

For the success of innovation activities of large, medium and small companies, the infrastructure that creates eco-friendly environment for innovation is needed. The innovation infrastructure includes all entities that through interaction help generate new knowledge, transform it into new products and services and facilitate their promotion to the market. The innovation infrastructure includes the so-called "development institutions", technological platforms, industrial parks, business incubators, areas of high technology, organization, which finance innovative activities, such as innovation promotion funds and venture capital funds, technology transfer centers (TTCs), staff training and information support centers, etc. Some of them scientific and business structures that promote innovation in enterprises are discussed in the next section.

### 5.3. Scientific and business structures in innovative activities of enterprises

To stimulate economic growth of the country creation of favorable conditions for activation of innovative activities of enterprises, development and transfer of progressive technologies is needed. In carrying out R&D and further new technologies transfer it is necessary to take into account interests of all participants of innovative process – researchers, consumers of new technologies, goods and services, investors, etc. The more complex the technology is, the more close interaction is needed between its institutional components. Effective forms of

innovative activities organization become the integrated structures which connect scientific, technical and production potentials, accelerate innovative process and increase its efficiency.

Due to the dynamic development of high-tech branches of science and business the value innovative and technological structures is growing. Today there is no single definition or model of these integrated structures, in different countries they are called “technological park”, “technopol”, “technological area”, “research park”, or “scientific park”. For example, the term "research park" is used in the USA, “scientific park” – mainly in Great Britain. In Russia the term “technopark” is more often used.

*Technoparks*

There are several organizational forms in which science and technology parks successfully function. So, the University or scientific research institute can be the unique founder of science and technology park. However, the most widespread option is when a park has from 2 to 20 founders. Such management mechanism is more complex than the mechanism with one founder, but it is more effective, for example in terms of access to various sources of financing. In the case of several founders either joint business, or limited liability company is created.

*Technopark* is the organization, the legal entity that have close links with one or several higher educational institutions, scientific centers, industrial enterprises, and regional and local authorities. Such organization should develop in its territory modern innovative ecosystem for support of innovative entrepreneurship. Technopark should create material, financial, and logistic background for effective operations of big, medium and small-sized innovative enterprises, commercial development of scientific knowledge, inventions, know-how and technologies as well as their transfer to the market to meet regional and national demand for these products.

*Scientific parks*

The first scientific park was founded in 1951 at the Stanford University. Many firms established in the park became later large multinational corporations.

In the 1980s in the result of rapid development of scientific parks the "Research Triangle" in Northern Carolina and the "City park of Philadelphia" in Pennsylvania were formed. The first represents the concept of "parkland", and the second one – "park in the downtown". Today in the USA there are more than 150 scientific parks.

Later the successful experience of the USA has been used in Europe. In the early 1970s European countries started to organize scientific parks among the most popular: the Research park of University of Heriot-Uatt, Edinburgh; Scientific park of Triniti-college at Cambridge; Leuven-la-Nev in Belgium; Sophia Antipolis in Nice, ZIRST in Grenoble, France and other. These parks each had one founder, who leased land to owners of knowledge-intensive firms.

As in the USA, rapid development of scientific parks in Europe has begun in the 1980s, but has been much faster. Creation of parks was based on the available experience, worked-out programs and business plans and was very successful.

In the 1980s the idea of scientific parks has overcome the boundaries of Europe. Scientific parks have been organized in Brazil, India, Malaysia, and later in Eastern Europe, the CIS countries and China. In the world there are more than 400 scientific parks nowadays. The process of scientific parks organization continues.

There are three *main models of science and technology parks*.

1. *American model.* In the USA and Great Britain three types of "scientific parks" function now: 1."scientific parks" in the narrow sense of the word; 2. the "research parks", where technologies are developed only to a stage of a technical prototype; 3. "incubators" in the USA and the innovative centers in Great Britain and Western Europe, where universities provide land, space, access to laboratory equipment and services at rather low cost to established companies.

Typical example of "research park" where on the lands which belong to the university the non-profit research institutes closely connected with the industry are located — is the Center of the Illinois Institute of Technology (IIT), the private research center of the USA with the budget about 68 million dollars a year[96].

2. *Japanese model*. the Japanese model, unlike the American model, presumes the construction of absolutely new cities – "technopolises", which concentrate advanced scientific research and the knowledge-intensive industrial production.

In 1982, 19 zones spread evenly across 4 islands were selected for creation of "technopolises". All technopolises should be located not further, than 30 minutes drive from the "cities parents" with the population of at least 200 thousand people and within 1 day of drive from Tokyo, Nagoya or Osaka; with space not more than 500 square miles. These technopolises should possess (or construct) the balanced set of modern scientific and industrial complexes, universities and research institutes in combination with living areas equipped with cultural and recreational infrastructure. These thechnopolises should be located in picturesque areas and stay in harmony with the local traditions and environment.

3. *The mixed model*. The examples of mixed model of "scientific parks" based on both Japanese, and American experience, are scientific parks in France, in particular, the largest of them of "Sophia Antipolis" . This scientific park is located in Riviera on the area over 2000 hectares. In the middle of 1980s the land has been sold to the companies and research organizations; the maximum occupancy capacity of the park is 6 thousand people[97].

Each scientific park can pursue several goals, which importance depends on local conditions and position of the founder.

*Science and technology parks in Russia*

In Russia development of the first science and technology parks has begun in the late 1980s. Many of them have been organized at the higher school. At that

[96] URL: www.treeland.ru/article/luxterra/hi/amerikanckaa_model.htm
[97] URL: www.treeland.ru/article/luxterra/hi/cme6annaa_model.htm

moment these science and technology parks had neither the developed infrastructure and real estate, nor the prepared teams of managers. Usually they were created as structural divisions of higher education institution and were not really operational entities, they were not able to create or support innovative enterprises. In some cases science and technology parks have been formed as closed joint stock companies with flexible management in case of relative independence from the basic organization.

The first Russian science and technology park – "Tomsk scientific and technological park" was created in 1990 as association with 100% state-owned capital. In the same 1990 the decision was made to organize the association of scientific and technological parks at higher educational institutions – "Technopark association". This Technopark association has united 27 science and technology parks and 65 incubators of innovative business, which serve as centers for development of small knowledge-intensive businesses. In 1993 the Technopark association together with scientific park of the University of Warwick of Great Britain and later with assistance of other foreign organizations started the project for training of managers and consultants for science and technology parks.

Today 56 science and technology parks function in Russia. Some of them are very successful, for example, like the science and technoparks in Tomsk, Dubna, Ufa, Zelenograd (Moscow). More than 900 innovative firms and 150 small serving firms operate in these parks; over 7 thousand new workplaces are created.[98]

The state support to technoparks has a great impact on development of these structures. According to International association of scientific parks (IASP) 40% of all scientific parks are completely financed by the state[99]. There is recognition of the importance of the state role in establishment and development of science and technology parks as effective forms of organization of innovative activities, which contribute to stimulation of economic growth.

[98] URL: www.kaztrade.ru/russian_federation/economy/industrial/tech/
[99] International Finance Corporation (2016). Available from: www.ifc.org

The mechanism of the state support of science and technology parks is presented in tab. 5.1.

Table 5.1.

**Mechanism of the state support to science and technology parks**[100]

| **Structural elements of the mechanism** | **Essence of the state support of science and technology parks** |
|---|---|
| Mechanism of state planning of science and technology parks development | • strengthening of science and technoparks strategic planning;<br>• standard legal support for science and technology parks;<br>• priority directions for technology development of technoparks |
| Organizational mechanism of support | • adoption of Federal Law "About Science and Technology Parks of Russia";<br>• development of venture investment system;<br>• creation of Fund for development of science and technoparks;<br>• organization of science and technology parks promotion;<br>• organization of the international cooperation for science and technoparks. |
| Motivational mechanism of support | • joint investment of innovative projects of science and technology parks;<br>• creation of conditions for activities of scientists and specialists of science and technology parks;<br>• enhancement of system of scientific personnel training;<br>•protection of intellectual property rights, priority financing of applied researches;<br>• strengthening of the state scientific and off-budget funds;<br>• financial support for innovative entrepreneurship |
| Mechanism of the state control over science and technoparks development | • enhancement of monitoring of science and technology parks;<br>• accounting for results of science and technoparks;<br>• creation of examination of development and implementation of scientific and technical projects;<br>• control over use of the state-owned intellectual property;<br>• development of the state accreditation system of science and technology parks |

In the late 1990s- beginning of 2000s with participation of the Ministry of Industry and Science of Russia organization of the network of the *Innovative and technological centers (ITC)* was initiated. The distinctive feature of ITCs is that they support new small innovative enterprises which have already passed the most difficult initial stage of creation, formation and survival, when about 90% of the small innovative enterprises perish.[101]

[100] Tribushnaya V.Kh. (2011) *Innovative infrastructure as the need for support of the knowledge-intensive entrepreneurship: science and technology parks and strategic management*. Izhevsk. - P.241 [Russian].

[101] See for more details Shepelev, G.V. (2005) *Problems of development of innovative infrastructure*. Available from: http://regions.extech.ru/left_menu/shepelev.php [Russian].

The first ITC has been created in 1996 based on OJSC Svetlana, one of the leading enterprises of electronic instrument production in the former USSR. The idea of creation of ITCs was that similar centers opened at industrial enterprises will help small businesses communicate with the industry.

52 ITCs with more than 1000 small firms function today in Russia. However, it is absolutely insufficient for Russian dimensions for example, in Germany there are more than 300 similar structures.

*Technological platform*

In the 2000s the new type of a scientific and technological complex – a *technological platform* has been created. The first platform the Advisory board on aviation researches (ACARE) has appeared in Europe in 2001. Its creation was the result of long process of establishing interaction between Airbus Corporation and other industrial companies with the research European centers engaged in development of the plane Airbus A380. Representatives of 24 European countries, European Commission, industry, airlines, research centers, and universities became members of the technological platform ACARE.

The development of Russian technological platforms have started in 2010 when the government commission of the Russian Federation on high technologies and innovations ordered to establish domestic technological platforms as new instrument for management of scientific and technical progress. In April, 2011 the list of 27 technological platforms has been approved, each platform containing from ten to several hundred participants.

The technological platform serves as "the instrument for consolidation of efforts of various participants – the state bodies and agencies, business, science – for detection of innovation challenges, development of the program for strategic researches and ways of its implementation"[102].

There are the following main *principles of technological platforms*:

[102] *Technological platforms as instrument of assistance to innovative development of the Russian economy* (2015). Available from: www.economy.gov.ru/minec/activity/sections/innovations/formation/doc20101004_02 [Russian].

• consolidation of efforts of the most significant and concerned parties state, business and science;

• ensuring development and implementation of long-term strategic priorities for selected sectors of economy;

• technological upgrade of the most perspective sectors of economy.

The Russian technological platforms can be divided into several groups depending on the method of their organization and their coordinators: 1. there are platforms with coordinators state corporations or similar organizations, like Rosatom, Rusnanotech, and the Russian Railway, Russian Technologies or their subsidiaries; 2. coordinators are the higher education institutions; 3. coordinators are scientific organizations of different ownership controlled by the state; 4. state joint stock companies or closed joint stock company and state institutions; 5. business structures and business associations, for example, the non-profit Laser Association and JSC SUEK.

There are certain benefits for all participants of technological platforms (tab. 5.2).

Table 5.2.

**Potential benefits for active participants of technological platforms[103]**

| Business | Science | State |
|---|---|---|
| Improvement of ecosystem for innovation, stimulation of demand for innovative products | Promotion of business –science partnership, demonstration effect for business, expansion of demand of business for R & D | Definition of mid- and long-term priorities for scientific and technological policy |
| Improvement of quality of training and upgrade of technological competences | Upgrading of the competences needed to business -training, engineering, design, long-term forecasting | Selection of priority directions for upgrade of economy of private and state resources |
| Financial support for implementation of innovative projects | Inclusion of the small firms at universities in subcontract networks | Coordination of the R & D financed by budgetary funds |
| New opportunities for technological upgrade and wider planning horizon | Corrections of applied science "failures" | Selection of directions of regulation improvement, including industrial regulation |

[103] *Technological platforms as instrument of assistance to innovative development of the Russian economy* (2015). Available from: www.economy.gov.ru/minec/activity/sections/innovations/formation/doc20101004_02 [Russian].

| | | |
|---|---|---|
| Opportunities for production of brand new goods and services | Formation of new cooperation ties in scientific sector | Better conditions for dissemination of advanced technologies |
| Better opportunities for selection of business partners and contractors | Formation of the centers of competences, as divisions of research institutes and universities | Increase of large state companies efficiency |
| Political support in the world markets, formation of international alliances in high risks and resource intense sectors of economy | Creation of potential for implementation of large-scale complex projects | Increase of budget expenses profitability |
| Support and public attention, increase of demand for innovative goods and services | | |

*Business incubators*

The business incubator is the organization engaged in support to startup projects of young entrepreneurs at all stages of their development: from the very development of an idea up to its commercialization. In some cases business incubators create and develop new companies they help with legal registration of companies.

More than a half of all programs of business incubators are "multipurpose" projects, i.e. they work with clients from various industries. Technological incubators account for 39% of all incubatory programs[104].

The first prototypes of business incubators have appeared in Great Britain in the middle of the 20th century. The first business incubator in modern understanding of this word was founded in 1959 in Batavia (State of New York) by Joseph of Mancuso who had purchased a warehouse of a factory and organized the first incubator in America — Batavia Industrial Center. His purpose was the creation of new workplaces in the city affected by economic depression.

In Russia business incubators appeared in 1990.

The business incubator provides the following main services:

1. lease or sublease of non-residential premises of business incubator to small businesses;

2. building maintenance;

[104] Knopp, L. (2007) *State of the Business Incubation Industry*. Athens, Ohio: National Business Incubation Association.

3. postal, secretarial and Internet services;

4. consulting in the tax issues, financial accounting, financial consultations, legal protection, business planning, advanced training , etc.

5. provision of access to information databases.

Financing of incubatory programs in many countries is performed out of regional or national budgets in accordance with the general strategy of economic development of the country. In the USA the majority of incubator programs is independent, and financed by local communities and through project financing. The Agency for economic development of the USA often finances new incubatory programs, but as soon as the program starts and begins to function, it, as a rule, ceases to receive federal financing. The rent and/or fees of clients in average constitute 59% of the income of incubators, 18% are brought by service fees or grants, and 15% come as subsidies for cash transactions.

### 5.4. Innovation business strategies of companies

There are different classification of innovative behavior of companies.

Economist L.G. Ramenskii proposed the following classification of companies according to their innovative competitive behavior in the market: violents, patients, explorers and commutants.[105] Each of these types of companies plays a specific role in the innovation process creates different in terms of field, scope and economic impact innovations, as well as differently promotes the diffusion of innovations.[106]

"*Violents*" are large companies with a substantial research base. Their activities are focused on the mass market and they meet standard demand. Violents have a high innovative potential. Thanks to available financial resources, scientific results and logistics resources, companies-violents are able to develop innovation,

[105] http://region-alliance.com/inno_strategii.html

[106] For more detail, see Davtyan M., Sherbakova T., Karzanova I. (2014) *Innovation Activity of Enterprise*. Moscow: RUDN. - PP. 221-225 [Russian]

to manufacture it and implement its commercialization. In Russia large companies in the defense sector, the oil and gas industry refer to the category of violents.

Companies "*patients"* are large, small and medium-sized firms which conduct adaptive innovation policy. They specialize in the production of unique new products, occupy a narrow niche and serve non-standard consumers. Due to its narrow specialization, company-patient is highly dependent on market conditions, which is a weak point of their strategy. There is a danger of absorption of patient by company-violent.

Companies "*explorers"* are small innovative companies-innovators, which specialize on early stages of the innovation process and create radical innovations. Their innovative potential is mainly based on intellectual resources. Companies *explorers* frequently miss sufficient financial and logistical resources, but in case of getting financial support the company-explorer demonstrates rapid growth and can turn into violent. Conversion of small innovative firms into division of company-violent allows it to work on innovation agenda with abundant financial resources. At the same time the company- violent gets access to the know-how of the controlled company.

Companies "*commutants*" simulate production of innovation goods and offer new services based on new products. Their role consists in promotion of the diffusion of innovation: they are engaged in the production of legal copies of products of well-known companies, as well as the provision of after-sales services for innovative products.

There are other approaches to classification of companies' innovation strategies. In terms of quantitative measurement and practical application worth mentioning the approach that combines information on where company sells its innovative products (locally or internationally), whether company develops on its own or borrows technology, since it largely determines the degree of products' novelty. The described above approach is used in the OECD statistics and,

according to it, five main types of companies in terms of their innovative behavior are identified[107]:

- *Innovators in the international market* companies that on their own develop product and process innovations new to the international market. These companies have the ability to produce the most radical innovations. In the OECD countries, the share of such companies is 25 - 45% of the total number of innovation-active companies. In most European countries, companies at the very beginning are oriented towards production for the integrated European market (which in statistics is qualified as international market). In Russia, the share of these companies is about 6-7%, which signals the level of competitiveness of Russian companies, and their skewed orientation towards the domestic market (see. Fig. 4.6).
- *Innovators in the national and local markets* companies that develop in-house product and process innovations, new to the national and local, but not new to international markets, where these companies do not operate. In Korea and Japan, the countries with the capacious domestic market, the share of such companies is 23-25% of all innovation active enterprises; in European countries the share is 5-12%, while in Russia the share of these enterprises amounts to 6%.
- *Imitators in the international market* companies that produce replication product and process innovations not new to the international market. At the same time these companies are active in the global market and produce in-house innovations. Specific feature of these companies is their ability to implement technological borrowings and spread further advanced technologies through national innovation systems. In Europe, these companies account for 27% -43% and in Russia up to 20%.

[107] Gokhberg L., Kuznetsova T., Roud V. (2010). *Analysis of innovation regimes in Russian economy: methodological approaches and some results*. Foresight, 2010. № 3 [Russian]; Grachev G., Roud V., Fursov K. *Statistics as a tool for the formation of innovation system*. Available from*:* econorus.org/onim/upload/18vi.pdf [Russian]

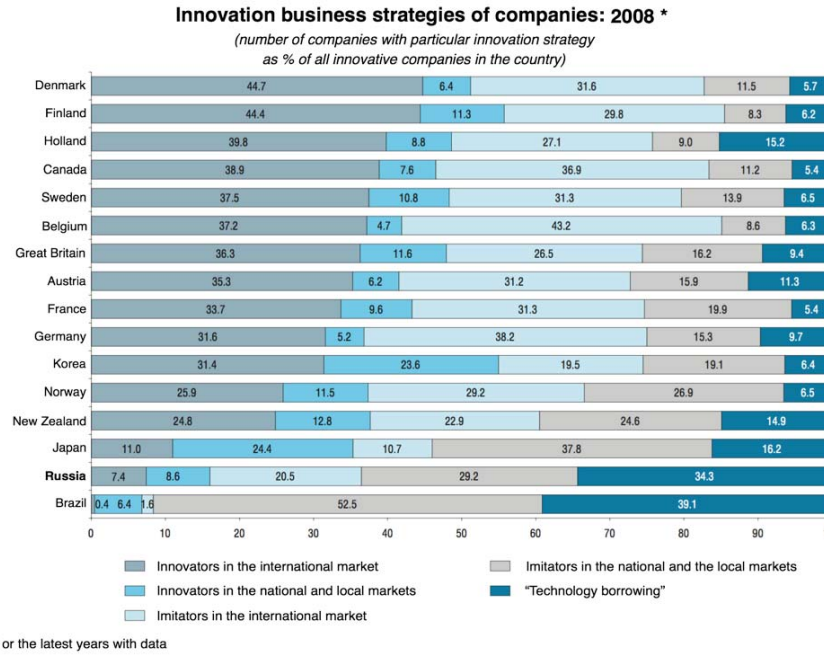


Fig. 5.6 Corporate innovative strategies, 2008.

*Source: Russian Innovation Index (2011) /* ed. Gokhberg L. Moscow*:* National research University "Higher School of Economics, P.19 [Russian]

- *Imitators in the national and the local markets* develop product and process innovations that are not new to the main markets of these companies. Innovative activity is carried out in-house. These companies perform as distributors of borrowed technologies within the national innovation system. In Europe, the share of companies with such behavior accounts for 8% - 27%, and in Russia – up to 22%.
- *Technology borrowing* an innovative strategy of companies when they conduct an imitation of innovative goods mainly due to the purchases of modern finished equipment and technologies without their own efforts to create new knowledge. These companies are relatively passive acceptors of new products and technologies and demonstrate the simplest type of innovation behavior. Such innovation strategy

is typical for 5% -15% of European companies. In Russia, the share of such companies accounts for 26%. In general, nowadays simple forms of innovative behavior of companies dominate in Russia.

Using this classification of innovative strategies one can get an idea of the international competitiveness of companies engaged in innovative activities, and determine the dynamics of companies' innovative strategies changes in different countries.

***Question for discussion:***

1. Distinctive features of innovative companies.
2. Definition of innovative organizations in the Russian statistics.
3. Trends in the development of innovative firms in developed countries (OECD study, 2015).
4. Features of innovative behavior of large companies and their role in the innovation process.
5. The importance of medium-sized fast growing companies, "gazelles", for the innovative economy.
6. The role of small innovative companies for innovative economy.
7. Interaction of large business enterprises and small innovative business.
8. "The Triple Helix" theory by H. Etzkovit: the role of the state, business and universities in the innovation economy.
9. Elements of innovation infrastructure and their functions in the innovative economy.
10. Different classifications of innovative company strategies.

# Chapter 6. Funding innovation

## 6.1. Sources of innovation financing: equity, debt and raised funds

Financing of innovation is a rather difficult problem for companies engaged in innovation. Innovative projects carried out by companies from the initial stages development of the idea, R & D, prototyping, creation of working models and product samples are risky, many of them turn out to be unsuccessful, and entail financial losses.

If we compare the financial situation of large and small high-tech innovative companies, the large companies run innovative projects on the background of already established core business, and the funding of innovative projects can partially use current profit from core operations. Large companies use their own, borrowed and raised funds to finance their innovation activities.

Small young high-tech companies, as a rule, do not have such financial cushion and in the early stages of their development they use primarily raised funds grants from public and private entities, business angel financing, venture capital, and only in the later stages, in the case of certain commercial success, they can receive debt financing.

A typical picture of cumulative profits / losses path during the innovation product lifecycle is shown in Fig. 6.1.

The financial results of companies during the development, creation and launch of a new product on the market change substantially over time. Such phases of a product life cycle as creation and testing of the concept, model development, the beginning of production of a trial batch of goods are connected with investing of funds and, consequently, the negative financial results during that period. Later on, if a new product is accepted by the market, mass production starts and in some time the project starts making profits, the total accumulated losses begin to shrink.

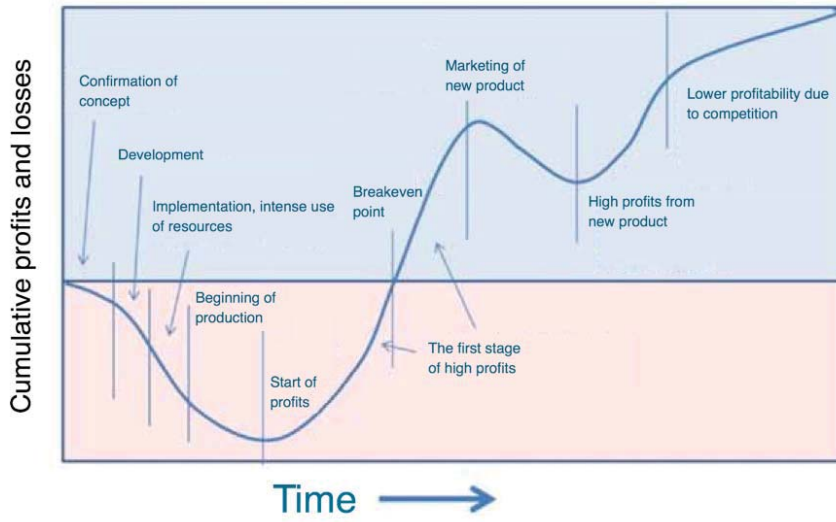


Fig. 6.1. Cumulative profits / losses during the innovation product lifecycle.

*Source:* Matthews J. (2011). *The innovation cycle in large companies*. Open Innovation for large companies. Moscow: The Skolkovo Moscow School. P.6 [Russian]

At some point of time the project reaches the break-even point, and then profits from sales of a new product start growing. The profitability of new production attracts competitors who enter the market. Gradually the saturation of the market with this product comes and modified versions of the product are needed to obtain profits, which requires additional investments and lowers profits. Modifications of the product may be repeated several times. For a while the modified product is still in demand and brings profits, and then it gradually disappears from the market.

Thus, the company has a particularly urgent need for funding at the early stages of the product life cycle, before it reaches the break-even point. The solution of financing problem consists in finding a variety of funding sources. These sources can be classified into four groups:

1. Own means of the company;
2. Borrowed funds;

3. Raised funds;

4. Indirect financing.

The specific forms of each type of financing are given in Table 6.1.

Table 6.1.

**The sources of innovation financing**

| **Own means of the company** | **Borrowed funds** | **Raised funds** | **Indirect financing** |
|---|---|---|---|
| Company's profit | Loans from commercial banks, credit institutions, institutional investors | Emission and placement of shares | Soft loans through the provision of state guarantees |
| The equity capital | Bonds | Direct investments of the state, national and foreign private sector in the form of direct investment, grants of various funds, business angel investing, venture capital, etc. | Tax incentives for innovative projects in a variety of forms (tax holidays, tax credits, accelerated depreciation |
| Means of the amortization fund | Mortgage | Crowdfunding | Benefits for the rent payments provided by technology parks, business incubators, etc.. |
| The fund of company's development | Leasing | | |
| Insurance benefits | Forfeiting | | |
| Revenues from the sale of excess assets | | | |
| Targeted revenues | | | |

***1. Equity.*** *Own means* that the company can use to finance innovative projects are formed by: 1. The business profits (if at the beginning of an innovative project, the company makes profits in the implementation of other activities); 2. The equity capital; 3. The means accumulated in the amortization fund to replace retired fixed assets (provided that the company really accumulates these means in the Amortization fund); 4. The development fund of the company; 5. The reserve fund to cover current losses; 6.The insurance benefits; 7. The revenues from sales of excess fixed, variable, and intangible assets; 8. The targeted revenues.

The own means of companies, often, but not always, are the main source of innovative activity financing. Large, successful companies, as a rule, have stable income, and can use all of the above listed types of own resources to finance innovations – see, for example, the case of the Microsoft (Table 6.2.)

Table 6.2.

**Financial indicators of Microsoft in 2015**

| **INCOME STATEMENTS of Microsoft 2015 and 2014** | | |
|---|---|---|
| **(In $ millions, except per share amounts) Year Ended June 30,** | **2015** | **2014** |
| Revenue | **$93,580** | $86,833 |
| Cost of revenue | **33,038** | 27,078 |
| Gross margin | **60,542** | 59,755 |
| Research and development | **12,046** | 11,381 |
| Sales and marketing | **15,713** | 15,811 |
| General and administrative | **4,611** | 4,677 |
| Impairment, integration, and restructuring | **10,011** | 127 |
| Operating income | **18,161** | 27,759 |
| Other income, net | **346** | 61 |
| Income before income taxes | **18,507** | 27,820 |
| Provision for income taxes | **6,314** | 5,746 |
| Net income | **$12,193** | $22,074 |

Source*: Microsoft Income Statement.* Available from: https://www.microsoft.com/investor/reports/ar15/index.html#income-statements

The example of technology company Microsoft shows that the total expenditure on R & D, production, transportation, sales, and marketing of products, which in the case of this company represents spending on innovation activities, is covered by the sales revenues. But, in addition, Microsoft also uses other sources of funding raised and borrowed funds; in particular, it raises funds through the issuance of shares and bonds.

But in the case of young small high-tech companies their own funds are insufficient at the early stages of the company's development; they do not earn profits yet, but instead should invest. Young companies at the early stages use other sources of funding: grants, business angels and venture capital investments, and, later, loans.

***2. Debt***. In addition to the companies' own funds, they use borrowed resources to finance innovation:

- *Loans* from commercial banks, credit institutions, and institutional investors such as investment companies, mutual funds, pension funds, insurance companies and others;
- Proceeds from the placement of *bonds* on the stock market;
- *Mortgage* loans secured by real estate (land, structures, buildings, and other objects that are directly related to the land.)
- *Leasing*;
- *Forfeiting;*
- *Project financing* the project founders lend money to the repaid (principal and interest income) from the profits earned in the project, and others.

*Commercial bank loans* commercial banks finance innovative projects that have clear sources of debt repayment, the payback period assessed, and good credit history of the company. The newly established high-tech company usually cannot get a loan from the traditional commercial structures, as it does not have collateral and credit history. Interest on a bank loan depends on the loan's duration, expected riskiness of the project, specific characteristics of the borrower, etc. There are government programs for provision of preferential rates loans to innovation companies, as well as programs of state guarantees for those private banks, which lend to those companies. These guarantees reduce the risks of banks and, consequently, reduce the interest rates on loans.

*Corporate bonds* are debt instruments the company gets from the bonds buyers loan for the lifespan of the bonds. There are short, medium and long-term

bonds. Bonds are widely used to finance activities of companies. However, not every company can place the bonds on the market  it is necessary to reveal a lot of information about the company, prove the legality and transparency of its activities, get approval of the draft bond issue from the market regulators and gain access to a particular trading system.

As a rule, only successful companies with a good activity history, that in view of customers reduces the risk of default on bonds, actually can place their bonds on the market. For example, despite the significant stable profits, Microsoft regularly uses this source of debt financing: in 2015 the total debt on long-term bonds, according to the financial statement, was worth $ 46.287 billion.[108]

*Leasing.* Another tool to obtain funds for the innovative project is *leasing*, when the *lessee* gets productive assets  machines, equipment, vehicles, computers, industrial facilities and the like, as well as intellectual property rights  licenses, software, know-how, etc., from *the lessor* with their subsequent purchase of the assets by the lessee. Leasing allows getting the industrial assets without large lump-sum payments. Assets can also be obtained through renting of equipment, but leasing is cheaper, since the firm should sign a two-year (not less) contract for the use of the equipment. Leasing allows avoiding reduction of cash flow in result of purchase of expensive equipment, and enables the use of capital for other, perhaps more profitable operations.

However, in the long run leasing is more expensive than ordinary purchase of equipment, because the leasing company requires its share of the profits.

*Forfeiting*. There is a specific instrument  forfeiting, which also can be classified as borrowing for the implementation of the innovation project. *Forfeiting* is an operation of transforming a commercial loan into a bank loan. The buyer of goods, who does not have required amount money for purchase, issues promissory notes to the seller worth the value of the transaction plus the interest on deferred payment. Seller accepts promissory notes at the bank on a condition “no right for

[108] *Microsoft Financial Highlights* – Available from: http://www.microsoft.com

turn on", which frees him from liability in the case of insolvency of the drawer. On accepted promissory notes the seller receives the money in the bank. Ultimately, the commercial loan is provided not by the seller, but by the bank, which agrees to accept a promissory note and to take the credit risk. In this way the commercial loan is transformed into the bank loan. The credit risk level, which depends on the reliability of the drawer, affects the discount rate at which the bank accepts promissory notes. Lending scheme via forfeiting is a medium-long-term (from 1 to 7 years).

***3. Raised funds***.

Innovation activities may be financed by fundraising. The category of raised funds includes different instruments: 1. financial assets obtained by shareholders through issuing and placing shares in the market; 2. direct investments by different investors – domestic, foreign entities, financial institutions of various forms of property, and individuals; 3. venture capital investment as a specific form of direct investment.

*1. Emission and placement of shares.* Funding through the additional emission and placement of shares is available to enterprises organized in the form of closed or open joint-stock companies. It is designed and effectuated it in the form of a public offering and targeted placement among individuals and companies. The first form is available to stable companies with established reputation, which already operate in the market. The targeted placement is more common for very young companies and venture capital firms. In that case, the main buyers of their shares are the private investment companies or funds.

The placement of shares on the stock exchange allows accumulating of substantial financial resources. Shares are acquired by various financial institutions that seek to diversify their investment portfolio and acquire certain high-risk investments. It could be pension funds (though in several countries, for example, in Russia, pension funds are not permitted to invest money in risky assets), private equity funds, banks, insurance companies, etc. Non-financial companies and

individuals also could be investors. Shareholders, who acquired the shares, share all risks of the company. However, this method of fundraising is only available to companies which are ready to disclosure information on its activities in the Prospect of Emission, agree to publish quarterly reports, and pay dividends to shareholders. Such method of fundraising is available primarily to large companies, carrying out innovative projects. For example, the market capitalization of Microsoft Corporation on June 30, 2015 amounted to $ 80.083 bn.

To facilitate access for young high-tech companies to stock exchanges special sectors, such as Market for Innovations and Investment on the Moscow Stock Exchange,[109] where companies can trade their stocks and bonds, have been created. Potential investors know in advance that this sector offers risky securities of young high-tech companies and build their strategies of acquisition of undervalued securities with expectations of their price growth in the future. And yet, despite these support, many small innovative companies cannot use this channel for fundraising and use other approaches (see Venture financing).

2. *Direct investment* in innovative companies is carried out by various investors from the public and private sectors. These are public, private and mixed funds and organizations that support research and development through grants and state procurements of R & D and innovative products. In addition the indirect financing is carried out through the provision of various tax benefits and other preferences for innovative firms (tax breaks, government loan guarantees, export subsidies, etc.).

3. *Public financing* as an example of fundraising for innovation (see Section 6.2.).

4. *Venture financing* (see. Section 6.3).

[109] Since 2009, at the Moscow Stock Exchange the Market for Innovations and Investment for young high-tech companies operates. The main objective of this sector is to help attracting investments for the development of small and medium-sized innovative Russian companies. For more details see: http://moex.com/s25

5. Crowdfunding[110] a relatively new, promising, rapidly growing method of funding for various, including innovative, projects. It looks particularly attractive because of the difficulty to get cheap loans and venture capital, as well as the limited market of seed funds for start-up projects.

Crowdfunding or collective financing is a technology for mobilization of financial resources of a large number of participants for the creation and dissemination of innovative products on a commercial basis or free of charge through specialized Internet sites. In fact, this method of financing allows connecting developers of radical and improving innovations with many small investors which together possess significant financial resources for the implementation of socio-entrepreneurial projects.

Crowdfunding is also a powerful and useful tool for the marketing of innovative products, sensing sales markets and business development. Through Internet sites designed specifically for crowdfunding, many creative people have got an opportunity to present their projects and collect money for their realization.

As for sponsors and funders, it is a unique opportunity to become the first owners of a new product and to support their favorite idea. Therefore, internet fundraising promotes the pace of development and implementation of innovative projects. Currently, there are four business models used on crowdfunding sites: Kickstarter, Indiegogo, Planeta and Boomstarter.[111]

***4. Indirect financing***

Indirect public financing of innovative projects is carried out in the form of:
• *tax benefits* for high-tech businesses, such as tax deductions, tax credits and tax holidays, as well as other forms of preferential tax treatment of R & D activities;
•*accelerated depreciation,* which reduces the income tax payments;

[110] For more detail see: Crowdfunding as a modern model to finance innovative projects [Russian] Available from: https://ru.intel.com/business/community/lofiversion/index.php/t9701.html

[111].For more details on the international practice of crowdfunding see: New Approaches to SME and Entrepreneurship Financing: Broadening the Range of Instruments, OECD 2015

• *easy loans*, i.e. commercial loans with reduced interest rate and guarantees of the state.

The main tools of innovation financing are presented in the Table 6.3.

Table 6.3

**Major financing instruments for promoting innovation**[112]

| Financing instrument | Key features in financing | Remarks |
|---|---|---|
| Bank loan | Used as one of the most common tools for access to finance, It needs collateral or guarantees in exchange for loans. | Obligation to repay as debt |
| Grant, subsidy | Used as seed funding for innovative start-ups and SMEs at the seed and early stage: small business innovation research in the United States, the United Kingdom and the Netherlands; feed-in-tariffs in Denmark and Germany: OSEO funding in France; Innovation Investment Fund in the United Kingdom. | Complements market failures, financing at seed and initial stage |
| Business angel | Financing source at early riskier stage and provides financing, advice and mentoring on business management. Tends to invest in the form of groups and networks, *e.g.* Tech Coast Angels and Common ANGELS in the United States, Seraphim Fund in the United Kingdom. | Financing at start-up and early stage |
| Venture capital | Tends increasingly to invest at later, less risky growth stage. Referred to as patient capital owing to the lengthy time span (10-12 years) for investing, maturing and finally exiting, *e.g.* Pre-seed Fund and Innovation Investment Fund in Australia, Yozma Fund in Israel, Seed Fund Vera in Finland, Scottish Co-investment Fund in the United Kingdom. | Financing at later expansion stage |
| Corporate venturing | Used by large firms to invest in innovative start-ups with a view to improving corporate competitiveness with either strategic or financial objectives. | Strategic motive |
| Crowd funding | A collective funding tool via the Internet which makes it easier for small businesses to raise capital at the seed and early stages. | Potential for fraud |
| Tax incentive | A broad range of tax incentives for R&D and entrepreneurial investments in most countries, *e.g.* Enterprise Investment Scheme in the United Kingdom, tax relief on the wealth tax (ISF) in France, Business Expansion Scheme in Ireland. | Indirect, non-discriminatory |

[112] *Financing business R&D and innovation*. Available from https://www.oecd.org/sti/outlook/eoutlook/stipolicyprofiles/competencestoinnovate/financingbusinessrdandinnovation.htm

## 6.2. Public financing of innovative activities

In developed countries, the government uses the state budget funds for direct and indirect support to research institutes, innovation infrastructure, public, private and mixed companies, carrying out innovative projects (see Fig. 6.2.).

In OECD countries, the government uses both direct funding (grants, contracts), and indirect financing (tax incentives, etc.) to promote R & D. In 2015, in 28 OECD countries the states provided tax incentives to companies conducting R & D. According to the data, Russia[113], Korea, and France provided the maximum combined support to R & D conducted by the private sector (% of GDP), while the US, China and France have provided maximum tax incentives. As a whole for the period of 2006-2013 the tax incentives to the private sector for R & D increased in all countries except Italy, Mexico and New Zealand.

Let us consider organization of public funding of innovative sector in Russia.

***System of budget financing of innovation sphere in Russia***

The Russian government promotes innovations, included in the national innovation program. This support is provided mainly in the form of direct funding from the state budget.

The federal budget funds are allocated to:

1. funding for state scientific and technical programs through contracts and state procurement;
2. funding for earmarked budgetary funds (RFBR, RHF, Promotion Fund, Industrial Development Fund, and others) for allocation of grants for innovative projects;
3. financing the "strategic core" the academic science and higher school sector, as well as public research centers and unique objects.

[113] The process of Russia joining the OECD has been suspended in 2014

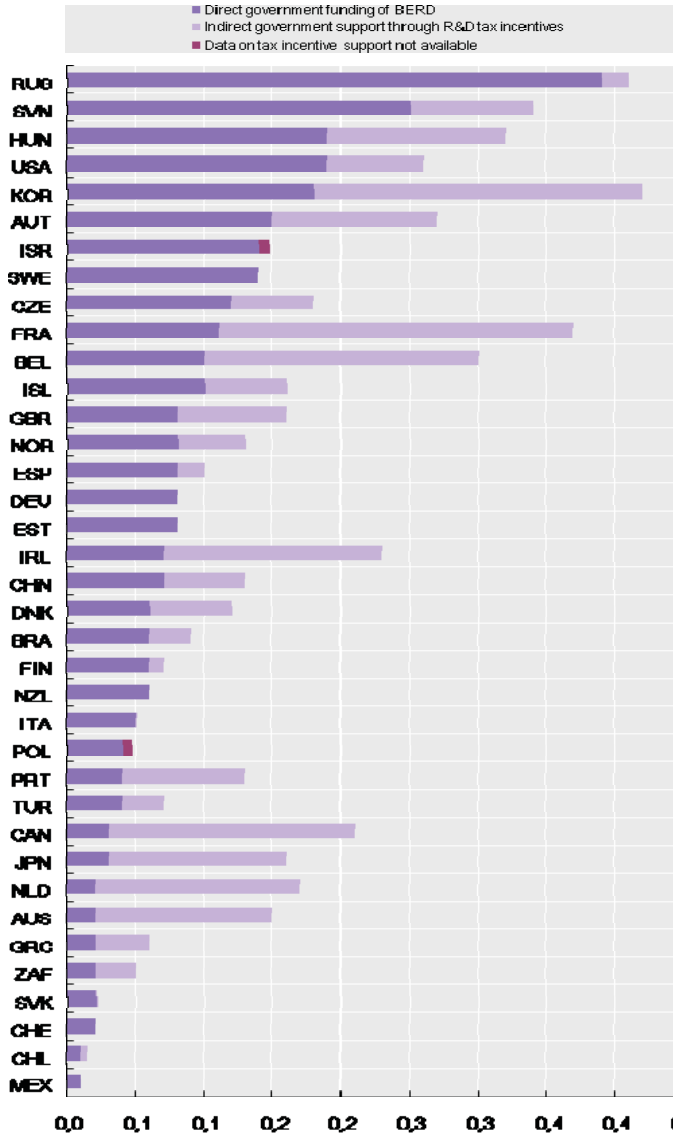


Fig. 6.2. Direct public funding for private sector R & D and tax incentives for R & D (% of GDP)

Source*:* OECD, *Main Science and Technology Indicators Database*, *June 2015, p. 170.* Available from www.oecd.org/sti/msti.htm

The structure of budgetary financing of the innovation sphere in Russia is shown in Fig. 6.3:

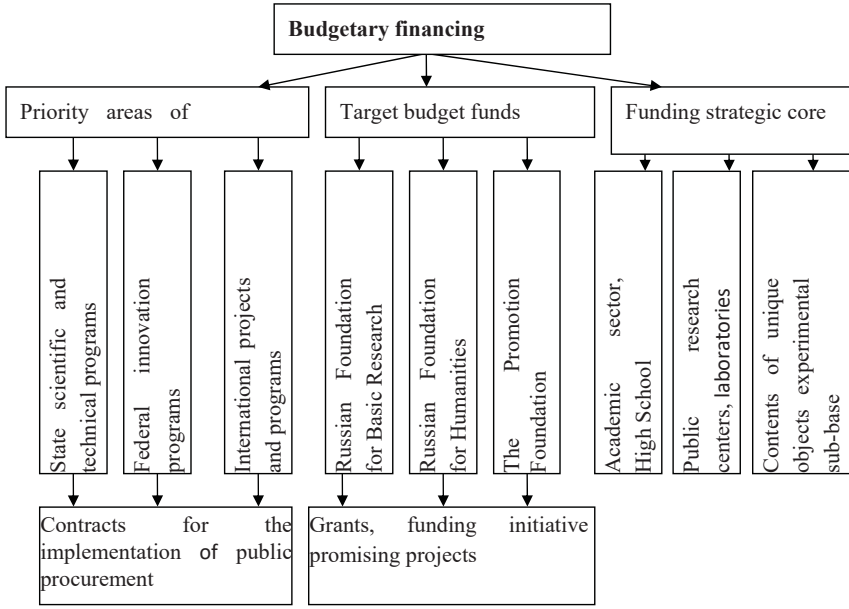


Fig. 6.3. State budget financing of innovations

### *1. State financing of priority directions of scientific and technical progress*

The Russian Government approves the budget allocation for "Innovations and innovative activity" for the state customers of the federal innovative programs, and the federal executive bodies. The budget allocations for the development and implementation of innovations may vary significantly over time.

In 2016, the priority programs of the state policy of the Russian Federation in hi-tech area, which received funding from the state budget, were the following federal programs:

• "National technological base";

- "Federal space program of Russia for 2016 2025";
- "Development of pharmaceuticals and medical industry of the RF until 2020";
- "Nuclear power technologies of the new generation for the period until 2020";
- "Promotion, development and use of GLONASS system until 2020";
- "Development of civil marine equipment" and other.

***2. State earmarked budgetary funds***

*The Russian Foundation for Basic Research (RFBR)* a self-governing state organization under the Government of the Russian Federation will organize a competitive selection of fundamental research proposed research institutions and groups, provides grant funding of selected projects.

Russian Foundation for Basic Research supports fundamental research in the following areas of expertise:

- Mathematics, Mechanics and Computer Science;
- Physics, astronomy;
- Chemistry and materials science;
- Biology and medical science;
- Earth sciences;
- Science of man and society;
- Information technology and computer systems;
- Fundamentals of engineering sciences.

Over the period activities of the Fund, an extensive system of competitions initiative projects, major contests, regional competitions and international competitions. The Foundation supports projects for the publication of scientific papers, organization of scientific events, development of the experimental base of scientific research, the creation and development of information, computing and telecommunication resources.

International activity provides funding for joint projects between Russian and foreign scientists. Fund created and developed Scientific Electronic Library http://www.elibrary.ru/defaultx.asp. Since 2004, through the library, Russian scientists have had access to information resources of foreign publishers.

The fund was generated in rubles and foreign currency at the expense of public spending, voluntary contributions of enterprises, organizations and individuals, including foreign legal entities and individuals, and other sources of funds.

*The Russian Foundation for Humanities (RFH)* is one of the main sources of funding for Humanities research in Russia. The main purpose of the Foundation is to support humanitarian research and dissemination of humanitarian scientific knowledge in society. The Foundation holds several dozen contests of various kinds on the history, archaeology, Ethnography, Economics, philosophy, sociology, political science, law, sociology of science, Philology, art history, psychology, integrated study of human psychology and pedagogy. Every year in the framework of competitions RFH initiative supports research projects, publication of scientific papers, projects for the development of scientific telecommunications and material base of scientific research, etc. Publishing program RFH is the largest in Russia in the field of academic publishing.

*The Promotion Foundation ("The Bortnik Fund")* – state profit organization established to provide financial support for R & D companies is in the early stages of the innovation development.

The Promotion Foundation currently conducts programs that are aimed at creation of new and development of operating small high-tech companies and commercialization of scientific and technological products. It also facilitates attraction of private investment to small innovative businesses and new jobs creation. The Promotion Foundation annually provides financial support to more than 1,500 small innovative businesses in more than 150 cities of the RF. So far, the Fund has supported more than 9700 projects from 75 subjects of the RF.

Thanks to the support of the Promotion Foundation small innovative companies have managed to develop sustainable high-tech businesses, attractive to domestic and foreign investors.

The main priorities of the Fund's activities in the coming years will be:

- support to small high-tech companies;
- scaling of pre-seed and seed financing programs, the involvement of young specialists in innovative activities;
- further interaction with development institutions, as well as active participation in the implementation of *innovative lift* mechanism and support to small innovative enterprises (SIE's) at universities and research institutes;
- further development of a regional network of representative offices of the Foundation, the involvement of new regions in the innovation process;
- grant support to SIEs, support to creation and promotion of the certification centers and the patenting of intellectual property;
- promotion of export-oriented SIEs and their integration in the international innovation environment.

Many SIEs supported by the Promotion Foundation in the 1990s have grown to date into leading manufacturers of innovative goods and in their category they supply 5 - 20% (sometimes even up to 50%) of the total production of these goods in the country. This, for example, refers to the production of software products, dental products and equipment, veterinary products, analytical instruments, instruments of security and fire alarm systems.

Analytical equipment, scientific instruments, instruments for ecological monitoring and diagnostic devices, designed and manufactured by the Russian SIEs, have successfully entered the international market. Their technical level and consumer characteristics match the level of their international competitors.

More than 1,000 patented inventions supported by the Fund were used for production of high-tech products worth billions of rubles. Tax deductions of SIEs

exceeded 2.4 times the amount of their budgetary funding, the cost of funded SIEs' fixed assets increased 11.3 times, and the output per worker - 12.7 times. Thousands of jobs have been created. The annual output growth during six years exceeded 30%, personnel have grown 2.5 times and the production areas increased 15 times. It is noteworthy that the main sources of investment growth in these companies were their own and extra-budgetary funds. In this way, relatively small budget funding injections by the Promotion Fund have played a role of a catalyst and stimulated the private capital investment.[114]

In 2016 The Promotion Foundation has performed the programs Egghead, Start, Development, Internationalization, Commercialization, and Cooperation. Brief information about these programs is given in Table. 2.1

Table 2.1

**Programs implemented by the Promotion Foundation to support innovations in 2016**[115].

| | |
|---|---|
| *Egghead* (for young innovators)<br>Support to talented young people, focused on innovation. Program participants - young scientists at the age of 18 to 28 years old. The best projects will receive financial support up to 400 thousand rubles for two years | *Start* (for start-ups)<br>Support to small innovative companies (up to 2 years old) at the seed stage. Eligible are companies with annual revenues up to 1 million rubles, as well as individuals (subject to registration of the legal entity within one month after publication of results). |
| *Development* (for companies)<br>Support for projects in priority areas of science and technology. The program is aimed at the development of domestic high-tech products market, the commercialization of scientific and technical activities, the new jobs creation in the high-tech sector. | *Internationalization* (for companies)<br>Promotion of international cooperation, support for the development of non-primary export-oriented production projects. |
| *Commercialization* (for companies)<br>Support for SIEs, which have completed the R&D and plan to establish or expand innovative | *Cooperation* (for large companies)<br>Support for innovation activities in cooperation of large companies with small |

[114] For more detail see: http://fasie.ru/success/

[115] Available from: http://fasie.ru/programs/

| | |
|---|---|
| goods production. | businesses. The purpose of the program is using small high-tech business potential for the development of product lines of large companies, the creation of new and renovation of existing facilities. |

In Russia, there are other successful funds that contribute to the development of innovative processes in the economy. First of all, the budget funds - the Russian Foundation for Basic Research, Russian Foundation for Humanities and Russian Foundation for Industrial Development[116].

Particularly noteworthy is the participation of the state in the development of venture financing of innovation sphere and the creation of the most important institution of the venture capital industry OJSC "Russian Venture Company", RVC.

***3. Public funding of the strategic core***

Academic sector is a leading institution exercising fundamental research, the main recipient of budgetary funds for specific programs of strategic national importance.

In recent years, the state attaches great importance to the role of university innovations. A program for obtaining grant universities for innovation. Highlighted the top 10 innovative universities in the country, who have a full government funding.

The system of public research centers (PRC) a key element of the national innovation system in the generation of knowledge; the translation of this knowledge in knowledge-intensive goods and training of scientific and engineering personnel. Research centers are major scientific and engineering and technological systems that perform a complete cycle of the fundamental and exploratory research to develop new techniques and technologies for the industrial economy of national security and defense.

[116] For more details see: http://www.rfbr.ru , http://www.rhf.ru, http://www.frprf.ru

## 6.3. Venture financing of innovation

The venture financing is a special type of financing of innovative firms, frequently young small high-tech firms, in expectation of receiving a high rate of return on invested capital due to the rapid growth of the company value. Venture funding is provided by both non-institutional investors, the so-called business angels, and institutional investors, which, despite the specifics of their organization, we can call venture funds.

*Financing of small and medium-sized enterprises*

The above-mentioned sources of financing of innovative projects, financing such as equity and debt, are available primarily to large firms and institutions. As for the newly established small high-tech firms, the sources of funding are limited and vary considerably in different periods of their growth. Among them there is venture financing that plays the most important role.

In the professional literature the stages of small hi-tech companies' growth are identified as follows:

1. Early stages of small high-tech company growth:

- "Pre-seed" stage: there is an idea. The goal to create a layout of the product;
- "Seed" stage: there is a layout. The goal to create a prototype of the product;
- "Start-up" stage: there is a prototype of the product. The goal to organize a small-scale production.
- "Early growth" stage: there is a small-scale production. The goal to develop a full-scale production, to ensure growth of sales, to obtain profits.

2. Later stages of small high-tech company growth:

- "Follow-on" stages: the goal mass production and profit growth;
- "Expansion" stage: the goal acquisition of leading positions on the market;

3. Exit stages of the company's venture capital investors, "Stage of

foreclosure":

- Management buy-out, MBO – purchase by managers of the company;
- Management buy-in, MBI purchase by third-party managers;
- Company is converted from private to public company, Initial Public Offering - I P O

At earlystages, when the young firm has neither profit, nor credit history, its sources of financing are very limited in American terminology they are: 1. FFF - family, friends, "fools". Family provides personal savings of the founders, friends can loan money, and "fools", those people who believe in the future success of the company; 2. Grants from different, mainly public, funds; 3. Venture capital provided by non-institutional and institutional investors, i.e. the so-called business angels and venture capital funds.

At later stages of development, when the small company has been able to market its innovative products and has started making profit, it gradually is getting access to the standard sources of financing – bank loans, bonds, shares through IPO. Funding sources for various stages of company's life are schematically shown in Fig. 6.3.

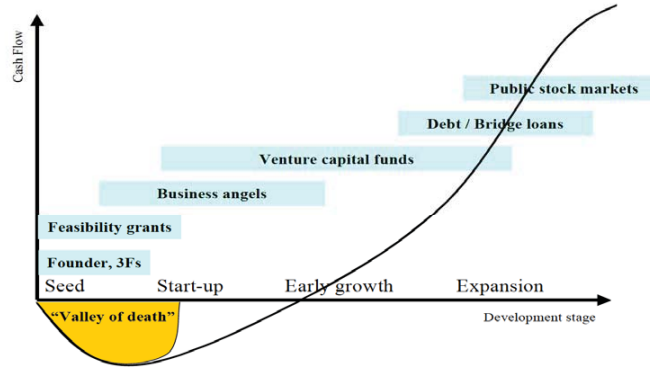


**Figure. Development Stages, Cash Flow, and Sources of Finance**

Venture investors put their money in equity by buying shares of the company (usually less than a controlling share). Venture capitalists believe that it is a promising high-tech company with a great potential for growth. They become co-owners of the firm; sometimes they also provide loans to the company. This source of funding is vitally necessary for young high-tech companies, since it is difficult to obtain credit or to place bonds.

The meaning of investing in such businesses is that after the direct venture capital investment, loans, and intellectual and organizational assistance from investors, the company begins to grow successfully and its value rises sharply. At the peak of prices, venture capitalists sell their shares in the company and fix their profits. This point is called the “exit” from the invested company. It is difficult to determine in advance when the "exit" out of the company will take place it may take 5-7 -11 years, depending on the situation. Different investors: managers of the firm, managers of other firms, strategic investors, the general public (in during the IPO) buy shares of the company. Professional venture capitalists usually invest share sales revenues in the next venture projects.

Venture capital is a long term high-risk capital invested by professional non-institutional and institutional investors in the stock (shares) of potentially high-growth companies. Venture capitalists by acquiring share in the stock and extending loans share all risks with the company. Despite the assistance with choosing development strategies, establishing business contacts, and assessment of potential markets for innovative products, projects often turn out to be unsuccessful and venture investors lose their money. Venture capitalists, including business angels, use all possible measures to reduce the risks of investment. First of all, they carefully select objects for investment. They pay special attention to how creative management team of the company is. Venture capitalists consider many offers from different companies and use their expertise to assess the feasibility and prospects of the proposed projects. Business angels join associations and use expert opportunities of all members of the association to select worthy

projects. Venture funds, which accumulate means of many individual and institutional investors, transfer the responsibility to choose investment projects to special investment management companies composed of professionals and experts. In addition to the investment, venture capitalists provide significant assistance to companies in their positioning in the market.

The main method to reduce the risks of venture capital investing is to diversify the objects of investment across industries and countries, in the hope that the decline in one industry (country) will be compensated by the successful development of other industry (country). Diversification also goes through investments in companies at various stages of development. The earlier the stage, the more uncertain is the result and higher risk of investment. Even the most professional venture funds and business angels have failure projects. But professionals compensate for their losses by super-profits from successful projects.

The most advanced at the moment is the venture capital in the United States. It also develops successfully in the European Union. Some progress has also been achieved in the development of venture investment industry in Russia.

**The set of Frequently Asked Questions about venture capital is given below. Answers are based mainly on statistics from the USA:**

*1."What kind of investors are venture capitalists?*

Venture capitalists are professional investors who specialize in funding and building young, innovative enterprises. Venture capitalists are long-term investors who take a hands-on approach with all of their investments and actively work with entrepreneurial management teams in order to build great companies.

*2. Where do venture capitalists get their money?*

Most venture capital firms raise their "funds" from institutional investors, such as pension funds, insurance companies, endowments, foundations, family offices, and high net worth individuals. The investors who invest in venture capital funds are referred to as "limited partners." Venture capitalists, who manage the fund, are referred to as "general partners." The general partners have a fiduciary responsibility to their limited partners.

*3. How many venture capital firms are there in the U.S.?*

In 2010, there were 462 active US venture capital firms defined as investing at least $5 million in companies. This compares with 1,022 such firms at the height of the tech bubble in

2000. If you define the universe of US venture capital firms as those raising money in any of the last 8 years, the 2010 count was 791. These firms managed $176.7 billion in committed capital.

*4. What's the average size of a venture capital fund in the USA?*

In 2010, the average venture fund size was $149 million.

*5. How many companies receive venture capital financing in the USA each year?*

In 2010, venture capitalists invested approximately $22 billion into nearly 2,749 companies. Of these, 1,001 companies received funding for the first time.

*6. What types of companies and industries do venture capitalists invest in?*

Venture capitalists invest mostly in young, private companies that have great potential for innovation and growth. Venture capitalists have been instrumental in developing sectors such as the computer, biotechnology and the communications industries. Today, the majority of venture capital is invested in high technology companies including software, biotechnology, medical devices, media and entertainment, wireless communications, Internet, and networking. In the last five years, the venture industry has also committed itself to investing in the clean technology sectors which include renewable energy, environmental and sustainability technologies and power management. However, venture capitalists also invest in innovative companies within more traditional industries such as consumer products, manufacturing, financial services, and healthcare services and business products and services.

*7. What impact does venture capital have on the economy?*

Venture capital activity has a significant impact on the U.S and global economies. Venture capital is a catalyst for job creation, innovation, technology advancement, international competitiveness and increased tax revenues. According to the 2011 Venture Impact study, produced by IHS Global Insight, originally venture-backed companies accounted for 11.87 million jobs and over $3.1 trillion in revenue in the United States (based on 2010 data). Those totals compare to 21% of GDP and 11% of private sector employment.

*8. How are venture capitalists different from other investors?*

Venture capitalists are long-term investors who play a very active role in their portfolio companies. When a venture capitalist makes an investment he/she does not expect a return on that investment for 7-10 years, on average. The initial investment is just the beginning of a long relationship between the venture capitalist and entrepreneur. Venture capitalists provide great value by providing capital and management expertise. Venture capitalists often are invaluable in building strong management teams, managing rapid growth and facilitating strategic partnerships.

*9. How do venture capitalists realize a return on their investment?*

The companies that venture capitalists invest in are private enterprises. Typically, the venture capitalist realizes a return on their investment when the company goes public (IPO) or is merged or purchased by another company (M&A).

*10. What percentage of venture-backed companies succeed?*

Venture capitalists invest in high-risk enterprises. However, venture capitalists manage that risk through portfolio risk management. It is estimated that 40 percent of venture backed companies fail; 40 percent return moderate amounts of capital; and only 20 percent or less produce high returns. It is the small percentage of high return deals that are most responsible for the venture capital industry consistently performing above the public markets.

*11.How does angel investing differ from venture capital?*

Venture capital firms are professional investors who dedicate 100% of their time to investing and building innovative companies on behalf of third party investors or their limited partners. The angel investment community is a more informal network of investors who invest in companies for their own interests. Typically, angel investors invest less than $1 million in any particular company, whereas venture capitalists usually invest more than $1 million per company.

*12. What's the difference between venture capital and private equity?*

Venture capital is a subset of the larger private equity asset class. The private equity asset class includes venture capital, buyouts, and mezzanine investment activity. Venture capital focuses on investing in private, young, fast growing companies. Buyout and mezzanine investing focuses on investing in more mature companies. Venture capitalists also invest cash for equity. Unlike buyout professionals, venture capitalists do not use leverage in their transactions.

*13. What impact does corporate venture investing have on the venture industry?*

Many corporations have been active venture capital investors for many years. Corporate venture capitalists often co-invest with traditional venture capitalists. Besides being savvy investors, many corporate venture capitalists provide their portfolio companies access to corporate distribution channels and potentially important strategic partners."

Source: available from *nvca.org/index.php?option=com...id*

### *Venture Capital in Russia*

The scope of the venture capital industry, now existing in the world, is estimated at $100 billion. It is represented by formal institutional and informal sectors. The institutional sector is represented by venture capital funds (mainly

partnerships), which concentrate resources of corporations, insurance funds, private and public pension funds, individuals and other. Informal sector is represented by unincorporated private investors.

Governments in developed industrial countries together with private businesses participate actively in the venture capital industry. The purpose of public financing of venture projects is to accelerate the innovation process and promote economic growth and new jobs creation. OECD governments annually invest about $ 3 billion in risky venture financing. They develop and implement special programs. As part of these programs government provide funding to innovative businesses, create financial and other incentives for private investment in risky projects, and improve the legislation. At the moment, in developed industrialized countries large experience of governments in this area have already been accumulated. There are many variants of direct and indirect aid to the venture capital industry. Despite their differences, all of them seek private capital participation in the innovation business.

In just two decades the venture investment industry in Russia has emerged. During the period of 2010-2012 the Russian venture market tripled, and the total amount of venture capital transactions in Russia reached the level of 30-32 billion rubles. However, in 2013, when the Russian economy has suffered from crisis, the venture industry also manifested fall in the volume and number of venture capital deals; investors' activity shrinked.

The main goal that the Russian venture industry faces is to achieve sustainable reproduction of venture capital for the development of a national system of innovation and technological entrepreneurship in Russia.

For the Russian innovation business the venture investing is one of the most promising instruments to fill the "gaps" between the financial needs of young technology companies that have not yet reached the break-even point, and the requirements of traditional sources of capital  financial and credit institutions, private equity funds, institutional investors, and capital market exchange

instruments. This venture investment industry does not only solve the problem of raising capital for the innovation segment of the economy, but also acts as an effective system of selection for the high quality projects competitive in national and international high-tech markets.[117]

Each of the described above sources of financing has its advantages and disadvantages, therefore, it is necessary to develop alternative options based on a combination of different forms of funding. For each innovation project various schemes of financing should be carefully assessed.

***Question for discussion:***

1. Sources of innovative projects financing.
2. What elements of the company's own funds can be used to finance innovation?
3. Conditions for obtaining borrowed funds to finance innovative activities.
4. Funds raised to finance innovative activity.
5. Crowdfunding to finance innovative projects.
6. Elements of indirect innovation financing.
7. Features of venture financing.
8. “Business angels” and innovation financing.
9. Ways to minimize the risk of venture investors.
10. Investors’ ”exit strategies” from financed projects.

[117] Draft of the Strategy for VC Industry Development in the Russian Federation, Moscow, 2015 - http://www.rusventure.ru [Rusian].

## Chapter 7. Innovative projects: efficiency and risks

### 7.1. Innovative project and its main participants

Innovation has become a major factor of economic growth in the post-industrial era. This is due to the acceleration of information and technological exchange. If ten years ago, a successful innovation enabled company to remain a leader and show high profitability for several years, today any good idea can be quickly replicated. In result the leader quickly loses its competitive advantage that forces him to develop and implement new innovation.

Today, innovation is not a one-time event, but a continuous process, a kind of assembly line, when a stream of new ideas is brought to their practical implementation in the finished products. Statistics show that less than 10 out of 100 ideas come to implementation stage and only one of them gives a significant economic effect. The effectiveness of innovation projects is hard to predict in advance and often forecasts are only qualitative. That uncertainty of the work duration, unpredictability of costs and scientific results distinguish innovative projects from ordinary investment projects. Innovation projects require special approaches to the organization of work, financing and project evaluation.

Development and implementation of innovations is carried out in innovative projects. Project is a temporary activity designed to create unique products, services or other results.[118]

In practice it is difficult to differentiate between innovative and ordinary investment project. Project work is usually combined with the ongoing operating activity of the company. The American and European management tend to single out projects into a separate organizational team with broad powers. It allows quickly solving management problems and defines strict responsibility of the team members for the final result. For Russia, more typical is the functional model of

[118] A guide to the project management body of knowledge (PMBOK guide). -- Fifth edition. Project Management Institute. 2013. http://www.pmi.org/PMBOK-Guide-and-Standards.aspx

project implementation, when project work is distributed among existing functional departments and project work merges with other activities of the company. Therefore, in Russia innovations are often associated with businesses as a whole, rather than with individual projects. Usually, company is considered "innovative" on the following grounds:

•high share of R & D spending in the total costs of the company;

• high share of innovative products in the company's output;

• number of advanced production technologies;

• number of patents on intellectual property;

• number of employees engaged in R&D.

The process of innovation creation goes through several stages, known as R& D.

Creation and implementation of innovations is a kind of business, which should provide profit. Therefore, a systemic view on all the work from idea to disposal of production is needed. In foreign practice it is called *product lifecycle management*, PLM, which is based on special integrated information systems Continuous Acquisition and Life Cycle Support, CALS.

In most cases, the work on creation and implementation of innovations is carried out by several different organizations that use different management methods and different sources of funding. The most significant scientific developments are created as results of fundamental research carried out at academic institutions and universities. They are funded through targeted public research programs and research foundations. The discovery of a scientific result generates the desire to find a practical application. At this stage, numerous private laboratories join the research activity they are trying to create prototypes of products or working models of innovative equipment. The difficulty to anticipate the future results makes the investment in such research too risky, therefore special investors are needed venture capital funds. These financial institutions combine

means of many investors into a single pool to fund several projects simultaneously, which allows spreading investment risks.

The result of R&D is the creation of intellectual property objects and prototypes that will demonstrate the prospects of new products (services). From this point it is possible to estimate the cost of products, their competitiveness, to make preliminary calculations of cost-effectiveness and to compose a business plan for the investment project.

At this stage of the project industrial companies, banks and a wide range of other investors reveal their interest to the project. Now developers can borrow to develop production, sell stakes in their assets to investors, to issue licenses for their intellectual property to industrial companies and attract financing in other ways.

Thus, the innovative project consists of several stages and combines many participants. The main participants of the innovation project are:

*Customer* is the individual or legal entity that will own and use the results of the project.

*Investor* is the individual or legal entity that invests in the project.

*Designer* (*planner*) is the project developer that is typically a specialized design organization, which develops project documentation.

*Provider* is the person (usually legal), who provides logistics for the project.

*Contractor* is a person responsible for the timely execution of works contract.

*Project Manager* is the person, who is authorized by the customer to implement the project.

Multiplicity of participants and work stages leads to different understanding of the notion "efficiency of the project." One can think of private economic effects for the individual participants or the integral effect as total benefits versus total costs during the entire period of the product lifecycle. It is also important that many research studies not only solve certain scientific problems, but also generate numerous synergies in related areas of the economy. For example, in space

exploration, the effect of the use of space technologies in other industries four times exceeds the effect from the space activities themselves. At the same time, these related effects are not known to developers beforehand and, therefore, may not be taken into account in the formation of business plans and valuation of investments.

The modern practice of innovative projects evaluation is based on system approach (PLM), but for this purpose a body that will monitor the entire chain of works on creation and implementation of innovation is needed. Usually this function is taken on by a large corporation or public customer (ministry, agency), which will become a potential user of the innovation. This body defines the work objectives, forms plans, selects the participants, provides funding and on the basis of CALS-systems monitors the achievement of the desired results. In the absence of a coordinating body, it is impossible to create a consolidated plan, and the project splits into several sub-projects carried out by different organizations: R & D project, construction work and industrial project for the production of innovative products, etc. It is important to understand that an economic assessment of the innovation project efficiency can be made only at the final stages of prototype development. In the early stages of R & D the effect is measured only by certain scientific and technical results compared with total resources allocated.

### 7.2. Specific features of innovative projects efficiency evaluation

An innovative project is realized in several steps. Each development and implementation stage of the project has its own objectives, tasks and implementation approaches, that`s why the efficiency assessment breaks up into two stages:

Efficiency assessment of R&D stage in the Project;

Project efficiency assessment at a stage of commercialization of results.

The specific feature of R&D stage is its duration and the absence of economic criteria of work efficiency. At these stages the possibility of idea realization is not obvious yet, the data on the structure and volume of the forthcoming works, expenses, competitiveness of future production and its price are not known yet. In such situation the effect is characterized by the received scientific and technical results, in other words by readiness of the product for practical application. The degree of readiness allows to define efforts for bringing technology to the necessary level and to justify investments for further works.

In every industry there is its own idea of production life cycle structure which is characterized by special events  milestones. These milestones characterize the level of product readiness and are fixed in industry standards in the form of various readiness scales.

Scales of technological readiness (Technology Readiness Level, TRL) which reflect readiness of product for the mass production are usually used. Below is the example of such scale for the National Aeronautics and Space Administration (NASA). It consists of nine levels covering all kinds of work for creation of space equipment from the initial idea formulation until carrying out of flight tests.

TRL 1 – Statement and publication of the basic technology principles.

TRL 2 – Formulation of the technology concept and assessment of the application area.

TRL 3 – Beginning of R&D works. Confirmation of characteristics.

TRL 4 –Checking the basic technological components in laboratory.

TRL 5 – Checking of the main technological components in real conditions.

TRL 6 – Tests of model or prototype in real practice.

TRL 7 – Demonstration of prototype under operating conditions.

TRL 8 – Completion of development and system testing under operating conditions.

TRL 9 – Demonstration of the final technology during the sample flight tests.

Similar scales exist in the oil and gas industry, medicine, power and other industries. By making report on carried-out works, the developer fills in the special questionnaire and deduces the rate of work completion on each level. Achievement of a final aim on the previous level allows attracting financing to continue work. The costs and terms of each stage completion are entered in the technological information databases. This information is used for the assessment of forthcoming expenses on the project and for the analysis of other similar projects.TRL usage is recommended for the innovative projects management by the European association of R&D organizations (EARTO).[119] At the moment the question of using this technique in ISO standards is actively discussed. It will allow to simplify the international research cooperation. In Russia the problem of TRL introduction is complicated by methodical and conceptual differences in the description of innovation life cycle stages. It does not allow using foreign experience widely, and own developments are implemented only partially, mostly on the level of large corporations.

As difficult projects aren't limited by the separate new technologies development but combine many different innovations, there are additional scales for other readiness indicators assessment:

Manufacturing Readiness Level, MRL production readiness for the serial production;

Engineering and Manufacturing Readiness Level, EMRL;

Programmatic Readiness Levels, PRL – readiness of information support;

Logistics Readiness Level, LRL logistic readiness;

Human Readiness Level, HRL personnel readiness;

Cost Readiness Levels, CRL characterizes the accuracy of expenses for completion of the project forecast.

There are also scales for integral assessment of readiness of complex technical systems System Readiness Level, SRL.

[119] The TRL Scale as a Research & Innovation Policy Tool, EARTO Recommendations April 2014. http://www.earto.eu/

In domestic project management practice the readiness industry scales are not widely used yet and for R&D stage project assessment a subjective qualitative criteria and an expert assessment are used. This causes problems in the selection of the best projects.

The highest level of readiness is the ability to start industrial manufacturing of the product. At this stage samples of the products are already created and tested, their consumer properties are known; competitiveness and other parameters are estimated. Further work on the organization of serial production is already standard: development of a detailed Work Breakdown Structure, WBS, and schedule. A visual representation of the project work in various diagrams allows to calculate the duration of the project, see the planning errors and to allocate resources optimally. As a result, spending planning error is reduced to 5-10%, which allows the use of these data in the project budget model.

The basic method of planning at the stage of implementation of innovations is development of a project financial model (budget approach), which is similar to the usual assessment of investment projects and consists of detailed counting of all cash flows. The popularity of the budget approach is explained by the maximum visibility of calculations. Even significant errors in forecasted revenues and expenses do not impede comparing of different versions of the project.

*Quantitative methods of innovative projects efficiency evaluation:*

Existing methods of investment efficiency evaluation are based on quantitative assessments, and use a standard set of key performance indicators:

Net Present Value - NPV;

Profitability Index - PI;

Internal Rate of Return - IRR,%;

Payback Period with Discounting - DPP;

All these indicators take into account the effect of time value of money: the purchasing power of today's money is higher than the purchasing power of the same amount of money in the future. This is due to inflation, the interest rate

forgone and the risk of default. The process of determining the present value of a payment or a stream of payments that is to be received in the future is called *discounting*. This method is defined in international and national requirements. It ensures uniformity of calculations and presentation of information to interested parties.

***1.Net present value, NPV***

NPV defines the difference between the sum of the discounted cash flows of the project and the sum of the discounted costs of the project and is calculated using the following formula:

$$NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+i_t)^t} - \sum_{t=1}^{T} \frac{I_t}{(1+i_t)^t}$$

where $T$ – is the life-time of the project;

$CFt$ – expected revenues in year $t$;

$I0$ – investment in year $t$;

$i$ - the discount rate.

The project is considered effective if NPV> 0. When choosing the best project c. p. preference is given to the alternative with the highest NPV. This method of comparing costs and benefits which accrue at different periods allows choosing the direction of profitable investments of limited financial resources in innovation projects. The strong point of this indicator is that it has a clear economic definition and takes into account the time value of money. It also accounts for the fact that the discount rate changes over time. The weak point is that it is an absolute indicator, so this method does not allow choosing between projects with different amounts of investment.

***2. Profitability Index, PI***

Profitability index is the ratio of the sum of the discounted cash flows to the sum of the discounted costs of the project. Calculation of profitability index (PI) is done according to the formula:

$$PI_t = \frac{\sum_{t=1}^{n} \frac{CF_t}{(1+i_t)^t}}{\sum_{t=1}^{n} \frac{I_t}{(1+i_t)^t}},$$

The numerator of this expression is the discounted value of the stream of expected future returns, and the denominator is the discounted value of investment during the life time of the project. In other words, two cash flows are compared here: revenues and costs, discounted to a single point in time. Profitability index, IR, is closely related to the previous indicator of Net Present Value, NPV. If the NPV is positive, the profitability index PI> 1, and vice versa. When PI>1 the innovation project is considered cost-effective. Otherwise, if PI <1 – the project is ineffective.

Given the shortage of funds, other things equal, the preference should be given to the project with the highest profitability index.

***3. Internal rate of return, IRR***

IRR (yield) is the compound annual rate of return earned by a long-term investment. IRR can also be defined as the discount rate that equalizes the present value of the revenues with the present value of costs. IRR is computed from the equation:

$$\sum_{t=1}^{T} \frac{CF_t}{(1+IRR)^t} - \sum_{t=1}^{T} \frac{I_t}{(1+IRR)^t} = 0$$

IRR calculation is often used as a first step in quantitative investment analysis. Innovation projects selected for further evaluation are those where computed IRR is not less than 15-20%. The calculated IRR is compared with the rate of return required by investors (so called *required rate of return*). If the IRR is equal or greater than the required rate of return, the project can be approved. If the project is completely financed by bank loans, the value of IRR indicates the upper

limit of the bank interest rate above which the project becomes economically inefficient.

In the case when funding comes from several sources, IRR corresponds to the upper limit of the "average" price of the financing, calculated as the weighted arithmetic average of different interest rates. For example, if 20% of funding comes as grants from the state budget (with the opportunity cost, say 4%), 40% comes from long-term loans at annual 12% and the remaining 40% of funding is raised through emission of bonds with annual 15% payments, then the price of funding , WACC, *weighted average cost of capital,* is:

4% • 0,2 + 12% • 0,4 + 15% •0,4 = 11,6%.

Once you know the yield and WACC, you can decide whether an investment is acceptable. If the yield, IRR, is greater than WACC and the required rate of return, then the investment is acceptable.

***4. Payback Period, DPBP***

Often calculated is the so-called payback period, PBP. Discounted Pay Back Period is the number of years during which the total discounted revenues earned are equal to the total discounted investments incurred.

$$DPBP = \frac{\sum_{1}^{T} \frac{I_t}{(1+i_t)^t}}{\sum_{t=1}^{T} \frac{CF_t}{(i+i_t)^t}},$$

Other things equal, preference is given to projects with a shorter payback period.

All of the above considered indicators require for computations information about expected cash flows. The very demand for accuracy of the input data is not realistic. For standard projects, this assumption can be made, but innovative projects are characterized by many uncertainties: the uncertainty of input data, the uncertainty in the external environment, and other. These factors of uncertainty

predetermine an increased risk of innovative projects and distinguish them from other investment projects.

***Qualitative assessment of innovative projects***

Together with quantitative methods to assess efficiency of innovative projects qualitative methods are used. The complexity of an objective assessment of the efficiency of innovative projects motivates stakeholders to focus not only on the forward-looking financial indicators, but also on non-financial approaches. The fundamental problem is to confirm the very feasibility of the project.

The decision-making is based on the discussion of ideas included in the list and further voting. Formalization of the selection procedure allows not only to find new ideas, but also to solve the inverse problem  do not try to cover everything at once.

Currently, the most popular method of project ranking is the score-rating analysis based on scorecards and the complex index of utility function. In practice, the process of the best project selection is greatly complicated by the fact that its assessment requires a multi- criteria analysis. So, either a multi-criteria approach, or a one generalized criteria approach should be used to select the best innovation project. The main disadvantage of all methods of rating is their subjectivity.

## 7.3 Analysis of innovative projects under risk

All the indicators of commercial efficiency of projects are based on forecasted future cash flows. Usually their accurate calculation is not possible due to the uncertainty of internal and external environment of the project.  Uncertainty may lead to negative changes in the project implementation and results. The possibility of negative impacts on business which may decrease its results is called the risk of the project.

Calculation of quantitative efficiency indicators are made on the basis of most probable averaged forecasts for the innovative projects, but it may lead to unacceptably large errors. For example, the marketing revenue forecast error for the sale of new products can reach 100 percent or more. In this case, the use of the average value will not allow the investor to make an informed conclusion on effectiveness of the project and its riskiness. Investor should assess not only the most likely value of efficiency, but also possible deviations. Evaluation of risky projects should always include two criteria: profitability and riskiness.

To analyze the risks several methods are used in design practice. The most popular approach to account for risk is the risk adjusted discount rate approach, RAD. This approach is usually combined with several other methods:

- Sensitivity analysis;
- Cost-Volume-Profit (CPV) analysis;
- The method of scenarios.

For calculation of NPV, PI, IRR the discounting of the cash flow at the time of evaluation using the discount rate is done. The discount rate is the lower limit for the yield on investments with similar risk. This yield should:

• cover inflation;

• provide real increase in the value of invested capital;

• compensate for the risk of investment.

The higher the risk the higher the required yield to the project, and respectively, the discount rate should grow. There are several ways to determine the discount rate:

- Cumulative Construction Method, CCM;
- Capital assets pricing model, CAPM;
- Weighted average cost of capital, WACC.

*The Cumulative Construction Method, CCM,* includes into the discount rate the risk-free discount rate, i.e., yield of the least risky types of investment: like the yield of T-bills and bank deposits of the first category of reliability, the Central

Bank refinancing rate and LIBOR (for currency investments). Then the risk premium depending on the nature of the investment project is added to the risk-free rate. The risk of the project can be evaluated on the following scale (see Table 7.1):

**Table 7.1**

**Type of the project and its riskiness**

| Risk level | Goals of the project (sample) | Probability of failure, P, % |
|---|---|---|
| Low | Investments in the intensification of production on the basis of existing equipment | 3-5 |
| Average | Increased sales of existing products | 8-10 |
| High | Production and marketing of a new product | 13-15 |
| Very high | Investments in research and innovation | 18-20 |

*Capital assets pricing model (CAPM)* is based on the analysis of the profitability of companies of a similar market segment. There, the risk premium captures the degree of fluctuations of stock returns of similar companies in comparison with the market average. The practical use of this method in Russia is difficult due to low activity of the stock market and it is used in practice only for evaluation of major projects.

*Weighted average cost of capital (WACC)* is the most popular method for calculation of discount rate for projects in existing enterprises. The discount rate there is equal to the weighted average cost of capital for the company.

Accounting for risks by adjusting the discount rate is the most popular method, but it has shortcomings. In practice, there are many different risks and it is not possible adequately incorporate them all in the risk premium. Therefore, the performed calculations require further analysis.

***Sensitivity analysis***

For sensitivity analysis in the project financial model we change the value of the relevant parameters and evaluate the corresponding change in performance indicators NPV, PI, IRR. Usually we evaluate the effect of the following factors:

- discount rate for the project;
- fixed and variable costs;

- volume of production and sales;
- selling price of the product;
- investment costs for the project;
- expenses on personnel.

Sensitivity is the ratio of the change of one of the performance indicators to the change of influencing factor. High sensitivity means that the factor with high sensitivity is an important factor for the project and requires special measures to control for the risk.

For the most important factors the *Cost-Volume-Profit analysis* to find the *breakeven point* is performed. This method allows us to find the critical value of relevant parameter at which the project becomes unprofitable. Usually we find a minimum volume of sales at which the NPV of the project vanishes to 0. If the difference between expected volume of sales and the break-even point is less than 15-20%, then the project is considered too risky.

***The method of scenarios***

The method of scenarios allows studying the sensitivity of the resulting indicators to variation of a set of exogenous parameters. The algorithm of investment risks analysis by this method is the following:

1. Determine several options of changes in relevant indicators (the pessimistic, the most probable and the optimistic variants);

2. Experts assess the probability of each option of parameter change;

3. For each option the expected value of the NPV is computed.

This way you can forecast the result of the negative impact of the set of influencing factors.

The method of scenarios is very time consuming and it is used only for large expensive projects with many different risks. Large number of scenarios allows constructing the probability – profitability diagram and using it for risk assessment. For simple projects only 1-2 pessimistic scenarios, which will show to investor his possible losses are analyzed.

A variant of scenario analysis is the Monte Carlo method. Scenarios are randomly generated based on known distributions of influencing factors. This allows quickly constructing the probability – profitability diagram, but the method requires many assumptions, which reduce its practical significance.

**Software for the evaluation of investment projects**

Special programs for investment analysis to evaluate efficiency of investment projects are developed. When choosing such programs we need to understand their capabilities and limitations.

*Programs and their capabilities*

Several programs are the most common in the Russian market. They are based on classical approaches to evaluation of investments. Developers of these packages regularly release new, more flexible versions. The number of users of software investment programs increases annually. There are also less well-known software packages that are based on spreadsheets and developed, as a rule, by consulting firms.[120]

All software products for investment projects analysis use common approaches. It is better to consider such packages as some tools, each of which is applicable in a particular situation. Currently, the functionality of the latest versions of packages to perform computations to assess investment projects is at the same level.

At the moment, all the software allow to:

• develop a comprehensive financial plan and assess the need for cash in the future;

• define scheme of the project financing;

• assess the feasibility and effectiveness of raising funds from different sources of funding;

• develop a plan for the production and development of the enterprise;

[120] For more details see Bersenev, N. *Software for evaluating the effectiveness of investment project.* Automation. 2002. #10 ||

• establish an effective strategy for marketing and the rational use of material, labor and financial resources;
• calculate and analyze different scenarios of the project by varying values of factors that could affect financial results;
• monitor the implementation of the investment project.

When selecting a particular software product for calculation of efficiency of investments one must first define uniqueness and industry-specific features of the project to assess.

Programs for automated calculations of investment projects can be divided into two groups. The first consists of universal packages that do not depend on the industry and the specific tasks, such as, COMFAR (UNIDO developer), Project Expert (developer Industrial Association “Information Technologies”, Russia), Alt-Invest (developer "Information and communication Technologies Alt ", Russia), INEC-Holding (developer INEC, Russia), TEO-Invest (developer Institute of Control Sciences of Russian Academy of Sciences). The second group of software includes packages designed for specific industries, for example, Energy Invest (developer Scientific Centre for Applied Research). For individual investment projects that are difficult to assess with the universal or specific industry program, individual modules are developed.

Many companies successfully use individual packages developed on the basis of spreadsheets for specific investment projects. When selecting a program specialist should take into account those subjective factors that are important to each individual company. The successful application of software to evaluate investment projects depends not only on competent work with the program, but also on the ability to correctly identify the input data for calculations. If the investment project is calculated to attract foreign investment then the most suitable program is COMFAR type program.

## 7.4 Risk management practices in innovative companies

Investment in innovative projects is the most high-risk investment. *Risk* is the chance that the actual return from an investment may differ from what was expected. The risk of innovative projects comes from probabilistic nature of the expected result in conditions of uncertainty. The search for innovation project funding from commercial sources requires realistic assessment of outcome. Depending on the degree of completion of the study and the type of R & D, innovation projects are divided into the following categories:

1. Innovation projects related solely to the promotion of the finished innovation products to the market;

2. Innovation projects with unfinished implementation stage;

3. Innovation projects with unfinished stage of development activities;

4. Innovation projects with unfinished stage of R&D;

5. Innovation projects with unfinished stage of exploratory research.

Project risk assessment allows making right investment and management decisions.

There are many ways to secure activity of innovation enterprise. Risk management methods can be grouped as follows:

- risk avoidance;
- risk localization;
- risk dissipation;
- risk compensation.

*Risk avoidance* is the most radical way of risk management which consists in rejection of any project or decision with the slightest suspicion of risk. The main method of risk avoidance is to transfer risk to insurance company. However, such a decision is costly, because it is necessary to pay to insurance company. Risk avoidance creates a problem of the cost effectiveness of risk prevention.

*Risk localization* of the risks of innovation projects consists in localization of risky activities within a separate division. For example, it may be an independent venture capital company.

*Risk dissipation* takes place both in time and in space. *Time dissipation* consists in clear delineation of stages of project implementation and selection of specific control measures over risks, which emerge in these stages. *Spatial dissipation* is much broader. Company can work simultaneously on several markets, so that the failure on one of them could be offset by the success on others. The allocation of risk can be distributed among all the participants of the investment process via multilateral treaty or several bilateral agreements that fix the responsibility of each party in case of the project failure. Division of the markets for output and inputs is also used to increase the number of customers and suppliers, and to redistribute operations among them so that the failure of one contracting party would not ripped off the whole production program.

*Risk compensation* can be carried out by one of the following methods: Search of guarantor method assumes equal mutually beneficial integration of small enterprises with large ones for the purpose of implementation of the investment plan.

The active market position method consists in active creation of demand for innovation products via such marketing methods and techniques as the market analysis, advertising, studies of the behavior of competitors, the development of win-win strategy with them and others.

Creation of material reserves presumes the creation of insurance reserves of raw materials, capacities and money in order to mitigate risks and reduce the shortages of supply and financial problems of the enterprise.

Creation of information resources requires regular forecasting and monitoring of the legal framework and socio-economic environment, as well as the analysis of the behavior of potential investment project stakeholders, evaluation of changes of any nature at the market, where the company plans to act.

The method of auto-perfection assumes an active and ongoing process of activation of internal resources of the enterprise by providing additional education and training to personnel, by development of specific corporate culture, and implementation of social programs for employees.

Choice of a particular way to minimize the risk of innovation activity depends on the experience of the manager and the innovation capabilities of the organization.

***Questions for discussion:***

1. What is understood by the uniqueness of the project's work?
2. Integral and partial effects of the project.
3. Criterion of the effectiveness of the project at the R & D stage.
4. Scale of technological readiness of innovative project.
5. Meaning of cash flows discounting in calculation of project performance indicators.
6. What is the net accounting profit of the project, if its NPV is zero?
7. What do economists understand by the term "risk"?
8. The practical meaning of the break-even point of the project.
9. Computer programs for scenario analysis of the project.
10. Algorithm for choosing the best projects under profitability-riskiness contradictions.

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