

**ESSENCE, STRUCTURE AND CONTENT  
OF SCIENTIFIC-RESEARCH AND INNOVATION ACTIVITY  
AT HIGHER EDUCATIONAL INSTITUTIONS  
OF UKRAINE, RUSSIA AND REPUBLIC OF BELARUS**

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**Abstract.** In this article is analyzed the research papers of Ukrainian and foreign scientists and Concepts of scientific-research and innovation activity at higher educational institutions of Ukraine, Russia and Republic of Belarus on the basis of which reveals the essence and identified key components of the structure of scientific-research and innovation activity of higher educational institutions: subject, object, motive, purpose, process, result. The content of the main types of scientific-research and innovation activity of higher educational institutions at its diverse levels; developed classification of innovative products at higher educational institutions; some forms of technology transfer of higher educational institutions; indicated the degree of scientists' participation as developers of innovative product in its practical exploration; identified the main stages of scientific-research and innovation activity.

**Keywords:** Scientific-Research and Innovation Activity, Scientific and Innovation Activity, Innovation Activity of Higher Educational Institution.

**INTRODUCTION.**

In real social and economic conditions of post-industrial economy new knowledge becomes independent product that has value and can be implemented in new products with high added value. According to economic estimates, the share of scientific knowledge in the cost of modern high-tech products reached 15-20%. However, about 90% of the world market of goods and services consists of high

technology products, i.e. products created on the basis of relevant scientific knowledge use.

As noted by Kovylin (2014, p.18), the effective interaction of science, industry and economics is possible only if, on the one hand, the goods and services produced, will be based on scientific knowledge and on the other – if the functioning of science obey to economic laws. It means that science as a branch which produces new knowledge gradually turns into a real productive force of society and becomes the subject of market economy as defined by the Organization for Economic Cooperation and Development (OECD) called the knowledge economy or the economy based on knowledge, which means an economy that is based on the creation, distribution and use of knowledge and information (OECD,1996).

In 1996, Peter Drucker, the founder of Management, professor of several American universities and adviser of the largest US corporations introduced in the scientific circle the term “knowledge society”, which determines the type of society in which knowledge plays a crucial role and is the main factor of social development (Drucker, 2004).

Thus, new scientific knowledge is currently a special independent factor production function and makes the appropriate social form of human capital. Converting information into knowledge comes through the mechanisms of distribution, storage and processing of information, usually in the research and education process. Therefore, the main task that relies today on higher educational institutions, by definition of Safonova (2012, p.28) is determined by growth objectification of new knowledge and its implementation in human and physical capital and technologies. A similar view expressed by Klimova (2015, p.15), who sees the mission of higher education in the production of new knowledge and their transfer to the manufacturing and service sectors, as well as the formation of the human capital as the driving force of innovation processes.

Following these important tasks entrusted to the modern system of higher education, is the subject of a special activity of the university, which is defined as scientific-research and innovation activity.

**The purpose of the research** is the disclosure of the essence, content and structure of scientific-research and innovation activity at higher education institutions with a post-industrial economy on the example of Ukraine, Russia and Republic of Belarus.

**The objectives of the article are:**

- to analyze research papers of national and foreign scientists and Concepts of scientific-research and innovation activity at higher educational institutions of Ukraine, Russia and Republic of Belarus, under which determined the essence and structure of the main components of scientific-research and innovation activity of higher educational institutions, which include: subject, object, motive, purpose, process, result;
- to consider the content of the main types of scientific-research and innovation activity of higher educational institutions at various levels;
- to develop a classification of higher educational institutions innovative products;
- to identify the main forms of higher educational institutions technology transfer;
- to establish the degree of scientists' participation as developers of innovative product in its practical exploration;
- to identify the main stages of scientific-research and innovation activity.

**Methods** applied – comparative, analyses, systematization, logics and other general research methods.

**TYPES AND LEVELS OF SCIENTIFIC-RESEARCH AND INNOVATION ACTIVITY OF HIGHER EDUCATIONAL INSTITUTIONS.**

Given that the main factor in the development of the knowledge society is the production, processing and transmission of knowledge (Boholib, 2010, p. 47), under the scientific-research and innovation activities of higher educational

institutions should be understood the complex activities aimed at creating, transformation (presentation in a form, which is suitable for external use) and further dissemination of new knowledge for their practical use in order to address natural and social problems.

The complexity of this activity is that it has two aspects: theoretical, which is aimed at creating the new knowledge (actual scientific activity) and practice aimed at applying of the new knowledge (actual innovation activity).

If the term “science” by F Geinberg, O. Simonova is a special kind of human cognitive activity aimed at obtaining, study and systematization of objective knowledge about the world, human society and cognitive process purely, that is why scientific-research and innovation activity focused not only on reception, but also on the practical use of knowledge, i.e. not only knowledge of the world, but its transformation. «Innovative science, by Kovylin (2014, p.16), is a science, which is focused less on obtaining new knowledge, opening new properties of the objects and patterns but more on the scientific knowledge use». Agrees with him and Kozlovsjkyj (2012, p.30) which indicates that this activity aimed both at gain knowledge about objects and processes created by nature and man, and the conscious transformation of objects and processes for solving specific problems.

Thus, the *object* of scientific-research and innovation activity influence represented by nature, human society, and which are the object of scientific activity, but not as an object of cognition, well as transformation of the surrounding reality.

So, at the first stage, the stage of formulation of the problem, manifested the fundamental difference between scientific and research and innovation activity as well as the last as a part of a single innovation process from the beginning aimed at solving a particular practical problem that exists in nature or society. Thus, *the purpose* of scientific-research and innovation activity is to develop new knowledge through research and development and creating conditions for its applications related to «solving problems which, in turn, is determined by the interests and needs of the individual and society» (Rykun, 2004, p. 27).

«In the past academic problems were selected according to academic interests, said Kuzjmenko (2014, p.180), now they are formed according to the further use of research results».

We now turn to the disclosure of the scientific-research and innovation *content*. As acquiring new knowledge is the main purpose, means and result of scientific activity, it is scientific activity serves the foundation of this process, the subjects of which are scientific, teaching staff, postgraduate students, doctoral students and university students involved in this activity.

Immediately it should be noted that not all scientific, teaching staff as main subjects of scientific activity, equally can act as scientific-research and innovation subjects, since the last is composed of two different activities associated with obtaining «new» and the introduction of «new». According to Kovylin (2014, p.11), this unity of cognitive and practical are dialectically is controversial because aims and means of scientific knowledge is not always in full compliance with the requests and practical ways to achieve them. Therefore, the degree of participation of scientists in scientific-research and innovation activity on the one hand, depends on the object of their research and development depth study problems with communication practice; and on the other hand – competence and personal qualities.

Considering this, in the scientific field there are three types of scientists: academic researchers, scientists-inventors and scientists-innovators who, accordingly, can produce an innovative product with a different degree of conversion of new knowledge and present it accordingly in the form of scientific information, intellectual (ideal) or material (materialized) product.

Research areas of academic researchers is a fundamental principle of science and its individual sections, which are caused general needs social and historical practices arising from the logic of science itself or defined by their personal interests (Novikov, 2010, p.31). The result of research activities at the level of fundamental research (principally aimed at obtaining new knowledge about the laws of nature, society, human, their relationship (Marcyn and all, 2002)), is new

knowledge about the world: concepts, theories, discoveries, new principles of knowledge, etc. which is not always aimed at solving specific practical problems. Thus, academic scientists not directly involved in the innovation process, but suppliers can act as scientific discoveries. So their task as *subjects* of scientific-research and innovation activity is that their research results are made available to a wide range of consumers, and therefore, properly documented and presented in the form of published articles, books, abstracts recorded performance reports of researches etc. Of course, knowledge and scientific publication is not the same thing. However, as Kozlovskiy (2012, p.109), between them there is a close relationship, as they are material carriers of the last.

Thus, *the result* scientific-research and innovation activity at the level of fundamental research is a scientific-information product containing new knowledge, also called academic novations. As shows statistics (Gherasymenko, 2008, p.213), only 5-10% of the results of fundamental research find their practical application, sometimes even after many years, but this, in turn, can lead to a fundamental transformation of reality and change as much as technological structures since discovery as a result of fundamental research is «scientific result that makes radical changes in existing knowledge, reveals still not known patterns, properties and phenomena of the material world, significantly affect the technological progress and development of civilization, serves as a source of inventions» (Kovtuneko, 2013). The most significant inventions that completely changed our lives over the past two centuries, include electricity, telephone, radio, television, electronic microscope, computer, internet, antibiotics, vaccines, etc.

The subjects of the scientific-research and innovation activity institutional level on this level are classical universities, conducting serious fundamental research, which is already innovative in essence as it always aiming for something «new», i.e. what was not there before.

The results of fundamental research serve as a source of innovative ideas that scientists-inventors as *subjects* of scientific-research and innovation activity of the second level (scientists, whose area of interest is the application of knowledge

– the invention and development with practical applications in consumer or professional activity) in the process of application scientific research (aimed at finding the most efficient ways of practical use of the results of fundamental research (Marcyn and all, 2002)), research and development, design, technology, engineering, projection (aimed at creating models (prototypes, samples) new types of equipment, technology, materials, scientific instruments and development projects in various fields) are trying to bring to the form in which they can be used in practice. These research results are presented in documented form (innovations, invention patent, patent for utility model, certificate of copyright (computer software), know-how, duly registered technology and various recommendations methods, specifications, standards, instructions, etc.) are called novations, which can be determined as scientific innovations; but activity, the result of which is scientific innovations, was named science and innovation (Kovylin, 2014, p.23).

Thus, the *result* of scientific-research and innovation activity at the level of applied, research and development, engineering, projection is new knowledge in the form of cognitive models that are theoretical prototype for future products and processes suited to solve specific of applied problems. Such knowledge is usually the intellectual property rights objects, and by definition, Vesnin (2006, p.430) are the intellectual product which has value, that is a commodity which can be implemented on the market.

Give the above, as well as research conducted by Vachugov (2005), Noskova and all (2009), Kasjjanova, Slezhenko (2014) propose the following classification of intellectual products that can be derived from scientific innovation and project innovation activity:

- information and analytical (databases, information and referral systems, information and thematic modules);
- technical and technological (utility models, prototypes, experimental products, technologies);
- software (computer software and systems);

- scientific and methodical (guidance, methodologies, specifications, standards, instructions, etc.);
- innovation project (developed for organizations, businesses, public authorities and local governments or through international and national grant programs various innovative (research, educational, social investment) projects that require strong scientific component and containing ready algorithm for solving specific natural or social issues.

Special result of scientific-research and innovation activity is the humanitarian product (Noskova and all, 2009, p.108), which is a so-called “living knowledge” (Homin, 2007) – it may be graduates who have innovative competences, students and postgraduate students involved in scientific-research and innovation activity, as well as the most scientific, teaching staff with their knowledge and creative activity.

The biggest development of scientific-research and innovation activity received in universities of research type, because at research universities entrusted a mission to provide breakthrough development of certain areas of knowledge on the model of combining education, research and innovation and to facilitate their integration into the global educational and research area, and the main task such universities are in production, stockpiling, retention, transfer and dissemination of new knowledge (Kolotylo,2010, p.32). According to F.Altbah, merit of research universities is that they produce a large amount of new information and analytics that not only lead to the development of technology, but also significantly contribute to the understanding of human nature due to the system of social sciences and humanities.

Finally, the third level of scientific-research and innovation activity is the introduction of new knowledge into goods and services that is actually innovation activity. *Subjects* of scientific-research and innovation activity at this level – it is scientists-innovators who can bring new knowledge to the stage of the finished product. As defined by Chernikova and all (2013, p.74), innovators in universities are professionals who have skills, knowledge, skills and experience to generate and



develop ideas and their commercialization, production and marketing of innovative products. In such a way, the *result* of scientific-research and innovation activity at the third, innovation level, new knowledge is implemented in a material product that can be realized in the market.

As noted Kovylin (2014, p.18), not all the inventions are automatically converted into innovation. The main role is played here by the fact that innovation requires additional resources and skills needed to commercialize the invention, turning it into innovation. It should be clearly aware of the fact that in a market economy, activities bringing to market research achievements and developments (converting inventions into innovations) can be represented at as the highest level of scientific-research and innovation activity as well as entrepreneurial activity (with all attributes inherent to this concept) (Kovylin, 2014, p. 26). Therefore, a prerequisite for the success of this activity is the availability of innovator-enthusiast seized with a new idea and ready to make every effort to put it into practice, scientist-entrepreneur who has found investment, organized production, pushed a new product on the market, took over the main risks and implemented a commercial interest. However, since such activity requires knowledge and skills in many areas, it has a distinct collective and can be implemented, usually in entrepreneurial universities, which have sufficient personnel, logistical and infrastructural resources to provide.

Hereabove i have examined the two main functions of scientific-research and innovation activity of higher educational institutions consisting in creation (cognitive function) and transforming (converting function) new knowledge in certain forms.

Thus, the «specificity of this type of higher education institutions as defined by Kasjjanova, Slezhenko (2014, p. 10), act both as a creative component, and as a production component, i.e. higher educational institutions not only produce ideas at theoretical positions, concepts or scientific evidence, but also bring them to the status of “finished product” and in the form of experimental prototypes, technologies, programs, datasheets or methodological inventions».

But, according to Kovylin (2014, p.16), for the effective use of new knowledge should be allocated one additional and independent link – activities bringing to market developments and scientific achievements. Agrees with him and Kasjjanova, Slezhenko (2014, p. 10), noting that universities in this context actually carry three different *functions*:

- innovations generation;
- innovations production;
- providing conditions for innovations diffusion.

Therefore, consider a third, equally important function of higher educational institutions – the function of new knowledge dissemination, since technology transfer as the transfer of innovative ideas or technology development is the main mechanism of integration of scientific and production activities, which promotes rapid introduction of innovative technologies in various industries.

The process of transferring new knowledge can occur both at commercial and non-commercial basis. Profiting from the application of new knowledge is the main purpose of scientific-research and innovation activity of higher educational institutions. As noted Guremina (2010), university should less rely on including to the structure of the implementing enterprises but more rely on interaction stimulation with implementing and bringing to market scientific and technological developments, generate in this direction, innovative approaches i.e. play the role of communication center in the chain «science – real market of high technologies». Moreover, not all the results of scientific research carried out in universities, especially the humanities can be commercialized, because traditional universities intelligent products are very diverse. I agree with the view of Safonova, Erysheva (2009, p.41), that the effectiveness of technology transfer should be assessed not only in the form of profit, but in a comparison of positive and negative useful innovation. The positive difference estimated as its effectiveness. This applies primarily innovation with social and environmental nature. Thus, universities can receive both economic and social, environmental and other kind of effect on realisation of innovative products (Efimov, 2015, p. 106).

According to Shevchenko (2014, p. 8-9), «important is not the ability of scientists to make money, but the benefits, which receiving society from university research activity». In addition, it should be noted that academic scientists very rarely innovators in the literal sense of the word, that is, entrepreneurs who receive financial benefit from the sale of innovative products. They are mostly devoid of commercial dividends from their discoveries (excluding grants and awards) and receive only moral satisfaction – fame and public recognition. Leonardo da Vinci, N. Copernicus, D. Mendeleev, A. Einstein and other great scientists were not wealthy people, the discovery did not bring them profit, in contrast, often served as a source of problems. But inventors and innovators received quite tangible results from innovation: Bill Gates (Microsoft) – 90 billion dollars, Warren Buffett (Berkshire Hathaway) – 46 billion dollars, Mark Zuckerberg (Facebook) – 45.8 billion dollars, Larry Ellison (Oracle) – 43.6 billion dollars, Larry Page (Google) – 15.8 billion dollars, etc.

However, given that new knowledge with its market value, the concept of «knowledge» is considered by modern scientists as a fundamental basis for a wider concept, called “intellectual capital” because «intelligence as such – is a mental activity, accumulated knowledge, because its transformation capital means the ability to make a profit through commercial use of intelligence» (Kazakova, 2003, p.57).

Intellectual capital of any company can operate in three main forms (Homin, 2007):

- “live” knowledge (creativity and innovation-quality characteristics of the employee);
- materialized knowledge (technique, technology, organization and management systems);
- information which includes knowledge (patents, licenses, trademarks, guidelines, research posts, etc.)

Along with the concept of «intellectual capital» in the scientific literature such terms as «academic entrepreneurship», «intellectual entrepreneurship», the

essence of which lies in the process of commercialization of human intellectual activity, and the term «intellectual entrepreneur», which can by certain intensification apply for determination the subjects of scientific-research and innovation activity. By Homin's (2007) formulation, intellectual entrepreneur – a person who seeks to realize the knowledge and intelligence through the creation of something that was not before. Profit for it is not the main purpose of; it appears as a derivative phenomenon, if it is available an innovative idea, innovative project, innovative product. The core mission of its qualitative transformation he sees the surrounding world and the human in it. Most creatively gifted people invent force, especially fascinating scientific discovery capabilities. Although one of the main objectives of innovation activity is to maximize profit from a long-term investment in scientific innovation, it should be noted that companies which have achieved significant success in business, moved somewhat different reasons than simply the desire to obtain a pecuniary advantage.

Foreign research (Hart, Milstein, 2003), (Prahalad, Hammond, 2002) show, the combination purpose profit organization with a wide range of social and moral goals and values conducive to obtaining greater financial income, especially in the long perspective. People and companies that are interested not only in the commercial benefit, but also working on their own sense of life, get an advantage over those who are unable to do so (Maslow, 1943).

As rightly observes Kovylin (2014, p.32), the world's leading companies founded by Henry Ford (Ford Motor Company), Bill Gates (Microsoft), Akio (Sony) hardly moved by only financial motives. Important factors here were and still wish to implement their own ideas and realize their creative potential to change the world, to raise their social status, etc. Thus, the main *motives* of scientific-research and innovation activity act as a commercial interest and social values of different stakeholders: the desire for self-realization, self-development, professional, social status, etc.

## **FORMS OF HIGHER EDUCATIONAL INSTITUTIONS TECHNOLOGY TRANSFER.**

What forms of technology transfer using higher educational institutions? Analyzing the Concept for Development scientific-research and innovation activity at higher educational institutions of Ukraine, Russia, Republic of Belarus (Konceptcija innovacijnogho rozvytku DVNZ «Uzhghorodskij nacionalnyj universytet (Ukraine, 2016); Strateghichna prohrama naukovo-innovacijnoji dijalnosti Kyjivskogho nacionalnogho universytetu imeni Tarasa Shevchenka (Ukraine, 2013; Konceptcija razvitija issledovatel'skoj i innovacionnoj dejatel'nosti v rossijskih vuzah, (Russia, 2010); Konceptcija razvitija nauchno-innovacionnoj dejatel'nosti v sisteme Ministerstva obrazovanija Respubliki Belarus' (Republic of Belarus, 2007) and personal experience as a head of Scientific and Research Department of Zaporizhzhya National University (Ukraine), I concluded that the main form of direct technology transfer of modern universities in these countries are:

- a) the commercialization of intellectual property (sale of licenses, know-how, patents, utility models, industrial designs, trademarks);
- b) performing of R&D for develop new technologies, methods, techniques and other innovations in order businesses, organizations, institutions and transfer them to the customer;
- c) providing high-quality services (scientific, technical, consulting, engineering) as well as services in the field of computer science, metrology, patent-licensing maintenance of R&D and production;
- d) participation in contests of innovation (research, education, social investment) projects announced by state and local authorities and other governmental and non-governmental organizations or held under international and national grant projects and programs;
- e) production and sale of innovative products through its own organization or jointly with other manufacturers of innovative enterprise at higher educational institutions;

f) electronic technology transfer (dissemination of scientific or technical data on specialized resources):

- Technology Transfer Network (National Technology Transfer Network of the Ministry of Education and Science of Ukraine: <http://www.nttn.org.ua/?lng=5>, Russian Technology Transfer Network: <http://www.rtt.ru/index.php/en/>);
- Innovation Platform (Innovative Convergence Platform for Education, Science and Business at the Classical University (Novosibirian State University, Russia): <https://xpir.ru/dossier/project/corebofs000080000im81ngrijqpf5iho>, The open platform of regional scientific and industrial partnership «Incube» (Zaporizhzhya National University, Ukraine): <http://incubeplatform.com.ua/>);
- database of innovative projects and technologies (Directory of Innovation Projects under State Committee on Science and Technology of the Republic of Belarus: <http://ictt.by/rus/Default.aspx?tabid=114>);
- eCommerce tools (Information and marketing center of the Ministry of Education of the Republic of Belarus: <http://www.imu.metolit.by/en>);

g) personal technology transfer:

- passing of practical training or employment of young specialists to the enterprise;
- academic mobility of teachers, doctors, postgraduates and students (both internal and external);
- participation in scientific conferences, seminars, symposia, exhibitions, fairs;
- publication of articles, books, abstracts and more in national and foreign publications, primarily included in the international scientometric databases;
- personal profiles creating of scientists at specialized scientific services (ORCID, Google Scholar, ResearchGate, Academia.edu, etc.).

It should be noted that in modern higher educational institutions the bulk of knowledge transferred in the industry mainly through the implementation of R&D “on demand” by entering appropriate household contracts rather than through the sale of licenses or organization of small innovative enterprises, as it's currently can be done by powerful and technical universities. Revenues from research and development “on demand” in many universities often exceed state funding of higher educational institutions research activities (Sovershenna, 2010, p.72).

Depending on the form of the transfer of new knowledge also is different the degree of participation of scientists in their practical exploration:

- passive participation – the publication of scientific information, licenses selling;
- partial participation – in carrying out of R&D or services «on demand»;
- direct participation – in the implementation of innovation projects or commercial development of innovations.

So, examining the whole *process* of scientific-research and innovation activity can be identified such its basic stages: awareness forecasting societal needs – problem definition – the study of the problem – the creation of new knowledge – the transformation of it into a product innovation (scientific information, intellectual, material, humanitarian) – providing innovative product transfer.

## **CONCLUSIONS.**

1. This paper describes the content and structure of scientific-research and innovation activity as well as identified its main components: subject, object, motive, purpose, process, result.
2. Depending on the degree of processing new knowledge allocated three levels of scientific-research and innovation activity: results of the first (scientific) level are scientific and information products produced by academic scientists; results of scientific-research and innovation activity of the second level (research and innovation, project and innovation) acting intelligent products, manufacturers of which are scientists-inventors; the

results of the third level (innovative) serving material products made by scientists-entrepreneurs. Special product of scientific-research and innovation activity is humanitarian – graduates of universities and scientific, teaching staff with their creativity and innovation and quality characteristics.

3. Determined the basic forms of technology transfer (including personal transfers) and shown that it can occur both at commercial and non-commercial basis.
4. It is found that depending on the form of technology transfer degree of participation of scientists as innovative product development in its practical development can be: passive, partial and direct.
5. The basic stages of scientific-research and innovation activity is determined.

On the other hand, the analysis showed that despite the post-Soviet past, when the principles of scientific activities of higher educational institutions in the former Soviet Union fundamentally different from the practices of Western research universities, today the development of scientific-research and innovation activity at higher educational system of these countries is approaching to common European trends.

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