PROBLEMS AND PROSPECTS OF INTERNATIONAL TECHNOLOGY TRANSFER BETWEEN EU COUNTRIES AND UKRAINE IN THE FRAMEWORK OF IMPLEMENTATION OF THE PAN-EUROPEAN DEVELOPMENT STRATEGY

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Abstract. The article is devoted to the analysis of the opportunities and prospects of international technological transfer between the EU and Ukraine. The authors consider the impact of international technology transfer on Ukraine's investment and innovation development, export-import potential and international competitiveness of the country. In the context of the main directions of production of world high technologies the most favourable and perspective directions for Ukraine are determined.

Keywords: knowledge economy, high technology, technology transfer, innovation, research and development

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Introduction

Effective international technology transfer in the knowledge economy is one of the main factors for the development of enterprises-subjects of international economic relations, along with foreign investment, labour resources and technological base.

Ukraine has taken into account the world trends and declared its own progress in investment and innovation development. The determining feature of the country's development is the concentration of efforts on activating the process of creation and implementation of innovations. In this chain, particular importance is laid upon the mechanism of technology transfer from the scientific to the industrial sphere, i.e. technology transfer.

According to TOT Code, transfer of technology is the transfer of systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service and does not extend to the transactions involving the mere sale or mere lease of goods *(Draft International Code of Condact on the Transfer of Technology, 1986)*. Technology transfer is inherent for humanity development since the earliest times when the object of the transfer was implicit knowledge *(Donald, 1991)*. In the course of time the concept undergone considerable change, especially with the deployment of globalization processes, development of technologies and innovations and growth of international technology and innovation

market. At the outset of the 20th century with technology having a local / national character, the technology transfer was not seen as a separate element of state policy, so international transfer, if occurred, was held at the level of low-tech industries. During 1950-1980s, technologies were recognized as a factor in national competitiveness. This period saw the development of TNCs and the first wave of moving manufacturing to developing countries. In the end of the 20th and the beginning of the 21st century, the emergence of high technologies brought acceleration of innovation dynamics, appearance of commercial forms of transfer *(Omelianenko, 2012).*

Since international technological exchange has a significant share in the volume of international trade, it is gaining relevance and attracting attention of the leading experts. Research and development (R&D) activities require huge financial costs, expensive equipment, highly skilled personnel. This is due to the rapid scientific and technological progress in material production, the deepening of the international division of labour and the emerging necessity to meet the socio-economic needs of many countries. The rapid development of international trade in technology and scientific and technical knowledge is closely connected with significant differences in the levels of technical and technological development of the world countries. With the growth of scientific and technological progress, advanced technology and equipment is concentrated in a small group of industrialized countries that spend huge amounts for R&D. Thus R&D expenses in the USA exceed those in Germany, France, England, Italy, Japan altogether.

Since January 1, 2016, the economic part of the Association Agreement between Ukraine and the EU entered into force. The state aid carried out by EU countries on the basis of "group exclusion" provides full support of enterprises due to compliance with European standards and stimulation of sectors of the economy. Implementation of the key statements of the agreement creates the preconditions for high-tech production to become a priority in the technological development in Ukraine.

The Article 379 of the Agreement mentions that EU countries directly support the stimulation of Ukraine's export potential, restructuring and modernization of the export-forming and import-substituting industries. According to the Strategy for the Development of High-Tech Industries in Ukraine for the period up to 2025, the goal of the Ukrainian economy is to form a new development model. The main tasks for increasing Ukraine's high-tech production are: ensuring the growth of the level of knowledge-intensive economy and its innovation development; reinforcement of the national economy's international competitiveness; introduction and commercialization of scientific activity; systemic combination of science and production; reducing the technological gap with the economically developed countries of the world.

Formulation of research objectives. At the same time some issues related to the introduction of technological innovations, the assessment of the technological level of production, technology monitoring and technological forecasting in the Ukrainian reality remain unresolved and require a comprehensive examination.

Theoretical fundamentals of international technology transfer

The basis of investment and innovation development both of enterprises and the country is the international technology transfer. O. Hryshchenko *(Hryshchenko, 2009)* interprets it as a movement of scientific and technological achievements, design decisions, systematic knowledge and manufacturing experience on a commercial or non-commercial

basis through the national borders (customs borders) for better recycling of resources, increasing the efficiency of production and maximizing profits, including such stages and types of production activity as industrial application, management, marketing, etc.

1. In a generalized form, international technological exchange (technology transfer) is referred to as the totality of economic relations of different countries concerning the transfer of scientific and technological achievements. The deepening international division of labour leads to the growth of foreign economic innovative resources associated with international technology transfer. International technology exchange can compensate to some extent lack of funds financing the country's scientific and technological development. International transfer of technology can be carried out by independent foreign companies via inter-firm channels and via TNCs' domestic channels while implementing in any TNC's national department the scientific and technical achievement developed by the organizational TNC unit in another country.

At present, rapidly developing directions are those producing the main high technologies in the world (Table 1).

Table 1

Characteristics of the main directions of production of world high technologies*

Direction	Characteristic
Optoelectronics	Development of electronic products and components conducting light and reacting to it. Particularly, the management of the processes of structuring, formation of the properties of constructional and instrumental materials, their welding, including the use of highly concentrated energy sources and electromagnetic effect (electron and ion beam technologies, laser technologies, etc.). Development of technologies for the production of functional materials for electronics, laser and diagnostic equipment, optical scanners, optical CDs, solar cells, photocells, laser printers, etc.
Information technology and telecommunications	Development of products that process the increasing amount of information in a short period of time. Particularly, fax machines, telephone switching devices, radars, communication satellites, servers, computers and the corresponding hardware peripherals, as well as software products, etc.
Electronics	Development of electronic components (without opto-electronic components) such as integrated circuits, boards, liquid crystals and other similar components enabling improvement and development of the main functions as well as creation of miniaturized products, etc.
Computerization	Development of technologies for industrial production automation. Particularly robotics, machines and devices with numerical control, automated means of transport which can significantly increase the flexibility of production and reduce the human impact on the technological process, etc.
New materials	Improvement and elaboration of the newest composite materials; exploring of mechanical properties of complex structures and systems constructed on their basis. Development of technologies for the production of synthetic diamonds and other superhard materials as well as tools based on them.
Aerospace technologies	Production of the majority of military, civilian rotor craft, aircraft and spacecraft (without communication satellites), jet aircraft engines, flight simulators and autopilots
Armament	Development of the military technologies for production of conventional weapon, missiles, bombs, mines, torpedoes, rocket launchers, etc.
Nuclear technology	Development of the nuclear power plants equipment, in particular, nuclear reactors and their parts, equipment for separation of isotopes, production of fuel elements, etc. (medical equipment is more related to the group of the science of human life).

* compiled by the authors

Within each of the mentioned directions, Ukraine can find its own niche and specific direction of high-tech development, especially by intensifying the international technological exchange.

The international transfer of technology has two main forms: commercial (international trade in goods and services and transfer of non-materialized technologies) and non-commercial (scientific and technical publications, exhibitions, fairs, symposiums, migration of specialists, activities of international organizations for cooperation in science and technology, etc.). In addition, there are some other forms of international technology transfer which are presented in Table 2.

Table 2

Forms of international technology transfer*

Forms	Content
Patent Agreement	International trade agreement providing that the patent holder gives up his right to use the invention to the patent holder. Typically, this kind of deal is used by small, highly specialized firms unable to implement the invention themselves which sell patents to large corporations.
License Agreement	International trade agreement whereby the owner of an invention or technical knowledge grants the other party the permission to use within the limits of his/her rights to technology.
Know-how	Provision of technical expertise and production secrets, including technological, economic, administrative, financial information, which if used provide certain benefits. The subject of purchase in this case is unpatented invention of commercial value.
Engineering	Provision of technological know-how required for the purchase, installation and use of purchased or leased machinery and equipment. They include a wide range of measures for the preparation of feasibility studies, consultations, supervision, design, examinations, warranty and post-warranty services.
Franchising	Sale of the right to conduct business under the name or trademark of the franchisor.
Copyright Agreement	Disposition of the exclusive right of the author to intellectual property, including printed matter.
Providing high-tech services	Providing services in the fields of production, circulation and management, including consulting, informing, management, personnel training, etc.

* compiled by the authors

The strategy development of the international technology transfer between EU countries and Ukraine

The formed preconditions for the liberalization of high-tech products import will facilitate the inflow of high technology within the appropriate selective innovation and investment state policy. It will ensure the synergistic effect of attracting new technologies and the positive impact of international technological cooperation on the economic growth both of enterprises and the country as a whole.

In recent years, a number of networks and technology transfer centers have been established in Ukraine, in particular the Ukrainian Technology Transfer Network (UTTN) and the Ukrainian Integrated Technology Transfer System. The basis of organization of the UTTN is the model of work and methodology of the European network EEN and Russian technology transfer network (RTTN). The main tasks of the UTTN are: technology and know-how transfer between the scientific sector and industry, as well as within the industrial sector;

search for partners and investors for co-operation, development and introduction of high-tech scientific product both in Ukraine and abroad. The project of network creation is aimed at consolidating information resources of state structures of Ukraine, specialized organizations, innovation centers of cities and regions of Ukraine into a single network and its further integration into European networks.

The purpose of UTTN creation involves ensuring open access to information about technologies and other objects of intellectual property of commercial value; automation of procedures for placing information on technologies through the creation of open catalogs, contests, query systems; creation of a transparent process of interaction between brokers and potential buyers; development of information resources and services contributing to the objective perception of Ukraine in the world community, gaining trust in various areas of international cooperation.

There is a direct link between the technological progress of the country and its international market competitiveness. Changes in the level of competitiveness of innovative products from different countries occur simultaneously with similar changes in the positions of countries in the field of development and introduction of new technologies.

The direct link between the development of advanced technologies in the country and the level of its prosperity is affirmed by the share of high-tech goods export in the total volume of exports. A progressive tendency involves not only the growth of the country's export potential, but also its "intellectualization", i.e. increasing share of science-intensive high-tech goods in the overall structure of exports. This is a factor in economic growth.

Table 3 shows the calculated ratio of high-tech products export volumes to commodity exports of the world countries in 2014-2016.

Table 3

Dynamics of exports of high-tech products of countries of the world in 2014-2016, billion dollars *

Country	High-tech products exports, billion dol.			Total goods exports, billion dol.			Ratio (%)		
	2014	2015	2016	2014	2015	2016	2014	2015	2016
World	3027,66	2872,30	3272,26	18077,48	18457,7	18663,72	16,75	15,56	17,53
South Korea	127,32	137,47	143,22	547,879	559,632	572,665	23,24	24,57	25,01
Japan	143,97	125,55	121,20	798,62	715,0972	683,8456	18,03	17,56	17,72
USA	267,41	266,89	278,32	1545,6	1578	1622,7	17,30	16,91	17,15
EU	434,62	459,15	463,84	2251,6	2396,2	2337,4	19,30	19,16	19,84
Germany	251,92	259,06	266,09	1408,37	1451,63	1505,47	17,89	17,85	17,67
Poland	18,14	21,37	24,45	179,6036	203,8479	214,4768	10,10	10,48	11,40
China	600,17	658,49	659,39	2048,94	2210,25	2343,19	29,29	29,79	28,14
India	19,68	24,59	24,83	296,827	314,809	319,757	6,63	7,81	7,77
Russia	6,50	8,11	8,40	524,7664	527,2659	497,909	1,24	1,54	1,69
Ukraine	3,22	2,59	2,20	68,6945	63,3205	53,9133	4,69	4,09	4,07
Belarus	0,78	0,63	0,73	46,0599	37,203	36,3894	1,70	1,70	2,01
Kazakhstan	0,69	0,57	1,02	92,2815	82,51	78,2367	0,75	0,69	1,30

***** compiled by the authors *(The Global Competitivness Report, 2014, 2015)*

As the Table 3 shows, the tendency towards shortening of the commodity exports and high-tech products of Ukraine is explained both by the fall in world prices for goods that are

the basis of Ukrainian exports and the subsequent degradation of the commodity structure of export (i.e., the increase in sales of raw materials and the decrease in exports of goods with value added) Data from the State Statistics Service of Ukraine show that the reason for the low presence of Ukraine on the world market of high-tech products and its further reduction is an outdated production structure, which in turn is a result of low R&D expenditures in Ukraine and decreasing innovative activity of Ukrainian enterprises.

We present the analysis of dynamics of the high-tech exports share of Ukraine during 2014-2016 in comparison with European and world developed countries (Fig. 1).

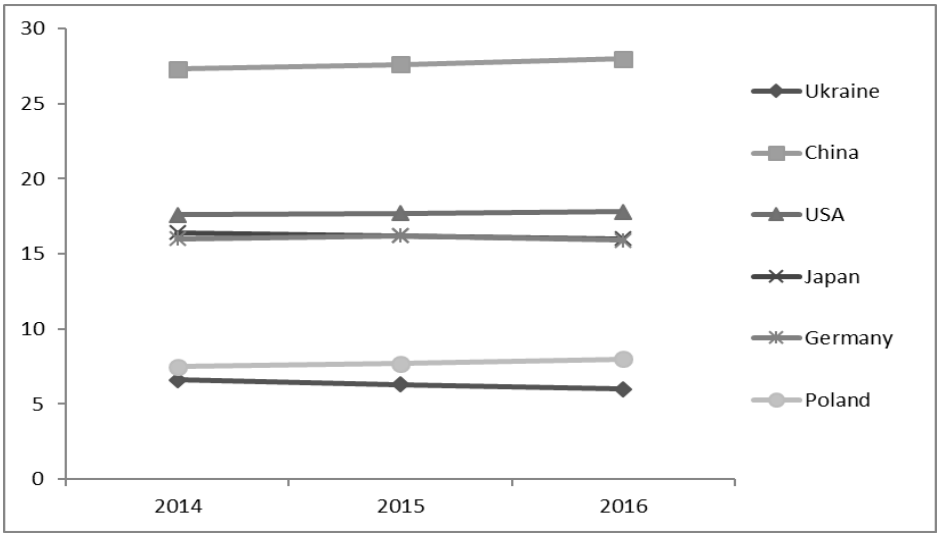

Fig. 1. Dynamics of the share of high-tech exports of Ukraine in comparison with the developed countries of the world, % *

* compiled by the authors **(data retrieved from http://www.worldbank.org)**

During 2014-2016, Ukrainian exports of high-tech goods are at the level of 5% of industrial output. Moreover, there is an outlined tendency towards volumes decrease of both general and high-tech exports of Ukraine. China during the same period managed to increase this figure more than twice (up to 27%). Even compared with Poland, exporting high-tech goods in volumes below the world level, Ukraine does not show a stable growth of this indicator.

Although Ukraine is shifting its export orientation towards high technologies, the country's export structure is still dominated by commodities and primary processing products. In the structure of Ukrainian high-tech exports, a considerable share is presented by aerospace products (36.2%). Moreover, the products with the highest aggregate value are: turbojet engines, aircraft and other devices with mechanical motion, turboprop engines, spacecraft and satellites. Non-electric machines and equipment account for 17.6%, telecommunications and electronics – 17.7%. The main high-tech products most exported in these groups are gas engines, transmission devices, radio equipment and control panels. Commodity structure of Ukraine's imports in 2015-2016 is presented in Figure 2.

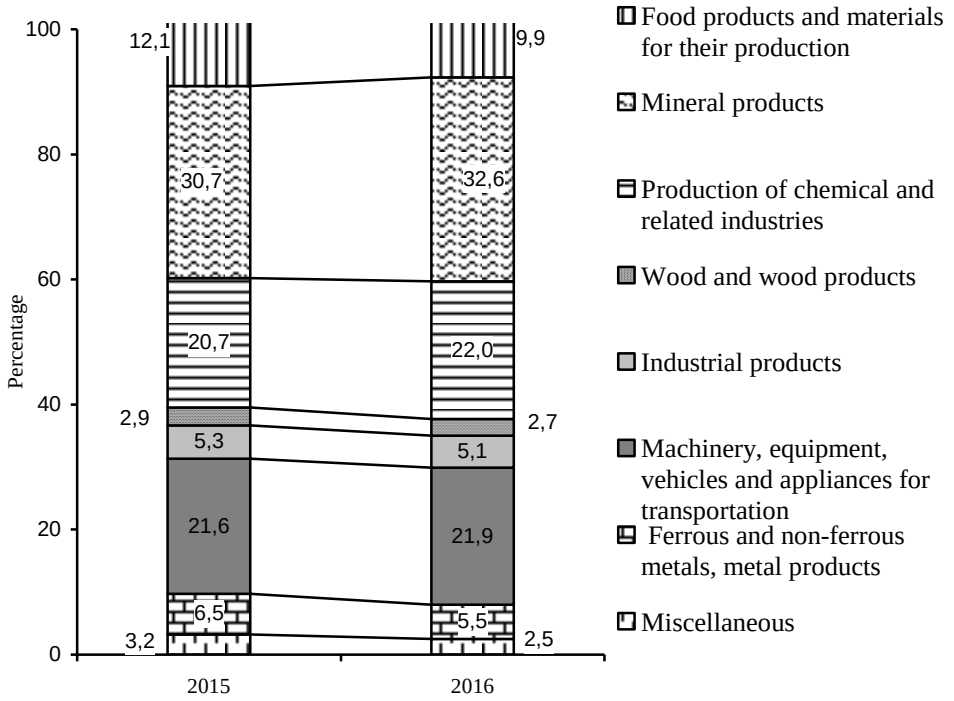

Fig. 2. Commodity structure of Ukraine's imports in 2015-2016*

* compiled by the authors retrieved from *(based on data of National Bank of Ukraine)*

Fig. 2 show that Ukraine's imports structure has hardly undergone significant changes. Mineral products, products of chemical and related industries, machinery, equipment, vehicles and appliances for transportation have the largest share in Ukraine's imports. The absence of domestic high-tech goods is offset by imports, which indicates Ukraine's import dependence in the segment of high-tech goods.

Thus, the national market of high-tech goods is dominated by foreign producers. The development of the knowledge-based segment isn't considered as a priority in the formation of the domestic market of Ukraine.

In today's world, the space industry is one of the most high-tech sectors of the economy. In order to ensure competitiveness of Ukrainian enterprises producing space products on the foreign markets, the fulfillment of the following conditions is necessary: to create the possibility of attracting highly professional and qualified personnel; to improve the use of highly developed specialized scientific potential; to form an effective mechanism for the implementation of high technologies and innovations in production. These conditions can be achieved by mobilizing significant funds, as well as the initiation of international co-operation.

According to international statistics, the main manufacturers of space engineering in the world are the USA and Russia, accounting for 57% of world production. The EU accounts for only 17% of the world's total volume of these products (Fig. 3).

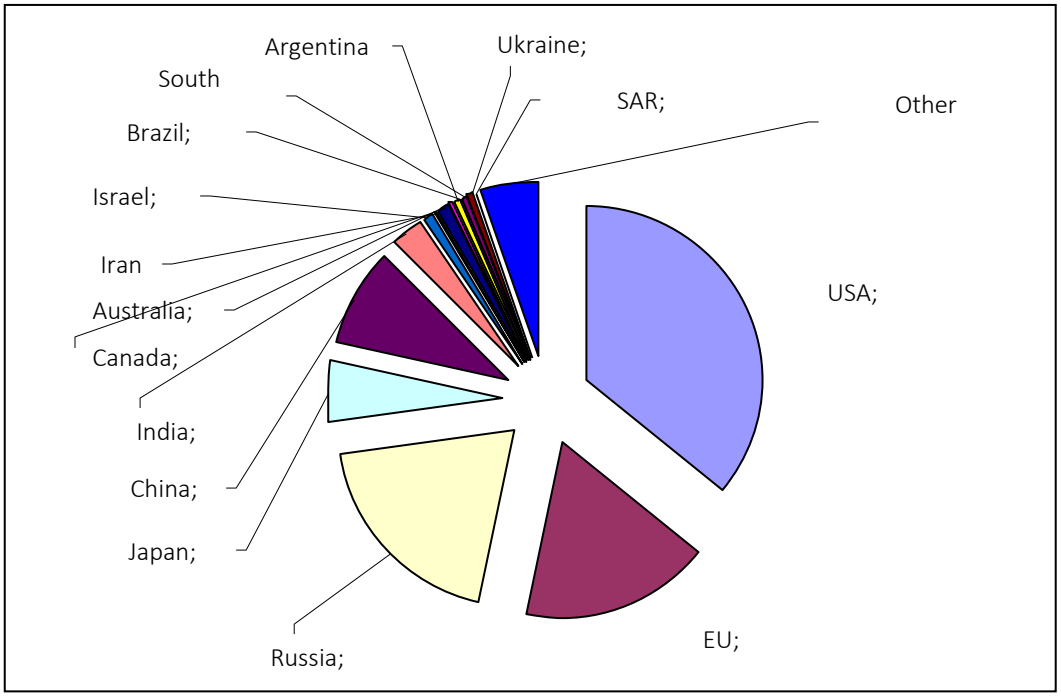

Fig. 3. Leading manufacturers of space engineering in the world (space devices, apparatus and rocket carriers) in 2016, billion dollars, % *

* compiled by the authors *(based on data of State Space Agency of Ukraine)*

The development of international technological transfer between Ukraine and the EU countries involves acknowledgement of the main goals and benchmarks of the EU 2020. This strategy is an innovative project, since it introduces the following innovative elements:

- EU responsibility for the implementation of the EU 2020 Strategy, empowering the European Commission to use the "prevention policy" as the last resort against troublesome EU member states;
- Practice of establishing national goals in strategic development of the EU, since each member state has certain tasks and conditions within the framework of implementation of the European development strategy;
- Improved financial support of the program and target-oriented process and maximum correspondence to other EU strategic documents.

The most important objectives of the "Europe-2020" strategy are: employment, innovations, education, social integration and climate (energy). By 2020, 3% of gross domestic product of each EU member state is expected to be assigned for research and development. Priority is given to three key factors for strengthening the EU economy:

1) smart growth and intellectual development of the EU, including:

- digitization of Europe, i.e. achieving free Internet access through its higher speed;
- innovative association for the effective use of R&D in practice;
- active youth movement in the EU through the Erasmus+ program, increasing the efficiency and international attractiveness of European universities, improving education at all levels of education and training;

2) Sustainable growth, involving:

- efficient use of European resources (emission reduction, higher energy security);
- implementation of industrial policy in the era of globalization (ensuring the competitiveness of European business, maintaining TNCs, socializing through the implementation of a global treaty, etc.).

3) inclusive (comprehensive) growth aimed at promoting the higher level of employment, achievement of social and territorial consent.

In 2016, the world's leading manufacturers of space equipment include 15 countries: the USA, Russia, the EU, Argentina, Israel, Ukraine, South Africa, Brazil, Australia, Canada, Iran, South Korea, India, China and Japan. The largest part of space products is produced by the USA, Russia and the EU countries – 388, 216 and 187 billion dollars respectively. Ukrainian space production accounts for less than 1% of world production, but production volumes in Ukraine are higher than in Brazil, Australia, Iran and Argentina.

Investing in the European Space Work Program Horizon-2020 is carried out in the directions outlined in Fig. 4.

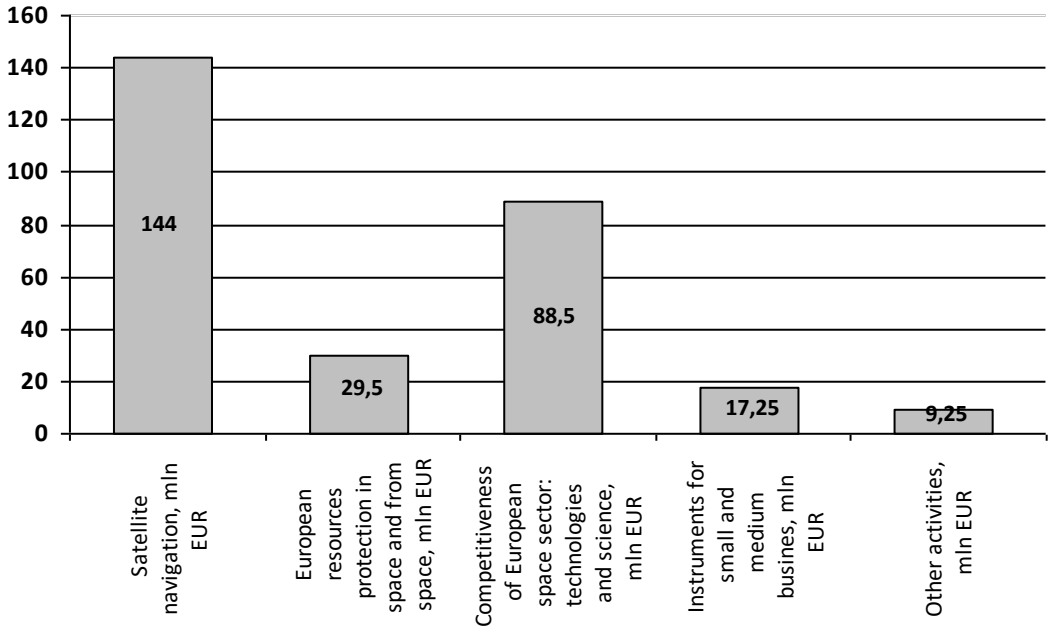

Fig. 4. Structure and investments in the space work program of EU countries "Horizon 2020", million euros *

*compiled by the authors *(Horbulin, 2016)*

Expanding of Ukraine's participation in international technological exchange with EU countries requires identification of "points of technological growth" and ensuring effective overcoming of negative tendencies in the high-tech sector of Ukrainian production, using experience and prospects of implementation of EU innovation policy. In order to reach these

goals, a group of strategic measures is recommended for implementation in Ukraine: regulatory, economic and organizational.

Regulatory measures include improvement of Ukraine's legislation on innovation activity and its harmonization with EU legal acts. The process facilitating the establishment and operation of innovative enterprises and innovative infrastructure organizations dictate the need of the appropriate legislation. Ukraine also has to legislatively regulate the issues of venture capital investment, functioning and support of venture funds. As the result, the development level of normative and legal regulation, efficiency of control over observance of the legal norms could reduce the amount of transaction costs.

Among the economic measures, the following should be mentioned: formation of the national system of international technology transfer based on the principles of public-private partnership; development of the system of indirect stimulation of innovation activity; stimulation of demand for innovative goods at the expense of provision of preferential loans, state guarantees for enterprises buying domestic high-tech products; introduction of tax privileges for innovative enterprises. Economic incentives for innovation would compensate the risks and difficulties of innovative projects, contributes to the formation of the innovation market, attracts new technologies in production. The development of public-private partnerships would provide enterprises with access to advanced technologies and highly skilled workforce, reduce the financial costs of developing and mastering innovation products, etc.

The measures in organizational sphere cover the improvement and simplification of the procedure for registration of intellectual property rights and establishment of special patent courts for the resolution of issues of intellectual property protection. Ukraine also should develop an integrated database of demand and offer of technology in Ukraine. In order to facilitate the search for foreign investors and customers, it is necessary to create a special Internet-exchange technology and form a corresponding coordinating body. In the context of organizational changes, the important role is played by the need of development of forecasting system using foresight methods, which allows more objective determination of priority directions of the state’s investment and innovation development with the corresponding resource support. There also should be created a professional association of innovators for the dissemination of successful practices of technology commercialization, professional training. The significance of these measures is explained by the fact that infrastructural environment of technology transfer facilitates solving specific problems of technology commercialization: providing venture investments, reducing uncertainty, decreasing transaction costs.

Thus, the efficiency of the international technological transfer between Ukraine and EU countries depends on the level of national development and high-tech sphere and efficiency of the international interaction of education, science, infrastructure, market, production, educational, legislative spheres on the basis of pan-European development.

Conclusions and suggestions

In conditions of innovative economy and increasing international competition, producers of high-tech products aim for creation of new products in the shortest terms and come out with them in the domestic and foreign markets. Therefore, the characteristic feature of the modern stage of development is the high speed of innovation processes.

The scientific and technological potential, its efficiency and the state’s innovative policy are becoming determinative factors in the system of international relations, particularly

in the field of technological transfer. The main factor in the long-term prosperity growth of the EU and the world is the scientific and technological progress and the ability of the states to innovate. The objective differentiation of the innovation process in the companies of different countries of the EU and the world determines the difference between the technological level of national economies and, consequently, the difference between the positions of the states in the European and world markets of technologies.

The main problems of the international technological transfer of Ukraine with the EU countries include:

- a tendency to reduction of the export of high-tech goods of Ukraine, which does not exceed 5% of industrial exports;
- significant lag in the development of new technologies in the aerospace industry of Ukraine in comparison with the economically developed countries of the EU and the world;
- insufficient involvement of Ukraine in participation in international cooperation in the high-tech sector;
- low level of use of highly developed specialized scientific potential and highly skilled personnel in Ukraine in the field of high technologies due to limited investment in the implementation of innovative programs, which results in the outflow of human resources abroad;
- insufficient adherence to the main goals and benchmarks of the EU 2020 Strategy and the EU Eighth Framework Agreement Horizon 2020 in the implementation of the Strategy for the Development of High-Tech Industries in Ukraine up to 2025;
- the imperfection of the legislative framework in Ukraine regarding certain important aspects of innovation activity and its lack of coherence with EU legal acts;
- weak susceptibility of the Ukrainian infrastructure environment to the international technology transfer.

The successful international technological cooperation between Ukraine and the EU countries would be realized with taking the next steps:

- coordination of strategic directions of national development of high-tech industries with the requirements of EU innovation policy;
- paying attention to the protection of intellectual property rights, standardization and convergence of the national accounting and reporting system;
- ensuring the development of innovative enterprises able to participate in the international technology transfer with EU countries;
- improvement of the interfaces of the national innovation system through transnational technological partnership;
- formation of a society favorable to innovation by forecasting of technological development in the future;
- study of the experience of implementing the EU Horizon 2020 Framework Agreement, focusing on emerging technologies and emerging technologies platforms, especially in the aerospace sector, with further adaptation to Ukraine.

In order to ensure the synergy effect from attracting new technologies and the favorable influence of international technological cooperation on the economic growth of individual enterprises and the national economy as a whole, it is necessary to form the preconditions for the liberalization of imports of high-tech products. This will promote the inflow of high technologies within the respective selective innovation-investment policy of the state. The key issue for the technological development of Ukraine is not whether it creates the leading

technology itself, but whether it receives and uses it and whether the feedback is established between the consumer country and the source country of this technology.

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