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# Participation of technology developed countries in the international transfer of technologies

***Annotation***
The article highlights the problems and prospects of development of the international exchange of technology and the participation of Singapore, Finland and the United States. The purpose of this article is to use the experience of these countries in the establishment and development of national innovation systems of such countries as Ukraine and Belarus. As methods of studies there were chosen methods of induction and deduction, structural analysis and a systematic approach, the method of comparison and observation. The findings were made by the author regarding the possibility of the participation of different countries in the international exchange of high and nano-technologies. The test of the country form the university participate in the international exchange of technologies. Thus, the United States of North Carolina State University, National University of Singapore and the University of Helsinki are an example of how you can be a member of the national innovation system and the transfer of knowledge within the international exchange of technology.

***Keywords***
Nano-developed countries, nanotechnologies, high technologies, nano-economics, international technology exchange

## 1 Formulation of the problem

A wide variety of countries take part in the international exchange of technologies and only those in which nano-technologies develop are net exporters of high technologies in the international arena. Also those countries in which nano-development is not sufficiently advanced are involved in the system of development of global high-tech markets. Thus, the problem of exit, as exporters or as importers of nano-technologies, to global high-tech markets is relevant for any country. Therefore, Ukraine, as a country with high technological potential, develops nano-technologies, but is not a net exporter of these technologies.

## 2 The purpose of writing an article

The purpose of the study is to determine the possible directions of the influence of nano-developed countries on the effectiveness of international technology exchange and its importance for the development of innovation systems in countries such as Ukraine.

## 3 Evaluation of existing sources

Didkovsky M.I. (Didkovsky, 2011) pays attention to the theoretical aspects of the development of international technology transfer, its forms, types of development trends. Liholoet SI (Licholet, 2009) defines the economic essence and content of transfrontal technologies in the context of innovative development of the national economy. Meglyuk B. G. (Meglyuk, 2013) describes the organizational and economic mechanism of the international transfer of military technologies, the ways of international exchange of technologies, the most common ways and tendencies of the international transfer of military technologies. Ostapenko T.G. (Ostapenko, 2012) outlines the conditions for the existence of an international exchange of technologies in the case of Italy. Yakovenko N.M. (Yakovenko, 2012) characterizes the theoretical aspects of the transfer of technology, its forms and groups. All the sources cited describe the theoretical aspects of the development of international exchange of technologies without specifying the role of any country in these processes. This article examines the participation of countries (Singapore, Finland, the United States) in the current process of international technology exchange.

## 4 Characteristics of the work done by the author

The author studies the international exchange of technologies in three spheres - in the pharmaceutical, electronic and aerospace, as the most intensively developing ones. In addition, the author explores the participation in international technology exchange of countries such as

Singapore, Finland and the United States as the top positions in the international competitiveness ratings of all countries of the world and having high rates of development of national innovation systems. The possibilities of using the experience of these countries in the realities of Ukraine are separately determined.

## 5 Statement of research results

An indicator of the development of global markets for high and nano-technologies is the functioning of such a phenomenon as international exchange of technologies. This phenomenon has not been sufficiently investigated, since data on the transfer of technology to international statistical centers are not presented by individual states. Usually it is technology transfer within certain investment, lease or trade agreements, when technology is the subject of other and not just technological operations.

Using the data of international statistics, we will try to assess the participation of nano-developed countries in the international exchange of technologies. To optimize the research, we use the statistics of such countries as Singapore, Finland and the United States, as representatives of three centers of innovation development: Southeast Asia, Western Europe and North America. Representatives of these regions were chosen to be the countries that are the most competitive - they occupy the top positions in the World Competitiveness Yearbook ratings - such countries as Singapore, Finland and the United States. Thus, there are data on international cooperation in the field of patenting. In 1999, 111497 inventions, utility models and industrial designs were patented in the world, and in 2012 - 137120. Based on external cooperation in the world, 17853 patents were issued in 1999 and 25259 in 2012 [6]. Among the three centers of attraction for patenting, the largest number of them in 2012 was registered in the European Union, namely 12624, in the USA - 6240 and in Japan - 956.

The USA is a country that has a significant indicator of registration of patents for various industrial property objects. So, based on international cooperation, 4357 patents were issued in 1999, and in 2012 - already 5488. The invention was actively patented in the European Union - 3098 (2012) and in Japan - 385. It is obvious that there is an intertwining of innovative ideas regarding the search and Introduction of industrial property. Individual innovators agree to patent inventions in other countries, especially in the European Union, which makes it possible to bring their own thoughts and decisions to a new level. As these innovative solutions are formed by individual individuals, it depends on the nano-level of innovation development. An individual person invents a certain object, formalizes it in the form of a patent and as a consequence, introduces it into the production process.

Data from international statistics state that international patent cooperation is characterized by internal ownership rights to inventions issued abroad. In 2013, 381 industrial property objects were registered in Singapore based on international cooperation, Finland - 678, and in the USA -9356 objects [6]. The external property rights of domestic inventions in Singapore totaled 958, in Finland - 1705, and in the USA - 60388. Patents registered with international participation were in Singapore - 315, in Finland - 378, in the USA - 6981 patents.

Possession of technologies in the world is determined based on different sections: from A to N. Thus, in 2013 Section B (operations and transportation) was characterized by the availability of 303 technologies; Section A (necessities for humans) - 434 technologies; Section C (chemistry and metallurgy) - 181; Section D (textiles, paper) - 183; Section E (fixed constructions) - 6202; Section F (mechanical engineering, lighting, heating, weapons, explosives) - 125; Section G (physics) - 41995; Section H (electrician) - 42181 technology. As you can see, the largest number of technologies in the world refers to physics, electrical engineering and structures. These forms of technology are most often transmitted precisely in the international environment.

There are also data on the financing of R & D expenditures from abroad. Therefore, in Singapore in 2011, international funds funded 338.4 million Singapore dollars for the scientific and technical needs of entrepreneurs. Of these, 16.2 million singles were spent out of international funds at enterprises employing 1-9 people. At enterprises with 10-49 employees, 14.5 million singles. Dollars, 50-249 employed - 96.9 million singles. $ 250-499 employed - 77.8 million singles. Dollars, with the number of employed 500-999 people spent on innovation 105.5 million singles. [6]. As can be seen, the largest number of costs are processed by large enterprises, which indicates the significant potential of these companies. But it is also noticeable that small business also does not stand aside from innovation activity, when even the smallest enterprises carry out scientific and technical activity.

Finland also has a similar structure of spending by enterprises in terms of employment. So, in 2013, international research funds funded research at enterprises with a number of employed 1-9 people - 8.4 million euros; With 10-49 employed - 57.6 million; With 50-249 employees - 44.3 million; With 250-499 employees - 72.4 million; And at enterprises with more than 500 employees - 355.9 million euros [6]. It is obvious that international funds are actively financing precisely large business and its scientific and technical activities and also

support family businesses.

In the United States in 2011, international funds have funded innovation projects totaling $ 294,092 million. Traditionally, large companies and their innovative activity are most financed from international funds. Thus, for small companies (1-9 employees), 4202 million dollars were spent; For enterprises with a number of employed 10-49 - 17640 million dollars; 50-249 employees - 21996 million; 250-499 employed - 12955 million; 500-999 employees - $ 10027 million. As you can see, international funds finance the most average business (with the number of employees from 250 to 499 people). This is a positive trend, since it is the average business that is the leader of development in the national economy of any country. It is known that the corporate business is developing in the US and 25% of GDP falls on transnational corporations, which mostly develop and introduce innovations and various innovations.

The industry structure of expenditures of Singapore enterprises, which were financed in 2010 from international funds is as follows: total - 289.53 million singles. Doll.; Production of final products - 47.633 million singles. Doll.; Business services - 241.895 million singles. Thus, there is no clearly defined specialization of innovation activity and the largest number of expenses falls on consulting services. This trend refers to countries with a not very high level of development.

The costs of Finnish companies, which are financed from international funds in 2013 amounted to 538.5 million euros. Specialization of costs was as follows:

- Agriculture, forestry and fisheries - 0.5 million euros;
- Production of final products - 164.0 million euros;
- Electricity, gas, air conditioning, water support - 1.2 million euros;
- Business services - 364.9 million euro;
- Health care, social services - 0.5 million euros;
- Other services, household activities - 0.211 million euros.

As you can see, the basis of innovative activity in Finland is business services, which are financed in particular from international funds, as in Singapore it is a consulting services segment. And also funds are spent for the production of innovative end-use products (from metallurgy to office supplies).

There are data on the share of government spending on R & D financed from abroad in Singapore - it is 5.84% in 2013, in Finland - 11.54% and in the US - 4.45%. To be more precise, in the United States, the bulk of research is financed through internal financial sources. In addition, in countries like Finland, the state focuses on external loans to finance scientific and technical research.

The business sector also focuses on receiving foreign funds. For example, in Finland, 11.70% of business receives finances from international funds (according to 2013 data). And 8.86% of Singapore's innovative business focuses on external financial funds. In the US, this share does not exceed 6%.

The external technological balance of payments in Singapore in 2005 was $ 2,518.57 million - receiving and 11,688.07 - payments. Thus, Singapore more intensively attracts technology and pays royalties for them. For the data of 2014 in Finland was received 11542.19 million, and paid 6527.58. It is obvious that Finnish innovative business structures are investing more intensively than attracting them from the outside. In the United States, the balance of payments in 2014 looked like this: receiving 136,271.00 and paying out - $ 89,415.00 million. Apparently, Americans are also intensively investing innovations abroad and are profiting from royalties or lump-sum payments.

It should be noted that the nano-factor is also significant for the development of the technological balance of payments, when an individual develops a technological solution so that he is willing to use it abroad. International innovations are new to the most innovative economies, which are developing under the influence of fundamental research conducted within the framework of state development programs.

It should also be noted that there is a Global Country Ranking on the development of innovative systems in 2015. He looked like this [7]:

1) Switzerland
2) Sweden
3) Great Britain
4) United States
5) Finland
6) Singapore
7) Ireland
8) Denmark
9) The Netherlands
10) Germany
11) Republic of Korea
12) Luxembourg
13) Iceland
14) Hong Kong
15) Canada

We draw attention to the fact that for optimal research it is necessary to stop on describing the development of individual global high-tech markets. For an objective analysis of these markets, it is necessary to characterize the markets for creative products, pharmaceutical markets, computer markets, electronics and optics, and aerospace products markets.

Of course, creative products are not always innovative, but they are related to the development of intellectual property. Since it is known, that intellectual property is divided into two areas:

objects protected by copyright - on the one hand and objects that are industrial property - on the other.

Therefore, the OECD statistician shows that in 2012, the total value of creative products produced in the world and exported was $ 473791 million. World imports of these products in the same year amounted to 431703 million dollars. It is obvious that creative products are more exported than imported. In 2012, compared with 2008, world exports of all creative products grew by 5.34%, and imports - by 1.74%. Among all the creative products are: artistic handicrafts (34339 million dollars of exports and 27741 million dollars of imports); Audio-visual products (32054 million dollars of export and 29748 million dollars of imports); Different types of design (284888 million dollars of exports, 255077 - imports); New media reports, information, video games ($ 40,673 million of exports and $ 45,905 million of imports); Musical works ($ 5,052 million of exports and $ 5,166 million of imports); Publishing books, newspapers (38.76 billion dollars of exports and 38.132 million dollars of imports); Visual art - paintings, photographs, sculpture (38325 million dollars of exports and 29935 million dollars of imports) [6].

Note that in the category of "design", as creative products, the following components are distinguished: architecture (226 million dollars of exports and 157 million dollars of imports); The fashion industry (72142 million dollars of export and 71137 million dollars of import); Glass products (22827 million dollars - exports and 1046 million dollars - imports); Interior design (71155 - exports and 69754 - imports); Jewelry art (101199 - exports and 69569 - imports); Toys (37340 - exports and 48900 - imports).

As can be seen from the data given, the world actively develops and implements a variety of creative products that single out an individual approach to similar products and becomes the basis for the development of industrial property objects. Individuals who create masterpieces of design and art in general, conduct excellent for developing, for example, industrial designs that are the shell for inventions and utility models.

In addition to the subjects of creative activity, the global high-tech markets are developing actively in the field of pharmaceutical products. It should be noted that the pharmaceutical industry is responsible for the development, supply and marketing of medicines. Thus, its importance as a global sector is determined. The total world level of income from the pharmaceutical industry rose to 1 trillion. US dollars [8]. The registration of brands in the pharmaceutical industry is the widest segment of revenue in this industry. For the population, the main task of this segment is the development and supply of affordable medicines.

The world's largest pharmaceutical multinational corporation is Pfizer. In 2012, the company created products worth $ 47 billion, while the company's total revenue increased to $ 60 billion. Another top pharmaceutical industry leader from the United States is Johnson & Johnson. The five European leaders appear in this way: Merck and Abbott, Novartis and Roche from Switzerland, Glaxo Smith Kline i Astra Zeneca from the UK, French Sanofi from France.

Oncological products are the broadest category regarding income generation in the entire therapeutic class of drugs. In 2012, more than $ 60 billion - this was the income from the sale of analgesic drugs for cancer. Other important categories are antihistamines and antidiabetic medications.

Pharmaceutical markets are based on fairly broad R & D. 20% of companies' income is spent on scientific research. And also, it should be noted that the US traditionally is strong in this area.

Statistics OECD emphasizes that the participation of the countries surveyed in the global markets for high technology pharmaceutical products in 2014 was: Finland - 0.21%, the United States - 8.80% and Singapore - 1.51%. The trade balance of payments at current prices was -1283.20 for Finland, -28566.46 for the USA, and $ 5619.81 million for Singapore. The US has the largest share of the development of pharmaceutical markets, but the balance is negative, which means that the US imports more drugs than they do export. Positive dynamics can be traced in Singapore, where there is a positive balance of payments in this area.

According to the forecasted OECD data, the dynamics of the global pharmaceutical market can be represented by 2024 thus [8]:

- 2014 – 475 million USD;
- 2015 – 505
- 2016 – 535
- 2017 – 560
- 2018 – 590
- 2019 – 625
- 2020 – 655
- 2021 – 690
- 2022 – 725
- 2023 – 760
- 2024 – 770 million USD.

Let us dwell on the characteristics of the gross profit of US companies in the field of biotechnology and narcotic drugs in the second quarter of 2016 [8]:

- Asterias Biotherapeutics 99.61%
- Araid Pharmaceuticals 98.37
- Seattle Genetics 92.77
- Gilead Sciences 88.89
- Allergan 88.02
- Dandrit Biotech 87.3
- Biogen 87.54
- Amgen 81.54
- Abbvie 78.22
- US.Stem Cell 65.30

- Emergent Biosolutions 64.91
- Entia Biosciences 63.84%

The list includes the twelve largest companies of the world's pharmaceutical companies, the level of their capitalization is quite high. The list of the largest pharmaceutical companies in the world in terms of capitalization (in billions of US dollars) is as follows [8]:

- Amgen (USA) 127,3
- Novo Nordisk (Denmark) 116,09
- Gilead Sciences (USA) 102,93
- Allergan (USA) 93,54
- Celgene (USA) 82,95
- Biogen (USA) 68,40
- Shire (Shire) 57.44
- Teva (Israel) 46,53
- Regeneron (USA) 41,90
- CSL (Australia) 36,06 bln USD.

The production of pharmaceutical products for women (contraceptives) in the US and the world is as follows in millions of US dollars [8]:

- Premarin (Pfizer) – 951
- Prolia (Amgen) – 837
- Mirena (Bayer) – 710
- Forteo (Eli Lilly) – 612
- NuvaRing (Merck) – 515
- Nexplaton (Merck) – 367
- Lo Loestrin Fe (Allergan) – 347
- Estrace Cream (Allergan) – 326
- Lupron (AbbVie) – 280
- Minastrin24FE (Allergan) – 272 million USD

The pharmaceutical markets are actively growing and introducing nano-technologies. The future of this market depends on high technologies, which are represented by robotic technologies, when a nano-mechanism is created that sends medicines to the affected organs. Such local action of medicines should direct health-improving funds to the affected organ, and not to the whole organism.

However, the active activity of transnational corporations is not cloudless and provides that these corporations are responsible for the introduction of low-quality products and products that in the end do not lead to overcoming the medical problem in humans. Therefore, there are statistics on financial payments in some US states regarding the release of low-quality pharmaceuticals on the market [8]:

- Texas - 691.1 million USD
- Louisiana - 300.6
- California - 210.3
- Pennsylvania - 189.9
- South Carolina - 169.0
- Kentucky - 147.3
- Alabama - 124,3
- Mississippi - 106.5
- Hawaii - 83.8
- Florida - 75,8 million. USD.

From the data given, it can be seen that the industrialized states of the USA are the most active developers of pharmaceutical innovations and they face shortcomings in such developments.

Another market that is actively developing is the global market for computers, electronics and optics. Data OECD note that the capitalization of this segment was in 2014, 41 billion. The US share is consistently high and amounts to 8.0% in 2014, compared to 16.39% in 2000. There are new players in this area and traditional producers lose their positions in these markets. Therefore, the share of Singapore will also gradually decrease from 6.73% in 2000 to 5.47% in 2014. Singapore traditionally manufactures these products and delivers it to international markets, actively introducing new electronic equipment. In particular, nano-electronic technologies are being developed that accordingly improve existing innovations and leave this country the industry leader.

Europe is also a center for the development of electronic technologies; France and Germany were the leaders. Finland is a weak player in these global markets and its share in 2000 was 0.99%, and in 2014 - 0.16%. Known NOKIA is only a single example of the development of nano-technologies in Finland. Certain developments are being carried out, but the Finns remain innovators in the field of forestry and paper technologies.

The trade balance of the presence in these markets looks like this: Finland had a positive balance of 5,131.67 million dollars in 2000, and already in 2014 a value of -2208.94 million dollars - as we see, Finland imports computers more than exports. The US balance was also negative -61344.15 million US dollars in 2000, which increased to 165940.15 million US dollars. Americans do not rest on their laurels and remain generators of other ideas, in particular nano-technological ones and remain modernizers of existing innovations in the electronics industry.

Singapore has a positive balance of payments for electronic products. Since in 2000 this country exported for 17530.38 million dollars of computer equipment more than imported. The balance for 2014 was $ 36,014.13 million. This country has a competitive advantage in the manufacture of computers, which is associated with the use of parts from around the world, which makes it possible to produce a quality product at affordable prices.

There are data on the spread of information technology in the world with forecast data from 2005 to 2020 (in billions of US dollars).

- 2005 – 2,648
- 2006 – 2,856
- 2007 – 3,177
- 2008 – 3,393
- 2009 – 3,228
- 2010 – 3,402
- 2011 – 3,573

- 2012 – 3,618
- 2013 – 3,677
- 2014 – 3,734
- 2015 – 3,413
- 2016 – 3,387
- 2017 – 3,486
- 2018 – 3,600
- 2019 – 3,692
- 2020 – 3,795.

Note that the computer equipment is supplied by different manufacturers whose capacities are represented in certain countries of the world, in particular, China, Malaysia, Indonesia, etc. This technology is produced under brands whose countries of origin are the USA, European countries, Japan and other countries of Southeast Asia.

Deliveries of computer equipment for the period from the 1st quarter of 2009 to the 2nd quarter of 2016 by the companies of the main manufacturers of this product looks like this (million units) see table 1:

Table 1 Supplies of computer equipment by companies - major producers*

| | 1st quarter 2009 | 1st quarter 2014 | 1st quarter 2016 |
|---|---|---|---|
| Lenovo | 4,38 | 12,87 | 12,48 |
| HP Inc | 12,77 | 12,14 | 11,41 |
| Dell | 8,40 | 9,53 | 9,15 |
| Asus | 2,16 | 5,46 | 5,37 |
| Acer | 7,78 | 5,56 | 5,40 |
| Toshiba | 3,40 | 4,10 | 4,20 |
| Others | 27,31 | 30,15 | 21,76 |

*Source: [8]

Based on the data, we note that Lenovo is the leader in sales of personal computers in the world, beginning in 2014. Moreover, in 2016, sales of this company amounted to 15.38 million units of this product. The US share in these markets was 12.5%.

Computer, electronic and optical technology is the basis for the development of the accompanying machine-building industries, in particular the aerospace industry. Global aerospace markets are extremely active. The main players in this market are the USA, France and Japan. However, Finland and Singapore are also attracted to these leading global markets.

According to the experts' definitions [9], the global aerospace and defense industry turned to the growth path in 2016. The total income of these industries increased by 3.0%. This positive signal of recent years began with a fall in the previous period: an increase of 3.2% in 2013, a 1.9% increase in 2014 and a fall of -05% in 2015.

The basis of these trends was the conditions for the production of these products in the United States. The appeal to growth in the global aerospace environment in 2016 was determined by the increase in the US defense budget and some key countries for this sector. We will add that the relatively stable growth of global GDP, the decline in prices for raw energy carriers and other products, and the steady growth in demand for passenger travel have contributed to a steady growth in the manufacturing sector with respect to the manufacture of next generation vehicles.

The state budget of the USA, Great Britain, France, Japan, some countries of the Middle East and other countries grew during the actualization of national security. Global in the defense subsector is associated with growth in 2016. The basis of growth is the production of the following defense products: defense armament platforms; technologies of the next generations, including cybernetics, smart assembly, defense electronics and precise percussion capabilities.

The commercial aerospace sector continues to show a long-term trend in relation to the increase in growth rates, which is caused by the growth in demand for passenger transportation and the acceleration of the life cycle of transport equipment. The steady increase in passenger traffic from year to year has led to an increase in two sales of this equipment in 2015 compared to 2005.

Growth in the aerospace industry is caused by the growth of this industry in the main producing countries. Analysts [9] emphasize that China is beginning to play an important role in this area. China is turning from a net importer into a country where import substitution is in effect. In addition, the revitalization in this area is based on the strong positions of the US dollar in international currency markets.

It should be noted that the aerospace industry has two subsectors: defense and commercial. A commercial boom is predicted in commercial aircraft construction [10]. Boeing's Dreamliner i Airbus Group's A350 form the basis of commercial aircraft construction. In this market there is a duopoly (two monopolists and other minor producers) and these two giants occupy 65% of the aviation transportation sector. Other manufacturers are Canada's Bombardier, Brazil's Embraer, Japan's Mitsubishi Heavey Industries - are secondary players in global aerospace markets.

General Electric and United Technologies

Corporation are suppliers of aircraft engines and spare parts for aircraft technology. The key competitors in the production of military aircraft are: Europe's EADS, Boeing, Lockheed Martin, Northop Grumman.

Note that a new global drones market is being formed. For 2015, it was estimated at $ 930 million [10]. The forecasted dynamics of this market is as follows:

- 2015 – 223,59
- 2016 – 257,46
- 2017 – 338,08
- 2018 – 461,45
- 2019 – 641,16
- 2020 – 929,13
- 2021 – 1375,87
- 2022 – 1971,16
- 2023 – 2715,28
- 2024 – 3502,27 million USD

Statistics show that the share of export markets for aerospace equipment is the largest for the United States. In addition, in 2014 it is 32.42%, which has decreased slightly compared to 2008, when it accounted for 35.88% of the world export market for this equipment. For fourteen years (from 2000 to 2014), Singapore increased its participation in these markets by half from 0.52% to 2.48%. Finland's positions are stably low - 0.07% and 0.10% respectively.

The positive balance of payments related to the sale and purchase of aerospace equipment has only the United States of America - 74344.94 million US dollars. And this positive balance grew almost threefold compared to 2000 (USD 25,767.29 million).

Negative balance can be traced in Finland and Singapore. Finns are active importers of this technology, however, the negative balance is declining: from -406.21 million in 2000 to -261.86 million in 2014.

In Singapore, the negative balance in the trade in flying equipment is increasing: from -543.68 million in 2000 to -2741.86 million in 2014.

Such data are explained by the fact that flight technology is an expensive mode of transport and is accompanied by expensive production. It is necessary to have quite expensive research and mass production, which provided consumers in different parts of the world. Compared with automotive equipment, which is manufactured in almost all developed countries of the world, air transport is a unique transport for most countries of the world, since only one producer must provide consumers in different regions of the world. Enter this competitive area is a rather problematic issue. Therefore, Ukraine, which has its own aerospace industry, must enter this closed segment and overcome the duopoly.

It should be noted that individual universities of certain countries also carry out active international activities in the field of scientific and technical developments. Therefore, the State University of North Carolina (USA) carried out innovative activities in 2016 so that it provided the leading places of the university in the ratings of technology developers. In 2016, scientific and technological developments consisted of such elements [11]: inventions (225 units); software (36), new plant varieties (17), copyright (13). The patent activity of this university in the same year was: 229 patents in new patent industries, 53 patents granted in the United States, and 12 patents granted abroad.

Important for universities is cooperation with industrialists, who are able to introduce new innovative solutions. Therefore, the collaboration of universities with the industrial sector is leading for universities and only from the United States. In 2016, the North Carolina State University entered into such contracts with the US manufacturing sector: patent licensing agreements (42); Licensing agreements for software (3); A license for the use of copyright (10); Licenses for the transfer of new scientific materials (1); Technological options (63); Only 164 contracts. Note that the revenue from innovation activities (royalties) of this university in 2016 amounted to $ 3.8 million.

Singapore's leading university is the National University of Singapore (NUS) [12], which is an important institution of higher learning in the Heart of Asia. NUS is an internationally recognized educational and research institution that carries out highly qualified research in the fields of science, technology and the humanitarian sphere. This university is ranked 12th in 2016 in QS World University Rankings. Also during the last two years NUS was named the best university in Asia. NUS has 29 schools and faculties, which are research institutes and centers focused on critical research, which are new for Asia and for the world.

The university also cooperates with three of the five Singapore Research Centers (RCEs), which specialize in quantum technologies, cancer research and mechanobiology. NUS is a partner of RCEs in scientific and research cooperation in the field of engineering and scientific living environment.

NUS conducts research in interdisciplinary areas: energy saving, water and environmental protection; Aging of the population; Biomedical sciences and applied medicine; Global Asian research; Financial and risk management; The world of the seas; Research of new properties of materials. In early 2016, the NUS conducted research on mental national research clusters, in which studies are conducted by specialists from different scientific branches of the university with the goal of developing social relations in the educational environment of Singapore.

Based on the data given, the NUS in 2015 conducted more than 2,400 studies, printed 8,300 publications, prepared 520 patents, formalized ownership of 295 inventions, and processed more than 714 million US dollars of grant funds. In the current year, NUS was a consultant to the government and enterprises of various industries in 1800 cases.

One of the leading universities in Finland is the University of Helsinki [13]. This university has 11 faculties, where 300 disciplines are taught. Within the Q1 level, there are Master's programs with teaching in English. The university has more than 35,000 students, of which 2,200 are foreign students. The scientific activity of the University of Helsinki is aimed at building a better, larger world in which the global problems of mankind must be linked. University scientists carry out interdisciplinary research, when education and training take place based on high world standards and are aimed at developing know-how regarding the improvement of human life.

The University of Helsinki has four doctoral schools, which provide for 32 doctoral programs. Strategic research areas in 2017 - 2020 include such areas:

- Health and well-being;
- Language and culture;
- Education and cognitive abilities of a person;
- Environment and science;
- Society and economy.

These strategic areas are an integral part of the Strategic Plan 2017-2020 of the University of Helsinki. This plan develops the following areas of activity: creativity, an international environment for learning and conducting high-level research, focusing the learning process on students, saving resources and carrying out reforms.

Thus, countries such as Singapore, Finland and the USA (being developers and users of nano-technologies) are actively innovating and exchanging them in the international environment. Foreign investments are one of the components of increasing the effectiveness of international exchange of technology and participation in it of individual countries. Analyzed countries actively patent inventions abroad, mainly in the US, Japan and the EU. Such global innovative markets as pharmaceuticals, electronics and aerospace products tend to grow and they use nano-technology. The countries studied form the participation of universities in the international exchange of technologies. Thus, the University of North Carolina USA, the National University of Singapore and the University of Helsinki are examples of how to be a participant in the development of the national innovation system and transfer knowledge in the framework of international technology exchange.

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