UDC 334.021
JEL classification: O32, O52, O53

Tsybulenko M.
ORCID ID: 0000-0001-7656-9103

Chernenko N.
Candidate of Economic Sciences, Associate Professor
ORCID ID: 0000-0002-7424-7829

National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

DEVELOPMENT STRATEGIES FOR SCIENTIFIC AND TECHNICAL COOPERATION BETWEEN UKRAINE AND CHINA

СТРАТЕГІЇ РОЗВИТКУ НАУКОВО-ТЕХНІЧНОГО ВЗАЄМОЗВ'ЯЗКУ УКРАЇНИ ТА КИТАЮ

There is analyzed the state of relationships between Ukraine and China in the article, that allowed to develop a number of strategies aimed at increasing the efficiency of scientific and technical cooperation of two countries. The implementation of outlined strategies in the article can serve as a factor for expanding spheres of influence in the international scientific and technical environment by improving the competitive positions of economies in the conditions of globalization, it will allow to strengthen the existing relations and reach a new level of bilateral scientific and technical cooperation, and can serve as the basis for studying international cooperation in the scientific and technical sphere of countries that didn`t become the subject of this study.

It has been revealed that the effective basis for expanding bilateral interaction are well-established relationships, which have been implemented on democratic foundations for a quarter of a century, and also the presence of a common vision of the future on the basis of integration processes in the world economic community on the principles of science and technology, – thus it was systematized the directions of Ukrainian-Chinese cooperation that cover the following issues: on issues of scientific and technical cooperation directly, on cooperation in the space industry and on cooperation in the field of medicine.

Based on a thorough analysis there are distinguished some benefits of cooperation on the basis of science and technology for each of the parties separately in the article, indicating the possibility of successful cooperation on the strategy of global development.

Based on this analysis, the authors found that the development of scientific and technical cooperation between Ukraine and China is possible only on the basis of economic development, which requires significant efforts from the state and improving ways of investment and stimulating of cooperation. The authors proposed to determine the amount of net foreign direct investment per capita, taking into account the volume of these investments. The authors state that the volume of foreign investment should be valued at the rate of 1 person, because this indicator reflects on how much influx of foreign capital affects the ordinary citizen of the state, and not the entire scale of the country.

Keywords: scientific and technical cooperation, partnership, strategy, potential, interconnection.

У статті проаналізовано стан українсько-китайських відносин, що дозволило розробити ряд стратегій, спрямованих на підвищення ефективності науково-технічної взаємодії двох країн. Реалізація окреслених у статті стратегем може слугувати чинником розширення сфер впливу у міжнародному науково-технічному середовищі за рахунок покращення конкурентних позицій економік в умовах глобалізації, дозволить укріпити вже

сформовані відносини та вийти на новий рівень двосторонньої науково-технічної співпраці, а також може слугувати основою при вивченні міжнародної взаємодії в науково-технічній сфері країн, які не стали предметом даного дослідження.

Виявлено, що ефективним підґрунтям щодо розширення двосторонньої взаємодії є вдало побудовані взаємовідносини, які реалізуються на демократичних засадах уже чверть століття, а також наявність спільного бачення майбутнього на основі інтеграційних процесів у світове економічне співтовариство на засадах науки та техніки, – тому систематизовано напрямки українсько-китайського співробітництва, що охоплюють наступні питання: безпосередньо з питань науково-технічного співробітництва, з питань співробітництва в космічній галузі та з питань співробітництва в галузі медицини.

У статті, на підставі ґрунтовного аналізу, виокремлені вигоди співпраці на базі науки та техніки для кожної зі сторін окремо, що свідчить про можливість вдалого співробітництва за стратегією глобального розвитку.

На підставі цього аналізу авторами виявлено, що розвиток науково-технічного співробітництва України та Китаю можливий лише на основі розвитку економіки, що потребує значних зусиль з боку держави і вимагає удосконалення шляхів інвестування та стимулювання співробітництва. Авторами запропоновано визначати обсяг чистих прямих іноземних інвестиції на душу населення враховуючі обсяг цих інвестиції. Авторами зазначено, що обсяг іноземних інвестиції варто оцінювати у розрахунку на 1 особу, адже даний показник відображає на скільки приплив іноземного капіталу впливає на пересічного громадянина держави, а не на весь масштаб країни.

Ключові слова: науково-технічне співробітництво, співпраця, стратегія, потенціал, взаємозв'язок.

Introduction. Ukraine and China are gradually taking joint steps towards mutually beneficial cooperation, since both countries have a common goal –it`s an integration into the world economic community through development of an innovative economy. Such orientation can turn these countries into strategic partners, above all in the field of scientific and technical cooperation. China is «interesting» by its development model, and Ukraine can study China`s experience, since China was an exclusively agricultural country more than a decade ago, but today it has one of the most attractive economy for investors in the world. At the same time, if Ukraine is interested in an innovative model of China, then China – in scientific resources of Ukraine. Therefore, the scientific and technical sector is the most promising field of interaction between states; therefore, the mechanisms of its development, taking into account already existing interactions in the field of science and technology, can become the strategies of economic activity of the two countries.

Each state pursues the goal of improving life, creating new conditions for society that would bring positive changes based on economic, political and social principles of development. Therefore, it is extremely important to understand the strategic plan of the future, taking as a basis today`s globalization processes.

A large number of scientists are engaged in the study of theoretical problems of international scientific and technical cooperation, in particular the impact of economic globalization on the transformation of scientific and technological activity sphere is learnt by: Kapitsa S., Zakirov M., Goncharuk A., Gobova Y., Kiktenko V., Koval O., Koshovy S., Manes A., Bader G., Reicher V., Raytman L. and others. Despite the fact that numerous researches in the field of scientific and technical cooperation are

conducted intensively and thoroughly, a number of scientific tasks remains unresolved, in particular, the problem issues are the development of strategies of international cooperation enlargement; therefore, the purpose of the study is to analyze the organization of cooperation between Ukraine and China in the context of modern strategies of scientific and technological activities and scientific and technical exchange.

Setting objectives. The purpose of the article is a theoretical substantiation, development of scientific-methodical principles and practical proposals aimed at improving scientific and technical cooperation between Ukraine and China as a factor for expanding innovation, scientific and technical spheres and enhancing competitiveness of economies in the conditions of globalization. The following methods were used to solve tasks: analytical – by studying cooperation in the field of science and directions of its implementation; comparison – by establishing research and development costs in scientific and technical sector and investment between countries; modeling – by highlighting possible interaction strategies between Ukraine and China. The basis of the work is: to establish the features of scientific and technical exchange and analyse of existing problems of business partnership to identify the most significant world experience in organization of scientific and technical cooperation; design a general strategy for development of scientific and technical relationship between Ukraine and China.

Methodology. The research is based on consideration of strategic approaches to cooperation between Ukraine and China, which together form the opportunities for increasing competitiveness, potential of each countries in the scientific and technical area.

Research results. Relationships between Ukraine and China have been built on a democratic basis for the past of a quarter century, which provide an effective basis for expanding the areas of interaction between these countries.

At this stage, the Ukrainian-Chinese cooperation is represented by the following areas of cooperation [1]:

- on scientific and technical cooperation (in priority areas for both countries, namely: energy efficiency, aircraft building, ship building, rational nature management, development of aerospace, information and communication technologies, as well as training and internship of specialists);
- on cooperation in a space industry (exploration and use of outer space for peaceful purposes);
- on cooperation in the field of medicine (cooperation in the field of health care, consideration of establishment of joint medical technology parks of a medical profile, etc.).

In order to distinguish promising strategic directions of interaction it is worth noting the benefits of such cooperation for each of the sides separately.

The advantageousness of scientific and technical cooperation for our country with China appears by following factors:

1. China updates its own economy every year, increasing R & D costs. Comparison of research and development costs in Ukraine and China over the 10-year period is presented in the Table 1 and Fig. 1.

Table 1 - Research and development costs in Ukraine and China for 2006-2015 years, % of GDP [3]

Research and development costs, % of GDP	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
China	1,371	1,374	1,443	1,662	1,710	1,776	1,907	1,991	2,021	2,066
Ukraine	0,949	0,853	0,846	0,857	0,833	0,738	0,754	0,759	0,649	0,617
Difference	0,422	0,521	0,596	0,806	0,877	1,039	1,153	1,232	1,372	1,448

Source: [compiled by the author on the basis of [3]]

From Table 1 it can be seen that in 2006, the difference in expenditures to this sphere between Ukraine and China was only 0.4%, while in 2015 it approached to 1.5%, increasing the gap between countries.

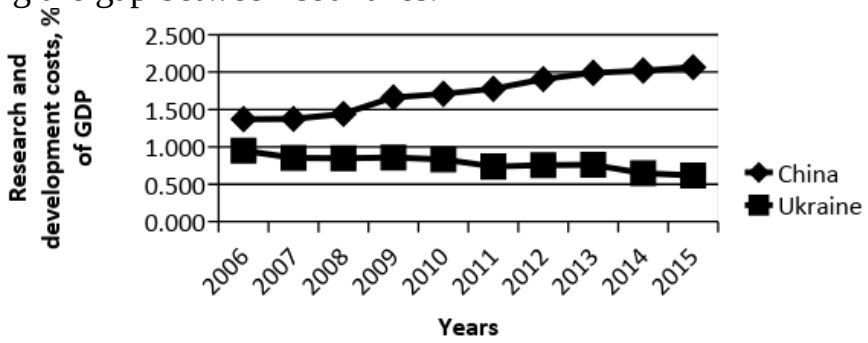

Figure 1 - Research and development expenditures in Ukraine and China for 2006–2015 years, % of GDP [3]

As can be seen from Fig. 1, China modernizes its own scientific and technical sphere, and the tendency to increase its research and development costs constantly increases. While in Ukraine such item of expenses decreases with each passing year, which is an adverse factor for the development of our country's scientific and technological activities.

2. The investment potential of China is rather high, as it has become one of the largest donors and, at the same time, recipients of investment. This is the fifth largest country in the world in terms of gold and foreign exchange reserves and in terms of capital exports [2].

Determination of net foreign direct investment per capita takes an interest by the formula 1:

$$\frac{FDI}{c} = \frac{FDI_{(net)}}{population}, \quad (1)$$

where FDI / c – foreign direct investment per capita;

FDI (net) – net foreign direct investment.

Foreign direct investment should be valued per one person, because this indicator reflects how much foreign capital influences on an average citizen of the state, and not on the entire country.

In the Table 2 and Fig. 2 it is shown the inflow of foreign direct investment per capita for China and Ukraine over 10 years, calculated by the formula.

Table 2 - Net inflow of foreign direct investment per capita for China and Ukraine for 2006–2015 years, US dollars

Net inflow of foreign direct investment per capita, US dollars	2006 year	2007 year	2008 year	2009 year	2010 year	2011 year	2012 year	2013 year	2014 year	2015 year
China	94,65	118,56	129,49	98,45	182,18	208,37	178,59	214,33	196,51	176,84
Ukraine	119,77	219,16	231,31	103,55	140,63	157,68	179,30	99,12	18,71	67,55
Percentage difference (%)	-26,55	-84,85	-78,63	-5,19	22,8	24,33	-0,4	53,75	90,48	61,8

Source: [compiled by the author on the basis of [3]]

According to the table above, since 2013, the net inflow of foreign direct investment per capita in China was almost twice as big as its value in Ukraine, indicating the country's stimulating reforms in favor of inflow of foreign capital and improving the quality of life of each citizen, increasing the economy openness.

The low level of this indicator in Ukraine means the need for diversification of international investment activity, since FDI can not only restructure and modernize the economy, but also accelerate the transition of the state to sustainable economic growth.

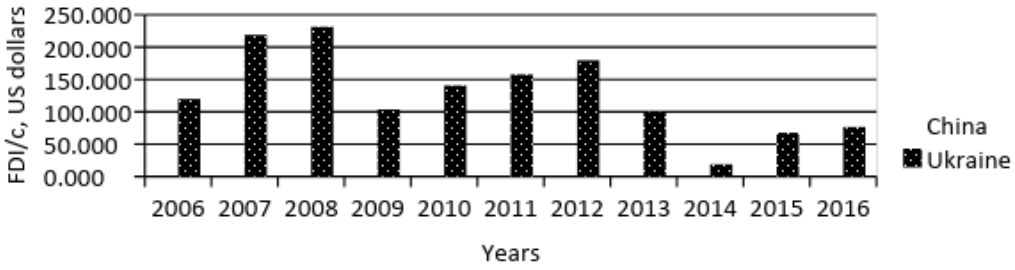

Figure 2 - Net inflow of foreign direct investment per capita for China and Ukraine for 2006–2015 years, US dollars

Source: [calculated by the author on the basis of [3]]

As it can be seen from Fig. 2, over the past 7 years, foreign investment per capita in China exceeds the corresponding figures compared to the Ukrainian ones.

The Chinese 13th Five-Year Development Plan (from 2016 to 2020) provides annual investments of $ 120–130 billion dollars, the main part of which will be directed to the projects of the countries participating in the New Silk Road «One belt, One road». The purpose of the latter is to create a new globalization space at the expense of China's wealth and know-how. The share of Ukraine in the structure of

Chinese investments is approximately 0.004%, but investment volumes increase annually [4].

Thus, one of the strategic initiatives should be the participation in joint projects between China and Ukraine. Possibility of cooperation on the strategy of global development «One belt, One road» – this is an opportunity not only for the revival of the Ukrainian economy, but also a creation beneficial relations with many countries by the project.

3. In the field of science and technology, Ukraine and China came to the world level or approached it in such areas as nuclear and space technology, high energy physics, biology, computing and telecommunications. Currently, trade relations between Ukraine and China go through a complex stage of structural transformation from the trade of Ukrainian goods of low processing and Chinese goods of wide consumption predominantly with low quality to the trade of high tech and high-quality products. Over the past few years, China has been among the most important foreign trade partners of Ukraine in terms of bilateral trade. There are reasons to count on the fact that in the case of a correct choice of priorities and the implementation of a number of relevant practical measures, China will remain an important foreign economic partner of Ukraine in the long run.

China also has some benefits of scientific and technical cooperation with Ukraine.

1. Realizing the relationships with Europe countries, Ukraine is an attractive transit point of science and technology to China.

2. This is an opportunity to increase the volume of trade, namely afamiliarization of new places of sale in Ukraine.

3. Cooperation of countries on the basis of the implementation of educational programs (especially in such areas as shipbuilding, rocket science, nuclear technology etc.), since fundamental and technical education, a high scientific and technical potential in space and aircraft construction, a large number of IT specialists are one of the Ukraine strengths.

4. Exchange specialists in these areas to create a synergy effect in terms of international cooperation etc.

In order to enhance scientific and technical cooperation between Ukraine and China, international cooperation should be strengthened and developed by a number of strategies aimed at increasing trade and economic turnover and the transfer of knowledge and technology. For intensification of such interaction, it is expedient to develop the following strategies (Fig. 3).

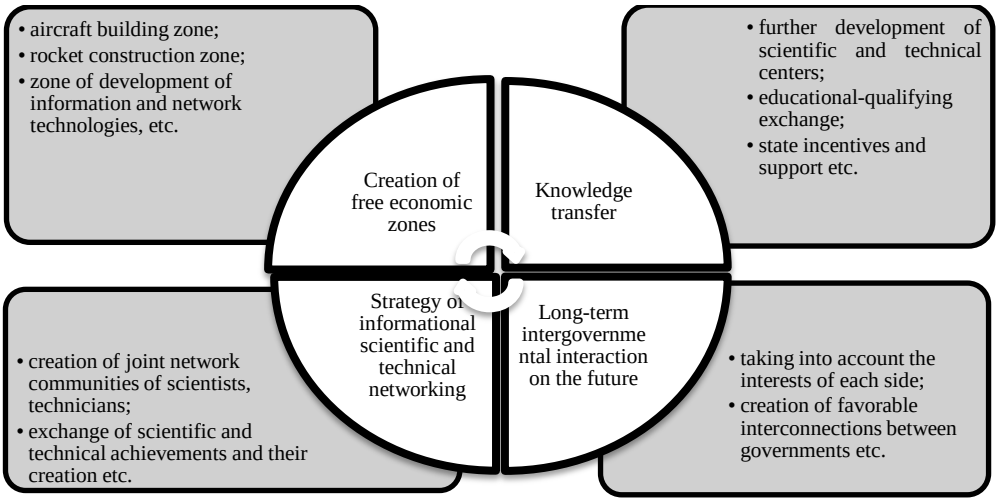

Figure 3 - Strategies of scientific and technical cooperation between Ukraine and China

Source: [compiled by the author]

Table 3 represents possible strategies of scientific and technological cooperation between Ukraine and China as a prospect of expanding bilateral cooperation.

Table 3 - Scientific and technical cooperation strategies between Ukraine and China

№	The name of the strategy	Purpose	Results
1	Creation of free economic zones	Concentration of priority industrial complexes on the actual directions of scientific and technical cooperation: aircraft and rocket construction zone; zone of development of information and network technologies etc.	Stimulating the development of scientific and technical sphere of both countries, promoting the functioning of science-intensive entrepreneurship, increasing the level of scientific and technological achievements.
2	Knowledge transfer	Development of the policy of attracting human capital to establish a balanced «knowledge triangle» (innovation, education and science) in both countries.	Further creation and development of joint scientific-innovation and technical centers; accelerating scientific and technological development.
3	Strategy of informational scientific and technical networking	Implementation of a common information space between scientific and technical personnel.	Sharing the achievements of science and technology, creating inventions and initiating new projects.
4	Intergovernmental interaction on the future	Creation of mutually beneficial conditions for realization of interests among the governments of the countries.	Conclusion of fundamental long-term relations between countries, improvement of scientific and technical cooperation; access to new markets.

Source: [compiled by the author]

According to the Fig. 3 and Table 3, it would be especially advisable to have a zone of high-tech industry where introduction of technological gains into production in both countries would be implemented. It should be emphasized that it would be beneficial to create such zones on the basis of joint investment into the development of a long-term projects. It should be noted that China has a considerable experience in creating SEZs (special economic zones), which have become one of the most effective incentives for development of Chinese economy. There is already a legislative base in Ukraine, that regulates a SEZ activity, as well as a number of such zones.

The exchange of human resources, by the second strategy, is a significant component of the transfer of knowledge and technology, so this exchange can be done on two levels.

The first level, actively implemented nowadays is the creation of joint scientific-innovation and technical centers. At present, the intentions of opening of Ukrainian-Chinese science and technology parks in Ukrainian cities are announced [5–6]. Such projects have a considerable potential, they accelerate the scientific and technological development of China and give the opportunity to Ukraine to become innovative.

The second level is an educational factor, namely: the exchange of human capital with state support. China's legislation is aimed at encouraging the return of scientific personnel who has received education abroad. Ukraine can also put on the agenda the adoption of such legislation, which would stimulate a scientific development of the state.

Today, in the era of information technology, the social aspect of science should evolve, which is reflected by the third strategy of information networking in accordance with the Table 3. The creation of joint Ukrainian-Chinese enterprises is not a sufficient incentive for development of science as it is. Between scholars it is necessary to introduce a common information space that will enable not only to share the achievements of science and technology, but also to create original inventions and initiate scientific projects.

The exchange of technologies is a powerful tool for an innovative economy, but scientific and technological progress is moving faster when the social factor plays a role in scientific interaction. Creating collaborative network communities of scientists can be a long-term investment in the future of science, which will certainly contribute to technological development.

The fourth strategy is based on the fact that Ukraine can serve as the overpass of Chinese cooperation to the European market, and China can be the overpass of Ukrainian cooperation to the Asian market. In order to realize these conditions, Ukraine and China should take into account the interests of each other and create mutually beneficial conditions for realization of such interests. Therefore, intergovernmental interaction should be at the basis of the development of scientific and technical cooperation between Ukraine and China that would flexibly respond to hourly needs of scientific and technical cooperation between the states and would contribute to the conclusion of fundamental long-term conjunctions that can produce an economic confidence that would be at the basis of the overall strategy for development of scientific and technical interconnection.

Consequently, seeing the benefits of scientific and technical cooperation, considering the existing directions of cooperation, the four strategic approaches to the expansion of science-and-technology relations were proposed, which can lead Ukraine and China to a new level of development in the long run, increase their competitiveness in world markets.

Conclusions. The scientific novelty of the work is to develop strengthening measures of scientific and technical cooperation between Ukraine and China, which is in the basis of implementation of four strategies aimed at promoting science development and initiative implementation of scientific and technical projects in particular.

The theoretical significance is to substantiate the modern directions of scientific and technical cooperation, the benefits of bilateral interaction and to represent broader perspective directions that are reproduced on a common basis within science and technology.

The practical value of the work is to implement the strategies of scientific and technical cooperation, which by a proper and timely implementation, will contribute to increasing a number of scientific projects and development of science and technology in general.

The direction of a further research is generalization and development of scientific and methodological foundations, the development of strategic forms of interaction between states in scientific and technical field.

References:

1. Scientific and technical cooperation between Ukraine and China. Embassy of Ukraine to the People's Republic of China. URL: http://china.mfa.gov.ua/ua/ukraine-cn/science.

2. Goncharuk A., Gobov E.(2016). Audit of foreign policy: Ukraine-China. K: Institute of World Politics. 60 p.

3. Data base of the World Bank URL: https://data.worldbank.org/topic/science-and-technology?end=2014&locations=UA&start=19954.

4. China Investment Resource for Ukraine. Ukrainian Institute for the Future. URl: https://uifuture.org/uk/post/investicii-v-ukrainu-z-kitau-stan-ta-mozlivosti-prognoz-ekonomista_459.

5. Cooperation of Ukraine with China. Science Park. URL: https://scp.knu.ua/ua/holovni-novyny/134-zustrich-z-predstavnykamy-knr.

6. Science park for realization of joint projects of Ukraine and China. URL: https://www.ukrinform.ua/rubric-technology/2281648-kitajci-proponuut-stvoriti-u-sumah-naukovij-park.html.