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THE STRATEGY OF INNOVATION DEVELOPMENT OF UKRAINE IN THE CONTEXT OF EU INTEGRATION

Abstract

The authors discuss the issues of improving and increasing the effectiveness of state policy in the area of international science and technology cooperation of Ukraine taking into consideration the integration priorities of the state, including the interactions with the EU.

Key words:

European Research Area, innovation development, innovation process, international integration, international science and technology cooperation, international science and technology interaction.

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Globalization of the world economy is an important factor of modern economic relations, which defines the development of the world economy at the turn of the 21st century. In the future as well, globalization will continue to produce effects on trade relations, financial flows, scientific and technological progress, as well as global environment, thereby calling for the search of dynamic equilibrium both at the international and national levels.

Ukraine occupies fifth position on the European continent by population and second – by the size of territory. In terms of economic opportunities and intellectual and S&T potential, it belongs to the largest developed European nations. The Ukrainian society possesses and should employ and realize its potential advantages, find its proper place on the world market, and take the leading positions in the areas of economic activity where relevant conditions are available.

Innovation development requires the state to solve a set of problems in different areas of economic activity directed at revealing deviations from the main goal of internal and external elements of activity, to search for and substantiate the ways to harmonize them with the purpose of creating conditions for sustainable socio-economic development of both individual economic subjects and society as a whole, especially in the light of globalization processes which have come to full swing since mid-1990s.

Under significantly accelerated S&T progress becoming the main factor of intensive economic growth, both national economies and the world economy as a whole find the effective use of achievements in science and technology for meeting the tasks of sustainable development becoming of increasing importance. In connection with that, modern scientific achievements and technologies precondition the countries' level of economic development, the degree of their inclusion into the international division of labour, their position in the world community, and their ability to succeed in resolving different socio-economic problems.

At the same time, in the science and technology sphere – taking into account its peculiarities and global nature – an immediate and most effective implementation of results is possible only on conditions of intertwining national potentials, integrating material and intellectual resources of different countries, risk-sharing and division of labour at the international and global levels. This peculiarity is embedded in the processes of internationalization of the science and technology sphere.

The innovational in its essence dynamics of the modern world economic development based on the factors of scientific and technological advance requests countries to choose relevant models of economic growth. Thereby, the Ukrainian economy faces the ultimate task – to move to the innovation path of

development based on the implementation of scientific and technological achievements into all fields of the national economy.

In the light of development and intensification of internationalization in the world economic and S&T areas, the employment of advantages of international scientific and technological integration is critical for improving the effectiveness of implementation of the national strategy of Ukraine's innovation development concerning its integration into the European Union.

The research of the nature and tendencies of internationalization of the world society, including S&T, is presented in the works of such national scientists as O. G. Bilorus, B. G. Hubskyy, D. G. Lukyanenko, Yu. V. Makohon, A. M. Poruchnyk, Ye. V. Savelyev, A. S. Filipenko, and others. The questions of scientific substantiation of Ukraine's strategy of innovation development, effective realization of S&T potential, and using the advantages of international cooperation in science and technology in order to meet the tasks of national and global development are reflected in the studies by V. P. Aleksandrova, Yu. M. Bazhal, V. M. Heyets, V. O. Husyev, O. O. Lapko, B. Ye. Paton, V. P. Semynozhenko, and others.

Today the necessity of improving the effectiveness of the state policy in the area of S&T cooperation of Ukraine with consideration for national integration priorities including relations with the EU as an integral component of the mechanism of innovation development strategy realization is *an urgent topic for research.*

The object of research is the process of international integration of the Ukrainian S&T sphere into the EU as a source for providing accelerated intensive growth of the national economy on the basis of innovation factors and an important direction for effective integration of the country into the system of world economy. *The subject of the research* is the theoretical and applied aspects of realization of international integration relations in science, technology and innovations, as well as the improvement of state mechanisms for activating and increasing the effectiveness of this process.

According to expert estimations of the Organization for Economic Cooperation and Development (OECD), in the middle of 20th century, 38% of economic growth was determined by the technological progress, while at the end of the century this figure reached 65%. It is generally known that the named factor accounts for nearly 75% of labour productivity growth and more than 50% of national income growth, thus essentially decreasing the cost value of the product. According to the UK Commission for Labour Resources, 60% of industrial productivity growth in the USA and Japan is attributed to changes in technology.

Presently, 15-25% of GDP growth in the USA and most developed Western European countries occur thanks to growth in high-technology industry. In the USA and Japan, the S&T sphere provides 65-85% of national income growth [1: 22]. Although the significance and essence of the innovation process were

highlighted in the works of numerous foreign and national scientists, there is no unequivocal definition of innovation.

As for the essence and matter of innovation, we can single out two approaches. The adherents of the first one, while interpreting the very definition of «innovation» differently, accentuate its scientific and technological origin [3; 4]. In this case, *innovation* is the use of the results of scientific research and development directed at improving the process of production and economic, legal and social relations in the area of science, culture, education, and other fields of social activity.

The OECD defines innovation as the new application of scientific and technological knowledge that ensures success on the market. The followers of the other approach consider that *innovation* can be founded not only on scientific discovery. They view innovation as the implementation of a new idea, practice or product that is both commercial and capable of meeting human needs. At the same time, the scientists who adhere to this approach also underscore the high significance of S&T-intensity of the innovation process.

Innovation activity is an extraordinarily complex process that depends on varying external environment (historical, socio-economic, etc), as well as on the goal it is intended to achieve. Overview of the nature of innovation process shows that its development originated from simple linear models to more complicated dialogue ones [21; 55; 105; 161].

Consequently, the realized study allowed to determine several generations of models of the innovation process (Table 1).

Table 1.

Generations of innovation process models

Period	Description
1950s – mid-1960s	Simple linear technology push model
late 1960s – early 1970s	Linear model with allowance for market requirements
early 1970s – mid-1980s	Coupling model with allowance for the interconnectedness and interaction among different elements
mid-1980s – 1990s	Parallel model describing integration within the firm with suppliers and buyers
recent years – the future	Systems integration model – flexible response of the company to changes in external environment, continuous innovation process.

The first generation (1955 – mid-1960s) – technology push model: a simple linear- sequential process with critical importance of R&D and treating the market solely as the consumer of the results of technological activity of production.

The second generation (late 1960s – early 1970s) – market-oriented linear-sequential need pull model with allowance for increasing importance of the market, to the needs of which responds R&D. The second-generation innovation process is pulled by the need.

The third generation (early 1970s – mid-1980s) – the coupling model: is largely a combination of the first and the second generation models with focus on the connection between technological facilities and capabilities and market demand.

The fourth generation (mid-1980s – the present time) – the Japanese model of leading experience: It is distinguished by focusing on simultaneous activity of integrated groups and horizontal and vertical ties. The main idea behind this model is the isochronous activity, simultaneous elaboration of the idea by several groups of specialists working in several directions.

The fifth generation (the present time – the future) – strategic networking model: Strategic integration and development of relations is distinguished by added new functions to the parallel process. This means that R&D is carried out by means of computer technology and informatics, with the help of which such strategic relations are established. The innovators exchange data electronically with suppliers, partners and consumers. However, marketing here is not the final stage, it is the starting point. It takes place all the way along from fundamental research to sold product servicing.

The evolution of approaches to modelling innovation development leads to ever growing intersection of the processes of new technology development, which in its turn leads to shortened duration of both the entire cycle and the separate stages in the innovation cycle. Strategic integration and establishment of relations by means of computer systems and informatics at the present stage of evolving innovation development models conduce to exchange of information about advanced scientific developments, on the one hand, and market needs, on the other.

The international S&T relations presently undergo intensive development in the area of interactions among science-intensive, or high-tech, branches and realization of national potentials at the world science-intensive market. By the type of production and industry specifics, the OECD classifies technologies into high-tech, mid-high, mid-low, and low technologies.

Different countries and their subjects in the S&T area could join their efforts on different levels (Figure 1). Each of those levels is described by its own system of forms and mechanisms of realizing international interaction in the field of development, transfer and application of scientific knowledge and technical achievements.

Table 2.

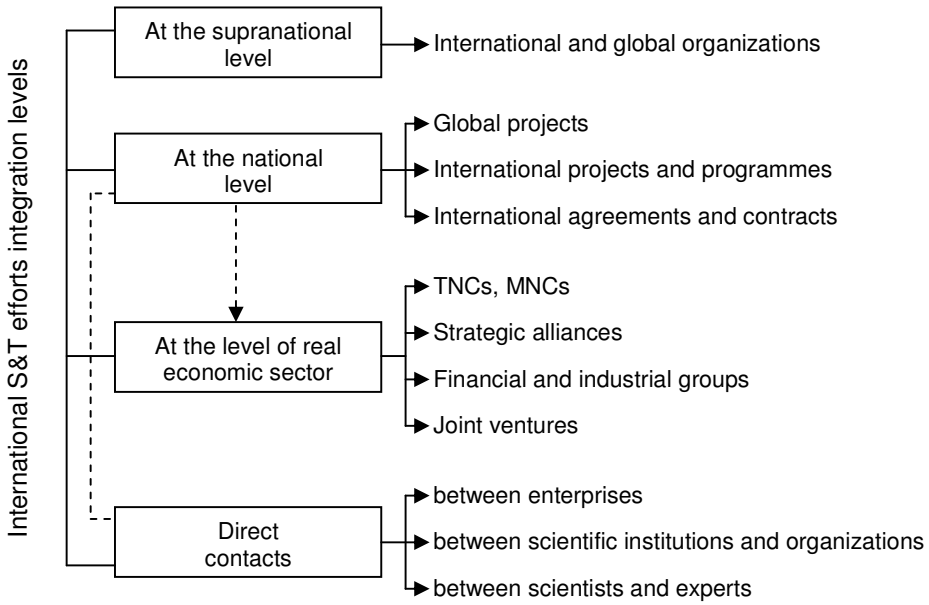
Periodization of major innovation waves
(after N. Kondratyev, J. Schumpeter, S. Freeman) [4]

Long Waves/Cycles		Situation in Science and Education	Infrastructure		Universal Cheap Resource
Time Frame	Description		Transport and Communications	Energy	
First 1780–1840	Industrial revolution: textiles manufacturing	on-the-job training; universities and academic societies	channels and earth roads	water power	cotton
Second 1840–1890	cycle of steam and railroads	mass primary education, first technical institutions, engineers	railroads, telegraph	steam power	coal, iron
Third 1890–1940	cycle of electricity and steel	first R&D laboratories in corporations, technical standards	railroads, telephone	electricity	steel
Fourth 1940–1990	cycle of automobiles and synthetic materials	intensive growth in corporations and public sector, mass access to higher education	highways, airlines, radio and television	oil	oil, plastics
Fifth 1990–present time	computer revolution	global R&D networks, life-long learning and professional education	information networks, Internet	gas/oil	microelectronics

Altogether, all levels with their attributes constitute an integral mechanism of interaction between the national S&T area and the world space, its inclusion into the world market for high-technology products and science-intensive services.

Figure 1.

Levels of international S&T interaction



At the same time, the direction, character and depth of all interaction spheres is determined at the state level responsible for the effective realization of preconditions and creation of favourable environment for realization of international S&T interaction.

At the present time, the EU channels to R&D about 1.9% of GDP, while the USA – 2.64%, Japan – 3.04% (only in several European countries this indicator is higher, making 3.6% in Sweden and 3.1% in Finland). In 2001 the EU spent $166.6bn on R&D in the medical engineering, aviation, pharmaceutics, and other science-intensive industries, whereas the USA allocated $285.6bn to R&D. At the same time, in the USA the share of private sector in total R&D spending makes 68.2%, whereas in the EU it constitutes 56.3% [5].

The reasons to such an equivocal situation in the EU in relation to its main competitors are the unbalanced common Western European market, which does not allow to effectively use the R&D spending and to introduce and implement developed products; high profits in the field of mid-tech exports; and imitation strategy in the production of many companies of the region. The tasks of the European Research Area include the following: to create a unified research area

all across Europe; to ensure maximally effective use of scientific potential and material resources of the EU countries with consideration for accumulated practice and achievements based on close interrelation of regional and national S&T policies; exchange of knowledge and information; and promotion of research staff mobility. For a detailed description of the goals, objectives and mechanisms of realizing the programme see Figure 2.

In order to achieve the objectives with maximal effectiveness, the ERA will be open to all countries of the world. Although the EU is currently controlling 4% of European research, it is expected to control 80% of it by 2010 [5].

Figure 2.

The ERA Matrix: objectives, tasks and mechanisms of realization

Objectives of the European Research Area

Tasks	**Improving the performance of European research**	**Strengthening technological innovation capacities in the EU**	**Strengthening the European research infrastructure**	**Strengthening the European human resources in science, technology and innovation**	**Establishing a new relationship between science and society on the European scale**
Research Activities	Networking and coordinated implementation of national programmes		Networking centres and areas of excellence in the public and private sectors		Carrying out large-scale targeted research projects
Research and Innovations, «Start-ups» and SMEs	Supporting research in the interests of SMEs		Dissemination and transfer of knowledge and technologies		Exploitation of research results and setting-up of technology businesses
Research Infrastructure	Implementing the European policy in this area			Solving the questions of access, opearation and construction of research infrastructure	
Human Resources	Increasing transfrontier mobility of human resources	Developing the European system of scientific careers	Increasing the participation of women	Taking measures to make scientific profession more attractive to young people	Improving Europe's attractiveness for researchers from third countries
Science, Society and Citizens	Strengthening the link between research activities and policies and the needs of society		Applying the precautionary principle and the sustainable development principle		Applying precautions of the social and ethical consequences of scientific and technological progress

The EU body that initiates and manages research and technical programmes is the European Commission (EC). The EC's specific programmes are structured according to thematic principle, they have general terms of participation (work programmes) and specific conditions put forward by the initiating EC Directorates-General. The EC Directorates-General are structured into the following departments: «Enterprise and Industry», «Agriculture and Rural Development», «Transport and Energy», «Environment», «Research», «Information Society and Media», «Fisheries and Maritime Affairs», «Regional Policy», «Education and Culture».

Therefore, despite the fact that every country in theory takes into account the high significance of international cooperation in science and technology, the world trends in joint S&T development continue to rely upon the principles of sovereignty and confrontation.

Today, five countries – the USA, Japan, Germany, France, and England – possess the highest science-intensive potential. They control more than 80% of the world market for high technologies. This market is the place for continuous rigid competition. As a result, starting from 1980s the USA has lost its leadership in some branches consequently losing respective market segments. The share of Japan, on the contrary, has grown immensely due to speedy expansion of the manufacturers of better-quality lower-priced high-tech products. Throughout the last decade, the established leaders in high technology have been approached by new countries from the Asia-Pacific region – South Korea, Malaysia, Singapore, and Hong Kong.

The rates of high-tech industry growth in 1995-2005 made 59% in the USA, 25% in Japan, 31% in the EU (recalculated for the EU-25), 103% in China, and 195% in South Korea. There is a clear tendency to increasing R&D funding in the developed countries. Thus, in 1995-2005 the USA increased their investments in research and development by 46%, Japan – by 27%, the EU (EU-25) – by 18%. Increasing rates of capital R&D investing is also observed in some developing countries, as well as countries with relatively small funds budgeted for science and innovation activity, such as Finland, Greece, Israel, and Hungary.

The geographical mapping of high-tech product deliveries points to big drawbacks in the national market penetration strategy. Evidence to it are negligible transfers of high-tech products from the American continent, the countries of Middle East, South-Eastern Asia and Africa, as well as dominance of the Russian Federation in both export and import operations.

Having analyzed the EU practice, we can conclude that in order to step onto the innovation path of development, the following directions in science should become the priority in the 21st century: applied mathematics and programming methodology, new energetics, automatization, pharmacology, complex ecology, scientific and technological fundamentals of instrument engineering, theory of knowledge-based society, biology and genetic engineering, computer industry, informatization, etc.

State innovation policy directed at creating favourable economic climate for realization of innovation processes is the link between academic science and production objectives. This policy should ensure the development of S&T potential, the formation of modern industrial technological regimes, the displacement of outdated regimes, and growth of product competitiveness.

The Ukrainian state policy in the area of innovation activity is realized along such directions, as improvement of organizational and legal environment for innovation activity; creation of the system of complex support for innovation activity at all stages of its realization on the national and regional scales; development of the innovation and investment infrastructure.

At the present, the S&T area is passing through the fourth stage of its development in the frames of an independent state, which is described by the weakening of negative tendencies. At the same time, for further stabilization and development of the Ukrainian S&T, it is necessary to elaborate the state strategy that would enable to effectively use national and external factors. The state S&T strategy is the aggregate of global long-term tasks and objectives of the national S&T development, which lay the basis for elaboration and implementation of major directions and mechanisms of the S&T policy.

The state S&T policy, as a system of interdependent state measures for effective resolution of the main objectives and complex development of the S&T area, contains major goals, principles, targets, and methods of state influence on the participants of the S&T and innovation activity, including those in the area of S&T cooperation [5].

In the context of the world S&T and economic processes, as well as current stabilization of the Ukrainian society and economy, the formation of the national S&T strategy is of critical importance. Since Ukraine has so far not pursued a targeted state S&T policy, whereas the Soviet experience in regulating this sphere has lost its actuality, the state faces the most important task – to develop a complex S&T strategy that would meet modern needs of the society and economy and correspond with the modern stage of scientific and technological progress (STP) and the world priorities.

A thoroughly verified S&T strategy, which is based on the principles of using national potential in science, technology and production and takes account of the modern international tendencies in world community development, the peculiarities of the modern STP stage, as well as the state interests and national security needs, should become the foundation for fast intensive growth of the Ukrainian economy.

Such a strategy should apply to all types of S&T activity, including fundamental and applied research and R&D. All these types – differing in the probability of achieving positive results (5-10% in fundamental research and up to 80% in applied research) and in the time lag between generation of an idea and its realization in specific project, – produce a sizeable effect.

The *objectives of S&T strategy realization* in Ukraine include the following:

1. Accelerating economic growth and solving critical problems and tasks of social and economic development of the country on the basis of S&T and innovation mechanisms.
2. Activating of Ukraine's participation in the development of the modern stage of STP and implementing its achievements on practice.
3. Ensuring the national security of Ukraine (S&T, energy, military, etc).
4. Transforming the structure of the national economy, in particular through increasing the role of high-technology and science-intensive branches.
5. Regenerating and restructuring of the existing industries and production, as well as creating the new ones based on the modern achievements in science and technology.
6. Increasing the share of high-technology and science-intensive industries and industries that produce finished products in the structure of Ukrainian exports.
7. Increasing the level of competitive capacity of the national science and technology, Ukraine's entry onto the world market for intellectual goods, science-intensive products and services.
8. Effective qualitative and quantitative growth of national S&T potential according to the requirements of national economy and dynamics of the world economic development.
9. Increasing the effectiveness and depth of Ukraine's participation in the process of internationalization of the world economy (in science, technology, and science-intensive production).
10. Intensifying the role of Ukrainian regions in executive nation-wide tasks of economic and S&T development with respect to needs and capacities of the regions.
11. Improving the quality of people's living in Ukraine, eliminating the unemployment of able-bodied population, keeping national specialists and stopping the «brain drain», etc.

Therefore, the main goal of the state strategy in the context of forming the innovation basis for national development is to create the new system of organizing, coordinating and managing the STP that would comprehensively tie the development of science and technology to economic processes with the purpose of speeding up the intensive growth of national economy and increasing its competitiveness, improving the quality of life, and guaranteeing the national security.

Table 3.

Current national S&T potential realization indicators in Ukraine

Advantages	Disadvantages
Ukraine belongs to 8 countries in the world having sufficient S&T potential to create advanced aerospace machinery	Ukraine's coefficient of science- intensity on the world market for high-technology products makes about 0.16%
Ukraine belongs to 10 major ship-building countries in the world	
The rate of employment in high- and mid-technology industries equals that of the EU countries	Labour productivity in high- and mid-technological industries is several times lower than in the EU countries
Ukraine rates 38th among 80 countries by competitive capacity (2003)	By competitive capacity growth rate the country ranks 77th out of 80 countries (2003)
	By index of technological development Ukraine rates 72nd out of 80 countries (2003)
	By ICT development Ukraine rates 62nd among 80 countries (2003)
By human resources potential Ukraine rates 76th among 173 countries (2003)	By wages of high-qualified specialists Ukraine rates 44th out of 46 European countries
The index of population's education level is 0.93, which is somewhat higher than the average index for Eastern European countries and the CIS (0.92)	By access to telecommunication technologies, Ukraine ranks 84th among 178 countries analyzed
Ukraine takes 4th place in the world by the number of certified programmers (after USA, India and Russia)	

International S&T cooperation allows for S&T activity of Ukraine together with foreign countries and international organizations under the auspices of inter-state, inter-government, and inter-departmental agreements on S&T cooperation. Such activity is realized with the participation of research organizations, public associations of scientists, individual scientists and experts from Ukraine and from foreign countries.

The choice of the directions, forms and methods of international S&T cooperation greatly depends upon general geo-political and geo-economic tendencies, interests of national security and development tasks of the national science and economy. The structure of goals and objectives of the Ukrainian state policy in the area of international S&T cooperation is influenced either directly or indirectly by a number of internal and external factors related to tendencies of the

world economic development, accelerated STP, acquiring by the S&T factors of the critical significance for economic growth, changing nature of competition on the world markets, etc. The main goals of the state policy in the area of international S&T cooperation should include the following: to increase the competitiveness of national production on external markets, to increase exports of high-technology and science-intensive products, to regulate technological exchange, to decrease technological backwardness of the country, etc.

The foundation for the development and implementation of the principles and mechanisms of state policy regulation in the sphere of national S&T cooperation of Ukraine is laid in the normative and legal base of regulations on the overall environment for carrying out activity in science and technology sphere, forming the market for intellectual property, and protecting its objects; various international agreements, contracts, programmes on multilateral and bilateral relations between Ukraine and international organizations, foreign countries and their representatives concluded at the national, industry and regional levels.

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