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EUROPEAN RESEARCH AREA: COMPARATIVE ANALYSIS OF INSTITUTIONAL PREREQUISITES AND INTEGRATION APPROACHES FOR UKRAINE

Abstract

The paper is dedicated to the issues of Ukraine's integration into the European Research Area (ERA) – a single research and innovation space open to the world and based on the internal market, which ensures the free exchange of researchers, scientific knowledge and technology. A comparative analysis of the institutional prerequisites for the creation of a single European research and innovation area has been conducted. The legislative basis of the European integra-

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tion vector of Ukraine's development in the science, technology and innovation sector is substantiated, while the flaws in the organisational and institutional support for euro-integrational reforms are identified. The idea and phases of ERA development are considered, the problems of implementing the Roadmap of Ukraine's integration of into ERA are defined. The main European programs of scientific, technological and innovative cooperation are systematized and Ukraine's participation in them is analysed. The case of cooperation between the Silesian Technological University «Silesian Polytechnic in Gliwice» and the Institute of Industrial Economics of the National Academy of Sciences of Ukraine is considered as a positive example of establishing collaboration in research and development between Ukrainian and European partner organizations. The authors propose the framework for creating institutional conditions that would ensure proper functioning and cohesion of the scientific, technological and innovative sector of Ukraine, as well as its effective integration to ERA in compliance with the strategic interests of international cooperation.

Key words:

European integration vector of development, European Research Area, European programmes, integration, institutional conditions, international cooperation, science and technology innovative sector, organizational and institutional support.

JEL: E11, F15, F55, O31, O33, O52.

Relevance of the research topic

The indifferent attitude of Ukrainian authorities to science and innovation for almost three decades has led to numerous negative consequences. These include a critical decrease in the knowledge intensity of GDP, loss of human capital in the scientific sector, wear and moral obsolescence of scientific instruments and equipment, a significant weakening of links between science and industry, distorted attitude to science, entrenchment of rent-oriented behaviour of enterprise owners, their focus on profit achieved through excess income from exports of raw materials and the use of cheap labour rather than investment in

innovation. This situation has already become a real threat to the state national security. Ukraine's European integration on the basis of a balanced mutually beneficial partnership with other countries provides it with significant potential opportunities to finally change the raw material orientation of the economy to an innovative model of economic growth. This is an important factor in increasing Ukrainian scientific potential and increasing the efficiency of the national system of research and innovation.

Literature review and problem statement

International and European scientific, technological and innovative cooperation is studied in many countries, therefore a significant amount of research is devoted to the problems and prospects of its development. In particular, the investigations have covered development of interstate and cross-border cooperation, including in the context of smart specialization of regions (Amosha et al., 2019; Shevtsova et al., 2020), ensuring the mobility of scientists and entrepreneurs, the transfer of knowledge and technology (Trippl, 2013; Edler et al., 2011), creation of transnational and transboundary regional innovation systems and clusters (Christodoulou & Christidis, 2020; Kravchenko & Zanizdra, 2019; Makkonen & Rohde, 2016). For instance, Kravchenko (2019) suggests an approach to the identification of national, transnational (supranational and global) innovation systems, and appropriate tools for modelling their development in the context of the four-link spiral model.

Organization for Economic Cooperation and Development (OECD) addresses the issues of international cooperation in order to face global challenges (epidemics, food and energy security, climate change, environmental crisis, increased exhaustion of natural resources. OECD experts claim that the level of global scientific knowledge and resources available to understand the causes of global problems and develop mitigation strategies is unprecedented. Maximizing their involvement in addressing existing challenges requires deeper and more effective international cooperation and appropriate distribution of tasks and benefits between countries, which in turn requires pooling financial resources, strengthening international research infrastructure, intensifying academic mobility, creating competitive regional, national, interstate and transboundary innovation ecosystems (OECD, 2012, pp. 13-14).

In recent years, in light of Ukraine's newfound status of an associated member of the European Union (EU), Ukrainian scientists have started paying more attention to the issues of European integration. Thus, urgent problems of socio-political development, including the necessity and prospects of ensuring innovative direction of Ukrainian economy are presented in the collective works of scientists of the National Academy of Sciences of Ukraine (Pyrozhkov et al.,

2016; Pyrozhkov et al., 2019). Yehorov and co-authors (2018) have analysed the main features and trends in the creation of single research and innovation space in EU, have examined euro-integration processes in some sectors of the national economy and features of the formation of the triple helix model in the EU member states and in Ukraine. They have also developed the main provisions of the «road map» for the implementation of the Association Agreement in terms of scientific and innovation cooperation. The analysis of the European research and innovation area through the prism of three EU priorities – Open Science, Open Innovation and Smart Specialization of Regions – was carried out by Matyushenko et al. (2017). The scientific articles of Ternopil-based researchers pose the idea of building upon the integration model of Visegrad Four and transforming it into Visegrad Five (Poland, Czech Republic, Hungary and Slovakia + Ukraine) model (Savelyev et al., 2019; Savelyev & Smalyuk, 2019). Savelyev and Smalyuk (2019) believe that sustainable development of the new group based on the single European market and structural reforms would be able to serve as a driver for the production of products in growing demand.

Nevertheless, European integration should not be considered a panacea that can ensure the country's innovative progress under any circumstances. On the contrary, responsibility and balanced approaches that take into account national interests are required for its development.

The aim of the study is to conduct a comparative analysis of the institutional preconditions for the creation of European Research Area (ERA) and develop proposals on this basis for a framework of institutional conditions aimed at making European integration of Ukraine in science, technology and innovation effective, while bearing in mind strategic interests of international cooperation and improvement of innovation competitiveness of Europe as a whole, and Ukraine in particular.

Research methods

The investigation is conducted on the theoretical basis of institutional economic theory using methods of analysis and synthesis, comparative analysis and a systematic approach. Primary sources for the study consisted of international agreements, Ukrainian laws and regulations and their projects, analytical and statistical materials of international organizations and the State Statistics Service of Ukraine, while the secondary sources included reports of European institutions and published research results of Ukrainian and foreign experts on this issue.

The article is structured as follows. Initially, the institutional principles of Ukraine's European integration in the scientific, technological and innovative spheres are systematized, the shortcomings of the organizational and institutional support of European integration reforms are revealed. Then the ERA is characterised, the idea of its development and a development phase are considered, problems arising during the implementation of the Roadmap of Ukraine's integration to ERA are defined. The next section systematizes the main European programmes of scientific, technological and innovative cooperation and analyses Ukraine's participation in them, considers the experience of cooperation between the Silesian Technological University and the Institute of Industrial Economics of the NAS of Ukraine as a positive example of establishing research cooperation between Ukrainian and European partner organizations. Further, a set of recommendations for ensuring the integrity of science, technology and innovation in Ukraine, and its effective integration into the ERA is given. Finally, the article offers conclusions and prospects for further research.

Institutional principles of Ukraine's European integration in the field of science, technology and innovation

Since it gained independence, Ukraine has focused its foreign policy on broad international cooperation, including with European countries. Here, it is worth mentioning the Resolution of the Verkhovna Rada of Ukraine of 1993 «On the Main Directions of Ukraine's Foreign Policy» and the Partnership and Cooperation Agreement between Ukraine and the European Communities and their Member States, signed in 1994. These documents stipulated that the Ukrainian state seeks to cooperate with all interested partners, and considers the expansion of participation in European regional cooperation one of its main directions of foreign policy. Although these documents are no longer in effect, at the time they signalled Ukraine's European integration intentions and its desire to become an integral part of a united Europe.

It should be noted that in 1990 the EU launched a programme of technical assistance for economic reforms for the USSR, and later for post-socialist countries – TACIS (Technical Assistance for the Commonwealth of Independent States). From 1991 onwards, Ukraine has received technical assistance from the EU under this programme in various areas of economic activity, including science and technology. The Ministry for Development of Economy, Trade and Agriculture of Ukraine (n.d.) provides a list of 137 agreements for the period of 1991-2016 between the Government of Ukraine and the EU on the provision of technical assistance and funding by the EU in various fields. Much of the latter was earmarked for scientific and technical purposes. Such critical areas of Ukrainian

science and technology as, for example, the production and use of nuclear energy, the development of new technologies, in particular, space and information, have received and continue to receive significant assistance from EU member states and the European Union as a whole. This is facilitated by the creative relations of Ukrainian scientists with the European Organization for Nuclear Research (CERN), the European Atomic Energy Community (Euratom), with which Ukraine has relevant cooperation agreements.

Active support of the European Commission for reforms in Ukraine has led to the strengthening of the European vector of cooperation. Developing this area of international cooperation at the beginning of this century, the state leadership and the public consciousness believed that EU integration was a strategic goal of the country, which was finally enshrined in the Law of Ukraine No. 2411-VI «On Principles of Domestic and Foreign Policy» of July 01, 2010. It positions Ukraine as a European state, and determines the integration into the European political, economic, legal space in order to gain EU membership among the main principles of Ukrainian foreign policy (art. 11).

An important step in the development of cooperation between Ukraine and the EU in the field of science and technology was made by signing of the Agreement on Science and Technology Cooperation between Ukraine and the EU (signed on July 4, 2002, ID 994_194). The Agreement still defines the principles, directions and forms of cooperation, which are relevant today, as the Agreement is periodically renewed and extended. At the same time, a number of bilateral agreements on cooperation in education, culture, science and technology were concluded with 18 EU member states, including Germany, France, Luxembourg, the Czech Republic, Spain, Poland and others (Ministry of Education and Science of Ukraine, 2019), which also contributes to the strengthening of European integration processes.

The most important stage of Ukraine's integration into the European Research Area started with the signing of the Agreement on Participation of Ukraine in Horizon 2020 – EU Framework Program for Research and Innovation (dated March 20, 2015, ID 984_018). It stipulates that Ukraine participates in the activities of the program on the same terms as EU member states, paying a financial contribution for each year of participation.

Ukraine definitively confirmed its developmental choice by signing the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their Member States, on the other hand, (hereinafter – the Association Agreement) on March 21, 2014, and by amending the Constitution of Ukraine to proclaim the strategic course of Ukraine to become a full member of the EU (Law of Ukraine No. 2680-VIII of 07.02.2019). Thus, the Ukrainian state has demonstrated its intentions and readiness to integrate into the European space and the framework of formal EU institutions, to adopt its rules, norms and practices, to become an integral part of the European community.

In order to assimilate Ukrainian legislation in the field of science and technology to EU law, a new version of the Law of Ukraine No, 848-VIII «On Scientific and Scientific-Technical Activity» was adopted on November 26, 2015. Article 66 of the Law establishes the obligation of the state to ensure the integration of the national research area into the European Research Area by implementing its priorities and provides for the relevant powers of the authorities. This is facilitated by the creation of the National Board for the Development of Science and Technology of Ukraine (hereinafter – the National Board). The list of its main functions, which are directly related to European integration, includes integration of domestic science into the world scientific space and the European Research Area taking into account national interests (item 3); preparation and publication of the annual report on a condition and prospects of development of the scientific and technical activity of Ukraine (item 8), as well as monitoring of implementation of priorities of the European Research Area by Ukraine and submission of proposals on the plan for their implementation for the next year (Regulations on the National Board of Ukraine for the Development of Science and Technology, 2017).

In 2020, National Research Foundation of Ukraine finally announced its first competitions. This foundation was established in 2018 and its main goal is to provide competitive funding for research based on transparent and high-quality expertise, including with the involvement of foreign experts.

Incentives for intensification of scientific and innovative activity were announced in the Resolution of the Cabinet of Ministers No. 981 of November 27, 2019, which introduced an electronic system of registration of technologies with remote access and provided for the possibility of state financial support to innovators. The Resolution of the Cabinet of Ministers No. 1030 of December 4, 2019 details the procedure for stimulating the innovative activity of small and medium enterprises, in particular, in cooperation between science and business, starting from 2020; increases the amount of remuneration for inventors of technologies that are implemented in the real sector of the economy.

Thus, the legal basis of the European integration vector of Ukraine's development in science, technology and innovation has been formed over the years of independence. Cooperation between European and Ukrainian organizations is gradually strengthening, but so far remains sparse and has little effect on the state of innovation processes. This indicates towards a number of problems, first of which is the insufficient organisational and institutional support for euro-integration reforms.

To ensure the European integration vector of development, the government established the Government Office for Coordination on European and Euro-Atlantic Integration in 2017. However, its activities are informational and legal in nature, and there is no mechanism for organizational support of the European integration processes in all spheres of public life, including in science, technology and innovation. The Ministry for Development of Economy, Trade and Agriculture

of Ukraine has created a Department for International, Trade and Agricultural Cooperation, which mainly deals with foreign trade issues. There is no information on the forms and directions of cooperation in the field of science, technology and innovation, as well as mechanisms for its support. The Department of International Cooperation and European Integration has been established at the Ministry of Education and Science (MES) of Ukraine. However, the Ministry of Education and Science of Ukraine oversees international cooperation only in educational and scientific institutions subordinated to it. A significant proportion of research institutions are outside the influence of this ministry. Thus, a significant part of the public sector institutions that carry out research and development belong to the National Academy of Sciences of Ukraine, branch academies of sciences and other ministries and departments, while 351 or 37% of the 950 organizations belong to the business sector (State Statistic Service of Ukraine, 2019a). Additionally, the link between higher education and research institutions and businesses is weak. Therefore, *the existing system of management of international cooperation in public authorities does not provide a comprehensive European integration direction for development in the fields of science, technology and innovation*. This was ciearly indicated in the analytical summary *European and Euro-Atlantic Integration. Transition book* – an audit of sorts – prepared by the Government Office in 2019. Its purpose was to provide the new government, as well as experts and the public with information on the current state of affairs, major achievements and challenges in implementing the course of European integration since the signing of the Association Agreement, as well as on Ukraine's path to NATO membership. (Cabinet of Ministers of Ukraine, 2019). It summarizes the activities of all Ministries in many areas, but the results and problems of cooperation in the field of «Science, Technology and Innovation, Space» of the Association Agreement are not discussed at all.

The Action Plan for the Implementation of the Association Agreement (hereinafter – the Action Plan), approved by the Resolution of the Cabinet of Ministers No. 1106 of October 25, 2017 does not provide for the *development of the Strategy for Science, Technology and Innovation of Ukraine as an interagency strategy*. Meanwhile, it does outline the development and implementation of a number of other strategies, such as the Strategy for Improving Road Safety and the Strategy for Ensuring the Coexistence of Genetically Modified Crops with Traditional and Organic Agriculture. Therefore, it follows that *science and innovation are given even less importance that road safety and safe agriculture, speaking to the true priorities of the state*.

The Concept of the state policy in the field of science for 2020-2024 developed by the Ministry of Education and Science of Ukraine requires further development. The Concept sets the inferiority of the results of Ukrainian science to the world standards as a challenge for the state policy, and assigns the responsibility for such a weakness to Ukrainian scientists, researchers and scientific-pedagogical workers. However, this does not reflect the truth, as the policy is the reason for this situation, rather than merely a tool for improving it. In addition, this

Concept is not able to replace an interagency strategy. After all, based on the basics of state strategic planning, the strategy is the main document, while all other documents are developed on its basis and are aimed at its implementation. Public policy is formed for a five-year term with consideration to and within the framework of the strategy, just as political goals prescribed for five years provide for the achievement of goals set out in the strategy. In fact, there are big problems with this in Ukraine, because ensuring consistency and continuity in the implementation of public policy is not possible in the absence of a strategic vision for the development of science and innovation.

Measures to promote European integration are not prescribed by either the Strategy for the Development of Innovation 2030, (No. 526-r approved on July 10, 2019) or the Action Plan for its implementation for 2020-2022. Other documents in the field of European integration – the Roadmap for Ukraine's Integration into the European Research Area and the Action Plan for the Implementation of the Association Agreement – are weakly linked to this strategy, although they should all be well coordinated.

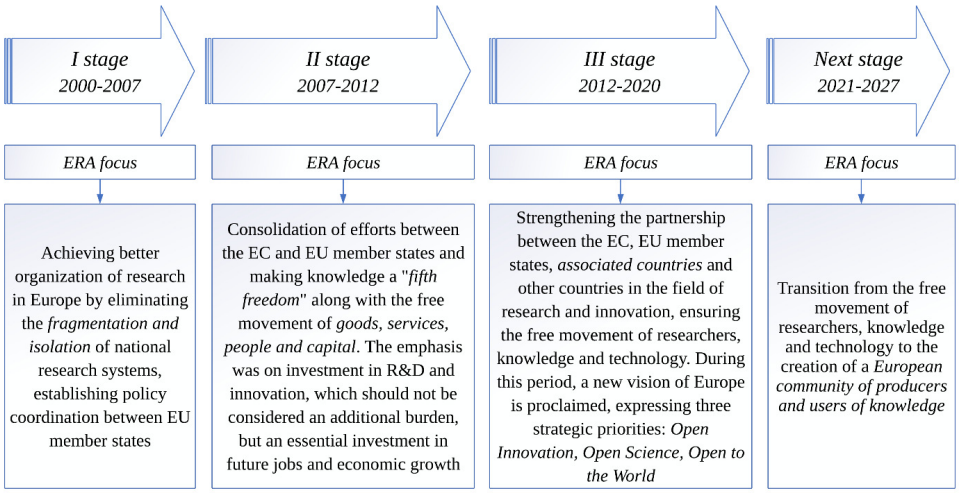
This is one of the reasons why Ukraine is moving very slowly along the path of pro-European reforms. The tasks of the Association Agreement in the field of «Science, Technology and Innovation, Space» have been completed by 9% in 2020 so far, and only by 35% for the period of 2014-2020 (Strikha, n.d.). In 2020, it is planned to develop and submit for approval to the Verkhovna Rada of Ukraine and the Cabinet of Ministers of Ukraine a number of important draft laws and resolutions. These include draft laws «On support and development of innovation», «On amendments to the Tax Code of Ukraine (to stimulate innovation)», «On amendments to some legislative acts of Ukraine to stimulate innovation», «On support for start-ups» and others. The development of these bills and draft regulations is in a precarious position right now, due, firstly, to the inertia of the government and its unwillingness to radically change something, and secondly, the COVID-19 pandemic and the economic crisis generated by it. However, science and innovation deserve the utmost attention even in difficult times. Therefore, as European experts advise Ukraine, public spending on science and innovation should not be considered budget expenditures, but national investment (Chang et al., 2017).

European Research Area (ERA) and Roadmap for Ukraine's integration into the ERA

European Research Area is a single research and innovation space open to the world and based on the internal market, ensuring the free circulation of researchers, scientific knowledge and technology. (European Commission, n.d.). The idea of its development arose in 2000 as a response to the fragmentation of national research and innovation systems and the need to ensure the coherence of national European research policies. Since then, the ERA has gone through three stages of development, and in 2021 will move to the next – fourth – one (Fig. 1).

Figure 1

Stages of development of European Research Area



Source: created by the authors using the data of European Commission (2020); Directorate-General for Research and Innovation (2016); European Research Area and Innovation Committee (2020).

The European Research Area and Innovation Committee (ERAC) notes that since the launch of the ERA, many initiatives have been successfully implemented that have helped to strengthen and increase the competitiveness of the EU's research and innovation sector. At the same time, progress in the implementation of the ERA has slowed down in recent years, and there are still differences between countries and regions in terms of the level of scientific and innovative development (European Research Area and Innovation Committee, 2020). Therefore, *A New Strategic Agenda 2019-2024* (European Council, 2019, p. 4) emphasizes that Europe and its countries «we must step up investment in people's skills and education, do more to foster entrepreneurship and innovation and increase research efforts, in particular by addressing the fragmentation of European research, development and innovation».

In 2015, the *European Research Area (ERA) Roadmap 2015-2020* was adopted (European Research Area and Innovation Committee, 2015). The aim is to identify a limited number of key priorities that will have the greatest impact on the European research and innovation system. During 2015-2016, almost all EU Member States developed national action plans to facilitate the implementation of ERA priorities. The same recommendation was received by the associated countries, including Ukraine (European Union, 2015). *Roadmap for Ukraine's integration into the European Research Area (ERA-UA)* was developed in 2017 by a work group consisting of representatives of government, scientific, educational, and public organizations. Its priorities are formulated in accordance with the European ones (Table 1).

However, *ERA-UA* was never approved by the government; instead, in March 2018 it was approved by the decision of the Board of the Ministry of Education and Science of Ukraine (Minutes No. 3-1-7 of March 22, 2018). In this way, the authorities have demonstrated that the issue of Ukraine's integration into the European Research Area is exclusively a matter for the Ministry of Education and Science of Ukraine, which is not consistent with the goals and priorities of *ERA-UA*, the implementation of which largely depends on other executive bodies. However, even under such conditions, it is not possible to assess Ukraine's success in implementing *ERA-UA* due to the lack of a National Plan for its implementation.

The implementation of the priorities and goals of *ERA-UA* should involve state institutions of all branches of government, industrialists and entrepreneurs, scientific organizations of all institutional sectors, public organizations and unions, innovation infrastructure. Their joint activities should be aimed at solving the main systemic problem of Ukraine – the lack of progressive structural changes in the economy during almost the entire period of independence, preservation of outdated production structures that have led to economic decline, deindustrialization, lack of investment resources and, consequently, to a worsening quality of life of the population. However, *ERA-UA* considers science separately from the innovation sector, which contradicts the priorities and goals of *ERA*. After all, although the European Research Area does not contain the word «innovations» in its title, it envisages their development in close connection with science.

Table 1

Comparison of *ERA-UA* and *ERA Roadmap* priorities

ERA Roadmap priorities	ERA-UA priorities
1. Effective national research systems	1. Effectiveness of the national research system
2A Jointly addressing grand challenges	2a. Jointly addressing problems arising from global challenges
2B Make optimal use of public investments in research infrastructures	2b. Make optimal use of public investments in research infrastructures
3. An open labour market for researchers	3. An open labour market for researchers
4. Gender equality and gender mainstreaming in research	4. Gender equality and a comprehensive gender approach to science
5. Optimal circulation and transfer of scientific knowledge	5. Optimal circulation and transfer of scientific knowledge
5a Fully implementing knowledge transfer policies at national level in order to maximize the dissemination, uptake and exploitation of scientific results. RPOs and RFOs should make knowledge transfer second nature by integrating it in their everyday work.	5a. Transfer of knowledge and Open innovation
5b Promoting Open access to scientific publications	5b. Open access to science and digital innovations
6. International Cooperation	6. International Cooperation

Source: Compiled by the authors.

In this context, European experts note that Ukraine is obliged to make the *development of research and innovation* one of the priority items on the national agenda. This applies in particular to Recommendation 24 on the need to develop an interagency Research and Innovation Strategy and Action Plan focused on priority areas that will ensure the production of innovation based on science and technology. (Chang et al., 2017). This recommendation is in line with the EU framework concept for the formation and implementation of state innovation policy. Known as the «knowledge triangle», it involves the application of an integrated approach to science, education and innovation policy and its close relationship with other policies on industry, entrepreneurship, investment, social affairs, infrastructure, and so on. This means that innovation policy must be coordinated with all other types of policies to implement a systemically coordinated impact on the development of innovation at the highest level.

ERA funding and Ukraine's participation in European programmes

ERA activities are funded by national and European resources, central to which are European programs, primarily Horizon 2020 – the EU Framework Programme for Research and Innovation (next – Horizon Europe), as well as COST, EUREKA, EUROSTARS, COSME (Table 2).

In addition to those listed in table 2, there are many other EU programmes and funds of various thematic areas. These include *Creative Europe* (aimed at supporting European cultural, audiovisual and creative sectors), *Erasmus+* (aimed at supporting education, training, youth and sport in Europe), *European Globalisation Adjustment Fund* (supports people who have lost their jobs as a result of structural changes due to globalization, for example in the event of a global economic crisis, the closure of production and its relocation outside the EU), *European Regional Development Fund* (aims to strengthen economic and social cohesion in the EU by addressing imbalances between its regions), *The European Neighbourhood Policy* (regulates the EU's relations with its 16 closest eastern and southern neighbours, including Ukraine), *European Social Fund* (supports jobs, helps people find better jobs and provides fairer employment opportunities for all EU citizens). Ukraine's participation in some of these and other programmes is possible, but the conditions of participation are different in each case.

Table 2

Main programmes of European cooperation and Ukraine's participation in them

Programme name	Programme description	Ukraine's participation
«Horizon-2020» – Framework Programme for Research and Innovation	The most powerful funding tool for research and innovation development in the EU on the basis of grants with a budget of over 80 billion euros for the period of 2014-2020. Horizon 2020 funds research from breakthrough innovation to market implementation, with grants ranging from €50,000 to €10 million. Enables associated and third countries not only to participate in projects, but also offers funding to researchers on the same terms as to participants from EU member states. The programme focuses on transnational cooperation at a high international level	Ukraine has been an associate member of the programme since 2015 and already has experience in programme calls and won projects

Programme name	Programme description	Ukraine's participation
COST – European Cooperation in the field of Scientific and Technical research	The oldest and widest intergovernmental European network to support cooperation in scientific and technological research. Supports the first stages of the innovation chain; multidisciplinary and interdisciplinary in nature; has a flexible structure that brings together prominent scientists under a clear strategic direction, focused on the development of scientific ideas	Ukraine is not a member of this network, but can participate in its actions (projects)
EUREKA – European Research Coordination Agency	Innovative European science and technology programme aimed at developing technologies, products and services of high quality, market promotion of scientific and technological developments; involves scientific institutions and industrial enterprises in the implementation of joint developments; increases labour productivity. Currently, more than 40 countries take part in it. EUREKA principles: bottom-up, international cooperation, flexibility, market orientation, decentralization, support measures, accession to other existing cooperation programmes	Ukraine has been a programme member since 2007, but began using its opportunities recently in 2018
EUROSTARS	A joint European programme between EUREKA and Horizon 2020, which supports small and medium-sized enterprises engaged in research and innovation to achieve competitive advantages. EUROSTARS projects must meet the following requirements: transnationality, targeting only small and medium-sized enterprises, involvement of at least two partners from two EUROSTARS participating countries, the involvement of at least one partner from another EUROSTARS participating country, lasting no more than three years	Ukraine is not a participant in the programme, but may participate to a limited extent at the invitation of one of the participants in the project consortium
COSME – Competitiveness for Enterprises and SMEs	European program to support small and medium-sized enterprises with a budget of 2.3 billion euros for the period of 2014-2020. Funding is provided in the form of grants aimed at supporting the export and innovation activities of small and medium-sized enterprises. Membership provides access to various sub-programs, projects, trainings, consultations on European legislation, market opportunities, finding business partners, international cooperation, etc.	Ukraine has been a member of COSME since 2017, which gives it access to the programme budget of about 900 million euros

Source: created by the authors using the data from Ivanov et al (2018); Smertenko et al. (2020).

Among the positive examples of cooperation between Ukrainian and European research institutions are the Silesian University of Technology and the Institute of Industrial Economics of the National Academy of Sciences of Ukraine. The former entered the top 10 universities according to the allocation of additional funding for research in the latest ranking of the Ministry of Education of Poland and has many years of experience in cooperation with the Ukrainian institution. One of the latest positive examples of strengthening ties between Ukrainian academic and Polish university science was in 2019, when the President of the NAS of Ukraine B. Ye. Paton granted Honorary Patronage of the National Academy of Sciences of Ukraine to the 5th International Scientific Conference «Social Development Towards Values. Ethics – technology – society». The conference was organised by the Department of Applied Social Sciences, Faculty of Organization and Management, Silesian University of Technology (Silesian Voivodeship, Poland) in cooperation with Kyiv National University of Construction and Architecture, Institute of Industrial Economics of NAS of Ukraine (Kyiv, Ukraine), The London Academy of Science and Business (London, UK), Centre of Applied Ethics (Banská Bystrica, Slovakia).

The purpose of this annual conference is, first of all, the integration of scientific communities from different European countries, exchange of research experience, presentation of the latest results of theoretical and empirical research, cooperation of interdisciplinary research groups. Topics of the conference include issues related to the theory and practice of sustainable development, the role of innovation in socio-economic development, technology assessment, axiology of intellectual development, the idea of «smart city» and its socio-economic conditions, the role of humanities in modern society, norms of mutual relations and ethics, development of Industry 4.0, artificial intelligence and circular economy. The conference under the Honorary Patronage of the National Academy of Sciences of Ukraine was a great honour for the organizers and increased the prestige of this unique scientific meeting in an international group.

This experience gives grounds to the Institute of Industrial Economics of the National Academy of Sciences of Ukraine and the Silesian Polytechnic to *initiate further integration of both countries into the European scientific and educational space by establishing a relevant Foundation in accordance with current Polish legislation.* After a series of negotiations, the initiators agreed that the Silesian Polytechnic, in accordance with the current legislation of the Republic of Poland, would initially register the foundation *Polsko-Ukraińska Fundacja Współpracy Naukowo-Badawczej* («Polish-Ukrainian Foundation for Research»), which would perform the functions of the Representative of the National Academy of Sciences of Ukraine in Silesian Voivodeship (with headquarters at Silesian Polytechnic).

Positive aspects of this cooperation: the opportunity to conduct joint research projects, compile and publish research results in journals indexed in Web of Science and Scopus, internships, joint PhDs, conferences, implementation of

the concept of «Innovation lift: from school to Europe» (Liashenko & Pidorycheva, 2019) and so on.

Many other universities, research institutions and public organizations of Ukraine have concluded similar agreements with universities and innovation establishments of European countries. However, the pace of establishing such cooperation is still slow, as evidenced, in particular, by the dynamics of foreign trade in scientific and technological services (Table 3).

Table 3

Ukraine's foreign trade in services in the field of science and technology with EU member states

Types of services	Export			Import		
	2017	2018	% of 2017	2017	2018	% of 2017
Research and development services	49088,4	49160,9	100,1	9632,4	9632,4	96,0
Scientific and technical services	62788,2	–	–	51552,6	69379,5	134,6

Source: adapted by the authors from State Statistics Service of Ukraine. (2019b). Cooperation between Ukraine and EU countries. Statistical yearbook. https://ukrstat.org/uk/druk/publicat/kat_u/2019/zb/06/zb_ES_18.pdf

The share of research and development services in the total volume of Ukrainian exports of services in 2018 was only 1.24%, and the share of imports was practically negligible – 0.29%. The development of the market of scientific and technical services between Ukraine and the EU has been slow. Ukraine's experience in participating in European programmes is growing slowly as well.

For example, Ukraine has been a participant in the EUREKA programme since 2007, but had not taken full advantage of its opportunities: only one Ukrainian project had been approved by 2017. In comparison, Spain carries out approximately one hundred projects a year. Ukraine's participation in this programme became more active in 2018, when the Ministry of Education and Science of Ukraine held an information and communication event «EUREKA info day» in October. A similar webinar event was held in September 2019. The main goal was to acquaint Ukrainian innovators and scientists with the opportunities offered by the programme, its practical tools for the introduction of domestic innovative developments into production and entry into European and international

markets (Ministry of Education and Science of Ukraine, 2018). Such measures had a positive result – as of the end of 2018, Ukraine had participated in the implementation of 32 projects and cooperated with more than 30 countries participating in the EUREKA programme. The most frequent partners included Poland, whose organizations acted as project partners 13 times, the Czech Republic and Lithuania – 9 projects each, and Spain – 5 projects (Ministry of Education and Science of Ukraine, 2018).

Ukraine's participation in the Horizon 2020 framework program is more active, especially for small and medium-sized enterprises, which for the period from 2014 to early 2019 provided 52.2% or 87 participations from Ukraine for the amount of 15.51 million euro. Then – in descending order: research institutions – 22.6% or 59 participations (6.7 million euro); higher education institutions – 17.4% or 49 participations (5.15 million euro); other organizations – 4.2% or 22 and 21 participations (1.23 million euro); executive authorities – 21 participations (1.1 million euro) or 3.7% of participations (Ministry of Education and Science of Ukraine, n.d.).

To strengthen participation in Horizon 2020, Ukraine has established a network of national contact points of the EU Framework Programme «Horizon 2020», the purpose of which is to provide information and advice on participation in projects of the Framework Programme, as well as to provide methodological implementation support (order of the MES of Ukraine No.1469 of December 08, 2016). In May of this year, the national contact points launched a series of webinars in relevant areas, in particular, «Actions of Marie Skłodowska-Curie», «Horizon 2020 for small and medium-sized businesses», «Horizon 2020: Energy and Climate», «Horizon 2020: Health and Food Security» and others.

According to the participants of the successful projects who took part in the webinars, the percentage of success of Ukrainian applicants in submitting projects to participate in the Horizon 2020 calls ranges from 5 to 10 (on average throughout the programme 20% of all applications are selected). Main recommendations for applicants shared at the webinars included strategically planning applications, clearly setting the goal of the project, listing joint high-quality publications with European partners, ensuring multidisciplinary nature, multiculturalism and complementarity of projects, advertising scientific achievements and visits to EU member states, publishing research results at European conferences, finding partners and building a sustainable partner network.

However, according to European experts, the key factor that determines the success of applications is still personal contacts. The project coordinator should know the applicant well from previous work or from the recommendations of other partners. Factors such as scientific reputation, popularity of the research institution / university, publications are very important, but they are the minimum necessary for joining the consortium of the framework programme. However, there are cases (on the part of Ukrainian applicants as well) when, despite the lack of a stable network of partners and experience of participation in European projects, applicants win the calls. Here, the topic of the project, its uniqueness and importance for achieving Europe's goals becomes crucial.

Research results: recommendations and topics for discussion

To ensure the proper functioning and integrity of science, technology and innovation in Ukraine, as well as its effective integration into the European research and innovation space, amendments and additions to the Law of Ukraine «On scientific and scientific-technical sctivity», some bills provided for in the Action Plan on Implementation of the Association Agreement, and the Statute of the National Academy of Sciences of Ukraine are proposed.

1. Article 56 of the Law of Ukraine «On Scientific and Scientific-Technical Activity», the draft Law of Ukraine «On Support and Development of Innovation» must be amended to determine the legal, economic and organizational principles of forming a system of state strategic planning for Ukraine's scientific, technological and innovative sectors, and to ensure their close adherence to the priorities of the European Research Area. The draft Law of Ukraine «On State Strategic Planning» can be taken as a basis. The main act in this system should be the State Strategy for the Development of Science, Technology and Innovation (hereinafter – the State Strategy), all other regulations should be developed on its basis and aimed at its implementation.

This proposal is in line with the recommendation of European experts on the development and implementation of an interdepartmental Strategy for Research and Innovation in Ukraine, in line with the EU framework concept for the formation and implementation of «integrated» state innovation policy, as well as strategic interests of Ukraine, as it will promote the production of innovations based on science and technology integrated into the real sector of the economy.

The system of long- and medium-term regulations should consist of: 1) forecast of scientific, technological and innovative development of Ukraine for up to 20 years; 2) interdepartmental State Strategy for the Development of Science, Technology and Innovation for up to 10 years; 3) state target programmes in the fields of science, technology and innovation (10-year for the long term and 5-year ones for medium term[1]); 4) regional and local target programmes in the fields of science, technology and innovation.

2. During 2021-2027, Ukraine's integration into the EU in terms of science, technology and innovation cooperation requires a gradual increase in the share of funding for science from public and private sources to the statutory level of 3% of GDP, including budget funding of at least 1.7% of GDP (Articles 47 and 48 of

[1] Long-term and medium-term planning was selected based on the norms of the laws of Ukraine «On priority areas of science and technology» and «On priority areas of innovation in Ukraine».

the Law of Ukraine «On Scientific and Scientific-Technical Activity»). This, firstly, is an absolutely necessary condition for preserving scientific potential and increasing it as the main driver of Ukraine's innovation progress. Secondly, this will send an important signal to European partners about the seriousness of the intentions and readiness of the Ukrainian state to promote the development of science and innovation in the long term, and thus promote the integration of the Ukrainian community into the European Research Area.

In this context, it is proposed to include two aspects in the draft State Budget of Ukraine for 2021 and the following years. First, increase funding for science to the statutory level of 3% of GDP (for the purposes of grant support for scientists through the National Research Fund of Ukraine and integration into the European Research Area). Second, finance state target programmes as a separate item, which will make it possible to ensure the implementation of priority areas for the development of science, technology, innovation and the effectiveness of strategic planning for the development of the national system of research and innovation.

3. The bill to support the functioning of startups system must establish the «innovation lift» in order to create a system of comprehensive promotion of entrepreneurial skills and initiatives of the population among the relevant innovation structures throughout the innovation chain of added value – from an idea to mass production and entry into the European market.

I. Conclusion of an Agreement on Cooperation between a scientific institution of the National Academy of Sciences of Ukraine / Ukrainian university and a European research institution / university.

II. Establishment of a branch or laboratory of a Ukrainian organization at a structural subdivision (department) of a European organization that carries out research activities in common (complementary) thematic areas.

To implement this opportunity, it is necessary to legislatively give scientific institutions of the NAS of Ukraine the right to establish branches and laboratories at relevant institutes and universities of EU member states by amending Article 7 of the Law of Ukraine «On scientific and scientific-technical activity». The proposed wording of the amendment is as follows: «Scientific institutions of the National Academy of Sciences of Ukraine for the purpose of integration into the European Research Area have the right to create branches and joint laboratories at European scientific organizations, universities and their departments that share the interdisciplinary and complementary topics of their research». Appropriate changes must also be made to the Statute of the National Academy of Sciences of Ukraine.

III. Joint participation of these partner organizations in the Horizon 2020 and Horizon Europe calls for proposals to obtain funding for joint R&D and innovation development.

IV. Ensuring access of Ukrainian scientists to the research infrastructure of the European partner, and vice versa, including to centres for collective use of scientific equipment.

V. Exchange of scientific and innovative staff (students, graduate students, doctoral students, scientists, professors, entrepreneurs) between organizations, development of their entrepreneurial and innovative skills.

VI. Ensuring additional funding for organizations (research, education, innovation) through funds of EU technical assistance, other European programmes and foundations, businesses and venture capitalists.

VII. Introduction of special courses «Fundamentals of Economics and Entrepreneurship», «Digital Economics», «Economics of Nanotechnology», «Economics of Biotechnology» and others in accordance with the specialization of partner organizations for STEM majors of partner universities.

VIII. Ensuring business incubation of innovative startups and replication of their developments at local incubators, science, technology and industrial parks. The case of cooperation between the Silesian Polytechnic and the Institute of Industrial Economics of the National Academy of Sciences of Ukraine can be used as the example. The process can look like this: Silesian Polytechnic provides premises for the foundation (Representation of the National Academy of Sciences of Ukraine) and allocates a separate fund (from additional funding received from the Polish government) for the Foundation's operation in the EU.

4. In order to deepen cooperation between Ukrainian and European research institutions and to disseminate the experience of cooperation between the Institute of Industrial Economics of the National Academy of Sciences of Ukraine and the Silesian Polytechnic, it is proposed to alter the wording of paragraph 2.1.8 of the Statute of the National Academy of Sciences of Ukraine. The suggested edition is: «Continuous participation of the NAS of Ukraine, regional research centres of the NAS of Ukraine and the MES of Ukraine and scientific institutions of the NAS of Ukraine in international cooperation in science and technology is ensured through creation of branches and representative offices of the National Academy of Sciences of Ukraine, its regional centres and institutions at scientific and educational institutions of, first of all, the EU member states with the purpose of creating more opportunities for publication of research results in periodicals indexed in international scientometric databases, comprehensively studying and implementing useful foreign experience in Ukraine, developing cooperation through agreements between NAS of Ukraine, regional centres of NAS of Ukraine and MES of Ukraine and its scientific institutions and international and foreign academies of sciences, leading universities, scientific societies and institutions, delegating representatives to international scientific councils, commissions and other international advisory bodies, creating joint laboratories, providing additional support for the publication of scientific works of domestic scientists in Ukraine and abroad in foreign languages, ensuring proper protection and exercising of intellectual property rights of domestic scientists».

Conclusions and prospects for future research

Ukraine has shown its intentions and desire to become an integral part of the European space since the beginning of independence, but finally made its civilizational choice by signing the Association Agreement in 2014. This choice gives Ukraine the opportunity to make a joint innovation leap in tandem with Europe, finally to change the primary sector orientation of the economy to an innovative model of economic growth.

The legal basis of the European integration vector of development in science, technology and innovation has been forming since the proclamation of Ukraine's independence. It includes the Association Agreement, in particular Chapter 8 «Space», Chapter 9 «Cooperation in science and technology», Chapter 10 «Industrial and enterprise policy», Chapter 23 «Education, training and youth»; Agreement on scientific and technological cooperation between the European Community and Ukraine (2002); Agreement on Associate Membership of Ukraine in the European Union Research and Innovation Framework Program – «Horizon 2020» (2015); Agreement on Association of Ukraine to the Euratom Research and Training Programme (2016); Agreement on granting Ukraine associate membership in CERN (agreement was ratified in 2016); certain norms of the laws of Ukraine «On the principles of domestic and foreign policy», «On scientific and scientific-technical activities», as well as bilateral agreements and other regulations. However, the pace of establishment of the institutional foundations of Ukraine's cooperation with the EU cannot be considered satisfactory. The objectives of the Association Agreement in the field of «Science, Technology and Innovation, Space» for the period of 2014-2020 have been achieved only by 35%, and only by 9% for 2020. Several main problems that require immediate attention can be distinguished.

First, the fundamental principles of the state strategic planning for development of science, technology and innovation do not strengthen and mutually influence each other.

Second, there is no interdepartmental State Strategy for the Development of Science, Technology and Innovation of Ukraine and there are no intentions for its development, which indicates the actual priorities of the state.

Third, the state does not introduce incentive legislation to stimulate innovation and the norm on the gradual increase in the share of funding for science from all sources to 3% of GDP prescribed in the Law of Ukraine «On scientific and scientific-technical activities» is annually blocked.

Fourth, there is a lack of interconnection between strategic and conceptual documents, no coherence and coordination of policy in the field of science, technology and innovation with other types of policies in the field of education, industry, entrepreneurship, which prevents Ukraine's innovative progress.

Fifth, the government is not involved in ensuring Ukraine's integration into the ERA and delegates the responsibility for this to the Ministry of Education and Science of Ukraine, which is unable to independently meet the goals and conduct measures set out in the ERA-UA.

Sixth, the current management system of international cooperation is inefficient and does not support a comprehensive European integration vector of Ukraine's development in science, technology and innovation.

These problems must be solved in complex by making appropriate changes and additions to the legislative and regulatory framework, improving organizational and institutional support and accelerating the pace of European integration reforms.

In the EU, the problems of fragmentation of national research and innovation systems were solved by creating the European Research Area. This framework concept includes three interrelated aspects: *first*, coordination of national and regional activities, programmes and policies in the field of research and innovation in the European context; *second*, creation of an «internal market» for research where researchers, knowledge and technology move freely; *third*, implementation and funding of joint initiatives at European level. ERA is currently in the third stage of development, implementing six key priorities.

Ukraine joined the ERA in 2017, developing a Roadmap for integration into the ERA. It is gradually expanding its participation in European programmes: it is a member of Horizon 2020, EUREKA and COSME programmes, may participate in projects of other programmes, but to a limited extent. Ukraine needs to participate in calls of various European programmes and funds more actively, follow the recommendation of European experts to join the COST programme, as well as EUROSTARS, which will strengthen international cooperation, expand opportunities for Ukrainian organizations to receive additional financial support for research, innovation at the highest level.

Positive experience of cooperation between Ukrainian and European research institutions is demonstrated by the Silesian University of Technology (Silesian Voivodeship, Poland) and the Institute of Industrial Economics of the National Academy of Sciences of Ukraine (Kyiv, Ukraine), which has initiated further integration of both countries.

In order to ensure proper institutional preconditions for the integration of Ukraine into ERA, it is proposed to amend the Law of Ukraine «On scientific and scientific-technical activity», Draft State Budget of Ukraine, some bills provided for in the Action Plan for the Implementation of the Association Agreement, as

well as the Statute of National Academy of Sciences of Ukraine. The recommendations concern, *first*, the introduction of a system of state strategic planning for development of science, technology and innovation in Ukraine and to ensure their close adherence to the priorities of the ERA; *second*, providing support for innovative entrepreneurship among relevant innovation structures throughout the innovation chain of added value with the entry of products of Ukrainian startups on the European market according to a certain algorithm; *third*, granting the NAS of Ukraine and its scientific institutions, regional research centres of the NAS of Ukraine and the MES of Ukraine the right to establish branches and representative offices at scientific and educational institutions of the EU member states. The implementation of these proposals will start the process of changing many negative trends in the economy of Ukraine, which hinder the very idea of building an innovative economy and make it impossible for Ukraine to join the ERA on favourable terms.

Prospects for further research are to develop tools for the creation of interstate and cross-border scientific and technological, educational and innovation spaces, and further on their basis – interstate and cross-border innovation ecosystems and clusters as a means of cooperation and cooperation between Ukraine and the EU.

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