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DETERMINING DIRECTIONS FOR IMPROVING TECHNOLOGY TRANSFER IN THE EUROPEAN UNION WITHIN THE FRAMEWORK OF THE EUROPEAN INNOVATION ACT

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A system of regulatory tools and procedures that regulate technology transfer in the European Union (EU) has been considered in this study in view of the adoption of the EUROPEAN INNOVATION ACT ("EIA"). Techniques that define technology and its transfer in the EU were investigated, as well as the directions for their improvement in view of EIA adoption.

During the study, it was established that the process of regulating technology transfer in the EU is not uniform. It has been proven that the current model of regulatory influence in the EU is not focused on simplifying and stimulating technology transfer. Its main task is to ensure the possibility of achieving socially useful tasks of a public nature. The need for improving the process of regulating technology transfer within the European Union has been substantiated.

Directions for improving the regulation of technology transfer in the EU have been defined, namely:

a) systematization of regulatory influence on technology transfer around technology;

b) formation of a separate independent definition of technology;

c) consolidation of the concept of forms of technology;

d) formation of means of ensuring the private interests of technology transfer participants.

It was determined that the main place (form) of change in the regulation of technology transfer in the EU should be the Horizon Europe Framework Program and the European Innovation Act.

The study is aimed at formulating proposals for improving the regulatory processes of technology transfer in the EU. The main achievement is that the results of this work could be used to improve the official rules of technology transfer in the EU. They could also be applied to form strategic public management decisions, state policy on the circulation of innovations; they might serve as the basis for further scientific research on these issues

Keywords: technology transfer, technology circulation, international agreements, technology, technology transfer regulation

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1. Introduction

Technologies occupy one of the key places in the economic system of the European Union. They are the key foundation of its production sector. The correlation of technology transfer and the policy of managing these processes is based on a combination of self-regulating market mechanisms with simultaneous intervention by EU institutions. Such intervention is implemented in order to ensure general public interests and provide measures to stimulate the introduction of technologies. The main task is to create prerequisites for the prompt and unhindered implementation of technologies in the real sector of the EU economy.

The diversity of approaches to identifying technology, the gradual increase in the means of regulating its transfer, have led to a significant level of complexity of the means of EU intervention in these relations. This circumstance has led to a systematic negative organizational impact on the processes of scaling up technology circulation relations. As a result, over the past decade, an active discussion

has been ongoing on the main directions for eliminating these shortcomings.

At the beginning of 2025, an initiative was launched within the EU to systematically improve the means of regulating all economic relations, including technology transfer. This initiative was termed "A Competitiveness Compass for the EU" [1]. It is aimed at comprehensively reforming the EU's public policy and increasing the competitiveness of its economy. Among the many areas of reforming the basic principles of the relationship between the economy and EU institutions, A Competitiveness Compass for the EU provides for special means for technology transfer. Thus, the status of this object of economic relations should be determined on new principles. The basic principles of involving technology in production and economic relations should be radically revised. All these changes should be reflected within the framework of a separate European agreement – the "European Innovation Act" [1]. The draft of this official regulatory document is currently undergoing active discussion and indicative business analysis by leading associations of business entities. Published reports, official statements and communiqués already allow us to clarify the basic principles of prospective regulation of technology transfer in the EU. All of the above indicates the relevance of conducting scientific research on this issue and forming relevant scientific proposals.

2. Literature review and problem statement

Issues of technology transfer efficiency were studied in [2], based on the results of the work of university research centers funded by state funds from 2013 to 2021. It was determined that the centers demonstrate a significant level of efficiency in the level of technology implementation. It was proven that the level of such efficiency directly depends on the level of knowledge of scientific personnel involved in technology transfer. The dependence of the level of technology implementation efficiency on a number of factors directly related to the transfer of knowledge, along with the material implementation of technologies, was substantiated. However, within the framework of the study, no proposals were suggested to improve the regulatory rules for technology transfer. Anyway, the conclusions could be used within the framework of our study.

In work [3], the content and compliance of the means of stimulating technology transfer, defined by the provisions of the Horizon Europe Framework Program, were studied. The conclusion was substantiated that the provisions of this EU regulatory act do not meet the needs of participants in technology transfer relations. It should also be noted that the results of the study provided directions for improving the existing regulation. However, when conducting it, the principles formed in the "European Innovation Act" were not taken into account. In addition, the main vectors of development of this issue formed in A Competitiveness Compass for the EU were not taken into consideration. Because of this, the conclusions substantiated by the study require further updating, refinement, and improvement.

Within the framework of work [4], an analysis of licensing mechanisms as a form of technology transfer in the EU was conducted. It was proven that the identification of technology as a combination of intellectual property rights does not meet the actual tasks of technology transfer. Official EU regulatory acts that determine the possibility of technology transfer through the conclusion of a license agreement were analyzed. It was substantiated that the author (developer) of the technology has no means of protecting his/her rights since s/he does not have the opportunity to revoke such a license. It was noted that this additionally violates competition rules in the EU. However, no proposals were offered to improve the regulation of technology transfer. A number of protective clauses are proposed that the parties to the relevant license agreement should use during the actual transfer of technology.

In [5], the compliance of the regulation of measures to stimulate technology transfer and innovation circulation in the EU with the requirements of sustainable development policy was investigated. As a result of the study, a number of proposals were formed regarding existing methods and techniques of regulatory influence. However, despite the fact that the work investigated the same rules of technology transfer, the object was only the issue of compliance with the goals of sustainable development. The issue of a general regulatory approach to technology transfer was not analyzed. In addition, the content of the "European Innovation Act" was not taken into account.

As part of study [6], the influence of such factors as knowledge transfer, the level of education of personnel, and the availability of innovation infrastructure on technology transfer based on foreign investment was analyzed. The conclusion was drawn that the absence of official regulatory requirements for the inclusion of these objects in the technology leads to a decrease in the level of efficiency of its implementation processes. It is proposed to include information about the technology, requirements for the level of education and the possibility of using the services of innovation infrastructure entities in foreign investment agreements. However, the results of the work did not identify areas for improving official regulatory rules but only formed a list of means to minimize their negative impact. The provisions of the promising "European Innovation Act" were also not taken into account.

In work [7], the current regulatory approach in the EU to technology transfer was studied. The inconsistency of existing methods and techniques of regulatory influence with the needs of the participants in these relations was established. The need to improve official EU regulatory acts was substantiated. The main areas for improving the processes of supporting and scaling technology transfer were proposed. They include the goals of sustainable development defined within the EU. However, the conclusions drawn in the study did not take into account the principles of updated regulation, which should be defined in the European Innovation Act.

Study [8] analyzed actual successful cases of technology implementation that were implemented by small (medium) enterprises in the EU manufacturing sector. The presence of a number of reasons and conditions that negatively affect the level of technology transfer scaling was substantiated. These included the complexity of existing official regulatory rules for technology circulation in the EU. However, the study was aimed only at identifying and systematizing the inconsistencies of the technology transfer regulation process with the needs of its participants. As a result of its implementation, no proposals were formed for improving universal regulatory methods of influencing technology transfer. However, the conclusions could be used as the basis for this study where methods for eliminating previously identified shortcomings should be formed.

In work [9], statistical data on the level of technology transfer efficiency in the EU were investigated. A direct relationship was determined between the number of successful technology transfer cases and the level of complexity of regulating these relations. However, no proposals were formed within the framework of the work to improve the means and methods for regulating technology transfer in the EU. In addition, the principles on which the "European Innovation Act" is formed were not taken into account.

In [10], the dependence of the efficiency of technology transfer processes on the degree of efficiency of regulation of these relations was investigated. It was proven that it directly depends on the level of efficiency of the official rules according to which it should be carried out. In addition, the direct dependence on the level of scaling of technology transfer and the level of economic growth of the economy was additionally substantiated. It was proven that the critical level of regulatory influence, through technology, has a negative impact on the level of economic development. However, within the framework of the work, no proposals were offered to improve the existing means of regulation contained in official acts.

All this allows us to assert that it is advisable to conduct a study aimed at devising proposals for improving the regulation of technology transfer in the EU. The proposals should be aimed at ensuring a higher level of their efficiency since they could be used to form the "European Innovation Act". The conclusions drawn within the framework of our study could become the basis for further scientific developments, to ensure the implementation of relevant international and domestic regulatory acts.

3. The aim and objectives of the study

The purpose of our study is to substantiate the directions for improving the existing rules for technology transfer in the EU. This will make it possible to increase the overall level of efficiency of technology circulation processes and create the prerequisites for their scaling.

To achieve this goal, the following tasks have been defined:

– to identify the features of technology transfer regulation in the EU;

– to formulate proposals for directions to improve technology transfer regulation within the EU.

4. The study materials and methods

The object of our study is the system of regulatory tools and techniques for regulating technology transfer in the European Union (EU), in view of the adoption of the EUROPEAN INNOVATION ACT ("EIA").

The principal hypothesis assumes that the current methods of technology identification and technology transfer do not contribute to its effectiveness and therefore need to be improved. When conducting this study, it was assumed that the inconsistency of the existing regulatory impact negatively affects the level of scaling of technology circulation.

During the course of this study, a simplification was adopted within which the feasibility of changes in the regulatory approach at the level of individual EU member states was not studied. Such a simplification is permissible since the process of improving the rules for technology transfer is currently underway within the EU, as a result of which a single and unified approach to regulating these relations should be introduced.

When conducting the study, official EU regulatory acts, information from open sources, recommendations of EU government bodies and institutions were processed. In addition, analytical data from international organizations, as well as statistical data and public information were used.

Within the framework of this study, general scientific theoretical methods were used, namely synthesis and analysis, deduction, induction, abstraction and comparison, as well as systemic and functional methods, modeling, formal and logical interpretation of the content of regulatory categories.

5. Results of investigating directions for improving technology transfer in the European Union through the prism of prospective agreements

5. 1. Identification of features of technology transfer regulation in the European Union

Despite the key role of technology in the EU economic system, official acts and agreements of this intergovernmental organization do not contain the main definitions of this concept. Instead, the method of borrowing the main features from other regulatory systems is used. This is due to both the internal complexity of the content of technology and the desire of the governments of the EU member states to secure the exclusive right to use them [11].

The main features of technology and technology transfer in the EU are determined at the level of recommendations of international bodies [7]. According to the results of analysis of all available sources of borrowing the definition of technology and technology transfer, the following can be distinguished:

The approach formed by the World Trade Organization ("WTO"). Thus, in the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (the "TRIPS" Agreement) [12] technology is defined as a combination of objects of intellectual property rights. Technology transfer is the transfer of rights to technology components within the framework of licensing and/or patent agreements [12].

A similar approach was also developed by the World Intellectual Property Organization (hereinafter referred to as "WIPO") [13]. However, here technology is defined as a complex object of intellectual property rights created on the basis of an artificial combination of its components [13]. As in the previous case, technology transfer is the transfer of rights to intellectual property rights under relevant agreements.

A special approach was defined by the United Nations Conference on Trade and Development (hereinafter referred to as "UNCTAD") [14]. Here technology is identified exclusively as information, which includes data in certain forms. The main forms of manifestation of technology (in addition to already existing ones) were attributed to:

– know-how;

– conclusions of technical expertise;

– results of technical consulting;

– results of industrial and technical cooperation;

– other forms of technological knowledge [14].

Within the framework of the UNCTAD recommendations, technology transfer was identified with the forms of transfer of rights to the listed objects, as a rule, on the basis of a certain agreement between its participants.

An approximate additional approach to the identification of technology and the concept of its transfer was

formed within the framework of the EU Framework Program "Horizon Europe" (hereinafter referred to as "Horizon Europe") [15]. Similarly, as in the UNCTAD recommendations, this regulatory act does not define the essential definition of technology but only lists the forms of its manifestation. And in these forms, technology already participates in economic turnover. The main forms of manifestation of technologies, the Framework Program "Horizon Europe" includes the following:

– results of scientific research;
– results of research and design work;
– experimental reproduction of technology;
– property complex of a small (medium) enterprise;
– knowledge, information, developments about the sequence of technological operations;
– other information about the technology.

Technology transfer is any form of transfer of the specified objects, which may be based on a specific agreement or in any other way provided for within the EU [15].

The first conclusion that can be drawn from the above is that technology is not an independent object of regulation and influence by the EU institutions. It exists as a special generic category, which includes a significant list of its external forms (manifestations). And they, in turn, are involved in participation in the EU economic system. For a more accurate understanding of how technology is involved in participation in economic relations, it is necessary to systematize all those forms of its manifestation that are used in the EU. The results of the systematization are shown in Fig. 1.

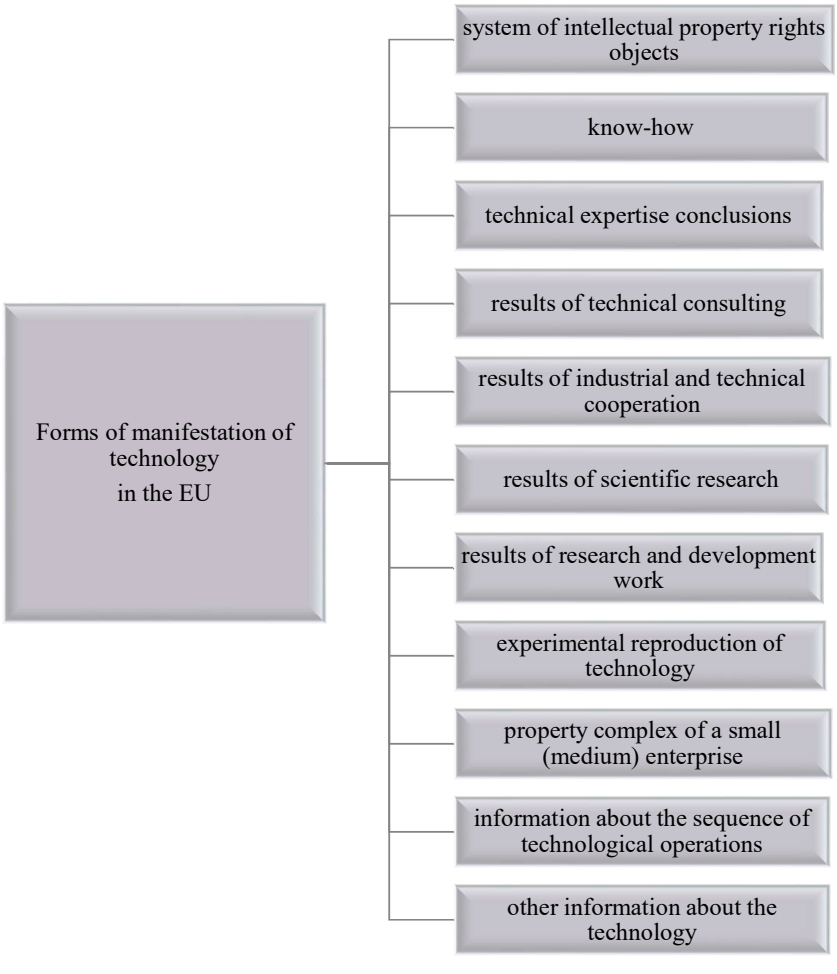

Fig. 1. Forms of manifestation of technologies in the European Union

Each of the objects identified in Fig. 1 as a form of technology manifestation is an independent object of regulatory influence. Separate rules for transfer, use, and circulation are determined for it. Within the framework of the analyzed scientific studies [1–10], all scientists are unanimous in the fact that such an approach to regulatory policy in the EU is ineffective. Another feature of such regulatory influence is that all means and methods of such influence are focused on achieving public, not private interests [6].

These and other reasons became the basis for initiating the process of reforming the regulation of technology transfer. Thus, in January 2025, a program for reforming the EU state policy was adopted and approved within the EU. It is aimed at increasing its competitiveness and was called "A Competitiveness Compass for the EU" (hereinafter referred to as "A Competitiveness Compass for the EU") [16]. This document provides for a whole system of organizational, administrative and other measures to comprehensively update the principles of intervention by EU institutions in its economic system. A separate section in "A Competitiveness Compass for the EU" is devoted to the change in the regulatory approach to technology transfer in the EU. The main formal change should be that the status of technology and the principles of its transfer will be determined by a separate EU agreement. Thus, a new intergovernmental agreement within the EU is planned – the European Innovation Agreement (hereinafter referred to as the "European Innovation Act") [1]. The ratio of the distribution of competences regarding intervention in technology transfer will also undergo a significant change. Thus, after the completion of the reform procedures, the issues of technology circulation should be transferred to the exclusive competence of the EU authorities. Such a change is aimed at eliminating the shortcomings of the regional specificity of regulatory influence. In other words, the status of technology and the features of its transfer will no longer be determined at the level of each EU member state. In the future, such regulation will occur for all countries equally, at the level of the central authorities of this intergovernmental entity.

Despite the fact that the unified content of the "European Innovation Act" is not yet widely available, its main provisions are already available for wide discussion. Thus, the main principles of building technology transfer regulation can be determined on the basis of the European Commission's information bulletins and relevant communiqués [1, 14]. In addition, interested representatives of the EU business community have already published their open appeals regarding the upcoming reform and its main directions [17, 18]. In addition, the main directions of changing the regulation of technology transfer in the EU are already being actively discussed in the scientific community [19].

The main directions of technology transfer reform can be attributed to the following:

– introduction of a single regime for regulating technology transfer in the EU (the so-called 28th regime);

– introduction of the division of technologies according to the criterion of usefulness and importance;

– giving priority to supporting technologies previously classified as useful and important;

– simplification of mechanisms for public (state) technology procurement;

– introduction of the possibility of functioning of special business entities (startups and skylups);

– introduction of new forms of technological cooperation between scientific and research institutions and business representatives;

– launching of a system of testing infrastructure centers to support the implementation of technologies called "sandboxes".

From open and accessible sources, it is possible to obtain information only on the above areas of improvement. However, their assessment and comparison with the obstacles to effective technology transfer allows us to determine that the "European Innovation Act" does not solve all problematic issues in this area. It is for this reason that it is advisable to conduct relevant research on this topic in order to timely formulate proposals for improving the regulation of technology transfer in the EU.

However, we must not forget that within the EU there is already an imperfect, but still a system of regulating technology transfer relations. The key among them is the functioning of a system of means and measures to support technologies based on the Horizon Europe Framework Program. The main feature of this program is that most of the measures and means of support are long-term. And a radical change in the regulatory approach is guaranteed to lead to a disruption of the existing mechanisms of economic interaction between technology transfer participants.

The existing regulatory system is effective and endowed with signs of efficiency. And all the directions for reforming these relations formed in the "European Innovation Act" should only contribute to increasing the level of such efficiency. Thus, the existing system of regulatory influence in the EU ensures the receipt of funding in the field of technology transfer. According to Eurostat data, the average amount of such revenues for the period from 2015 to 2023 remains at the level of 59–55 million euros each year [20]. Detailed information on the amount of funds attracted to the field of technology transfer in the EU is given in Table 1.

The data given in Table 1 indicate a relatively stable number of financial (monetary) assets that are systematically involved in the sphere of technology transfer in the EU.

Table 1

Information on the amount of funds attracted to the field of technology transfer in the EU, during 2105–2023

Time	2015	2016	2017	2018	2019	2020	2021	2022	2023
Units of measurement	million euros	million euros	million euros	million euros	million euros	million euros	million euros	million euros	million euros
EU (27 countries)	56.96	58.18	59.03	59.31	58.96	57.86	57.61	–	56.72

5. 2. Formulation of proposals on directions for improving the regulation of technology transfer in the European Union

All identified inconsistencies in the regulation of technology transfer in the EU should be eliminated at this stage of an open discussion of the directions for reforming these relations by the European Innovation Act. According to the results of the study, it is advisable to propose the following directions for improving technology transfer in the EU:

First, this is the construction of regulatory influence on the sphere of technology circulation in such a way that technology, and not its forms or manifestations, act as the main object of regulatory influence. To do this, it is necessary to identify technology at the level of a separate and independent object of economic relations, that is, as a special type of thing (subject). Without changing the object of regulatory influence, technology transfer will continue to be based not on the technology itself, but on its external manifestations. This will not contribute to the scaling up of technology circulation. Conversely, in the case of fixing and formalizing technology as a separate and independent object of economic relations, technology transfer will become more effective.

Secondly, this is the introduction of a separate independent definition of technology into the EU regulatory system. This will contribute to the centralization and systematization of regulatory influence on technology transfer relations. As a basis, we can take the definition formed and proposed based on the results of study [3, 11].

Thirdly, this is the preservation of existing approaches to the regulation of technology transfer and their integrated modification in order to change the object of regulatory influence. The means of achieving this is the introduction of the concept of technology that form into the content of official regulatory documents. The technology form should act as a subject (not an object) of regulatory influence. It is advisable to fix an indicative list of technology forms. It is advisable to include in it those forms of manifestation of technology that have already been established within the EU. Namely:

– system of objects of intellectual property rights;

– know-how;

– conclusions of technical expertise;

– results of technical consulting;

– results of scientific and research works;

– results of research and development works;

– experimental reproduction of technology;

– property complex of a small (medium) enterprise;

– information on the sequence of technological operations;

– other information about the technology.

In the case of introducing the above categories into the process of regulating technology transfer, within the EU regulatory system, the continuity of the means of regulating technology transfer will be ensured. On the one hand, this will make it possible not to revise the existing rules of circulation of those technologies that are already being implemented. On the other hand, it will significantly accelerate the process of adapting technology transfer participants to the updated means of regulatory influence.

Fourth, this is the formation of a holistic system of regulating technology transfer. As a basis for such systematization, it is advisable to take the life cycle of technologies, from the moment of its creation to the moment of its implementation or implementation within the production sector of the economic system. In this case, all relations related to the creation, transfer of rights and implementation of technologies will be influenced. However, the question of from what point a technology acquires the features of an integral object of economic relations is not identified within the EU at all. Influence

measures are determined exclusively regarding the external manifestations of technology, which deprives their developers of interest in the development and creation of technologies [4].

The optimal place for implementing the identified areas of improvement of technology transfer regulation in the EU should be their official regulatory acts. These include:

1) Horizon Europe Framework Program [15];

2) European Innovation Act [16].

6. Discussion of results related to the study on improving technology transfer in the European Union

The scientific results obtained during this study (in terms of directions for improving technology transfer in the EU) are explained by the need for a systematic solution to the identified problems. The forms of manifestation of technology, defined in Fig. 1, are the object of regulatory influence. However, none of these forms separately determines all the features of the technology. As a result, the regulation of its circulation processes does not take into account all the characteristic features of this object. However, the existing regulatory approach already provides a stable increase in financial support and scaling of technology transfer in the EU. This is confirmed by the data given in Table 1. Substantiated directions for such improvement resolve most of the identified inconsistencies in the existing regulation but take into account the need to preserve the existing system of regulatory tools.

During this study, limitations were identified due to the non-publicity of the content of the "European Innovation Act" and the active process of reforming the rules for technology transfer in the EU. The absence of regulatory structures for the definition of "technology" is an objective obstacle to conducting a comprehensive study. The main drawback of this proposal is the uncertainty regarding the essence and place of technologies within the framework of EU law, due to the non-adoption of the "European Innovation Act". This drawback can be compensated by the implementation of existing mechanisms for regulating technology transfer in the EU with their subsequent revision if necessary. Given the level of stability of the regulation of the economic system in the EU, such a procedure for unification is seen as effective. An additional drawback of this study is that the experience of individual EU member states was not taken into account within its framework. Given that each country pursues a separate policy for regulating technology transfer, the directions of their development are quite different from each other and their systematization requires a separate scientific study of this issue.

The main advantage of the proposals formed is that they take into account all the identified shortcomings of the regulation of technology transfer in the EU to the maximum extent possible. All other proposals are not endowed with such a level of universality, completeness, and systematicity and are fragmentary in nature. An additional advantage of the research conducted is that the results obtained can be used in official regulatory acts of the EU. Further study of the outlined issues will allow obtaining results of a practical orientation that can be used within the framework of state policy measures. In the case of the formation of official regulatory structures, the substantiated directions will require some refinement and changes. In any case, the scientific conclusions obtained can become the basis for both further scientific developments and future regulatory and legal acts. All previously conducted studies [1–10] either did not form similar scientific proposals or investigated only individual aspects of technology circulation. Based on the results of our work, several directions for solving the issue of improving the regulation of technology transfer in the EU have been formed. However, all these results do not have signs of systematicity and do not apply to most participants in relations related to their circulation. The results of the study substantiate the directions for solving most of the identified problems and improving technology transfer in the EU. In addition, the identified proposals provide for more effective mechanisms for solving the problems of technology circulation in the EU than in studies [1–10].

The main limitations of this study are that it is aimed at improving approaches to the formation of universal regulatory structures. In the case of their implementation in official EU regulatory acts, they will require some specification and personification. The degree of such individualization will require additional scientific research.

Possible further directions for the development of this study are the formation of directions for improving national regulatory methods of influence of EU member states. In addition, the results of this study could form the basis for improving regulatory methods of influence within individual sectors of the EU economy.

7. Conclusions

1. We have determined that the existing regulation of technology transfer does not meet the needs of its participants. It is aimed at satisfying public interests while private interests are ignored.

2. The following directions for improving the regulation of technology transfer in the EU were formed:

– systematization of regulatory influence on technology transfer around technology, and not possible forms of its external manifestation;

– fixing a separate independent definition of technology;

– introduction of the concept of forms of technology into the EU regulatory system;

– formation of means and methods of regulatory support for the private interests of technology transfer participants.

It was determined that the main place (form) of changing the regulation of technology transfer in the EU should be the Horizon Europe Framework Program and the European Innovation Act.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

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Data availability

All data are available, either in numerical or graphical form, in the main text of the manuscript.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

Authors' contributions

Iuliia Ostapenko: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization; **Nadiia Holieva:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization; **Igor Borysov:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization; **Olena Sivash:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization; **Kateryna Lisohorova:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Visualization.

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