

The object of this study is to determine the essence and ways of improving regulatory prohibitions of environmental, industrial man-made safety within the limits of technology transfer. The existing approaches to the definition and normative registration of methods and techniques for the formation of technology safety requirements have been summarized. It was established that the existing approaches to the definition do not fully meet the needs of state regulation and the requirements of technology transfer subjects. The expediency of improving the existing methods of determining the ecological, industrial, and man-made safety of technologies was substantiated. The definition of technology safety at the level of generalized regulatory structures is proposed, which means a ban on introducing into circulation technologies that cause irreparable changes in the environment, carry a threat of causing harm to life or health, or mass property damage as a result of its proper use. The expediency of introducing the specified normative regulatory structure to international treaties and agreements, as well as to regulatory acts of national legislation, was substantiated. Also, directions for improving current international agreements and contracts in the field of technology transfer were formed by introducing into their content requirements regarding environmental, industrial, man-made safety of technologies, as a mandatory condition for their introduction into circulation.

The research is aimed at forming general theoretical foundations for improving the system of safety identification criteria in the field of technology transfer. The generated research results can be used in the formation of international normative acts, acts of national legislation, and serve as a basis for further scientific research on these issues

Keywords: technology transfer, technology safety, environmental protection, ecological, technogenic, industrial safety

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IDENTIFYING DIRECTIONS FOR IMPROVING MEANS OF TECHNOLOGY TRANSFER SAFETY REGULATION

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1. Introduction

Technology transfer is the key to the economic development of any state or region. It is based on the degree of prevalence of knowledge-intensive technologies in the production sector. The level of competitive gains that can be obtained as a result of technology implementation is a desirable result for any business entity.

However, we must not forget that technology is also a means of production that transforms raw materials into finished products. This purpose of technology determines that it interacts in a certain way with the surrounding environment, influencing it. The historical experience of economically developed countries of the world indicates that the in-

tensive transfer of technologies is guaranteed to be reflected in the ecological state of the surrounding environment. Any technology can affect the personnel who manage the flow of technological processes of production purpose. The great man-made disasters of the 20th century proved that certain technologies could cause massive damage to the life and health of the population of a certain country or territory.

Mankind is well aware of the potential dangers of using advanced science-intensive technologies and has been trying to develop and implement various protective measures for many decades. Such means are complex and include not only the establishment of certain rules for the use of this or that technology. These are systemic actions related to the implementation of preventive mechanisms, the introduction

of restrictions on the methods of their use, the transfer of technical information on the method of their use, etc.

Technology transfer, and especially its international transfer between different countries, created the prerequisites for the formation of restrictive prohibitions and import and export restrictions. These restrictions became part of regulatory systems and provided for the use of certain types of prohibitions and restrictions, with the help of which state policy was implemented. As of today, compliance with environmental, industrial, and technogenic safety requirements is a mandatory condition for the transfer of any technology.

At the same time, the requirements for the safety of the technology are the result of a certain social and economic consensus. On the one hand, the private interests of the business entity to increase the level of its earnings were limited by the general public interests of common security. Such a compromise is the subject of heated debates in scientific circles and within public discussions of regulatory state measures. Because of this, until now no established concept of what prohibitions and restrictions aimed at ensuring the safety of technology should look like has been formed.

This determines, on the one hand, the relevance of scientific research on this topic, and, on the other hand, entrusts scientists with the task of forming proposals for a universal normative construction of technology safety. It is science that should form such a system and thereby form proposals for the stabilization and intensification of the technology transfer process.

2. Literature review and problem statement

Issues related to the definition of requirements and criteria for the safety of technology transfer are the subject of many scientific studies. They are studied both as a whole and in terms of their individual elements, both at the national level and within the framework of international regulatory documents.

For example, paper [1] examines the effectiveness of the evaluation of food processing technologies (honey) during their transfer to the territory of Slovakia. The regulatory restrictions set for participants in the transfer of this kind of technology were investigated. The inconsistency of the existing regulatory restrictions with the market needs of this country was identified. It was proposed to change the approach to assessing the safety of such technologies. The expediency of using technology as the main criterion for safety, quality control of the result of its use (finished products) is substantiated. However, within the scope of that work, no universal criteria for technology safety during its transfer have been proposed. Also, the work focused only on the safety of food production technologies and the formation of food safety criteria for their consumption. Requirements for other aspects of technology safety were not explored there.

In work [2], a fundamental study of the economic consequences of the interaction of established social and environmental restrictions for the transfer of technologies was carried out. Three main components were identified, which must be taken into account under the conditions of any technology transfer, for its successful implementation. They included public safety, environmental compliance, and the ability to provide an economic result. International legal acts containing restrictive regulatory measures are analyzed. However, the work does not formulate proposals of

a universal nature for solving the identified problems. Only, the necessity of fixing the requirements of environmental, industrial, and man-made safety during the transfer of technologies has been proven.

Within the framework of research reported in [3], it was concluded that the technology, as a result of its transfer, has a significant impact not only on economic relations but also on the environment. Under such conditions, the prevailing means of determining the safety of technology through intellectual property mechanisms are not effective. Low efficiency requires significant improvement of legal regulation both at the international level and at the level of the legal systems of individual countries. China's experience in establishing minimum regulatory requirements for environmental, industrial, and man-made safety of energy technologies was analyzed. It was found that the absence (minimum level) of restrictive requirements for environmental protection and public safety does not have a decisive influence on the level of technology transfer. At the same time, the presence of generalized requirements, based on a certain level of combination of public interests and private interests, have a greater economic effect. In general, the work focused on the study of patterns of influence of environmental, industrial, technogenic safety restrictions on the level of technology transfer. In the course of the research, no new regulatory structures were formed that could be used to resolve this issue.

In work [4], the degree of influence of restrictions on the interaction of technology with the environment on various subjects of innovative relations was investigated. It was established that environmental, industrial, and man-made technology safety restrictions have a negative impact on small (medium) enterprises and are a force for large business. The need for the formation of generalized safety requirements, which should take into account the interests of all participants in innovative relations and technology transfer, has been identified. However, the concept of these limitations was not proposed, and their models were not formed.

The impact of industrial safety requirements on the level of technology transfer in the field of high-rise construction works was investigated in work [5]. Within the framework of that work, the necessity of forming generalized criteria for the normative registration of high-rise construction technologies has been established. It was established that such criteria should take into account the private interests of developers and the interests of public safety. However, as a result of the research, generalized universal criteria of such safety, which could be used in regulatory acts, were not determined. In addition, the work did not investigate other safety criteria and did not investigate such requirements in other economic sectors.

Within the framework of work [6], the experience of the European Union and Ukraine regarding the formation of legal methods and methods, which can be used to record requirements for the environmental safety of technology, was studied. Proposals were made to orient such requirements to the actually detected deviations of environmental standards within a separate territory. The main drawback of that work is that the authors studied only the safety rules of technologies related to the protection of atmospheric air. In the course of the study, only the main directions of the formation of regulatory means were formed. There were no concrete proposals for the identification of normative techniques for determining the safety of technologies. The main drawback of the conclusions formed by the authors is the formation of

methods and methods of regulatory restrictions that should be formed based on the fact of deviation of environmental standards. This approach is only aimed at eliminating shortcomings, but not at prediction.

In study [7], the expediency of introducing technology safety requirements in the formation of global agreements on joint space exploration is substantiated. The regulation of the number of atomic technologies in space, as well as the procedure for joint use of the stationary orbit of the planet Earth, are defined as specific subject restrictions. A special place in the study was devoted to restrictions on the placement of waste in space. In the course of the study, the expediency of the formation of requirements for industrial, man-made, and environmental safety in space was substantiated. It was determined that such regulatory restrictions should take into account the common interests of all countries and the needs for further scientific exploration of space. It was emphasized the need to fix such restrictions not only at the level of international documents, but also at the level of acts of national legislation. However, universal legal constructions that could be used in regulatory acts of prospective legislation have not been formed.

Within the framework of work [8], fundamental international agreements in the field of human interaction and the environment were studied. It was concluded that ecological, industrial, and man-made safety is a key element of the functioning of any economic system and state. Attention was focused on the fact that any transfer of technology must meet the environmental, industrial, and man-made safety criteria. The definition of the place within the hierarchical system of regulatory acts, which should be occupied by requirements regarding the safety of technologies, has been formed. It is indicated that due to the special importance of technologies for economic development, the requirements for their safety should be identified at the level of international agreements and at the level of acts of national legislation of each of the countries of the world. In addition, it was proposed to introduce security restrictions at the level of the constitutional acts of each of the countries. However, within the scope of that work, universal criteria that could be used were not formed.

All the studies analyzed above [1–8] testify to the focus of scientific research on solving the issue of limiting the freedom to use technology, taking into account the interests of public safety. No works were found within which generalized constructions of regulatory techniques were formed. However, we can talk about the presence of many problematic aspects of implementing the safety of technology transfer, due to the lack of a generalized understanding of their essence.

All this allows us to state that it is appropriate to conduct a study aimed at forming proposals for improving the approach to identifying the safety of technology transfer. Formed proposals should ensure a higher level of efficiency of technology transfer, stabilizing state influence on it. The conclusions formed within the scope of this study can become the basis for further scientific developments, as well as the basis for the formation of promising international and national regulatory acts.

3. The aim and objectives of the study

The purpose of this study is to substantiate the areas of improvement of the existing system for determining the safety of technology transfer. The obtained achievements

can be useful for changing the provisions of international acts, rules of the World Trade Organization, internal rules of the member states of the European Union, European Union legislation, national legislation.

To achieve this goal, the following tasks are defined:

- to analyze the essence, structure, and content of the methods of regulatory registration regarding the safety of technology transfer;
- to investigate the level of effectiveness of existing methods of regulatory determination of the safety of technology transfer;
- to formulate proposals for improving the system of universal regulatory structures in the field of technology transfer.

4. The study materials and methods

The object of our study is to determine the essence, location, and role of environmental, industrial, and technogenic safety restrictions in the field of technology transfer.

The hypothesis of the study assumes that the existing mechanisms for identifying the safety of technology do not meet the needs of the economy and society and therefore should be improved. When conducting this study, it was assumed that the inconsistency of the existing technology safety identification system negatively affects the level of intensification of their transfer. The basis for this was the evaluation of the methods and techniques of their application and a large amount of feedback from the participants of technology transfer.

In the course of the research, a simplification was used, within which all existing methods of ensuring environmental, industrial, and man-made safety were not taken into account. Only a part of them was studied, namely the restrictions and prohibitions recorded in normative and regulatory acts. Within the scope of the study, organizational, technical, and instrumental means of ensuring the safety of technologies are not taken into account. The safety of technology within the scope of this study is studied as a means of state (interstate) regulatory regulation of economic (social) relations. A means by which the state (or interstate entities) restricts the absolute freedom of technology transfer participants in order to ensure social and economic security.

In the course of the research, the provisions of the European Union and World Trade Organization regulations, information from open sources were used. In addition, recommendations of leading international institutions, statistical information, and public information were used.

When conducting the research, general scientific theoretical methods were used, namely: analysis, synthesis, deduction, induction, comparison, abstraction, generalization, system and functional methods, modeling methods, formal and logical interpretation of the content of scientific and economic categories and concepts.

5. Results of the study on determining directions for improving the means of regulating the safety of technologies

5.1. Study of the essence, structure, and content of the methods of regulatory registration regarding the safety of technology transfer

The current state of development of the system of means of minimizing the negative impact of the means of production on the environment can be identified as a complex

system of state prohibitions and restrictions related to the results of the functioning of the means of production. In other words, the existing safety system is focused exclusively on material forms of technology implementation (equipment, machines, and mechanisms). It includes such means as:

- determination of the maximum permissible values of the influence of the means of production on the environment (maximum permissible concentrations of emissions);
- implementation of current state supervision and control over compliance with the maximum permissible values of impact on the environment;
- provision of a system of constant monitoring of the surrounding environment is not subject to its compliance with environmental safety standards;
- formation of individual instructions (prescriptions) regarding the industrial improvement of certain equipment, machines, and mechanisms that have an impact on the environment;
- decommissioning those means of production that are guaranteed not to meet the established requirements of environmental safety.

The specified system of environmental safety means can also be characterized in the following directions:

- environmental restrictions, regarding the minimization of the impact on the environment (atmospheric air, land resources, flora, and fauna);
- limitations of industrial safety, which can be defined as the absence of the possibility of injury to workers (operators) of the technology;
- man-made safety requirements, i.e., the absence of risk of mass destruction of architectural objects and/or mass damage to life or health.

5.2. Research on the level of effectiveness of existing methods of regulatory determination of the safety of technology transfer

The existing system of means of minimizing the environmental safety of the means of production is imperfect and does not meet all the challenges that exist within the economy and society. The main drawback is that it is aimed at minimizing only those negative consequences of impact on the environment that were identified during environmental monitoring. In other words, the entire system of preventive measures is aimed exclusively at eliminating those negative environmental phenomena that are already taking place. That is, intervention occurs only when a negative impact on the environment has already been caused. No preventive techniques, methods, or means of influence are implemented.

The next shortcoming of the existing system is the ignoring of the negative impact of the results of the production process, namely products of industrial and technical purpose and consumer goods. As well as the disproportionality of the established restrictive measures and the available economic opportunities for their implementation.

Determination of the legal nature of this object of economic and civil turnover is an essential prerequisite for the low efficiency of the means of ensuring the safety of technologies. On the one hand, it is the result of scientific or research works, and on the other hand, it acts as a certain composite (synthetic) object of intellectual property law.

The legal consolidation of technology as an object of intellectual property law makes it possible only to protect the property and personal non-property rights of its developer. And it does not create any prerequisites for the formation of the peculiarities of its functioning in connection with the impact on the surrounding environment. The lack of a uniform national approach to determining the legal nature of this object has an even greater negative impact on the possibility of regulatory regulation of technology safety.

5.3. Research on improving the system of universal regulatory structures in the field of technology transfer

All of the listed shortcomings of the system of technology safety identification means can be overcome by implementing international and national legal regulation of their transfer, certain regulatory restrictions. Such restrictions should be identified as regulatory prohibitions on the transfer of technologies that do not meet safety requirements.

The process of forming a generalized model of technology safety should be based on the following elements:

- environmental prohibitions and restrictions on the impact on the environment;
- prohibitions and restrictions of industrial safety, regarding the ability to cause harm to the worker (operator) of the technology;
- man-made prohibitions and restrictions regarding the threat of mass destruction and mass damage.

It is considered appropriate to propose directions for improving the safety criteria of technology transfer, formed in the form of a scheme shown in Fig. 1.

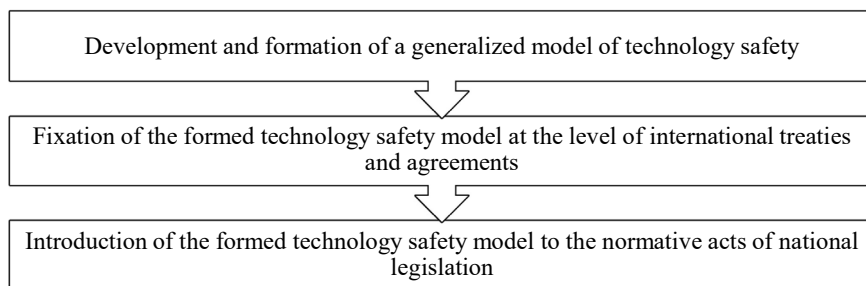


Fig. 1. Directions for improving technology transfer safety criteria

The generalized regulatory model of technology safety should be focused on the introduction of restrictions that will act on “anticipation”. That is, until the moment when the technology causes changes and affects the surrounding environment. It is most appropriate to introduce the specified restrictions as a condition for the creation or transfer of technologies.

The regulatory structure of the generalized technology safety model must contain the following regulatory structures:

- no technology should lead to irreparable (irreversible) changes in the surrounding environment;
- no technology should have the ability to cause harm to the life and health of its operator under the conditions of its proper use or operation;
- no technology should carry the risk of uncontrollably causing mass destruction, provided it is properly used (exploited).

Registration of the established technology safety model at the level of international treaties and agreements should be implemented in those regulatory acts that are recognized by the majority of economically developed countries. These include the following:

- agreement on trade aspects of intellectual property rights (“TRIPS” agreement), adopted within the framework of the Uruguay Round of the General Agreement on Tariffs and Trade of the World Trade Organization;

- methodological recommendations “Oslo Guidelines”, which are developed on a permanent basis by the Organization for Economic Cooperation and Development and the European Statistical Bureau (Eurostat);

- the framework program of the European Union “Horizon Europe”.

The introduction of the formed model of technology safety to the normative acts of national legislation is the final stage of the process of improving the issue of technology safety. It consists in the introduction of the normative construction of the safety of technology to the content of normative acts of direct effect. Those regulatory acts, the implementation of which is controlled by the relevant state authorities, endowed with power and coercive powers. It is advisable to carry out such an introduction in two main functional areas:

- introduction into the national legal systems of requirements for environmental, industrial, technogenic safety of technologies, as mandatory conditions for their introduction into circulation;

- establishing, at the level of national legal systems, prohibitions on the transfer of technologies that do not meet the requirements of environmental, industrial, and technogenic safety.

6. Discussion of results of the study of directions for improving the means of regulating the safety of technologies

Within the scope of scientific achievements, technology transfer means the transfer of rights to technology from one participant to another. At the same time, the technology itself exists mostly at the level of the results of scientific or scientific and applied research [2, 3]. The rules of such a transfer are established either at the level of individual contracts or at the level of separate regulatory and legal acts. Transfer is inextricably linked to the process of moving technology in space and subject-wise. In any case, these are active actions regarding the transfer of the rights of the developer of the idea for its use to another entity [9]. Technology transfer has a commercial purpose. All its participants prefer to introduce technology to the production complex of the business entity and carry out economic activities. These processes, for the most part, are aimed at obtaining a commercial result (profit). This indicates that the technology will be used for the processing of raw materials and the production of certain consumer goods or industrial products. And this, in turn, shows that no technology will represent a closed, isolated system of elements. On the contrary, technology will and should interact with the environment, leaving certain consequences of such interaction in it. These consequences are guaranteed to affect the state of the surrounding environment, changing it to one degree or another.

During the evolutionary development of economic processes, humanity quickly realized the need to limit the effects of the means of production on the environment. Along with the intensification of industrial production processes, certain preventive measures to minimize harmful effects began to be introduced. Thus, space technologies [7], as well as automobile transport technologies [6] have the greatest negative impact on the environment today. The issue of atmospheric air

pollution, due to the mass use of vehicles with internal combustion engines, became the basis for the formation of the first international treaties and agreements in this area. On this issue, the European Union became the first intergovernmental entity that decided to intervene in economic activity and establish certain restrictions [6]. It was this experience that became the conventional reference point used by other countries to minimize the harmful impact of production means on the environment. The question of formation of means of minimizing the consequences of pollution of the surrounding environment by elements of rocket and space technologies is actively being worked out by international institutions [7].

As can be seen from previous studies on this topic, ensuring environmental, industrial, man-made safety is one of the directions of state policy and state regulation. From the point of view of the process of its provision, this is continuous supervision and control [4]. Like any other activity of the state, environmental, industrial, and technogenic control has predetermined rules and limits of its implementation. This activity is systematized and centralized. It is based on the establishment of a number of normative prohibitions and restrictions. The main object on which this regulatory influence is directed is the means of production (equipment, machines, and mechanisms) [4]. One should agree with the opinion given in [3], where exactly such forms of implementation of technology are defined as its material embodiment. Within the scope of scientific studies of safety requirements of material forms of technology manifestation, it was determined that ecological, industrial, man-made regulatory influence on the transfer of technologies includes a whole system of means of influence. They include the following:

- the functioning of the system of bodies and institutions to determine the maximum permissible values of the impact of equipment, machinery, and mechanisms on the environment;

- implementation of control over compliance by business entities with the level of ecological, industrial, and man-made impact on the environment;

- the functioning of constant monitoring of the level of pollution of the surrounding environment;

- implementation of a system of active countermeasures against violations of previously established requirements, through the formation of individual bans on the improvement of technologies that have a negative impact on the environment;

- establishment and control of a ban on the use of those equipment and facilities that are guaranteed to have a harmful effect on the environment [6].

In many scientific works, the structure and means of restrictive influence on economic processes are investigated in order to ensure the common interests of the state and society. Environmental, industrial, and man-made security requirements for technology transfer are no exception. Thus, within the scope of work [2], the expediency of including environmental restrictions in the safety requirements of technologies is substantiated. They are proposed to mean the minimization of the impact on atmospheric air, land resources, flora, and fauna. However, the complex nature of the technology and the possibility of its use as the basis of the production process prove the need to extend the requirements and industrial safety to it. Such restrictions are explained as the design of the means of production in such a way that, in the case of their proper use, the possibility of injury to workers interacting with it will be minimized or eliminated. This justification is given in the scope of work [5]. The degree of prevalence of technologies in the production sector, their scaling, led to

the need to spread to them and requirements regarding the absence of risk of mass damage to life, health and property in a certain territory. Within the overall system of safety requirements, this kind of restrictions and prohibitions were identified as man-made safety requirements [7].

This system of preventing harmful effects was created in the course of the evolutionary development of economic relations. It was formed gradually, as the means of production began to change the environment. Such a system was the result of an actual reaction to the deterioration of the natural state of things around. It is universally recognized in the world, represented in the absolute majority of international agreements and treaties, and fixed in the majority of national regulatory systems of individual countries.

The fact that the system of ecological, industrial, and man-made safety has remained unchanged for many decades in a row, and the state of the environment is not improving, determines the need for its revision. The inadequacy of the existing technology safety system is indicated in many studies. Thus, one can often come across the conclusion that ecological, industrial, man-made safety, the system of which is implemented in most countries, is aimed only at the consequences that are already taking place in the surrounding environment. At the same time, focusing exclusively on the consequences is the main subject of further current development of the safety system. Most of the active joint actions of various states are aimed at replacing and improving systems for monitoring and detecting the impact on the environment. In other words, exclusively for the elimination of those negative environmental phenomena that are already taking place. And as a result, the intervention takes place only when a negative impact on the ecology has already been caused, and no preventive measures are taken at the same time [6].

Among the main shortcomings of the existing implemented system of environmental bias, the ignoring of the potential negative impact of production and technical products and consumer goods is also mentioned. These objects of economic relations are massive, actively consumed, turning into waste, which in turn actively affects the environment. Within the scope of study [1], it is even proposed to introduce an assessment of the impact of production results as an additional criterion for the safety of production technologies. That is, how the technology affects the environment and products produced.

Also, you can often find studies, as a result of which it is established that the existing environmental, industrial, and technogenic safety restrictions are the factors that nullify the entire economic effect of the use of technologies. The question of proportionality of state-imposed safety restrictions, potential environmental damage, and possible economic impact is what backfires in many countries. When entrepreneurs refuse to carry out economic activities and stop their business processes in general [5].

Very often, one of the main reasons for the low efficiency of the technology safety system is the lack of a uniform approach to its identification within individual economic systems. In some countries, technology is called the result of scientific or research work, and in others it is identified as a composite (synthetic) object. intellectual property rights [3]. At the same time, as a result of separate scientific studies, this issue is considered as the main prerequisite for all other possible actions by all countries of the world. First of all, they draw attention to the fact that the regulatory consolidation of technology as an object of intellectual property law allows only the protection of property and personal non-property

rights. Such legal protection does not contain any regulatory restrictions regarding the impact on the environment [8].

All the existing shortcomings of the safety of the means of production are especially aggravated when it comes to the transfer of technologies. The existing model of environmental protection is focused exclusively on one form of existence of technology. This form is its material embodiment in the form of equipment, machines, and mechanisms [9]. All other forms of implementation of technologies do not fall under any of the existing safety restrictions, which allows one to ignore their potential impact on the environment.

However, most of the identified shortcomings of the existing system for determining the safety of technologies can be overcome by applying appropriate regulatory measures. Namely, by implementing the relevant prohibitions and restrictions to the international and national legal regulation of technology transfer. These restrictions should take the form of regulatory prohibitions.

The use of regulatory restrictions, unlike other methods of regulatory influence, will ensure their strict compliance by all participants in technology transfer. If, for example, normative prohibitions are replaced by such a means of influence as a recommendation or an autonomous decision of the parties to the relationship, then they will not be able to ensure the appropriate degree of their compliance. When using the regulatory approach, the final decision whether to comply with regulatory restrictions will depend on the will and desire of the participants in technology transfer. And when using the method of autonomous decisions, the parties to the transfer of technology will be guided by commercial interests, and not by the requirements of public environmental safety. At the same time, the use of prohibitions as a way of identifying the appropriate behavior of technology transfer participants ensures an effective level of their compliance. This is due to the fact that it lays down the only permissible option of behavior that will not depend on the will of the parties or on other factors.

Another positive manifestation of the possibility of using bans as a means of ensuring the safety requirements of technologies is that they allow ensuring the universality of regulatory influence. Prohibitions introduced into regulatory systems make it possible to establish equal conditions for all without excluding types and types of technologies. They can cover all existing forms of transfer, thereby ensuring a high level of coverage of technology transfer relations. At the same time, the use of the existing method of limiting the impact of technologies on the environment, based on the minimization of existing environmental damage, does not make it possible to achieve such results.

In addition, the use of a regulatory construction of determining the safety of technologies, which is based on prohibitions, creates prerequisites for fixing such a level of restrictions, which will be based on taking into account both the private interests of business and the public interests of society. Consideration of private business interests and public interests of the state must be taken into account when identifying the safety of technologies [2, 4, 9]. And their neglect is guaranteed to lead to negative economic consequences for entire sectors of the economy [3].

The definition of the legal construction of technology safety should be based on:

- environmental prohibitions;
- industrial safety restrictions;
- man-made restrictions.

The identification of just such a circle of social relations, which should fall under the regulatory influence of the safety of technologies, corresponds to the main directions of minimizing the harmful impact on the environment that already exist for the means of production. The use of usual approaches to determining the essence of new regulatory constructions will make it possible to ensure their faster adaptation in law enforcement practice. Faster adaptation compared to other normative constructions of prohibitions and restrictions.

The main drawback of the existing system of safety environmental, industrial, and man-made restrictions is that they are formed exclusively upon the fact of detecting certain changes in the surrounding environment. They are a reaction to the changes that have already occurred in the atmospheric air, flora, and fauna [6]. At the same time, the main activity of nature protection institutions around the world is mostly aimed not at the formation of preventive measures but at the operative reaction to those changes that are already taking place. This approach is impractical, as it does not provide any leverage on how to prevent the occurrence of large-scale potentially threatening situations. And the greatest potential threat of this is contained in the technologies themselves. Because they are able to change the prevailing method of production and the level of impact on the environment. It is because of this that, within the framework of the regulatory regulation of technology transfer, generalized regulatory restrictions must be formed, which will be mandatory for all participants in technology transfer.

It is also considered appropriate to propose the content of those normative structures that can be laid as a basis for acts of prospective legislation at the international and national levels. The specified regulatory restrictions should be as follows:

- no technology should lead to irreparable (irreversible) changes in the surrounding environment;
- no technology should have the ability to cause harm to the life and health of its operator under the conditions of its proper use or operation;
- no technology should carry the risk of uncontrollably causing mass destruction, provided it is properly used (exploited).

The main advantages of the proposed regulatory measures for determining the safety of technology transfer are their universality, the possibility of spreading to an unspecified circle of persons and any types of technology transfer. The main disadvantages are that these designs are not based on clear criteria or objective factors but are based on evaluative concepts. Such an evaluative concept, in the course of applying the normative limitation of technology safety, should be interpreted additionally. At the same time, the use of evaluative concepts when identifying prohibitions to determine the safety of technology is not only a negative factor. On the other hand, such a regulatory approach allows the application of already existing normative and regulatory restrictions on the safety of the means of production to the field of technology transfer.

The effectiveness of any restrictions based on prohibitions directly depends on the regulatory document in which they are specified. It is appropriate to agree with the conclusion that technology safety should be identified at two main levels of regulatory acts [9]. Namely, at the level of major international agreements that determine the status and conditions of technology transfer, as well as at the level of acts of national legislation of individual countries. A systematic analysis of the main international documents allows us to

determine that the issue of the safety of technology transfer has not been settled by them.

If we evaluate the existing legal mechanisms for ensuring the transfer of technologies, as a system of objects of intellectual property rights, we can see that the issue of safety has not been resolved here at all. And this is defined as one of the main shortcomings of the existing legal regulation of technology transfer [4]. Thus, the Agreement on Trade Aspects of Intellectual Property Rights, which was adopted in 1994, within the framework of the Uruguay Round of the General Agreement on Tariffs and Trade of the World Trade Organization (“TRIPS” Agreement), resolves the fundamental issues of the exchange of rights to intellectual objects [10x]. This international document does not provide for any security restrictions during the transfer of rights to intellectual objects included in the technology. Only issues of preserving and protecting the rights of technology developers are resolved. At the same time, the “TRIPS” agreement is an effective international document that already provides for mechanisms for the implementation of those restrictions established by it. Thus, this agreement establishes the procedure for import and export control of any goods, for compliance with certain indicators of intellectual “purity”. The legal mechanisms of the TRIPS agreement are convenient for their use within the framework of technology transfer. With these procedures, the process of assessing the safety of technologies during their international transfer can be fully ensured. It is because of this that the mentioned international agreement should be used as a tool for prospective regulation of technology safety. The absence of any ban on the transfer of technologies that are dangerous in this agreement leads to the fact that the participants of the World Trade Organization do not solve this issue within the limits of their national legislation. And the participants of the transfer of technologies may not limit themselves to the observance of social and public interests of environmental, industrial, and man-made safety.

Within the framework program of the European Union “Horizon Europe”, the technology safety category is also not used [11]. However, the safety of technology, which is a type of innovation, is actively mentioned there. In general, the framework program “Horizon Europe” does not contain a generalized definition of the safety of technology transfer. However, it refers to a large number of already approved restrictions on ecological industrial and man-made safety related to means of production. All legal mechanisms of this normative document are focused on ensuring the functioning of the system of minimizing the effects of harmful effects on the environment by means of production. The issue of determining the degree of safety of technologies at the stage of their development and/or transfer is also not settled here. Ignoring technology safety criteria at the level of this international document leads to the fact that all European countries do not introduce any prohibitions and restrictions on technology safety into their legal systems. The norms of the framework program of the European Union “Horizon Europe” are norms of direct effect. They directly regulate social relations related to the creation, transfer of rights and implementation of technologies. The absence of regulatory prohibitions on the transfer of dangerous technologies allows its participants to ignore public safety aspects of the implementation of technologies. This regulatory approach does not meet public needs and does not protect the environment, life, and health of people. Guided by this normative document, the participants in the transfer of technologies contin-

ue to transfer them without taking into account the need for their safety for the surrounding environment.

Within the framework of the Organization for Economic Cooperation and Development, since 1992, there have been processes of systematization of information about innovations, technologies, and their components. Since 1997, the European Statistical Bureau (Eurostat) has joined this process. The result of this work is the formation of methodological recommendations under the name “Oslo Guidelines”. This document is a fundamental methodical collection of recommendations on determining the status of innovations and technologies, as well as the conditions of their circulation [12]. Within this document, many key elements of prospective regulatory regulation of technology transfer are defined. However, the issue of safety of innovations and technologies, explained or shaped in any way. The Oslo guidelines are the clarification that all the world’s leading cranes are guided by when formulating their prospective legislation. The high level of its authority requires fixing in it all without excluding the key moments of technology transfer. Including the safety criteria of technology, which are relevant for all the countries of the world without exception.

In general, a systematic analysis of the cited international acts, recommendations and clarifications makes it possible to establish that they do not determine safety criteria for innovations or technologies. However, their content contains provisions of a blanket nature, referring to certain safety standards that have already been developed, adopted, and are functioning within many countries. However, these safety standards do not apply to the technology itself or its transfer. They are only focused on minimizing the environmental damage that has already been caused to the environment. That is, they do not contain any prohibitions aimed at preventing possible negative environmental, industrial, technogenic consequences of technology transfer.

The level of national legal regulation of technology transfer is generally characterized by the same gaps in legal regulation as international treaties and agreements. A classic example of this is the Law of Ukraine “On State Regulation of Activities in the Field of Technology Transfer” [13]. This regulatory document provides for the definition of technology as a special object of social and economic relations. It means: the result of scientific and technical activity, a set of systematized scientific knowledge, technical, organizational, and other decisions about the list, term, order and sequence of operations, the process of production and/or sale and storage of products, provision of services. In this regulatory document of the national level, no special requirements for the safety of technologies are defined. However, it is stated that such requirements must be met if the technology claims to receive state support. At the same time, the fundamental requirements for controlling the impact of technologies on the environment are contained in another regulatory document. Thus, within the framework of the Law of Ukraine “On Atmospheric Air Protection”, basic forms of control over the level of harmfulness of implemented technologies are defined [14]. However, the general regulatory approach is the same as within international documents. That is, control and restrictive regulatory measures are taken only when a negative impact on the environment is recorded within the limits of state supervision and control.

The approach to reacting to already detected changes in the surrounding environment should be identified as the main drawback of the existing technology safety identification system. This shortcoming should be eliminated by changing the regulatory approach. For this purpose, it is ex-

pedient to make changes to the existing regulatory regimes and to establish in them the universal normative structures formed in the course of our seminal study.

In general, a regulatory model of technology safety presented, taking into account the scheme shown in Fig. 1, should be aimed at introducing restrictions that will apply to the “future”. That is, until the technology causes damage to the environment. This is its main advantage. It is not aimed at implementing some kind of reaction to the ecological, industrial, or man-made damage that is already taking place. On the contrary, all the regulatory restrictions included in it should apply until the moment such damage can be caused. For this, such prohibitions should be applied as mandatory conditions for the creation or transfer of technologies. The main advantages of the proposed regulatory measures for determining the safety of technology transfer are their universality, the possibility of spreading to an unspecified circle of persons and any types of technology transfer. Also, the advantages include the fact that these measures will prevent the creation and transfer of technologies that can cause a negative impact on the environment, human life, and health, and pose man-made threats. The implementation of such regulatory measures will enable the use of ecological, industrial, and man-made monitoring and control systems not after the fact of causing damage, but much earlier.

The essence of the regulatory mechanisms of the specified international treaties and agreements is such that they impose on the participating states a direct obligation to bring the norms of national legislation into line with their provisions. This will mean that prohibitions and restrictions on the safety of technology transfer will be gradually introduced into the legislation of most countries. This effect is a significant advantage compared to others.

However, within the limits of the specified international treaties and agreements, it is expedient to record not only the generalized regulatory model of technology safety formed in the course of our breakthrough study but also to provide the relevant prerequisites for it. The main prerequisite for the improvement of the existing means of determining the safety of technologies is the harmonization of approaches to the definition of technology in the regulatory acts of the World Trade Organization, the European Union, and the Organization for International Cooperation and Development. Without it, all the requirements of safety of technologies will have low effectiveness, as they will be leveled by the essence of acts of national legislation.

The introduction of the formed model of technology safety into the normative acts of national legislation is the final stage of solving the issue of technology safety. The essence of this process is the introduction of technology safety requirements to the content of the regulatory acts of an individual country. At the same time, such introduction should take place at the level of those normative acts, the implementation of which is controlled by the relevant state authorities. Those bodies of state power, which are endowed with imperative powers and are able to ensure the implementation of these normative prescriptions, by force of coercion.

The proposed directions for improving the requirements for the safety of technology transfer are aimed at increasing its effectiveness. They are our vision of the direction of development of this issue. When forming them, the circumstances that are discussed in scientific circles were taken into account. In general, the identified directions are suitable both for use within the definition of the official rules of their activity and for its further scientific development.

The main advantage of this study is that its results can be used within the framework of the normative technique of forming prescriptions of acts of international legislation or acts of national legislation. Further development of this research will allow obtaining results of practical orientation. On its basis, drafts of international documents can be formed. The study is aimed only at improving the existing approach to determining the safety of technology transfer. It is not excluded that in the case of formation on its basis of the process of changing their status, the proposed concept will require some refinement. However, in any case, all previous scientific studies [1–8] either did not formulate such proposals or investigated separate aspects of this issue. Thus, various options for increasing the level of certain elements of the safety of technology transfer were proposed. However, all these results have no signs of universality and are not able to influence all participants of technology transfer. At the same time, the results of this scientific study contain conclusions that can become the basis for the formation of official regulatory rules, which is their advantage over similar studies.

Our unique scientific results solve most of the actual problems that exist when determining the safety of technologies. The main advantage is that they are aimed at preventing a potential negative impact on the environment and are not related to the application of response measures to the damage that has already occurred. The use of the established normative structures can organically fit into the existing systems of state regulation, supervision, and control over the safety of technologies. They are able to influence all technologies of various industry orientations and do not provide for obvious exceptions. Formed proposals offer more effective mechanisms for solving existing problems with the impact of their products on the environment than was proposed in paper [1]. Also, the research results solve the problems formed within works [2, 3], while their authors only outlined the main regularities of the existing state. Within the framework of our study, conclusions were formed that offer a solution to the issues identified in work [4], at a time when its author only states the need for such improvement. This further emphasizes the value of results of our revolutionary scientific study.

The main drawback of the study is the lack of objectively systematized information about the use of methods and techniques for determining the safety of technologies by participants in their transfer. Regional features of technology identification have a significant negative impact on the research of this issue. The diversity of such approaches determined the significant level of generalization of conclusions and research results. This shortcoming of the study must be taken into account in the case of further study of the outlined issues. It must be taken into account during the practical use of the results of scientific research since new normative recommendations that may be formed must be based on the interpretation of the content and concept of technology, previously recorded in such a legal system. Especially in the case when, on its basis, research will be conducted on the peculiarities of the means of protection of violated rights within the boundaries of individual countries.

7. Conclusions

1. It was determined that the modern system of means of minimizing the negative impact of the means of production on the environment is a complex system of state prohibitions and

restrictions. The existing safety system is focused exclusively on material forms of technology implementation (equipment, machines, and mechanisms). It includes such means as:

- determination of the maximum permissible values of the influence of the means of production on the environment;
- implementation of current state supervision and control over compliance with the maximum permissible values of impact on the environment;
- provision of a system of constant monitoring of the surrounding environment is not subject to its compliance with environmental safety standards;
- formation of individual instructions (recommendations) regarding the industrial improvement of certain equipment, machines, and mechanisms that have an impact on the environment;
- decommissioning those means of production that are guaranteed not to meet the established requirements of environmental safety.

2. The existing system of technology safety means is imperfect and does not meet economic and social challenges. The main drawback is that it is aimed at minimizing only those negative consequences that have been identified. The next shortcoming of the existing system is the ignoring of the negative impact of the results of the production process, namely products of industrial and technical purpose and consumer goods. A significant drawback is the disproportionality of the established restrictive measures and the available economic opportunities for their implementation. An essential prerequisite for the low effectiveness of the means of ensuring the safety of technologies is the different definition of the legal nature within the national legal systems. And also the fact that the existing legal consolidation of the technology allows only to protect the property and personal non-property rights of its developer and does not contain prerequisites for limiting its impact on the environment.

3. All identified shortcomings of means of identifying the safety of technologies are solved by implementing into the international and national legal regulation of their transfer normative prohibitions on the transfer of those technologies that do not meet safety requirements.

The process of forming a generalized model of technology safety should be based on the following elements:

- environmental prohibitions and restrictions on the impact on the environment;
- prohibitions and restrictions of industrial safety, regarding the ability to cause harm to the worker (operator) of the technology;
- man-made prohibitions and restrictions regarding the threat of mass destruction and mass damage.

The regulatory structure of the generalized technology safety model must contain the following regulatory structures:

- no technology should lead to irreparable (irreversible) changes in the surrounding environment;
- no technology should have the ability to cause harm to the life and health of its operator under the conditions of its proper use or operation;
- no technology should carry the risk of uncontrollably causing mass destruction, provided it is properly used (exploited).

Registration of the formed technology safety model is expedient at the level of the following international treaties and agreements:

- agreements on trade aspects of intellectual property rights (“TRIPS” agreement), adopted within the framework

of the Uruguay Round of the General Agreement on Tariffs and Trade of the World Trade Organization;

– methodological recommendations “Oslo Guide”, which are developed on an ongoing basis by the Organization for Economic Cooperation and Development and the European Statistical Bureau;

– the framework program of the European Union “Horizon Europe”.

The introduction of the technology safety model into the normative acts of the national legislation is the final stage of the process of improving the legal regulation of this issue. It is advisable to carry out such an introduction in two main functional areas:

– introduction as mandatory conditions for the introduction of technologies into the circulation of requirements for environmental, industrial, technogenic safety of technologies;

– establishing, at the level of the legal systems of individual countries, restrictions on the transfer of technologies that do not meet the requirements of their safety.

It was established that the outlined ways of solving the tasks meet the main current requirements of the economy

and society. They prevail over similar results, as they form mechanisms to prevent not only the already detected impact on the environment but also prospective threats.

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 and the results reported in this paper.

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Data availability

All data are available in the main text of the manuscript.

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