

*The object of this study is to determine the economic effect of technology transfer during the period of its viability. This paper suggests a methodology that takes into account the appropriate amount of profit and the accumulated amount of royalties in the commercial use of innovative technology. The necessity of taking into account the viability of the transfer of innovative technology as the beginning of its new life cycle was substantiated. The possibility of formalizing this process in the form of an assessment of the sum of the present values of all projected cash flows, taking into account the eligibility criterion and the barrier rate, has been established. We propose an approach, which, unlike the existing ones, consists in allocating a certain period of viability of innovative technology transfer in the life cycle of technology. It is argued that based on the results of technology renovation, it is possible to assess the economic effect of its transfer due to the benefits of implementation and achievement of licensing activity by expanding the number of licensees. We substantiate the possibility of generating profits and royalties to the licensor as the amount of investment that can and should be directed to the development of a fundamentally new or improved technology in relation to the previous one. The transition to a new technology causes an increase in the overall technological level and leads to the formation of a technological gap between the S-shaped life curves of technical systems and, in parallel, forms a new S-shaped curve of a new technological system based on new knowledge. An economic and legal approach to the development of a methodology for determining the economic effect or viability of innovative-level TT was implemented. The results of the current study could be used in the formation of legislative and subordinate national regulations, as well as serve as a basis for further research on this issue*

**Keywords:** commercial technology transfer, viability, licensing activity, transfer effect, technology gap

# DEVISING AN ECONOMIC-LEGAL APPROACH TO THE VIABILITY OF INNOVATIVE TECHNOLOGY TRANSFER IN THE PROCESS OF ITS COMMERCIALIZATION

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## 1. Introduction

The field of technology transfer (TT) is constantly in the view of scientists as it is directly related to innovative activities. Scientific research into TT is connected with the process of dissemination of scientific and technical knowledge in the form of transfer of new technologies, technological systems, technical and technological equipment, know-how, and legal regulation. The search in this area is also important in that it is connected with the need to carry out calculations to assess the economic efficiency of the commercial transfer, to achieve the level of effectiveness and stimulation of patent activity on this basis.

Practice shows the tendency of a gap between the creation of the latest technology and its introduction into industry. Namely, the technological gap between S-shaped curves (old technological trajectory) and the formation of new S-shaped

curves (new technological trajectory) but based on new knowledge. It is important here to take into account the peculiarities of the development of the TT domain in terms of innovative activity towards designing TT tools, creating a network of transfer agencies, and commercialization, through joining international agreements taking into account the observance of national interests. Due to the weak interaction of science and business, TT has not yet found its proper development, therefore, promising scientific developments are often not commercialized, as a result of which the opportunity to use the strategy of building innovative potential is lost. That is why the study of commercial TT under the conditions of innovative activity becomes important.

According to the Law of Ukraine "On State Regulation of Activities in the Field of Technology Transfer" [1] TT is, first of all, the transfer of technology. Secondly, the latter is formalized by concluding a bilateral or multilateral

agreement. Thirdly, this contract establishes, changes, or terminates property rights and obligations regarding the technology and/or its components. And finally, fourthly, individuals and/or legal entities can be the subjects of contractual transfer relations.

In the forecast period, the implementation of TT should be considered as a possible increase in the scale and acceleration of the pace of innovative activity of business entities. In the future, the results of research on scientific issues related to TT can be implemented in the practice of enterprises, the object of which can be scientific and scientific-applied results, objects of intellectual property rights (in particular, inventions, useful models, works of scientific, of a technical nature, computer programs, commercial secrets), know-how, which reflects the list, terms, order and sequence of operations, the process of production and/or sale and storage of products, provision of services.

This will contribute to technological modernization and the emergence of a new technical and technological direction, taking into account previously accumulated experience. In addition, TT has a positive effect on the creation of conditions for the activation of scientific and technical activities of the developer or owner of the technology. That is, the relevance of scientific research on this topic is currently definitely important not only for the modern and post-war recovery of the state's economy but also in the legal aspects of the European integration of Ukraine.

Legal aspects of European integration are issues related to the implementation, adaptation, and harmonization of Ukrainian legislation to EU law, including in the field of TT. At the end of 2023, the second year of the full-scale Russian war, a historic event took place – the European Council agreed to start negotiations on Ukraine's accession to the EU. This process involves a set of systemic reforms, some of which have already begun, and one of the key ones is legal European integration.

As for the role of TT in the post-war recovery of the state economy, the construction of an innovation-type economy is impossible without the active use of research and innovation potential, as well as an effective mechanism for ensuring interaction between the stages of the innovation process, in particular, between the stages of creating scientific knowledge and implementing it into practical activity. In this regard, the establishment of an effective mechanism for the transfer of objects of intellectual property rights into practical activity, i.e., technology transfer, is of particular importance.

Currently, there is a statement under which object of commercialization of TT are the results of scientific research works, which are formalized in the form of rights to objects of intellectual property (IP). But the most representative among scientists is the position in which preference is given to the role of the object of technology, that is, knowledge in various forms. It seems that such a view blurs the prospects of the final effect of TT, its targeted focus on the birth of innovative technology, based on the accumulation of innovative knowledge and experience.

In addition, it should be taken into account that the above-mentioned law establishes a function for the state to implement measures to support TT as a priority area of innovative activity in accordance with Art. 6 of the Law of Ukraine "On Priority Areas of Innovative Activity in Ukraine" [2].

All this testifies to the relevance of our research:

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## 2. Literature review and problem statement

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First of all, investigating the tasks of technology formation from the standpoint of TT innovation is the focus of a number of papers by well-known scientists in this field. In their works, the essence and significance of the process of technology formation, the impact of research and innovative development on TT, the mechanism of TT, development trends and assessment of the effectiveness of transfer regulation and the level of effectiveness of patent activity are revealed.

In particular, the understanding of the process of commercialization of technologies in university spin-offs is investigated [3]. But the authors, focusing mainly on the involvement of students and the impact of the university ecosystem as a whole, considered the issue of commercialization policy, due to the chosen research subject, in a superficial format.

The issues of commercialization of technologies remain insufficiently considered by the authors of paper [4], mentioning only that TT is also carried out through scientific works, educational and government initiatives at the international, national, and regional levels.

Investigating a specific subject of TT, namely the international transfer of low-carbon technologies, the authors of [5] drew some interesting empirical conclusions based on a case study. However, their main emphasis was on the priorities of Chinese, not foreign actors in cooperation and the purpose of the TT, which best corresponds to domestic political and economic interests.

TT has been extensively reviewed by other researchers who noted in two publications that this process encompasses a variety of activities that contribute to the implementation of academic findings in the public sector. The authors first analyzed the steps in obtaining IP rights [6], and then focused on the commercialization processes, including the office with TT, project development for the purpose of commercialization and licensing through the creation of startup companies or directly to industry [7]. However, the issue of the economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization was not within the scope of the study.

The authors of [8] drew attention to significant differences in the scope of activities of commercialization institutions. In their paper, after examining individual top-performing institutions, they suggested improvements that universities and TT offices could implement to emulate the environments of these high-performing institutions. However, these proposals did not reflect the viability of TT, which has an innovative nature.

Paper [9] is quite interesting; the authors reported the results of a bibliometric analysis on TT issues and investigated the main elements and specific aspects that make up this process. In particular, they identified key approaches to TT and its elements (agents, technologies, mechanisms, policies, barriers, supporters, models, as well as effects and consequences). But the researchers found only certain characteristics of subjects and objects of TT. They also cited the characteristics of TT channels and the conditions of the demand environment for their management but left out the question of the viability of TT.

Other researchers believe that the circular economy is necessary to update outdated business practices and create new business sectors. In their opinion, such transformations

should be based on the transition from a linear paradigm of production and consumption to a non-linear one based on innovative methods of reuse of intermediate and final products [10]. However, the proposed idea does not take into account the renovation of the original object itself.

The purpose of another study was to determine the essence, place, and role of guarantees of TT participants in the general system of measures to support innovative activities and to formulate proposals for their improvement. In particular, the relative effectiveness of the existing system of guarantees for TT participants was determined, which is determined by a number of objective circumstances [11]. Instead, the question of the relationship between such TT subjects as the licensor and the licensee was left out of the authors' attention.

A critical review of the literature [3–11] reveals that the economic and legal approach and methods of assessing the effectiveness of the commercial transfer of innovative technologies, taking into account their types and features, the connection with the general life cycle, are not yet sufficiently researched.

Moreover, in practice, the perception of the consequences of the introduction of the technology and/or its components after the transfer is accompanied by a number of problematic aspects regarding obtaining the effect in the future. As a rule, this situation is caused by the lack of sufficient information from market counterparties about the purpose of TT, its economic effect, payback period, the term of use of the transferred technology, its further technical support, etc.

Such an approach predetermines the setting of an important task regarding the determination of the position relative to the economic and legal approach of changing the effect or effectiveness of the implemented commercialization of TT for counterparties of the profile market and steps in time during further investment in the system of the life cycle of the technology.

On the other hand, there is an equally urgent need to study the viability of TT. The latter should be considered as an opportunity in the forecast period to accumulate profits and royalties for investment in renovation or development of new technology in the future based on new innovative knowledge and experience.

Therefore, it is currently obvious that scientists do not pay enough attention to methodological issues of the viability of TT of an innovative level in the process of their commercialization. The reason for this is probably the objective difficulties associated with the need to take into account the set of economic and legal factors that condition and accompany this process.

So, this allows us to state that at the current stage they remain undiscovered, and therefore appropriate for conducting research into the issues of life cycle of technologies depending on their specificity, features, assessment of the effectiveness of TT. Before us, scientists considered this field from different points of view, covering different periods of technology development and its life cycle.

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### 3. The aim and objectives of the study

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The purpose of our research is to devise an economic and legal approach to the viability of TT of an innovative level and to determine the economic effect, which characterizes the possibility in the forecasted period (time) of the licen-

sor's accumulation of profit and royalties for investment in renewal (modernization) or development of new technology.

To achieve the goal, the following tasks were set:

- to establish the grounds and form a methodology for calculating the economic effect of TT;
- to reveal the economic and legal features regarding the viability of the transfer of innovative technology;
- to justify the main factors of viability of TT;
- to identify a set of subjective and objective signs of the period of obtaining part of the profit using the implemented innovative technology;
- to define the content of the legal institute of TT.

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### 4. The study materials and methods

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The object of our study is the formation of an economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization.

The main hypothesis of the research assumes that in order to determine the economic effect of TT, the organizational and economic mechanism of TT, assessment of effectiveness and potential of TT from the standpoint of forming an economic and legal approach to the viability of TT for a certain period is investigated. This opens up the opportunity to formalize this process in the form of an assessment of the sum of the present values of all projected cash flows (parts of profit and royalties).

When conducting this study, it was assumed that under the modern conditions of innovation and investment policy of the state, it is difficult to obtain the economic effect that is foreseen in the process of technological modernization of the economic entity.

The methodological basis of the research was made up of general and special methods of scientific research. In particular, we use methods of comparative analysis, structural, abstract-logical generalization, analytical, forecasting, economic-legal analysis, and empirical.

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### 5. Results of research into the development of a methodology of the viability of the transfer of innovative technology in the process of its commercialization

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#### 5.1. Establishment of grounds and formation of the methodology for calculating the economic effect of TT

TT issues are most often considered from the angle of commercialization of the results of research and development (research and development, hereinafter – R&D), as the basis of innovative technology [4, 12, 13].

At the same time, it should be taken into account that commercial transfer (commercialization of technologies) involves the process of sale by the creator or inventor on contractual terms of the results of scientific, technical, and innovative activities in the form of objects of IP rights. Technical and technological implementation of these objects in production makes it possible to obtain a significant economic effect (profit, income) and cover (recoup) all investment costs. Therefore, the use of the term “commercialization” implies a commercial aspect and reflects the market relevance of innovative technology.

As a rule, the economic effect is understood as its basis and forms, that is, the useful result of economic activity and profit from it. Scientists consider the effect of commercialization of TT from different points of view, covering different periods of technology development and its life cycle, which

requires appropriate assessment and justification of decision-making on viability.

In terms of the chosen direction of research, the comprehensive approach presented by the authors of [14] deserves attention, according to which the useful result or economic effect of TT is proposed to be considered as part of innovative activity through the organizational and economic mechanism of TT. In it, activity processes are connected to each other, creating such a chain:

a) the purpose is to transfer know-how, new technologies, technological equipment, and scientific and technical knowledge from the owner to the customer;

b) process – selection, assessment, and implementation of technology promotion;

c) the result is the promotion of the technology to the specialized market. The stages of essential importance for understanding the innovation process are:

– selection and preliminary assessment of technology;

– assessment of the selected technology;

– conducting research to identify the calculation of the assessment of the development potential as an object of commercialization and promotion of ready-to-use technology on the specialized market;

– cooperation with technology consumers.

It can be seen that the specified sequence of the organizational and economic mechanism of TT has a significant economic meaning for determining the basis of the economic effect of TT. It is about the costs (investments) for each stage and establishing the total costs (investments) or the cost of the developed innovative technology, which is offered for transfer in the specialized market. At the same time, it should be emphasized that this process should also be accompanied by the establishment of appropriate forms:

a) expected income (profit) as agreed by the contracting parties of the contract on property rights and obligations regarding the transferred technology and/or its components;

b) the appropriate sales (commercialization) price, the size of which affects the return on costs (involved investments in innovative technology, investment project). Such a statement does not contradict the Recommendation on the application of Art. 81 of the EU Treaty on technology transfer agreements [15].

The practice of managing the commercialization of TT considers the assessment of the effectiveness of technology transfer in three directions [16]:

1) assessment of the predictive (expected) effectiveness of TT at the stage of selection of developments for implementation or licensing;

2) monitoring the effectiveness of TT projects at individual stages of their implementation;

3) evaluation of the effectiveness of TT projects at the time of their completion, which characterizes the degree of achievement of the set goal, and also includes an analysis of the expected impact of TT results on the overall efficiency of the enterprise's functioning.

Instead, according to the author's vision, the evaluation of the effectiveness of TT should, first of all, be considered from the standpoint of the economic risk for the operation of the enterprise – the owner of the technology, and then the result of the impact of TT on the overall efficiency of the operation of the enterprise should be evaluated. Such caution is supported by the proposal to obtain a reliable quantitative assessment of the effectiveness of TT.

For this purpose, paper [16] describes the practice and experience of the TT Center at the Kyiv National University of Trade and Economics (CTT KNTEU), summarizing and proposing the following indicators:

1. The level of patent activity (activity) at the university is defined as the ratio of the number of (active) patents to those employed in the field of scientific research and development.

2. Patent efficiency is defined as the ratio of the issuance of the number of protective documents to R&D costs (the number of patents, for example, per 1 million UAH of costs).

3. Licensing activity is defined as the number of licenses issued by the enterprise (license agreements concluded) per year.

4. The efficiency of the transfer of one's own developments – the ratio of the total income from the sale and licensing of one's own developments (advance payments, lump-sum payments, and royalties) to R&D expenses.

5. The efficiency of CTT activity is the ratio of the total income received from the sale and licensing of its developments, revenues for the services provided, to the costs of its creation and maintenance.

6. The share of revenue from activities related to IP rights in the total income of the enterprise.

Of the given quantitative evaluation indicators, the last three take into account the total income received from the sale and licensing of developments, as a result of commercial TT. Such a quantitative assessment of the effectiveness of TT is based on the previously acquired economic-legal and technical-technological achievements (the number of active patents, R&D expenses, the number of concluded license agreements). This is carried out at the time of completion of TT and is the expected primary effect (lump sum payments and royalties) and efficiency (efficiency of the TT activity), with which the total payback of the involved investments is associated for a certain period or time.

The effectiveness of TT is considered as an assessment of spent resources, which includes the use of all types of intellectual resources to achieve the set goals. The TT management function and its effectiveness become meaningful [17].

However, it can be seen that there is caution when diagnosing innovative developments on TT. This position is based on the fact that the majority of objects of patent law protected by protective documents are not used in production and end their life immediately after development and obtaining legal protection. It was previously established that the dominant position of copyright protection for certain IP objects does not always correspond to the rights and interests of their authors. The latter are increasingly advocating the introduction of alternative, patent-legal protection of them by special legislation, rather than by the principle of precedent law [18].

It was established that the economic effect of TT is based on integration, determination of its basis and methods of calculating the economic effect of the viability of the transfer of innovative technology. The first are objectified in the form of costs (investments) for each stage and the establishment of total investments or the cost of the developed innovative technology offered for transfer on the market. The second should take into account the set of components that determine the technological gap between the end of the old technological period and the beginning of the formation of a new technological period. At the same time, the forms of the economic effect of TT are the obtaining of the final result by the owner of the innovative technology in the form of part of the profit and royalties accumulated by the licensee during its commercial transfer.

## 5. 2. Revealing the economic and legal features regarding the viability of the transfer of innovative technology

Investment legislation in Resolution No. 571 of the Cabinet of Ministers of Ukraine (CMU) dated 22.07.2015 (as amended by Resolution No. 312 of the Cabinet of Ministers of Ukraine dated 07.04.2021) considers the concept of “life cycle of a state investment project”. This is a period of time consisting of successive actions and stages, each of which has its own time limits:

- preparatory;
- investment;
- operational.

Instead, the concept of “viability” in national legislation is used only in relation to intangible cultural heritage (Order of the Ministry of Culture of Ukraine dated 11.12.2017 No. 1319). It is considered as such a state of functioning of its element, which does not contain risks for the continuous transmission of this heritage from generation to generation.

Therefore, the introduction of the term “viability of the transfer of innovative technology” allows us to distinguish a period (time) and its characteristic cause-and-effect relationship, such as:

a) increase in profit as a result of improving the efficiency of the enterprise as a result of the advantages of the implemented technology;

b) accumulation of the appropriate amount of remuneration (royalty) as a result of achieving license activity by expanding the number of TT subjects (licensees). Under such conditions, the appropriate amount of profit and royalty (amount of investment) is formed, which characterizes the effectiveness or effect of TT.

The formation of profit and royalties (amount of investment) allows the licensor to start implementing separate elements of the organizational and economic mechanism for the development of fundamentally new or improved (modified) technologies in relation to the previous technology. This, in turn, obliges the licensor to raise the level of intellectual requirements for technology developers, to scan the innovative potential of TT. Such initial elements include technology selection and preliminary assessment; assessment of the potential of a new development as an object of commercialization in a specialized market; cooperation with consumers of new technology.

Therefore, the achievement of the viability of the transfer of innovative technology is the reference point for the beginning of its new life cycle. The transition to a new technology leads to an increase in the technological level. It is during this period at the general level of genesis that a technological gap between *S*-shaped curves (old technological trajectory) appears and a new *S*-shaped curve (new technological trajectory) begins to form, but on the basis of new technical and technological knowledge.

Therefore, relying on the available economic and legal features that take into account the above established grounds (chapter 5.1), we offer our economic and legal approach to the viability of the transfer of innovative technology. It includes six complexly interconnected consecutive stages of investing in a new (modernized) innovative technology, formalized by a general assessment of the sum of the present values of all projected cash flows over time.

With this approach, each of the stages separately relies on the generalized practice of performing the corresponding set of actions. In particular:

– preparatory stage – completion by the technology owner of the implementation of the organizational and economic mechanism of preparation for TT; the stage includes an assessment of staged costs and total costs for the implementation of innovative technology, which is proposed for transfer in the specialized market;

– the first stage – production of innovative products and marketing of the sales market of manufactured innovative products with the simultaneous search for buyers of innovative technology; the stage includes an assessment of the payback of costs from the introduction of innovative technology and obtaining profit (income) from the sale of innovative products;

– the second stage – commercialization of technology, which involves the process of sale by the licensor on contractual terms to licensees of innovative technology in the form of objects of IP rights and its technical and technological implementation by licensees;

– the third stage – the use of innovative technology and transfer by licensees of the appropriate amount of royalties based on the results of using innovative technology;

– the fourth stage – the development of a new (modernization) innovative technology by the licensor at the expense of using the accumulated amount of part of its profit and received royalties (investments);

– the fifth stage – the implementation of forecast estimates of the sum of the current values of all expected cash flows in accordance with the requirements of the calculation method using the reduction of costs for each year to the current date.

Stages are carried out at the appropriate time (forecast periods), the interval of which depends on certain circumstances and factors related to the achievement of the licensor’s main goal – investing in a new (modernized) innovative technology that corresponds to its projected viability.

Actually, the viability of the transfer of innovative technology has a certain period (time), which is formalized in the form of an assessment of the sum of the current values of all forecasted cash flows (Net Present Value, NPV)  $NPV$  (the criterion of acceptance is the value of  $NPV \geq 0$ ) taking into account the barrier rate (discount rate) according to formula (1) [19]:

$$NPV = PV - I, \quad (1)$$

and when investments are made in several periods (time), then  $I_t$  is found by reducing costs for each year to the current date according to formula (2):

$$I = \sum_{t=0}^n I_{Pt} + \sum_{t=0}^n I_{Rt} = \sum_{t=0}^n \frac{I_t}{(1+r)^t}, \quad (2)$$

where  $I_t$  is the cost of funds (amount of investments) in the  $t$ -th period (in absolute value), which consists of:

$I_{Pt}$  – parts of the amount of profit based on the results of sales of products using the implemented previous technology in the  $t$ -th period (in absolute value);

$I_{Rt}$  – the amount of royalties due to the expansion of the number of TT subjects in the  $t$ -th period (in absolute value);

$n$  – number of periods;

$r$  is the barrier rate (discount rate).

So, in this case, NPV is suggested to be calculated according to formula (3):

$$NPV = \sum_{t=0}^n PV_t = \sum_{t=0}^n \frac{CF_t}{(1+r)^t}, \quad (3)$$

where  $PV_t$  is the current amount of the value of profits and royalties, which is found by reducing the income in the  $t$ -th period (in absolute value) or for each year up to the current date;  $CF_t$  is the inflow of funds in period  $t$ .

Thus, the presented assessment of the sum of the current values of all projected cash flows, taking into account the barrier rate (discount rate), is an integral component of the economic and legal approach to the viability of the transfer of innovative technology. Its task is to promote the development of innovative activities of the licensor and to stimulate technical and technological development.

The latter makes it possible to determine the beginning of a new life cycle of technology for a certain period and its characteristic cause-and-effect relationship. Under such conditions, the appropriate amount of profit and royalty (amount of investment) is formed, which characterizes the effectiveness or effect of TT and allows formalizing this process in the form of a projected assessment of the sum of the current values of all projected cash flows.

### 5.3. Justification of the main factors of viability of technology transfer

The above-mentioned economic and legal features of the economic and legal approach to determining the viability of TT of the innovative level lead to the determination of the grounds of its viability and the justification of the main factors affecting it. These are defined as:

- a) acquisition and protection of rights to technology and/or its components;
- b) obtaining protective documents for objects of IP rights;
- c) receiving payment of the licensor's fee after the implementation of TT. A similar statement follows from the following.

Currently, Ukraine lacks a system of economic incentives (tax, credit, insurance) for the creation and commercialization of objects of industrial property rights, and the system of innovative provision is very poorly developed [20]. In addition, currently undefined and/or not implemented:

- a) minimum remuneration rates to inventors, authors for the use of objects of patent law;
- b) mechanisms of state support for patenting abroad of inventions created at the expense of budget funds;
- c) the method of determining the amount of damage caused by the violation of rights to objects of industrial property [21].

Instability, conflict, and the presence of gaps in national legislation in the field of TT act as relevant legal restrictions accompanying this study. The main reason for this situation, as we see, is the lack of sufficient sources of funding and the underestimation of the development of an innovative intellectual environment, which requires the attention of scientists and government officials in the near future.

Forecasting efficiency is also considered from the point of view of assessing the potential of TT. To assess the potential of TT, three aspects are taken into account:

- 1) transmission mechanisms;
- 2) the terms in which the transfer takes place;
- 3) zones of influence or results [22].

We believe that the assessment of the potential of TT is even more cautionary for an enterprise that intends to develop technologies for further transfer.

It is proposed to consider it from the position stated in [22]:

1) benefits for the recipient company: expenditure of time, money and effort for technology marketing, profit after technology transfer, creation of incentives, effect of stimulating personnel and R&D, assessment of image improvement, etc.;

2) advantages for the client company: the use of merchandising technology, which evaluates the technology from the point of view of customers and subjects who are potential consumers;

3) life cycle of the technology: the technology is protected by a patent, which is valid for a certain time and defines the time frames of a legal nature, which must be combined with the economic ones, which consist in the life cycle of the technology;

4) TT opportunities: IP rights, adaptation to the consumer's environment (the possibility of combining with the company's existing technology);

5) determination of the volume of necessary resources for the transfer: the transfer of technologies, as a rule, takes place with the provision of know-how of a certain level, so that the technologies can be properly used by the buyer.

However, such caution indicates only the initial stage of the company developing innovative technology, in which the risks have not yet been calculated. The definition of the life cycle of technology is considered as a production cycle during which the enterprise can make a profit when applying the technology, that is, a time frame of a legal nature that is combined with an economic one. Other scientists believe that the life cycle of technologies reflects the idealized process of its development in relation to the results of use [13, 14]. It follows an S-shaped curve, from which it is clear that any technology gradually becomes obsolete, and its effectiveness decreases over time; it is a set of stages from the birth of technological innovations to its destruction [13, 19].

The given approaches to determining the economic effect of TT, to one degree or another, are based on obtaining the final result by the owner of the innovative technology in the form of part of the profit and royalties of licensees in the case of commercial TT.

We believe that for the seller or subject of TT, it is important not only to receive part of the profit and royalties of licensees but to a greater extent to generate a certain amount of profit. The latter is the equivalent of accumulating an additional amount of investment to carry out in a certain period renovation or development of a new technology. Based on the initial effect of the implementation of the investment project, the technology developer, in addition to the received part of the profit using the implemented innovative technology, can also receive a reward due to the expansion of the number of TT subjects (licensees). This circumstance should become the business goal of the seller of innovative technology (licensing activity).

From an economic point of view, the period of obtaining a part of the profit from the sale of products using the implemented technology and the corresponding amount of royalties due to the expansion of the number of TT subjects in a certain time should be allocated. We propose to consider it as the viability of the transfer of innovative technology. It is precisely this sign that should be attributed to the completed stage of the life cycle of an innovative technology. At the same time, we note that the expansion of the number of TT subjects of the innovative level in the specialized market (licensing activity) is subsequently limited by the action of the law of supply and demand for products with the loss of the technological perspective of the transferred technology.

#### 5. 4. Identification of a set of subjective and objective signs of the period of use of the implemented innovative technology

The periods of use of the implemented innovative technology are considered by us as legal relations of lawful behavior that have the appropriate composition, that is, a system of signs of behavior that corresponds to the provisions of the law. Such signs are subjective and objective side.

TT subjects are more often business entities for which an important aspect of activity is the accumulation of investments for the needs of updating the existing material and technical base, increasing the scope of activities, innovative development, increasing production efficiency, etc. Here, the assessment of the effectiveness of real investments involves a comparison of the volume of investments and the future cash flows generated by the investments during the forecast period.

Therefore, based on the definition of “commercialization of the results of scientific and technical activity” given in the Law of Ukraine “On Science Parks” [23], it is possible to distinguish the following subjective and objective features:

1) object – objects of IP rights, created in the process of scientific, scientific-technical, and innovative activities;

2) objective side (external form of expression, action) – transformation of objects, useful results (products or services);

3) the subjective side (the internal attitude of the subject of the right to the activity and its results) – making a profit, disposing of property rights of IP for use by other economic entities under the contract, use by other natural or legal entities, use of scientific knowledge in their own economic activity park

The attention of researchers is not always fully focused on these features, although it is their content that depends on the viability of TT, knowledge, experience from a scientific to a business entity – participants in the relevant legal relationship. The level of intellectual, financial, and technological potential, communication, purpose and motivation of the subjects, together with the innovativeness and quality of the transfer objects, play a decisive role in the investment process of a new life cycle of a certain innovative technology.

No less important is the content of other subjective and objective signs characterizing:

1) the level of licensing activity of subjects – licensors;

2) quantitative and qualitative composition of involved subjects – licensees;

3) the level of the economic effect of the transfer;

4) current (life) cycle of the transfer object (viability of the technology);

5) ability of the object to transfer (viability, commerciality of transfer);

6) the object’s ability to be renovated (viability of innovation), etc.

The world experience of the subject composition of TT gives reasons to represent the variability of its relations, as well as the grounds for cooperation in the following form:

1) licensing: subject of technology creation (science, hereinafter – SST)+license+subject of bringing the technology to the market (business, hereinafter – SVTR);

2) spin-off of the company: SST (science)+contract+SVTR (science and business/or business);

3) joint ventures: SST (science and business)+SVTR (science and business);

4) agreements on joint research: FTA (science and business)+agreement+FTA (business).

So, it can be argued that the peculiarity of the period of receiving part of the profit due to the use of the implement-

ed innovative technology and the corresponding amount of remuneration (royalty) is a specific set of subjective and objective features. It is mainly determined by the quality (viability, commerciality, innovativeness) and the number of objects and subjects of transfer-technological relations.

#### 5. 5. Definition of the content of the legal institute of technology transfer

The development of any economic model and/or economic-legal approach, including those related to TT, should definitely have appropriate legal support. Likewise, legal prescriptions regarding the viability of the transfer of innovative technology must be economically justified. Only such a symbiosis will contribute to the efficiency of the economy, and technology transfer legislation will become an effective tool for regulating relevant social relations. Under the conditions of Ukraine’s European integration obligations, this circumstance becomes even more relevant. The latter will only grow when, among other things, TT of an innovative level is aimed at the post-military recovery of the economy.

When implementing it, first of all, it is necessary to comply with the legislative requirements of TT by concluding contracts, defined by the Civil Code of Ukraine, regarding the disposal of IP property rights, taking into account the requirements of Art. 19 of the law on state regulation of activities in the field of TT [1].

That is, the right to self-defense of one’s civil law and the rights of another person against violations and illegal encroachments. The general principles of legal regulation of activity in the field of TT, namely objects, subjects of IP law, the procedure for their interaction and the basic conditions for the transfer of IP rights are also defined by civil legislation.

Secondly, the authorized body for the implementation of state policy in the field of TT carries out, among other things, control over the payment of remuneration to authors at the expense of funds received as a result of TT. This procedure, according to Art. 23 of the aforementioned law, was established by CMU. The latter also determines the minimum remuneration rates for the authors of technologies and persons who carry out their transfer. In a broader aspect, the analysis of the regulatory and legal framework that ensures the regulation of control and supervisory relations in the field of IP was carried out by us in a previous publication [24].

Thirdly, the sum of the value of profits and royalties taken with consideration of deductions in the  $t$ -th period (in absolute value) or for each year up to the current date should be determined in accordance with the procedure established by the Tax Code of Ukraine.

Fourth, the provisions of European innovation and national IP legislation should be taken into account. In particular, the meaning of the term “innovative activity” is disclosed in the Regulation of the European Parliament and the Council (EU) on establishing the rules for participation in the Framework Program for Scientific Research and Innovation “Horizon 2020” [25]. According to the provisions on IP, the right holder has no right to prevent the sale by licensees or buyers of such products that contain the licensed technology. The European principle of exhaustion of rights corresponds to the main function of IP rights, which is to grant the right holder the right not to allow others to use the IP objects of the author without his consent.

We can expand our knowledge in the field of IP, among other things, on the basis of massive open online courses on leading distance learning platforms. In particular, these can be

online courses on the platforms: Coursera, EdX, FutureLearn, SWAYAM, Canvas Network, the e-learning Center of the World Intellectual Property Organization, and others [26].

So, in the legal dimension, the institute of TT law, in terms of investing in a new life cycle of innovative technology, is interdisciplinary in form. In terms of content, it is a set of relatively separate legal norms of several branches of law, which regulate a group of interdependent social relations related to the field of TT. Such branches of law are civil (IP law, industrial property law), economic (investment, innovation, competition, commercial), tax, administrative, scientific, etc.

## 6. Discussion of results of devising an economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization

We have devised a new approach to assessing the viability of the transfer of innovative technology over a certain period of time that takes into account the receipt of part of the profit as a result of its implementation and the corresponding amount of remuneration due to the expansion of the number of TT subjects.

From an economic point of view, such a calculation is or should become the main business goal of the seller of the innovative technology (licensor) and is calculated according to formula (3).

The economic effect involves the accumulation of the amount of profit based on the results of the implementation of innovative products by the licensor using the implemented previous technology in the corresponding periods and the amount of royalties. The latter is achieved by expanding the number of TT subjects in the relevant periods for new innovative activity, which is new and effective for the licensor. In addition, it directs the net profit into investments, as required by the Tax Code of Ukraine.

Special feature of the presented calculation mechanism that we designed for the economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization is that it is based on the sequence of evaluating the sum of the current values of all projected cash flows over time. This approach allows us to determine their current amount in the form of the value of profits and royalties in the  $t$ -th period (in absolute value) for each year, taking into account their receipts in the corresponding periods. These amounts are considered in the form of investments made in several time periods, which are found by bringing the costs for each year to the current date according to the eligibility criterion.

Therefore, the results are significantly different compared to available known achievements by other scientists.

The proposed economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization is significantly different compared to the existing known achievements of scientists. In particular, the approach presented by us is different from:

- TT mechanism and its implementation in the innovation process [14];
- management practices of TT commercialization [16];
- the approach of considering TT as an assessment of spent resources to achieve set goals [21];
- a comprehensive approach to assessing the potential of TT, which is proposed in [22]. Also, the proposed approach

completely covers the caution offered in approaches to evaluating the effectiveness of TT [17], as it only indicates the initial stage of the activity of the enterprise – the developer of innovative technology.

Our results are adequate and can be reproduced to confirm the viability of the implementation of the investment project. According to the latter, the developer, in addition to the received part of the profit as a result of the sale of products using the technology, also receives royalties due to the expansion of the number of licensees. Together, these revenues are considered as a certain amount of investment (the final result in time), which ultimately reveals the essence of the presented economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization.

In addition, in this way, a model approach to the transfer of the cost of transferring a complete intangible system is built [27]. The main factors related to the acquisition and protection of IP rights, as well as receiving the licensor's remuneration, should be considered a real limitation for the viability of TT.

Note that the amount of remuneration to authors of technologies and their components is determined by legislation. Its variability is presented as follows:

- 1) the share of income received as a result of their use;
- 2) a fixed amount per product unit according to its price;
- 3) a fixed amount of part of the income received from the transfer of technologies or their components;
- 4) other benefit that can be obtained from the use of technologies, which is confirmed by relevant documents.

At the same time, it should be noted that the results of the current study cannot be used to evaluate the transfer in which the components of the technological process are used separately. However, these restrictions apply to the renovation of components of the technological process, which only improve its condition.

It should also be noted that the TT law institute may have difficulties of an economic and legal nature on the way to implementing the presented economic and legal approach. They should be connected both with the cross-industry features of establishing the legal status of the object-subject composition of transfer-technological relations, and with the problems of forming a coherent long-term investment project.

## 7. Conclusions

1. It has been established that the economic effect of TT is based on obtaining the final result by the owner of the innovative technology in the form of part of the profit and accumulated royalties of the licensees during the commercial transfer of the technology.

2. An economic and legal approach to the viability of the transfer of innovative technology in the process of its commercialization is proposed. It determines the beginning of a new life cycle of an innovative technology for a certain period and its characteristic cause-and-effect relationship. Under such conditions, the appropriate amount of profit and royalty (amount of investment) is formed, which characterizes the effectiveness or effect of TT and allows formalizing this process in the form of an assessment of the sum of the current values of all projected cash flows over time.

3. It is substantiated that the main factor in the viability of TT is the acquisition and protection of rights to innova-



tive technology, obtaining protective documents for objects of IP rights and payment of remuneration to the licensor after implementation of TT. It was determined that, under these conditions, there is caution in diagnosing innovative developments on TT. This position is based on the fact that the majority of objects of patent law protected by protective documents are not used in production and end their life immediately after development and obtaining legal protection. It was previously established that the dominant position of copyright protection for certain IP objects does not always correspond to the rights and interests of their authors. The latter are in favor of introducing into the legislation the possibility of choosing between precedent-law and patent-law methods of protecting these objects.

4. It is argued that the peculiarity of the period of receiving part of the profit due to the use of the implemented innovative technology and the corresponding amount of remuneration (royalty) is a specific set of subjective and objective features. It is mainly determined by the quality (viability, commerciality, innovativeness) and the number of objects and subjects of technological transfer relations. It is noted that the formation of profits and royalties (volume of investments) allows the licensor (entity) to start implementing separate elements of the organizational and economic mechanism for the development of fundamentally new or improved (modified) technologies in relation to the previous technology. Such initial elements include technology selection and preliminary assessment; assessment of the potential of a new development as an object of commercialization in a specialized market; cooperation with consumers of new technology.

5. It is proposed to consider the interdisciplinary institute of TT law as a set of relatively separate legal norms of several branches of law that regulate a group of interdependent social relations related to the TT field. This is due to the need to ensure not only complex but also systemic legal regulation of the specified relations. A similar response to

their transformation will make it possible to harmonize both existing and newly formed inter-branch links of legal norms.

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#### Conflicts of interest

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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

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

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#### Use of artificial intelligence

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

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