

DEVELOPMENT OF APPROACHES TO THE VALUATION OF INTELLECTUAL PROPERTY OBJECTS INFLUENCED BY INDUSTRY 4.0

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Abstract.

The article analyzes the existing approaches and methods of valuation of intellectual property, identifies the advantages and disadvantages of each approach, improves the classical interpretation of the concept of "life cycle of intellectual property", explains the relationship between stages of the life cycle and the application of certain approaches to assess the value of intellectual property. The obtained results deepen the theoretical and methodological bases of valuation of intellectual property objects, new vision of the graphic image of a continuous life cycle is offered considering the spread of Industry 4.0.

Keywords: valuation, intellectual property, life cycle, Industry 4.0, valuation methods.

Introduction

In recent years, the topic of valuation of intellectual property object (IPO) is becoming increasingly important and is actively included in the scope of production and commercial activities of industrial enterprises, influencing the efficiency of their work. The importance of this topic in the framework of modern economic innovation strategy is difficult to overestimate. Suffice it to mention that the 2018 Nobel Prize in Economics was awarded precisely for the study of the impact of technological innovations on the efficiency of the economy in long-term macroeconomic analysis [1].

Each scientific and technological revolution, as a rule, introduced something innovative, which in turn led to a series of changes in all sectors of the economy and the spread of new products and technologies. At the international level, the legal development of intellectual property culminated in the entry into force of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) on January 1, 1995 [2]. TRIPS required World Trade Organization (WTO) members to enact laws that would meet international standards for the protection and enforcement of intellectual property rights. For example, on the digital electronics front, TRIPS has paved the way for universal recognition of integrated circuit designs among WTO members. In general, and in line with the changes of the digital revolution,

TRIPS has instilled in the common goal among WTO members the active promotion of technological innovation, technology transfer and dissemination. However, all these developments seem to be pale in comparison with the innovations caused by Industry 4.0. Compared to its predecessors, Industry 4.0 exceeds expectations and is rapidly changing the fundamentals of many areas, including intellectual property.

1. Formation of basic principles and methods of valuation of intellectual property

The choice of approaches and methods of estimating the value of IPO property rights should be based on the basic principles, the essence of which is presented by us in table 1.

Table 1. - Principles of economic evaluation of intellectual property

Principles	Characteristic
Certainty	Evaluation methods should be credible and reliable from a practical and theoretical point of view.
Objectivity	The evaluator should be guided by the quantity and quality of objective information.
Versatility	Reliability will increase if standard approaches for companies, industries and types of intangible costs are used.
Criterion of monetary costs	The benefits of the evaluation should be sufficient to justify the evaluation effort.
Sequence	The methodologies should be used consistently from year to year and thus facilitate the evaluation process.
Reliability	The evaluation should be reliable so that other evaluators can reproduce the process using similar evaluation approaches.
Adequacy (compliance)	Evaluation approaches and selected approaches should meet user requirements.
Practicality	The methods and parameters used should be clear and relatively simple to use in practice.

Source: compiled by the authors using [3]

The valuation procedure includes the following stages: study of special literature on each object of intellectual property; study and search for analogues of IPO; market research on the use of IPO; collection and analysis of cost data on the development and registration of similar IPOs; performing calculations; analysis and coordination of results; evaluator's conclusions; preparation of the Report on the assessment of intellectual property rights.

The main methodological approaches (methods of determining the value) to the valuation of property, property rights, including intellectual property rights, contain National Standard № 1 "General principles of property valuation and property rights" [4] and National Standard № 4 "Valuation of property rights intellectual property" [5], according to which the determination of the value of property of enterprises is carried out on the basis of three main approaches - cost, market and profit, each of which has its own methods. Comparison and extensive analysis of the methods are given in table 2.

The comparative analysis presented in the table allows to reveal advantages and lacks of each approach to an estimation for the further formation of the integrated approach.

Table 2. Advantages and limitations of existing approaches to IPO valuation

Approaches	Most often applicable	Benefits	Limitation
Cost approach - a set of	For IPOs, property	Use of primary	It does not take into account a

valuation methods based on the cost of reproducing the initial value of intellectual property as part of the intangible assets of the enterprise, taking into account their further improvement or replacement	rights to which are valued cannot make a profit immediately. For unique IPO, which are sold very rarely or not at all. Is the main in the case of determining the tax base.	accounting documentation. Objective cost estimation. High accuracy of price determination.	number of important factors (profit from commercialization, investment risks, income growth potential, etc.). Costs incurred are not always accurately correlated with market success. The need to accurately estimate the cost of creating a similar object of intellectual property and its depreciation under the condition of relative equilibrium of supply and demand in the market.
Comparative (market) approach - a set of valuation methods based on determining the value of intellectual property by comparing with the value of analogues for which there is information about prices and conditions of patent agreements	When an efficient market is formed and there is access to a representative sales database of similar IPOs. For large-scale production and a developed target market segment.	Based on real market conditions. Reflects the current practice of buyer-seller relations.	Difficulty in obtaining the source data, lack of access to the necessary information and understanding that there are no such IPOs. The need to amend taking into account existing trends; Lack of consideration of future benefits. The need to consider only transactions that meet the definition of market value, ie those that were in no way affected by non-market factors.
Income approach - a set of valuation methods based on future income associated with the use of IPO	When the value of the appraised object can be equated with capital. (investment) of a certain size.	Takes into account expectations and future benefits. Takes into account the contribution of IPO to the capital of the enterprise as a business asset.	The difficulty of forecasting future benefits. Subjectivity in the evaluation, as the evaluation is conducted by employees of the enterprise.

Source: compiled by the authors using [7] and [8]

2. IPO life cycle research taking into account Industry 4.0

In terms of creating the preconditions for the transition to Industry 4.0, increasing the number of innovative technologies and reducing the useful life of innovations, the life cycle of IPO is important in the valuation procedure. Management of the process of creation, protection and use of a patentable result of intellectual activity (RIA) is carried out step by step over time. The stages of managing the result of intellectual activity correspond to the stages of its life cycle. It is proposed to call the life cycle of the result of intellectual activity the gradual process of its existence, starting from the planning of the result of intellectual activity and ending with the transition of the object of intellectual property created on its basis to the public domain.

Classically, there are five stages of the life cycle of IPO: creation, acquisition of rights, use (commercialization), protection, utilization, which we present in table 3.

Table 3. Life cycle of intellectual property objects

Life cycle stage	Characteristics of the stage
Creation	IP management begins with finding or generating ideas that could ensure the competitiveness of new products or services in the future. That is, it is forecasting non-existent goods in a non-existent market in the absence of information about competitors' plans. Marketing is a tool for this task. At this stage, it is advisable to agree on the distribution of rights to the created IPO between the main participants in this process: the customer, the executor, the user, etc.
Acquisition of rights	It is necessary to make a choice between legal protection of IPO and protection in the mode of a trade secret
Use (commercialization)	An important task of management is to create a "portfolio" of intellectual property in the enterprise, which would comprehensively protect its main products on the market. Equally important is the monitoring of innovation activities of competing companies. An effective tool for this is the search and analysis of patent information and documentation
Protection of rights	You should choose the optimal patent strategy. The need for action to protect rights arises from the moment when rights can be violated. From the point of view of management, the protection of rights should be considered in a broader aspect than just the fight against the violator
Utilization	Use of intellectual property after the legal term of IPO rights has expired, or this term has not expired, but the license agreement, the subject of which is IPO, has expired, or the technology in the production in which they were used has been replaced. In these cases, it is necessary to anticipate the consequences, as well as decide on the most effective further use of IPO

Source: compiled by the authors using [7]

With the advent of Industry 4.0, the main goal of effective management of intellectual property of enterprises is to make the process of creation and existence of the result of intellectual activity not only continuous but also cyclical. To make the process of creation continuous and cyclical, we distinguish five stages of the production cycle of IPO, which we present in Fig. 1.

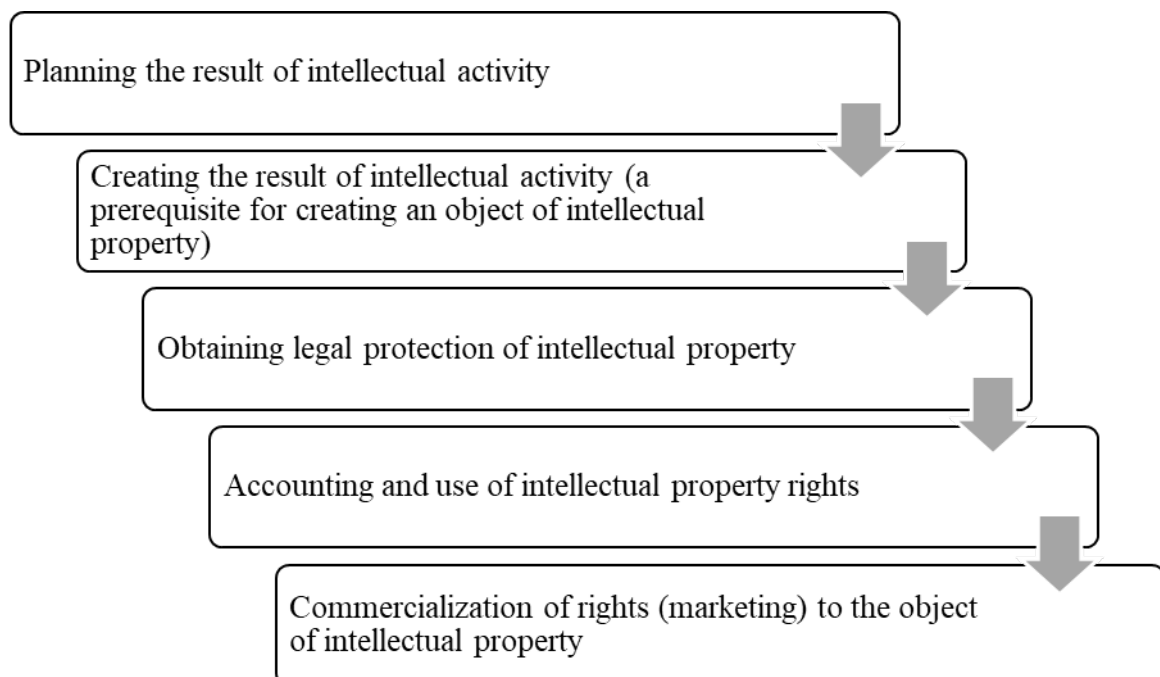


Fig. 1. Stages of the production cycle of intellectual property

Source: Own elaboration

At each stage of the life and production cycles of IPO, we deal with various forms of its implementation. At the first stage it is a question of the result of intellectual activity created in the course of research and development works (R&D). After receiving a security document, the result of intellectual activity becomes the object of intellectual property rights. Upon registration, the IPO becomes an intangible asset. As a result of successful commercialization, intellectual property begins to generate income and becomes an innovation.

Table 4 shows the main actions to be taken by the intellectual property management unit of the organization at different stages, as well as the various forms of implementation of intellectual property.

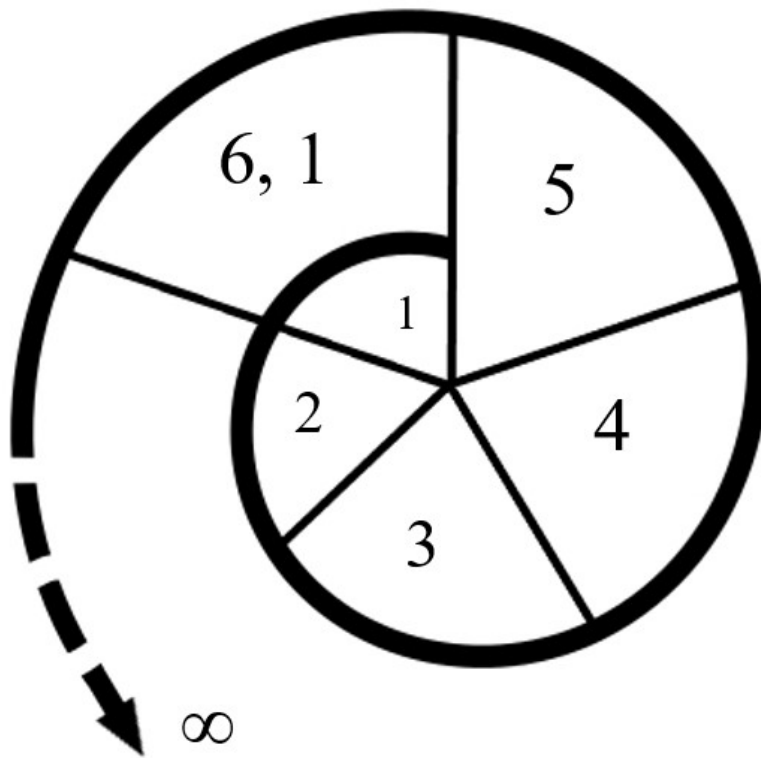
Table 4. Main actions of the intellectual property management service at the stages of the life cycle of the intellectual property object.

Stages of the life cycle of an intellectual property object	Forms of embodiment of intellectual property	Actions for the management of intellectual property
1	2	3
Planning the result of intellectual activity	R&D object	Research of industry development trends and technical level

1	2	3
Creating the result of intellectual activity	Patent-based result of intellectual activity	Study of patentability and patent purity
Obtaining legal protection of intellectual property	The transition of the RIA in the legal form of IPO	Choice of the mode of registration of rights to the result of intellectual activity
Accounting and use of intellectual property rights	IPO is presented as an intangible asset	Accounting as an intangible asset. Execution of the act of use
Commercialization of rights (marketing) for IPO	Innovation	Concluding a license agreement or transfer of rights

Source: Own elaboration

To ensure the process of cyclicity and continuity, the stage of commercialization of the obtained intellectual property must coincide or flow into the advanced stage of creating a further result of intellectual activity, created on the basis of previously obtained, ie to start the life cycle of new IPO, as shown in Fig. 2.



- Where:
1. Planning the result of intellectual activity
 2. Creating the result of intellectual activity
 3. Obtaining legal protection of intellectual property
 4. Accounting and use of intellectual property rights
 5. Commercialization of intellectual property rights
 6. Marketing, market promotion
 - ...

Fig. 2. Continuous life cycle of IPO

Source: Own elaboration

With the transition to new industrial revolutions and taking into account rapid changes in technology, intellectual property rights are becoming very sensitive to technical (moral) aging, and therefore, probably, their useful life is reduced. Under useful life, we propose to define the period during which the asset is expected to be suitable for use by the entity. During this period of time, the entity expects to receive from the asset a sufficient number of units of output using the IPO. In market conditions and many industrial products, intellectual property is often created with the expectation of artificially rapid aging. This phenomenon has become especially acute in modern industries of information technology (smartphones, gadgets, computer programs, mobile communications, etc.).

Based on these premises, there is a need to adjust the graphic image of the life cycle in accordance with the features of the third and fourth industrial revolutions, namely the creation of a three-dimensional spiral funnel of the life cycle of IPO, which is shown in Fig. 3.

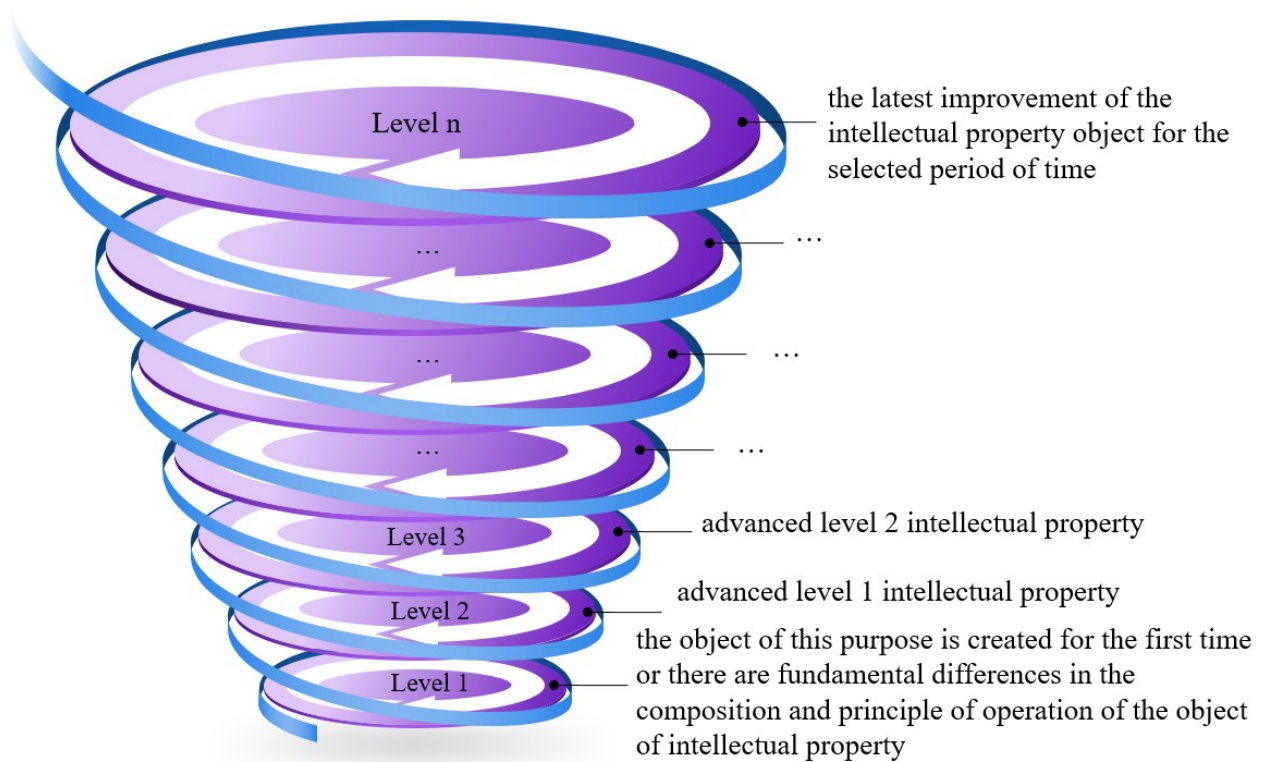


Fig. 3 - Three-dimensional spiral funnel of continuous life cycles of IPO

Source: Own elaboration

The three-dimensional spiral funnel includes the n-number of spiral life cycles of IPO from Fig. 2 (each life cycle is a new level of the three-dimensional funnel) so that the first life cycle is at the bottom, and all subsequent levels have a larger scale because they include previous levels. The very first life cycle of IPO is the so-called "pioneering invention", ie the first created object of this purpose, for which there is no prior art or there are fundamental differences in the composition and principles of operation of objects of the same purpose. For the harmonious development of enterprise technologies, it will be expedient to improve its own intellectual property with the construction of new levels of the spiral funnel of the continuous life cycle of IPO.

3. The influence of the stages of the IPO life cycle on the assessment of its value

Consider in more detail the relationship between the stages of the life cycle of IPO and approaches to its evaluation, as shown in Fig. 4.

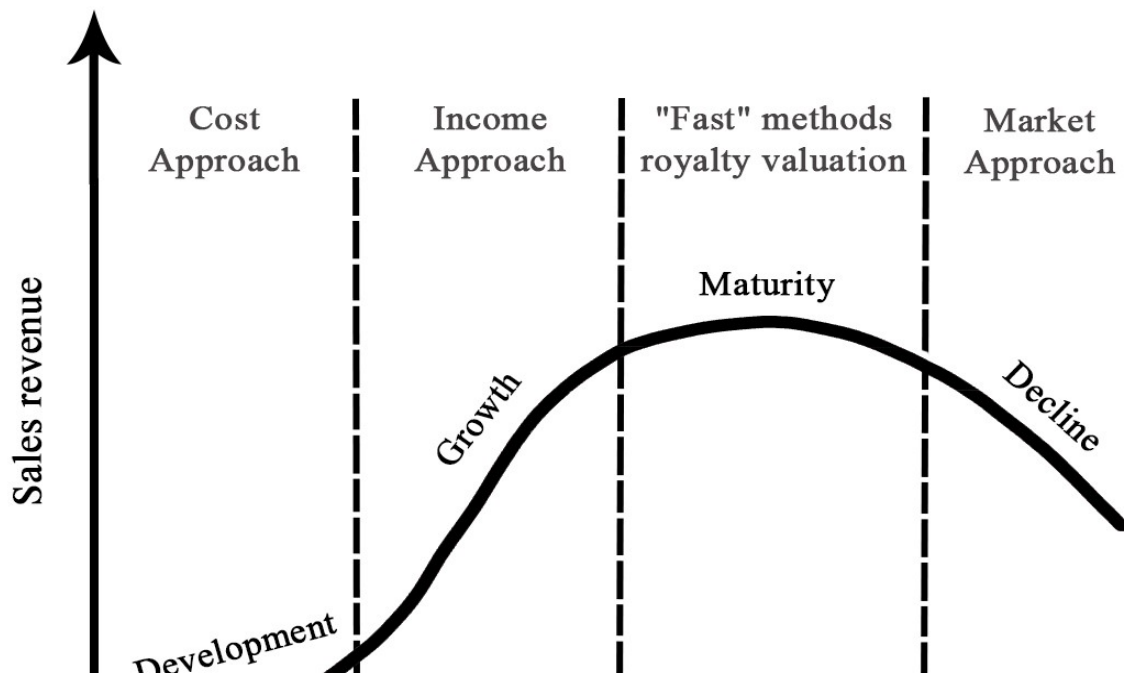


Fig. 4. The relationship between the stages of the life cycle of intellectual property and approaches to its evaluation

Source: Own elaboration

In the early stages of the product life cycle (development and start of commercialization), a cost-effective approach to the valuation of intellectual property is more appropriate. In this case, the price of intellectual property may include the cost of development and the profits of developers. Starting from the moment of receiving the first profits from the sale of a patented product, when the company is interested in the monopoly use of its intellectual property, its evaluation should be based on a income (profitable) approach that allows taking into account the value of additional assets, investment risks and market size.

At the stage of market saturation, it is advisable to use "fast" valuation methods (such as royalties), associated with determining the amount of royalties as a fixed share of the licensee's income. This is due to the company's interest in obtaining additional income from the sale of licenses or its desire to standardize products related to the evaluation of patent rights on the basis of royalties for the right to use this intellectual property.

At the stage when the security documents have not expired, but intellectual property has ceased to be profitable and is not used for commercial purposes, in order to sell to interested buyers it is advisable to evaluate it on a market (comparative) approach, because to reproduce the object of interest. would be an amount similar to that spent by the owner.

Conclusions

Summarizing the results of the study we can draw the following conclusions.

1. Existing approaches to the valuation of intellectual property have a number of shortcomings. In particular, the cost approach does not correlate market success with the costs incurred and the invention can be highly valued, but does not meet the needs of consumer enterprises; in the comparative approach it is

necessary to consider only operations that meet the definition of market value, ie those that are in no way affected by non-market factors, and to separate such factors is very difficult, this procedure takes a long time and sometimes it is impossible to perform data; the profit approach does not take into account the complexity of forecasting future benefits and subjectivity, which hinder the rapid and high-quality economic evaluation of IPO.

2. With the transition to Industry 4.0, the life cycle of intellectual property objects should be improved, because due to rapid changes in IPO technologies they become very sensitive to technical aging and their useful life is reduced. A new vision of the continuous life cycle of IPO was first presented by the authors in the form of a three-dimensional spiral funnel.

3. At different stages of the IPO life cycle, valuation approaches will change depending on the objectives of the chosen stage, for example, for the period of first profits from the sale of a patented product, when the company is interested in monopoly use of its intellectual property, which allows to take into account the value of additional assets, investment risks and market size.

4. The proposed approaches to the economic evaluation of intellectual property, in our opinion, do not fully cover the possibilities of evaluation, taking into account the rapid growth of technologies and reduce their useful life, and in general the life cycle of intellectual property, so there is a need to develop new evaluation tool. Further research should be focused on the development of approaches and methods of valuation of intellectual property and scientifically substantiate the relevance of developments in view of Industry 4.0.

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