METHODOLOGY OF INTELLECTUAL PROPERTY OBJECTS COMMERCIAL POTENTIAL EVALUATION

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Abstract. The current state of the world economy and crisis phenomena show that the sustainable development of national economies is possible with the development of science and technology embodied in technologies, equipment and personnel qualification systems, production organization. Successful development of the modern economy is impossible without increasing the competitiveness of high-tech innovative products in the total volume of GDP. In order to activate the implementation of innovative developments in the real sector of the economy it is necessary for developing intellectual property objects to have concrete value for enterprises. Conformably, the developed intellectual property must be evaluated for the possibility of commercialization. A methodology is proposed for evaluation the commercial potential of IPO, which takes into account both the actual parameters of the intellectual property rights, its external environment, and the potential of patent holders. The approach takes into account the assessments of experts in the field of intellectual property and as a result of the IPO evaluation, we get not the exact value, but the interval that indicates the low, medium or high potential for commercialization of this IPO. The proposed methodology will allow estimating IPO that are still incomplete in order to identify their growth points and determine the prospects for commercialization.

1. Introduction
The current state of the world economy and crisis phenomena show that the sustainable development of national economies is possible with the development of science and technology embodied in technologies, equipment and personnel qualification systems, production organization. Successful development of the modern economy is impossible without increasing the competitiveness of high-tech innovative products in the total volume of GDP.

The leadership of the Russian Federation has repeatedly noted the need to create auspicious conditions to stimulate the implementation of scientific and technological progress in domestic enterprises in order to increase their competitiveness in the world market.

The modern high-tech complex of Russia is characterized by significant imbalances that have developed during economic reforms due to a lack of investment resources and mistakes in carrying out these reforms.

The specifics of the current situation is that the country has significant fundamental and technological developments, a unique scientific and production base. At the same time, the orientation of the existing innovative potential towards the implementation of scientific achievements in
production is extremely weak. Russia, having obvious competitive advantages, consisting in significant scientific and technical potential and highly qualified personnel, having a large scientific base (12% of the number of scientists worldwide), Russia’s share in the world market of high-tech products, according to various estimates, from 0.35% to 1% [1]. In the ranking compiled by WIPO (world intellectual property organization), according to the report “Global Innovation Index 2017”, Russia took 45th place in the list of 127 countries, and among the BRICS countries, Russia ranks second place after China (22).

An important indicator of innovation potential is the number of patent applications fed. In 2017, 3.17 million patent applications were fed worldwide, with 85% of the applications received by the five leading intellectual property offices: China, the USA, Japan, the Republic of Korea and the European Patent Office.

In 2017, the Chinese Office received a record 1.38 million patent applications, which is more than double the number of applications received by the US Office (606,956). In third place is the Office of Japan, which has 318,479 applications; the next positions are taken by the Office of the Republic of Korea (204,775) and EPO (166,585). Of the 10 leading agencies, the highest growth rates of applicant activity in 2017 were noted in the offices of India (+3.4%) and EPO (+4.5%).

Particularly noteworthy are the high growth rates of trademark applications (Figure 1). In 2017, the number of applications from the PRC increased by 55.2% and amounted to 5.74 million. High growth rates were observed in the patent offices of Iran - 87.9%, Japan - 24.2% and the Russian Federation - 16.1%.

* EPO – European Patent Office

**Figure 1.** Number of trademark applications fed to patent offices

Thus, the importance of creating intellectual property objects for the development of the country's economy is obvious. This is indicated by James Mackenzie [2], who determines the importance of creating intellectual property objects and commercialization of innovative technologies for the development of the country's scientific and technological potential in his study. David Potich and Mark Duncan [3] point out a number of problems that arise when entering the intellectual property market, for example, researchers and potential clients of intellectual property objects should be confident in the value of the product and its innovativeness.
James H. Bratton [4] describes in detail the importance of the interaction of commercial enterprises that use intellectual property and research universities that create intellectual property objects, and at the same time, it is necessary to comply with intellectual property policies. Such policy typically describes the management of IP ownership, its use and distribution of compensation in case of successful commercialization.

Intellectual property is considered an important way of stimulation of innovations, giving innovators exclusive rights to certain aspects of their innovation, usually for a limited period of time. The need to stimulate innovation is also noted by Ross Petty [5], who reveals the topic of protecting innovation through patenting in his study.

The studies of Grigory Ivanovich Sencheniya [6] are particularly the most important and relevant. He argues that with the acceleration of technological development and the digital transformation of the economy, the influence of intellectual property on economic growth will increase. In Russia, the digitalization of legal protection and the use of intellectual property rights will allow to form public-private platforms for managing rights, which will create additional opportunities for authors to effectively manage their rights.

Leading domestic scientists note the need of finding a scientific frontier to develop advanced solutions and implement them in the real sector of the economy. It is especially worth noting the research of scientists [7-15] who are engaged in basic research in the field of implementation of innovative developments in industrial enterprises Scientists [16-18] analyze changes in the business processes of enterprises in the non-productive sector when innovations are introduced. A group of scientists [19, 20] engaged in deep research of marketing innovations in conditions of digitalization.

After analyzing domestic and foreign scientists who deal with the problems of creating and commercializing intellectual property, it should be noted that innovative transformations not only increase the competitiveness of the enterprise, but also provide an opportunity for consumers to get better products or services at the best price. At the same time, the introduction of innovations is connected with high risks for the enterprise, therefore, one of the important problems facing domestic enterprises is the development of breakthrough, innovative technologies that would organically combine with the existing business environment of the organization. Accordingly, innovative developments should be created for specific market demands, take into account the specifics of production and the financial capabilities of enterprises - potential customers.

The object of research is the innovative activity of enterprises aimed at increasing competitiveness at a qualitatively new level. The subject of the research is the intellectual property objects. The purpose of the research is to develop a methodology for evaluating the intellectual property commercialization, which would reflect the likelihood of successful intellectual property commercialization in the market.

2. Methods

Assessment of the potential of commercialization is currently carried out using three main methods: costly, profitable and comparative. Each of them has its own advantages and disadvantages, however, none of the methods presented makes it possible to determine the objective potential of commercialization. At the same time, the complexity of the object of study determines the need to identify fuzzy assessment intervals, also characterized by the level of confidence of the expert in the conclusions made. Therefore, one of the most suitable for building a model for assessing the potential for commercialization of intellectual property is a fuzzy-plural approach.

The general algorithm for constructing fuzzy-multiple estimation models is presented in Figure 2.

To begin with, we identify the factors that have the greatest impact on the potential for commercialization of intellectual property objects. Nowadays, most scientists identify typical groups of factors affecting the commercial potential of intellectual property objects, such as:
- technological;
- economic;
- aesthetic;
- social;
- ecological.

However, this classification does not take into account the features of intellectual property objects, in connection with which it is proposed to distinguish three main groups of factors affecting the potential for commercialization of intellectual property.

**Preparatory stage**

1. **The internal potential of intellectual property.**

   Intellectual property objects have a number of characteristics that reflect their internal potential, which will directly affect the commercial potential of an intellectual property object. This group of factors includes the technical and organizational characteristics of an intellectual property object, such as the ability to use intellectual property without significant changes in technology, the rate of obsolescence, etc.

2. **The potential of the subject that developed the intellectual property**

   An important group of factors will be the potential of the subject who developed the IPO. The success of the IPO will depend on how competent and experienced the IPO developers are. This group of factors comprehensively characterizes the subjects of inventive activity.

3. **Factors of external environment**

   In this group, factors related to the external environment are used: this is the development of the industry for which the IPO is developed, this is the level of competition in the industry, the economic condition of the country as a whole, etc.

   Thus, this classification reflects the main three groups of factors that have the greatest impact on the potential for commercialization of intellectual property objects.

   The degree of influence of each particular indicator on the influence of the factor is different, therefore, it makes sense to build a balanced system of indicators. The weight assignment to each of the selected indicators can be carried out through a combined approach, which implies both expert weight distribution and weight distribution in accordance with Fishburn's law. In this case, the weight distribution was carried out in accordance with the law of Fishburn. For these purposes, the factors were ranked by experts according to the degree of influence on the final result. The distribution of weight within the groups themselves is made evenly in order to prevent the weight gain of those factors that are evaluated by several indicators. The distribution results are presented in Figure 3-5.

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**Figure 2. General algorithm for constructing fuzzy-multiple estimation models**

1. **Selection of model indicators**
2. **Designation of the indicators significance**
3. **Designation of linguistic variables**
4. **Splitting an axis into fuzzy subsets**

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**Indicator Assessment Stage**

1. **Linguistic interpretation of the integral indicator**
2. **Formation of an integral indicator**
3. **Determination of actual indicators belonging to fuzzy subsets**

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**Preparatory stage**
Figure 3. Distribution of model weights of an integral indicator of the IPO commercialization potential

Figure 4. The integral indicator of potential subject of commercialization weights model distribution

Figure 5. The weights distribution of the integrated indicator model of IPO environmental factors.

As a result, a set of indicators, consisting of three integral indicators, which in turn consists of factors affecting the potential for commercialization of IPO, ranked by significance level, has been formed.

Next, the linguistic variables have been defined. In the framework of this study, 3 integral linguistic variables have been identified:

1. Linguistic variable M.R.:
   a. $\gamma$ – the degree of influence of the IPO internal potential on the IPO commercialization potential;
   b. $T$ - 5 subsets of the base term of the set $\xi$: 

   unique character of IPO (weight – 17%)
   time of preservation of the innovative resource (weight – 20%)
   degree of obtaining the result without changing the existing technology (weight – 35%)
   potential of scope of application (weight – 13%)
   cost level for IPO (weight – 15%)

   commercialization experience (weight – 34%)
   accessibility of necessary resources (weight – 20%)
   availability of resources for commercialization (weight – 26%)
   technological capabilities of the enterprise (weight – 13%)
   level of legal protection (weight – 7%)

   economic situation in the country (weight – 7%)
   Competition acuteness (weight – 34%)
   government support for innovation (weight – 13%)
   industry development level (weight – 26%)
   liaising with suppliers and distribution networks (weight – 20%)
1. Extremely low degree of influence;
2. Low degree of influence;
3. Medium degree of influence;
4. High degree of influence;
5. Extremely high degree of influence.

2. Linguistic variable Ex.R.:
   a. \( \gamma \) – the influence degree of the potential of the subject of IPO commercialization on the potential of IPO commercialization;
   b. \( T \) – 5 subsets of the base term of the set \( \xi \):
      i. Extremely low degree of influence;
      ii. Low degree of influence;
      iii. Medium degree of influence;
      iv. High degree of influence;
      v. Extremely high degree of influence.

3. Linguistic variable S.R.:
   a. \( \gamma \) – the influence degree of environmental factors on the potential for commercialization of IPO;
   b. \( T \) – 5 subsets of the base term of the set \( \xi \):
      i. Extremely low degree of influence;
      ii. Low degree of influence;
      iii. Medium degree of influence;
      iv. High degree of influence;
      v. Extremely high degree of influence.

The given indicators, in spite of their heterogeneous character, and different direction of influence on the integral indicator, can be universalized by one linguistic variable:

Linguistic variable P.M.:
   a. \( \gamma \) – the value of a quotient indicator;
   b. \( T \) – 5 subsets of the base term of the set \( \xi \):
      i. Extremely low value of a quotient indicator;
      ii. Low value of a quotient indicator;
      iii. Medium value of a quotient indicator;
      iv. High value of a quotient indicator;
      v. Extremely high value of a quotient indicator.

![Figure 6. Five-level 01-classifier of a quotient indicator](image)

A standard five-level 01-classifier was used as a classifier of both integral and quotient indicators. In the classifier, as a segment of linguistic variable the real axis \([0; 1]\) (01-carrier) has been used. This segment is universal, since any segment of the real axis can be reduced to the segment \([0; 1]\) (Figure 6).
Figure 6 shows the trapezoidal membership functions, where the ordinate values of membership functions (from 0 to 1) are indicated, and the terms are represented along the abscissa.

Creating a system of fuzzy subsets involves the introduction of a set of nodal points, which are abscissas of the midpoints of the trapezoid upper bases of the classifier. In this case, we have five nodal points: \{0, 1; 0.3; 0.5; 0.7; 0.9\}. As an example, we can cite a system of classifiers of indicators to assess the degree of IPO internal potential influence on the potential for IPO commercialization (Table 1)

| Indicator designation | T-numbers \{y\} for linguistic variable values P.M.M.R. |
|-----------------------|--------------------------------------------------------|
|                       | Extremely low value of a quotient indicator | Low value of a quotient indicator | Medium value of a quotient indicator | High value of a quotient indicator | Extremely high value of a quotient indicator |
| \( F_{\text{m}-1} \)  | (0; 0; 2; 2) | (2; 2; 4; 6) | (4; 6; 8; 10) | (8; 10; 12; 14) | (12; 14; +\infty; +\infty) |
| \( F_{\text{m}-2} \)  | (6; 6; 10; 12) | (10; 12; 16; 18) | (16; 18; 24; 26) | (24; 26; 36; 40) | (36; 40; 60; 60) |
| \( F_{\text{m}-3} \)  | (0; 0; 1; 2) | (1; 2; 3; 4) | (3; 4; 5; 6) | (5; 6; 7; 8) | (7; 8; +\infty; +\infty) |
| \( F_{\text{m}-4} \)  | (300; 300; 500; 700) | (500; 700; 1000; 1500) | (1000; 1500; 3000; 5000) | (3000; 5000; 10000; 15000) | (10000; 15000; +\infty; +\infty) |
| \( F_{\text{m}-5} \)  | (50; 100; 200; 300) | (200; 300; 500; 700) | (500; 700; 1000; 1500) | (1000; 1500; 3000; 5000) | (3000; 5000; +\infty; +\infty) |

The fuzzy-multiple indicators system characterizing the influence degree on IPO subject of commercialization potential and the degree of influence of environmental factors on the potential of commercialization of OPI is built similar to table 1.

According to the calculation results of each of the particular indicators, their values are recognized by the criterion \( \lambda_{ij} \in [0; 1] \). This indicator correlates the values of particular indicators with the values of the 01 carrier:

\[
\lambda_{ij} = 1 - \frac{X_i - a^*_{ij}}{a^*_{i} - a^*_{j}}
\]

where \( a^*_{ij} \) and \( a^*_{i} \) are T-numbers of the i subset of a term-set.

Based on the results of recognition of the values of particular indicators, integral indicators are calculated:

\[
\text{M.R.} = \sum_{j=5}^{n} p_j \times n_i \times \lambda_{ij} \\
\text{Ex. R.} = \sum_{j=5}^{n} p_j \times n_i \times \lambda_{ij} \\
\text{S.R.} = \sum_{j=5}^{n} p_j \times n_i \times \lambda_{ij}
\]

where \( p_j \) – nodal points 01 carrier:

\( p_j = 0.9 - 0.2 \times (j - 1) \)

where \( j \) – the number of subsets of the base term of the set \( \xi \).
The results obtained are characterized by two components: a linguistic interpretation of the IPO commercial potential level and the reliability degree of the result. First of all, we consider the linguistic interpretation of the result. The experts found that the border state is state No. 3 - “Average commercialization potential”. In the event that the OIC under consideration goes into state No. 4 - “Low potential for commercialization” - it is automatically sent for revision.

3. Results and Discussion
The applied effectiveness of the proposed methodology can be estimated using the analysis of intellectual property, for example, let's evaluate the commercial potential of patent RU 2323474 C1 “Method for accounting for product promotion on the market and identifier for this” (patent holders and authors are Pavlov D.F., Maslyaev M.K. and Larin V.V.).

The invention relates to electronic systems and can be used in the manufacture and sale of products to provide information regarding the authenticity of products and the history of products sales dates, as well as to obtain manufacturer information for marketing research. The technical result is to ensure the uniqueness and simplicity of informing about the number of goods resales, increasing the reliability of accounting for goods. The specified result is achieved due to the fact that they use an identifier made in the form of a card designed to be placed on a product or its packaging. There are several stripes on the card with serial numbers, with hidden unique numbers assigned to the goods at the production stage. The strips are made with the possibility of irreversible disclosure of the hidden number. The authenticity of the goods is checked by referring to the manufacturer’s database using the information on the front side of the card, the unique number read out, as well as the serial number of the strip on which the read unique number is applied [6]

For the selected patent, we calculate the integral indicators M.R., Ex.R., S.R.
As a result of the assessment, we will construct a polygon of the commercial potential of the IPO (Figure 7)

![Figure 7. Polygon of commercial potential of IPO](image)

The experts determined threshold values of 3.5 for groups of factors that were identified above. As can be seen from the figure, the patent has an internal potential below the threshold value, so it is necessary to assess the reliability level of this group of factors (Figure. 8).
The reliability level of the IPO internal potential analysis

The reliability level of the external environment factors analysis

The reliability level of the IPO potential subject analysis

Figure 8. The polygon of results reliability of the IPO commercial potential analysis

This polygon clearly demonstrates the reliability of the presented results. All obtained reliability values exceed the boundary value. Accordingly, the internal potential of the IPO is lower than permissible, which suggests that the patent “A method for accounting for the promotion of goods on the market and an identifier for this” needs to be further developed with regard to internal factors of commercialization. The given example clearly demonstrates the practical significance of the proposed toolkit, as well as its relevance.

4. Conclusions

Taking everything into consideration, a methodology for assessing the commercial potential of intellectual property based on a fuzzy-plural approach is proposed. This technique takes into account both the actual parameters of the IPO, its external environment, and the potential of patent holders. The approach takes into account the assessments of experts in the field of intellectual property and, as a result of evaluating the intellectual property rights, not the exact value is determined, but the interval that indicates the low, medium or high potential for commercialization of the intellectual property in question. The proposed methodology will make it possible to evaluate IPO that are still incomplete in order to identify their growth points and determine the prospects for commercialization.

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