MODELING THE CHOICE OF THE INTELLECTUAL PROPERTY COMMERCIALIZATION FORM IN HIGH TECHNOLOGY ENTERPRISES USING THE TOOLKIT OF COLOURED PETRI NETS

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The problem of the choice of the form of intellectual property commercialization is the most difficult for modern high technology enterprises. In the article the author offers a model of the choice of the form of commercial use of the results of intellectual activity with the use of Petri networks CPN Tools toolkit which allows to display the procedure on the basis of values of the chosen parameters of the model.

The main reason of poor intellectual property (IP) management in Russian high technology enterprises is the absence of experience in the transformation of scientific and technical potential into commercial outcome. The given statement is based on the analysis of the patent system that existed in the USSR which was aimed at the estimation of patentability of the inventions, the submission of applications for the grant of patents, the reception of certificates on registration and was never focused on searching for partners and buyers of the produce. In the majority of modern high technology enterprises such system is still in operation, therefore, despite positive dynamics of the process of patenting, the number of sold technologies remains exclusively low.

Speaking about commercialization, first of all, it is necessary to differentiate the essence of this concept. In the publications on the given topic the concept of "commercialization of technologies" is often used together with another concept - "the transfer of technologies". These concepts have recently appeared in Russian-speaking literature and are directly connected with reorientation to market relations in the majority of spheres of human activity. The semantic maintenance of these concepts is not the same:

♦ commercialization of technologies presupposes the necessity of making a profit and is not necessarily connected with the inclusion of the third parties (except the technology source and the end user);

♦ technology transfer suggests obligatory transfer of technology to the recipient that carries out its industrial development, but it is not necessarily connected with making a profit by either the technology source or its recipient[1].

The major part of the process of technology commercialization is the protection and commercialization of intellectual property. The matter is that the created technology (under condition of its technical exclusiveness and market demand) gets commercial value only in two cases: if the exclusive rights on its use are confirmed (the patent for the invention, the certificate for useful model, etc.) or if the technology represents a know-how, that is also a subject of copyright protection.

In other words, today practically any innovative technology is inseparably linked with exclusive rights to its use - intellectual property rights, that is why the concept of "commercialization of intellectual property" is inseparably linked with the concept of "commercialization of technologies" which is rather new for Russian business, but at the same time it has gained considerable popularity.

Having analyzed the literature in the field of management of intellectual property, the author has come to the conclusion that the commercialization of IP represents commercial advancement of the results of intellectual activity, the essence of which is their introduction (use), and the contents and its specific feature are the relations between economic subjects (founders and/or proprietors and consumers) in the process of market exchange[2]. Commercialization of research projects is aimed at the reception of commercial result and begins with the moment of revealing the prospects of commercial use of a new research project and comes to an end with research project realization (the tech-

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nologies, the goods received with its help or the rendered service) in the market and the reception of commercial effect.

According to the author, the problem of the choice of the form of technologies commercialization is not studied enough in the type of economic literature devoted to the questions of intellectual property management, therefore this problem should be paid special attention to within the limits of the given research.

As a result of the analysis of the literature in the field of intellectual property seven forms of commercialization of scientific and technical research projects most common for high technology enterprises have been identified.

1. Implementation into its own production. This form is the most effective within the limits of the activity of a high technology enterprise as it allows to separate manufacture from production realization in the basis of which lays the object of intellectual property. The result is making a profit and the development of innovative activity of the enterprise.

2. The exclusive right concession (sale of the rights) - this form is almost similar to commercialization of the usual goods and represents the process of alienation-assignment of the intellectual goods and the property rights to it.

3. Cession of rights on use (licensing) is carried out on the basis of license contract in which one party (the licensor) gives the rights to volume, character and terms of use of the rights concerning the object of IP to the other party (the licensee) which pays a corresponding compensation in the form of royalties, lump-sum payments.

4. Franchise is carried out under the contract of commercial concession when one party gives another party the possibility to use a complex of exclusive rights in enterprise activity, such as: a trade mark, a service mark, know-how, etc. for compensation (item 1 of item 1027 of the Civil Code of the Russian Federation).

5. Leasing is renting high technology production with intellectual property components in the certain territory used for commercial or industrial purposes by one party with the preservation of property rights of the lessor.

6. Engineering assumes granting a complex of separate kinds of technical services connected with research, designing, building, commissioning, working out new technological process-es at the enterprises of the customer, with the improvement of available production on contractual basis.

7. Industrial cooperation is a form of technologies commercialization when intensive technological exchange is provided. In the case of technologies commercialization in the form of industrial cooperation agreements on industrial cooperation are entered into, in the frameworks of which the long generality of the interests aimed at the reception of additional mutual benefits is created besides direct or mutual deliveries (sales and purchases) production or rendering of services between the parties.

The choice of IP commercialization way is a complicated process when it is necessary to analyse real possibilities of application of the results of intellectual activity and their conformity to the following criteria: patent cleanliness of products, perspectivity of IP, conformity of the technological level of research projects to market requirements, estimation of probability of commercial success and many other things. The author suggests to use the free-share toolkit of Petri nets CPN Tools for modeling the choice of the form IP commercialization as it allows to graphically display the procedure of choosing the form of IP commercial use on the basis of values of the chosen parameters of the model.

The theory of Petri networks formulated in the early sixties of the 20th century by a German mathematician K.A.Petri now contains a considerable quantity of models, methods and means of analysis which have extensive quantity of appendices practically in all branches of computer facilities and even out of it.

Coloured Petri Nets (CPN) is a graph language for design, description, imitation and control of distributed and parallel systems. Graphics primitives show process flow and structures of a special language simulate necessary data processing. The network is represented by a directed graph with two types of vertices - places and transitions, thus arcs cannot connect the vertices of one type. The set of places (designated by an ellipse) describe system state. Transitions (designated by rectangles) describe the conditions of change of states. The places are called "input for a specific transition" if the arc runs to a transition. The places are called "output for a transition" if the arc runs from transition to place[3].

Unlike "classical" Petri networks, in its coloured version the important role is played by data structuring based on the concept of many colors which is similar to the concept of type in declarative programming languages. Thus, to manipulate with colour they apply variables, functions and other elements known from programming languages. The key element of CPN - the place - has certain value of the set of colours. For better reflection of dynamic properties the concept of network marking is introduced into Petri network and is realized by means of the so-called tokens put in places. The colour of the place defines the type of token which can be there. A specific token in the given place is defined by initializing expression of the initial marking or formed as a result of the correct performance of the step of iteration of Petri net.

The network represents an asynchronous system in which tokens move to places through transitions. A transition can work (i.e. move a token from the input place to the output for the specific transition) if there is at least one token and the logic expression limiting the transition (trigger function) is executed at all input places for the given transition. Arcs can have marks in the form of expressions (variables, constants or functions), defined for the set of colours, and be used either to "exarticulate" complicated token colour components in the process of defining conditions of an operational transition, or to change the next place token colour directly after transition operation.

The model of choosing the form of intellectual property commercialization in high technology enterprises is presented on figure. We will consider each block of model development in details.

The first block assumes the definition of criteria of intellectual property commercialization. As a result of the research of high technology enterprises activity such criteria have been defined:

1. Indicators characterizing the object of intellectual property.

2. Indicators describing the condition of the high technology enterprise.

The second block of the model is connected with working out the algorithm of the choice of commercial use of intellectual activity outcomes on the basis of coloured Petri nets. Thanks to the algorithm's work the output is a vector of seven co-ordinates in which co-ordinates correspond to forms of commercialization, and their value to the advisability of each specific form. The maximum co-ordinate corresponds to the best form of IP commercialization in a high technology enterprise.

The third block of the model consists of the construction of colored Petri network to choose the form of IP commercialization with the help of free-share toolkit of Petri nets CPN Tools.

According to the description of the parameters of IP commercialization form choice model we will put in conformity a certain number of tokens to each factor X_i for the considered IP. Thus, we receive M data file for IP which contains the information on the value of the given criterion.

There is serial gradual information transfer on the value of the considered factor from the given data file through transition T1 to place P_n, to its removal from place X1-X26. Simultaneously place X_n is being filled with margin values according the description of the parameters of IP commercialization form choice model. The filling is executed via the extraction of information from the Base file in which margin values for all factors X1-X26 are stored.

Only those packages pass through transition T2 for which the equality $p = l$ is applicable. Then in place V packages containing information on the chosen forms of commercialization are collected. Thus there is a zeroing of place X_n (all packages leave for place Stok) and increase in the unit of counters S1 and S2. This procedure repeats again, but now only for the second factor X2 and then for all certain parameters.

After the work of the network and processing of all the factors V place contains packages about the choice of this or that form of commercialization, and these packages are summarized.

The fourth block is final and consists of the definitive choice of the IP commercialization form following the results of the modeling and working out the recommendations about commercial use of results of intellectual activity in high technology enterprises.

The recommended model of the choice of the form IP commercialization considers a significant amount of the factors describing both

Block 1. Definition of the criteria of intellectual property commercialization

INPUT: criteria of intellectual property commercialization

Indicators characterising the object of intellectual property

TECHNICAL AUDIT

1. Factor of the reached result

2. Factor of industrial readiness

3. Factor of complexity of the solved technical problem

4. Novelty factor

5. Factor of aesthetic perception

6. Factor of compatibility with existing technologies

7. Factor of alienability

MARKETING AUDIT

8. Factor of market demand

9. Factor of potential application

10. Competitiveness factor

11. Factor of market monopoly

12. Cooperation factor

PATENT SEARCH

13. Factor of reliability of copyright protection

14. Uniqueness factor

15. Factor of volume and territory of action of exclusive rights

16. Factor of IP obsolescence

Indicators characterising the condition of high technology enterprise

17. Level of the enterprise technological system development

18. Productivity of technological system of the enterprise

19. Level of manufacturing readiness for new product development

20. Factor of development of new production

21. Level of material resources supply for innovative activity

22. The amount of trained staff for innovative activity

23. Level of intellectual property security

24. Level of funds for innovative activity

25. Factor of possible attraction of extra means

26. Factor of own financial assets security

Fig. **Model of the choice of intellectual property commercialization form of high technology enterprise (beginning)**

Block 2. Working out the algorithm of choice of IP commercialization form based on the coloured Petri nets

Block 3. Construction of the coloured Petri nets by means of CPN Tools toolkit

Block 4. Choice of intellectual property commercialization form

Algorithm of the choice of the form of intellectual property commercialization

Procedure of construction of the coloured Petri nets by means of CPN Tools toolkit

THE BEGINNING

$i=1, j=1$

$K_i > \alpha_{ij}$ Yes → $V_{ji}=V_j+1$

No

$j=j+1$ $i=i+1$

Yes   No
$i > 26$

$V_i * = \max \{V_i\}$

THE END

INDEX

i - the number of commercialization criteria, $i = 1 \ldots 26$;
j -the variant of commercialization form, $j = 1 \ldots 7$;
K_i - the value of commercialization criteria;
α_{ij} - the value of i-criteria of commercialization for j-form of commercial use;
V_i - values got as a result of modeling for each commercialization;
V_i* - final form of commercialization

Forms of intellectual property commercialization

Formation of **Base** file in which margin values of parameters of the model (criteria of IP commercialization) are stored

Assignment of certain number of tokens to each parameter

Data file on values of parameters of **M** formation

Information transfer through transition **T1** to place Pn

Filling place **Xn** margin values of parameters

Transfer of packages through transition **T2** under condition **p=I**

Place **V** - packages about the choice of this or that form of commercialization

OUTPUT: the form of intellectual property commercialization

1. Own manufacture (SP)

2. Industrial cooperation (PK)

3. Engineering (Inz)

4. Leasing (Liz)

5. Franchise (Fr)
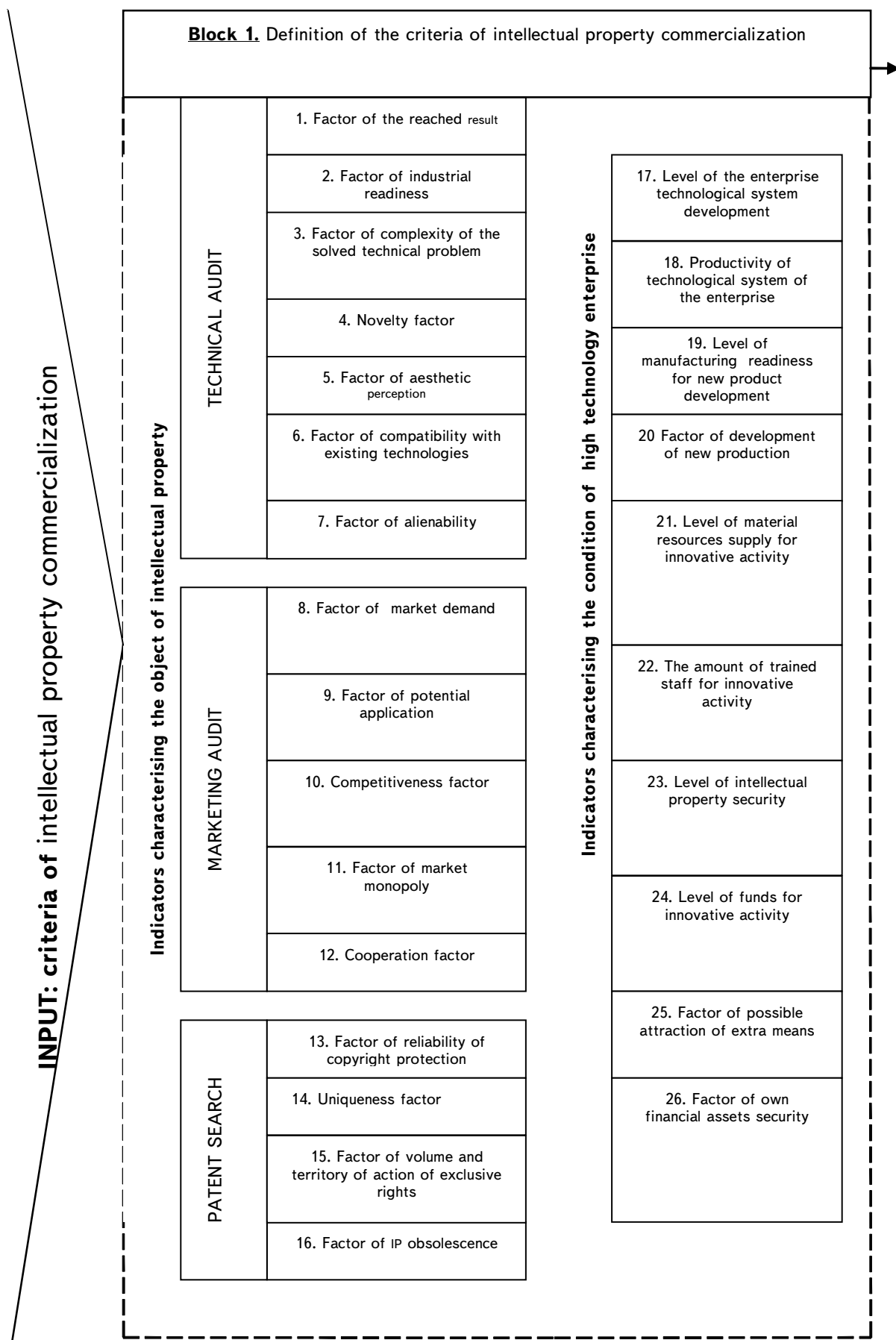
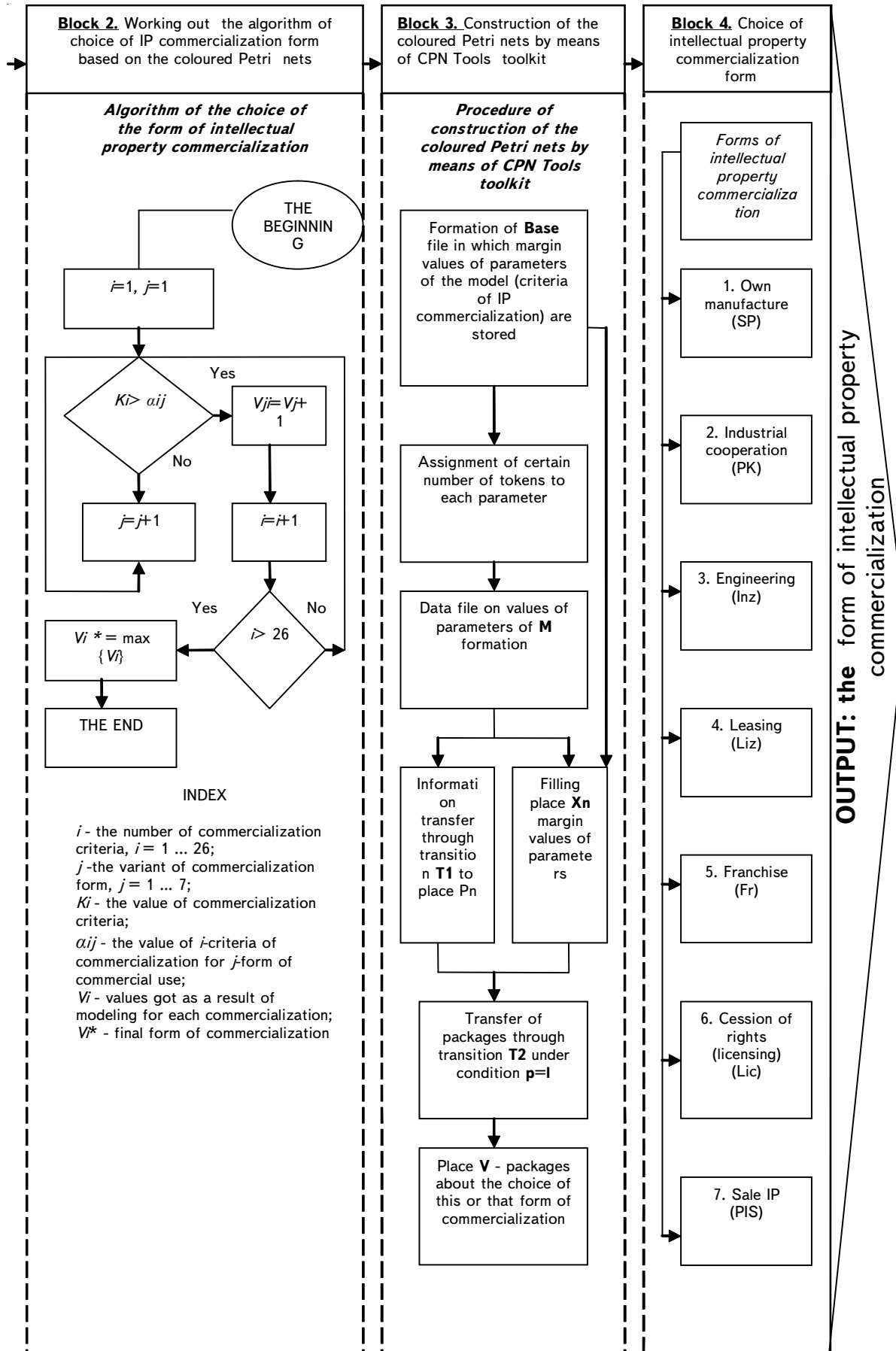6. Cession of rights (licensing) (Lic)

7. Sale IP (PIS)

Fig. **Model of the choice of intellectual property commercialization form of high technology enterprise (ending)**

the object of intellectual property, and the state of the high technology enterprise; contains rather simple algorithms of calculations; combines advantages of expert and analytical methods, has a universal applied and automated character.

It is obvious, that problems of formation of market relations of commercial use of intellectual property are very complicated and actual in practical application as the possibility of achievement of final positive results of investment and innovative activity of the high technology enterprises depends on degree of successful decision of these problems. Therefore the perfection of processes of commercializa-tion of intellectual property will allow the hi-tech enterprises to follow the way of innovative development and to raise the level of using of the high technology products for achievement of social and economic growth of Russian economy.

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[1] *Barsukova O.V.* Definition of an innovative transfer and model of a choice of a variant of its resource maintenance // Management of public and economic systems. 2008. № 1.

[2] *Nigmatullina L.G.* Feature intellectual property commercialization in transitive economy. Kazan, 2005.

[3] *Kotov V.E.* Petri nets. M., 1984.