

Commercialization of high-tech products: theoretical-methodological aspects

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Abstract. Based on theoretical knowing of modern, economic concepts of innovation, systems theory, management and information and also on the practice of their using in the management system of enterprises, in this case was proposed a new solution of scientific problems. It was the development of theoretical and methodical applied principles concerning the commercialization of high-tech products industry.

Key words: Commercialization, high-tech product, diffusion, effectiveness, innovativeness, evaluation.

THE PROBLEM STATEMENT

With the reforming of the national economy the strengthening of integration processes in industrial plants that produce high-tech products is a problem of commercialization. There are objective and subjective motives. To begin with, all these plants are established during the Soviet time, they worked traditionally for the state offering and had state financing. In case of the changing usual circumstances they would be unready to the survival of the presence competition. Secondly, in a context where the national market demand for high-tech products is low, food-analogues of foreign production have appeared. Consumer demands are increasing, so there is a need extending the professionalism in the study of demand, usage of competitive pricing and permanent efforts for the improving quality of finished high-tech products. In order to meet these requirements personnel of industrial enterprises, especially managers must possess methodological tools commercialization of high-tech products. Thirdly, in the market conditions, due to the foreign practice, the process of commercialization is based on partnerships manufacturers of high-tech products with risky financial industries. The success depends on control of allocation of property rights to commercialization. In Ukraine, unfortunately, the law of intellectual property rights only emerging, venture organizations are slow to invest in Ukrainian high-tech projects through unfavorable investment climate. As a result, the problem of commercialization of high-tech products by industrial enterprises is in the lack of systematic theoretical and methodological conditions concerning rational and administrative decisions which is connected with supplying effectiveness in commercialization of high-tech products.

In most scientific papers of conceptual and methodological commercialization of high-tech products are as a component of the national innovation system and at the same time as the final stage of interaction of educational, research and industry within technology parks, innovation clusters or other structures. In turn, in the works that are more applied nature of the problem of commercialization are considered in terms of marketing, including tactical tools to promote these products to consumers.

Existing theoretical, methodological and practical developments in the commercialization of high-tech products industries are characterized by fragmentation, unsystematic ideas about causal relationships that arise between the subjects of the commercialization of high-tech products. Researches have unnoticed: the methods to identify the diffusions high-tech products in the

process of commercialization, methods of evaluation in the level of innovation high-tech enterprise, methodological approaches to determine the level of effectiveness of the commercialization of high-tech products, the sequence of construction phases of the commercialization of high-tech products and industries.

The research was conducted for the development theoretical and methodological-applied statements due to the commercialization of high-tech products of industrial enterprises.

THE MAIN MATERIAL AND RESULTS

According to the results of the research above is approved that the features of high-tech products are its capacity of knowledge and complexity of the technology. The level of high-tech complexity of production characterizes spatial and time coordination of realization high-tech operations, capacity of knowledge and uniqueness of the work. Also it characterizes specificity program complexes and devices, which is necessary for the management technological units, especially its interaction.

Commercialization of high-tech products is a process of establishing, selling and progress on the market of high-tech products, which supplies the expected economic effect to the industry. Analysis of statistical, expert and empirical data suggests that it is the commercialization of high-tech products, and not its creation is a problem for domestic industry. The Lack of government involvement in the formation of effective demand for high-tech products, expand markets for these products abroad, and also without adaptability of enterprises to competitive conditions are the main reasons that the part of high-tech products in total industrial output of enterprises is low and constantly decreasing.

Studies have shown that the additional feature of high-tech products is its innovativeness. It doesn't mean that all high-tech products are innovative, but today on the market of high-tech products is a significant number of innovative products. The higher level of innovation is characterized by activities the more likely it is to ensure the effectiveness of commercialization. With information additional position when choosing the best options for commercialization of high-tech products the business leaders advisable to use a classification of commercialization (Table 1) [1,3,9,11-15,17-20].

The proposed classification can serve as logical structure for the construction of databases related to the preparation and implementation of decisions related to the production and promotion of high-tech products on the market.

Analysis and synthesis of information on the practice of commercialization of high technology products in different countries has shown that a key role in the development and establishment of high-tech products is played by Multinational Corporation; All without exception Multinational Corporations stimulate the creation of small venture enterprises in its structure that are funded by domestic venture capital funds; geographical location of the place of research centers and venture companies depends on the financial benefits of administrative regions as well as the level of skills development in the region; the vast majority of venture capital firms focused in technical parks, business incubators and other innovative structures, a key role in the creation of innovative structures such as technology parks and technopolis play the governments; commercialization of high-tech products starts when Multinational Corporations would include regional differences in demand for a new product and ensured all conditions for rapid return on investment.

Table 1. The types of commercialization

Classification	The types of commercialization
By contents	The commercialization which goes by subject, which is an entity that acts as a developer of high-end products, its manufacturer and seller of one person; Commercialization, which is the entity that owns intellectual property rights to the high-tech product through licensing business partners; Commercialization, which is the entity that owns intellectual property rights to the high-tech product using franchising agreements; Commercialization, which is the entity that owns intellectual property rights to the high-tech product using the lease; Commercialization, which is the entity that owns intellectual property rights to the high-tech product through a combination of the above methods of commercialization
In terms of efficiency	Commercialization of high-tech product, which provided the expected economic effect; Commercialization of high-tech product, which did not provide the expected economic benefits
The number of subjects	Mono-subject commercialization of high-tech product; Bi-subject commercialization of high-tech product; Poly-subject commercialization of high-tech products
By geographical coverage of subjects commercialization	Commercialization of high-tech products in the national market; Commercialization of high-tech products in the foreign market; Commercialization of high-tech products both nationally and in foreign markets
By way of financing	Commercialization of high-tech product, which occurs at the expense of banks and venture capital funds; Commercialization of high-tech product, which occurs at the expense of budgetary and extra-budgetary funds; Commercialization of high-tech product which is using its own funds of commercialization; Commercialization of high-tech product which is due to funds from various funding sources

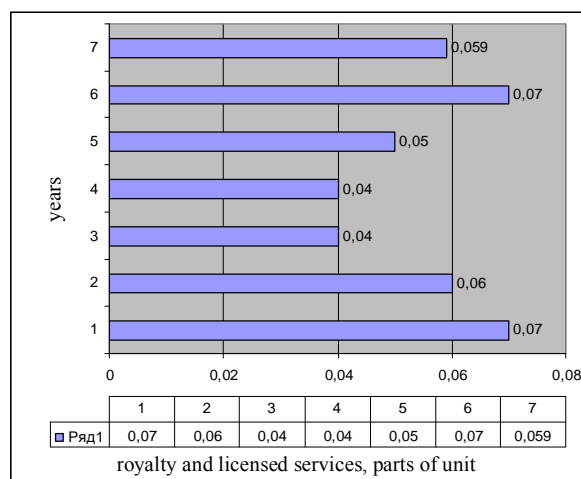
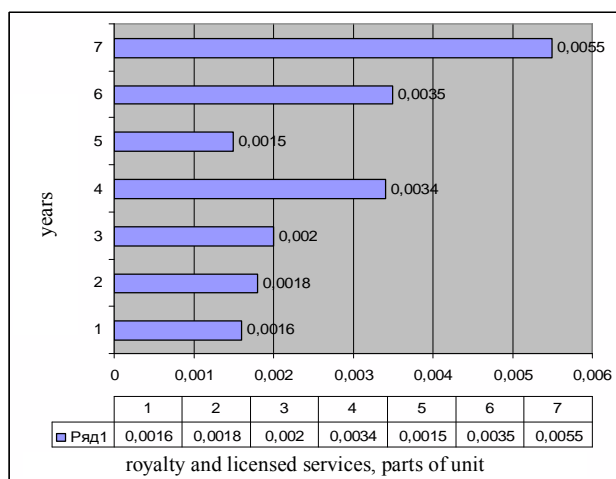
Notes: Developed by authors of article

Thus, in Ukraine, despite some real steps taken to create a national innovation system the prerequisites are absent for activation of processes of production and commercialization of high-tech innovation. First of all, the investment climate is not favorable for the coming strategic foreign venture capital investors, including those that are transnational. Secondly, the existing innovation infrastructure in Ukraine has too little in common with traditional, by world standards, innovative formations, in particular such as techno-parks, technopolis, innovation clusters. They are almost devoid of tax and administrative privileges. Thirdly, the base of high-tech manufacturing and commercialization of innovative products are high local concentrations of skilled, mobile staff. They can retrain and do intellectual operations.

In the economy of Ukraine during the commercialization of high-tech products in the industry there are a number of common problems. Among them are the problems that require adaptation of enterprises to the environment and the problems where the source of problems is the same company, such as decision makers. Studies have shown that solving these problems is possible only if commercialization of high-tech products subject to the following principles: information security, protection of intellectual property rights to the product and diversification the source of funding of commercialization, making business plans for commercialization of high-tech products in the pessimistic scenario, reaching flexibility in the selection and implementation of the strategy and tactics of the commercialization of high-tech products, the use of differentiated in time and space pricing mechanism.

The study of statistical information and exploring data of enterprises showed that the commercialization of

high-tech products can be made as based on the use of know-how and the basis of the patents. This applies to cases of promotion of high-tech products in Ukraine, and in the case of exports. Studies have shown that out of a total population of industrial enterprises in Ukraine only about 1,600 companies produce high-tech products, these are the processing and engineering industries. More than 400 companies, more than 12% of industrial enterprises develop and implement innovations while in developed countries the share of enterprises in 4-5 times higher. Most of these businesses are unevenly distributed by region of Ukraine, and most innovations are not patented. Commercialization is mainly based on relationships, based on know-how, which significantly reduces the organizational and legal positions of commercialization entities in defending their economic interests in interaction with business partners. Innovative high-tech products exports 36.2% of enterprises. With only a third of its volume of production is new for the market, all other high-tech products exported belong to some innovation [2, 4-8, 10, 16]. The Analysis of information of payment balance showed that the structure of export and import volume licensing and royalty services for Ukraine is traditionally very small. It is far less than 1%, while there is a steady excess of import licenses and royalties on their exports (Figure 1). The third part of post-Soviet countries are potential domestic consumers associated with high-tech products. Thus, there is no doubt that for the activation of processes of commercialization of high technology products and increase the level of geographic differentiation of its sales, it is necessary to update its quality, provide it with evidence and protect the rights of ownership of its production.



A) The part of export

B) The part of import

Fig. 1. Dynamics of particles royalties and licensing services in the structure of exports and imports of services during the 2005-2011

Notes: The authors constructed it according to the State Statistics Committee of Ukraine and the National Bank of Ukraine. Marks: 1 – 2005 year, 2 – 2006 year, 3 – 2007 year, 4 – 2008 year, 5 – 2009 year, 6 – 2010 year, 7 – 2011 year.

The tax preferences, the sources of funding for the commercialization of high-tech products, the level of interest rates on bank loans and the conditions of their provision, the value sector of the market, which is oriented for the manufacturing high-tech products, the chosen strategy of promoting high-end products, etc. are factors that influence the effectiveness of the commercialization of high-tech industrial products enterprises. Their economic content, the links between them and the total impact must be considered when forming a strategy and tactics of the building commercialize high technology products.

In order to obtain the expected economic results from the commercialization of high-tech products, the manufacturer should permanently monitor the parameters that characterize the effectiveness of commercialization, it is necessary to neutralize the factors that affect the commercialization of high-tech products or adapt to them. Due to the analysis was developed the method of evaluation of economic efficiency commercialization of high-tech products. It is based on the calculation of several groups of indicators. There are: indicators of economic efficiency commercialization of high-tech products; indicators of market opportunities subject of commercialization of high-tech products; gaining comparative advantages during the commercialization of high-tech products, performance completeness and timeliness of the plan commercialization of high-tech products.

The set of indicators that reflect the effectiveness of the commercialization of high-tech products, in a formalized form can be written as:

$$E^n = \bigcup_{i=1}^a e_{f_{1i}} \cup \bigcup_{j=1}^b e_{f_{2j}} \cup \bigcup_{x=1}^c e_{f_{3x}} \cup \bigcup_{z=1}^d e_{f_{4z}}, \quad (1)$$

where: (n) – is a total number of indices that characterize the effectiveness of the commercialization of high-tech products in the context of all groups; e_{f_1} – the indices that characterize the economic efficiency of the commercialization of high-tech products; a – the quantity of indices in plural (number); e_{f_1} ; e_{f_2} – the indices that characterize the realization of market possibilities of subject in commercialization of high tech products; b – the quantity of indices in plural(number); e_{f_2} ; e_{f_3} – the indices that characterize the gaining of industry comparative advantages during commercialization of high-tech product; c – the quality of indices in plural(number); e_{f_3} ; e_{f_4} – the indices that characterize the completeness and timeliness of the plan commercialize high-tech products; d - number of indices in the set e_{f_4} .

Each component of the constructed set is a subset of those that consist of a number of interacting elements. Consider the relationship between them:

1) a subset of economic efficiency commercialization of high-tech products:

$$\bigcup_{i=1}^a e_{f_{1i}} = \left\{ e_{f_{1.1a}} \right\} \cup \left\{ e_{f_{1.2b}} \right\} \cup \left\{ e_{f_{1.3c}} \right\} \cup \left\{ e_{f_{1.4d}} \right\} \cup$$

$$\left\{ e_{f_{1.5e}} \right\} \cup \left\{ e_{f_{1.6f}} \right\} \cup \left\{ e_{f_{1.7j}} \right\} \cup \left\{ e_{f_{1.8g}} \right\} \cup \left\{ e_{f_{1.9h}} \right\}, \quad (2)$$

The subset of indices of market opportunities subject commercialization of high-tech products:

$$\bigcup_{j=1}^b e_{f_{2j}} = \left\{ e_{f_{2.1i}} \right\} \cup \left\{ e_{f_{2.2k}} \right\} \cup \left\{ e_{f_{2.3l}} \right\} \cup \left\{ e_{f_{2.4m}} \right\} \cup \left\{ e_{f_{2.5n}} \right\}, \quad (3)$$

3) Subset of parameters that characterize the acquisition of companies comparative advantage in the commercialization of high-tech products:

$$\bigcup_{x=1}^c e_{f_{3x}} = \left\{ e_{f_{3.1o}} \right\} \cup \left\{ e_{f_{3.2p}} \right\} \cup \left\{ e_{f_{3.3v}} \right\} \cup \left\{ e_{f_{3.4q}} \right\} \cup \left\{ e_{f_{3.5j}} \right\} \cup \left\{ e_{f_{3.6r}} \right\}, \quad (4)$$

4) A set of indices completeness and timeliness of the plan commercialization of high technology products company:

$$\bigcup_{z=1}^d e_{f_{4z}} = \left\{ e_{f_{4.1s}} \right\} \cup \left\{ e_{f_{4.2v}} \right\}. \quad (5)$$

Multi proposed method will identify resources needed to increase the efficiency of the commercialization of high-tech products; to establish the activation of creative and management initiatives for projects commercialization of high-tech products; to provide the mark of phenomena and tendencies inside, outside surroundings of industry of high tech products; to show the feasibility of the establishment license in respect of the transfer of the production and promotion of high-tech products to third parties; justify the timing of the life cycle of high-tech products and more.

The process of commercialization of high-tech products is inevitably accompanied by diffusion, in other words the distribution of these products on the market. Despite the efforts of manufacturers to control the diffusion of the probability of turning it into a natural phenomenon always is present. However, businesses can evaluate the diffusion and application of certain measures for its restriction or guidance in the right direction. Studies suggest that alternatives of morphological analysis are the discriminant and cluster analysis, in particular isomorphic and isotopic, functional analysis, the method of construction of network graphs, and analysis by constructing cognitive maps, in particular Petri nets. In (Table 2) shows the comparative characteristics of alternative types of analysis that can be used for assessing the effect of diffusion on the effectiveness of commercialization of high-tech products.

Table 2. Comparison of alternative types of analysis that can be used for assessing the effect of diffusion on the effectiveness of commercialization of high-tech products

Type of analyses	Common characteristics	Different characteristics
Morphological analysis	-Focus on the objects, that have common features; -using the formalization as higher level of abstraction; - predict the point of explored phenomenon on independent parts and establishment of some relations between them	- Characterized by descriptiveness; - Making possible the transition from decomposition to recomposition and vice versa
Discriminant analysis		Let the possibility to identify the studied object to a class of objects
Cluster analysis		Allow to form the structures of elements of explored phenomenon
Functional analysis		Provide the information about line connections between factors, that influenced on effective indices and let set the reserves of improvement meanings of these indices in future
Analysis method for constructing network graph		Allow to set the optimal way of established goal and also to find the time reserves of optimization
Analysis by constructing cognitive maps, in particular Petri nets		Make possible simplified modeling of connections between key parameters

Notes: Done by authors of the article

Critical analysis of existing approaches of evaluating the phenomenon of diffusion suggests that the greatest benefits of evaluation are based on the morphological analysis (Fig. 2). Morphological analysis provides a decomposition of the diffusion parameters of high-tech products, which allows on its basis of essential characteristics to identify causal relationships between the factor and effective signs that are quantitatively and qualitatively characterize this phenomenon.

Summary of background information of morphological analysis can be used to improve the results of commercialization of high-tech products. This task should be used by morphological synthesis, which is based on the binary morphology. Morphological synthesis allows to identify set of vectors that point the way of improvement in the results of commercialization of high-tech products, analysis the events that have a material impact on the results and commercialization of high-tech products to transform their qualitative characteristics in quantitative and form a so-domain data for inputting the clearly information.

Research has shown that generalization of the original morphological analysis of information should be based on the so-called morphological synthesis. Morphological analysis of the phenomenon of diffusion of high-tech products is a decomposition process of extracting the essential characteristics of diffusion to determine causal-effect relationships between factors that led to the phenomenon of diffusion. Diffusion is inextricably linked with the commercialization of high-tech products. To identify stocks of commercialization important are to synthesize input data derived from morphological analysis. The synthesis involves bringing together disparate information in total. If the analysis builds a tree structure in the form of dendrites so during the synthesis of dendrite morphology will be a set of vectors that point the way to improve the results of commercialization of high-tech products. Automating the process of developing the management solutions with improvement results of the commercialization of high-tech products on the basis of morphological analysis and synthesis is possible on the basis of

provisions of binary morphology display, which represents an ordered set of data symbols marked as "0" and "1". Binary morphology allows produce the events that have a material impact on the process and results of commercialization of high-tech products, to transform their qualitative characteristics in quantitative. The incoming information should be classified. This will increase the level of argumentation in development management of decisions and expedite the process of their formation. It is essential to achieve the expected results of commercialization of high the products.

From the standpoint of economic efficiency commercialization of high-tech products important is to provide to this product as a lot of innovations. The Urgency of this task increases when high-tech products have the analogues on the market. Under these conditions, if the company that sells high-tech products commercialization can provide some of its innovations, it is essential competitive advantage. Studies have shown that innovation can be seen from the perspective of destination product, its functionality, quality and price used in its production materials (Fig. 3).

The method of innovative high-tech production enterprise is based on innovative features of high-tech production in enterprise including the commercialization, levels of diffusion and phases of the life cycle of high-tech production. Using this method business leaders get to track the changes in innovative high-tech enterprise. It is important for reasoning of necessary management decisions concerning investments in the improvement or modification of the product or collapse of the project in its production.

As a result of the studies was demonstrated that the process of commercialization of high-tech products is a manageable phenomenon, an artificial system that is formed by business leaders to achieve specific economic goals. The elements of this system are high-tech products as an object of commercialization, consumers of innovative products, supply and demand for it, the cost of commercializing of innovative products and its price. In Fig. 4 is built a graphical model of commercialization of high tech company.

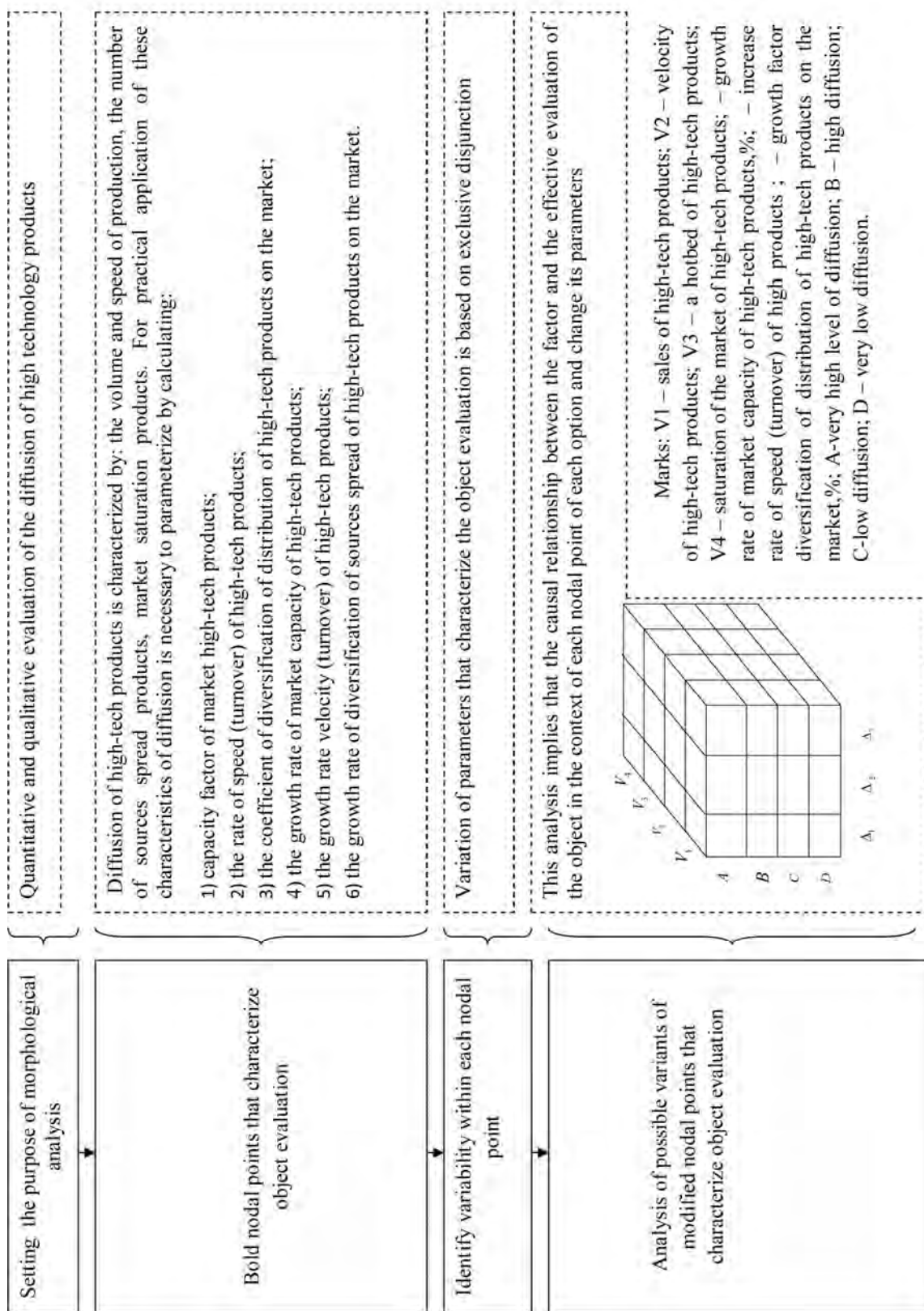


Fig. 2. Stages of Evaluation diffusion of high technology products through the use of morphological analysis

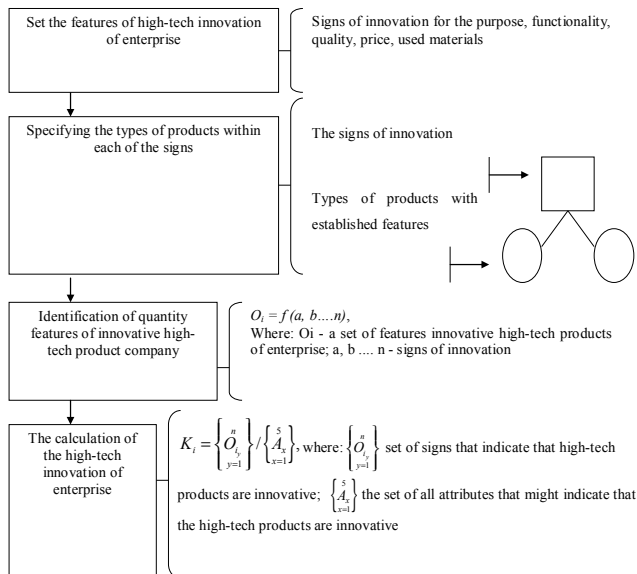


Fig. 3. The sequence of stages evaluation of innovative high-tech products of company
Notes: Done by authors.

Under the influence of enterprise management solutions, which is a manufacturer of high-tech products of elements of the system to each other and the environment are aimed at increasing innovation of high-tech products. The growth effects of diffusion will contribute to the economic efficiency of the process of commercialization.

CONCLUSIONS

Based on the problem commercialization of high-tech products, policies to address them, as well as factors that affect the commercialization of high-tech products industry proven that assessment commercialization of high-tech production enterprise should carry through the calculation of economic efficiency indicators of market opportunities subject commercialization of high-tech products, gaining comparative advantage indices company during the commercialization of high-tech products, performance completeness and timeliness of the plan commercialization of high-tech products. Using this method of control subjects commercialization of high-tech products are able to reasonably make tactical decisions, organizational and marketing nature regarding adjustment of the commercialization of high-tech products.

Basing on the problem commercialization of high-tech products, principles of their solution and factors that influence on the commercialization of high-tech products industry was proven that assessment commercialization of high-tech production enterprise should be carry through the calculation of economic indicators of market opportunities on commercialization of high-tech products, gaining a comparative advantage indices company during the commercialization of high-

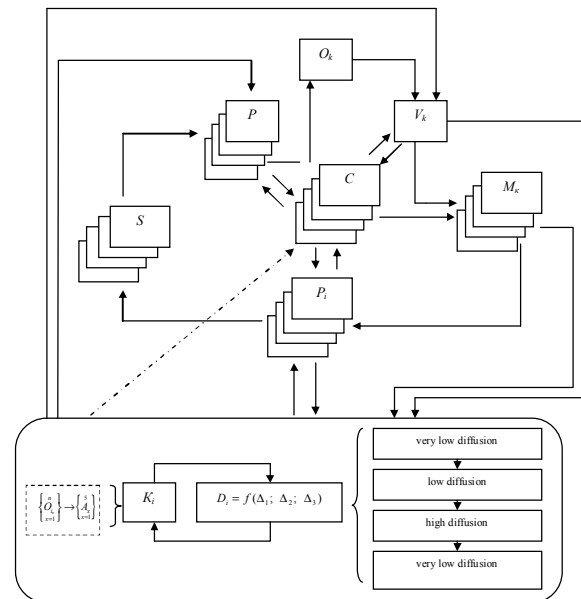


Fig. 4. Diversified system in space commercialization of high-tech products
Notes: Done by authors.

tech products, performance completeness and timeliness of the plan commercialization of high-tech products. The phenomenon of diffusion that accompanies the commercialization of high-tech products is necessary realize objective justification for the choice of commercialization.

The Proposed method made by F. Tsvikki is based on morphological cube. The method of diffusion allows the project managers of commercialization of high-tech products to establish causal relationships between the factor and the effective diffusion characteristics of high-tech products in the context of each nodal point and each option of parameter changing. It reduces the level of commercialization of high-tech products.

It is shown that in a diffusion that is often uncontrollable phenomenon of objective reality for ensuring the effectiveness of commercialization of high-tech products is necessary to implement the measures aimed at ensuring a certain level of innovation. The innovative method of high-tech products based on the number of changes in the number of innovative features. Awareness of managers about the change in the level of innovation of high-tech products in time and also the increasing of reserves shall help of effective commercialization of high-tech products.

Stages of the construction of the commercialization of high-tech products selected taking into account the relationship between the diffusion phenomenon that accompanies the process of commercialization and the level of innovation of high-tech products. The system of commercialization of high-tech products is necessary to form diversified in space and time. There are certain principles in this case: (information security, protection of intellectual property rights, business planning of high-tech

products, flexibility in the selection and implementation of strategies and tactics commercialization of high-tech products; differentiate pricing scheme in time and space) will allow them to avoid common problems that arise during the commercialization of high-tech products.

REFERENCES

1. **Aleksandrova V. 2004.** Sources of providing of innovative activity. Problems of science, №1, 22-29. (Ukraine)
2. **Androsova O. and Cherep A. 2007.** Technology transfer as a tool for the implementation of innovative activity: Monograph, 356. (Ukraine)
3. **Antonyk L., Porychnik A. and Savchyk V. 2003.** Innovation: theory, development mechanism, commercialization: Monograph, 394. (Ukraine)
4. **Bazylevych V. and Ilyin V. 2008.** Intellectual property: Creative metaphysical search: Monograph. - Kyiv, Znannya, 687. (Ukraine)
5. European and Asian Credit Transfer System. The view from a Canadian University Perspective – Summary of Case-Study Findings and Workshop Discussions. **2000.** Association of Universities and Colleges of Canada, 12. (Canada)
6. For determination of criterions taking to products of high-tech products [Electronic resource]. – Mode of access: [www. old.niss.gov.ua](http://www.old.niss.gov.ua) . (Ukraine)
7. **Fulova L. 2004.** State and prospects of development of high- tech sector of industry of Ukrain. Economics and forecasting, №3, 49-54. (Ukraine)
8. **Halytsya I. 2001.** Commercialization of intellectual property and applied scientific researches, Economy of Ukraine, № 2, 63- 67. (Ukraine)
9. Innovative Development [Electronic resource]. – Mode of access: <http://www.innodev.com.ua> . (Ukraine)
10. **Androsova O. and Cherep A. 2007.** Technology transfer as a tool for the implementation of innovative activity: Monograph, 356. (Ukraine)
11. **Kovtunen Y. 2012.** Features of organization of process of commercialization of innovative developments of highly technological enterprises. Proceedings of the Odessa Polytechnic University, №2 (39), 313-317. (Ukraine)
12. **Lyashyn A. 2011.** Strategies of commercialization innovacy— bridge between innovatorom and business.[Electronic resource]. – Mode of access: www.eg-online.ru. (Russia)
13. **Paranchuk S, and Korbutyak A. 2013.** Problems investment support innovative development of the national economy and solutions. Econtechmod an international quarterly journal, Vol.2, №4, 53-61. (Poland)
14. **Pervushyn V. 2006.** System of commercialization of technologies. Innovations, №1, 54-57. (Ukraine)
15. **Prateko A. 2008.** Commercialization of technologies in modern terms in Ukraine. [Electronic resource]. – Mode of access: www.experts.in.ua/baza/analitic/index.php?ELEMENT_ID=31888. (Ukraine)
16. **Solovyov V.P. 2006** Innovationas a systemic process in a competitive economy: Author. thesis for the sciences the degree of Doctor. Econ. Science. Specials 08.02.02 "Economics and management of scientific and technical progress, Kharkiv, 35. (Ukraine)
17. **Stanislavsk O. and Kovtunen K. 2011.** Commercialization of results of innovation. Proceedings of the Odessa Polytechnic University, № 2, 301-306. (Ukraine)
18. The intellectual property system [Electronic resource]. – Mode of access: <http://www.fabrikaidei.kiev.ua> (Ukraine)
19. **Tihonov N.** Efficiency of methods of commercialization of innovations. [Electronic resource]. – Mode of access: www.uecs.ru/uecs40-402012/item/1271-2012-04-19-06-35-1. (Russia)
20. **Voronkova A. E. and Kalyuzhna N. and Otenko V. 2008.** Management decisions to ensure the competitiveness of the enterprise: organizational aspect: Monograph, Volodymyr Dahl East Ukrainian National University. – Kharkiv, Publishing House "INZhEK", 512. (Ukraine)