The model of decision-making about the implementation of technological innovation at the machine-building enterprise in the context of its economic security

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S u m m a r y . The model of decision-making about the implementation of innovation, focused on the economic security of the machine-building enterprise has been proposed in the article. A preliminary study and evaluation of the level of economic security of the specific innovative solution from the field of locomotive-building has been produced. The basic directions of the economic security of the innovation process have been described

K e y w o r d s . Decision-making, machine-building, innovations, economic security.

INTRODUCTION

The process of innovation projects control is related to the high level of financial, time and labor costs. The main problem in the preparation of the innovative project is characterized by difficulties in determining the magnitude of the possible risks and deviations from the planned parameters.

That's why, to improve the efficiency of decision-making about the implementation of the innovative projects at the machine-building enterprise one need to have some specific tools to support the decision-making process, including the evaluation of the level of risks and economic security, carried out with the help of expertise and advanced computer technologies that can significantly improve the objectivity and reliability of the results obtained during the management decisions.

MATERIALS AND METHODS

This procedure of decision-making is focused on the implementation of the innovative solutions to ensure the economic security of the machine-building enterprise. For example, when having low energy efficiency of the output it is first of all necessary to develop and implement innovative solutions aimed at reducing energy consumption or to find cheaper alternative sources of energy etc.

A large proportion of the machine-building enterprises have developments, the implementation of which will enable them to compete effectively on the both domestic and global market, but it is difficult to realize it in the near future due to several reasons. The main problems of the innovative sphere development and implementation of the innovations at the machine-building enterprises are as follows [13, 31]:

1. The lack of investment or the critical level of investment in the innovations.

2. Inefficient use of available resources (difficulties in identifying effective and unprofitable production areas of the enterprise).

3. Old systems of accounting, control, planning, inefficient financial and innovation enterprise management, lack of methodological tools of evaluation and planning of the innovation and associated risks and threats.

4. The decrease of the intellectual capital of enterprises, as a result of the "brain drain" from the science sector, as well as the aging of the staff.

5. Low efficiency of the scientists' incentive.

6. Imperfect system of the search and selection of the innovation.

7. Short-term planning, lack of development strategy.

8. Ineffective communication between marketing and innovative business sector.

RESULTS

Nowadays, in the scientific literature the unified approach to the criteria for the selection and evaluation of innovative projects for a decision on its implementation had not yet developed. Typical decision-making algorithm, described in detail in [19, 29], includes:

- definition of the goals, objectives and criteria for decision-making,
- development of possible options,
- discussion and evaluation of possible options,
- select the optimal variant for the selected criteria,
- specification of the decisions creation of conditions for implementation of the project; - Testing of decisions,
- monitoring and analysis of the results of the decision, the possibility of its adjustment.

However, many authors are inclined to believe that the decision about the implementation of the innovative project should be based on an accurate analysis of individual criteria, especially with regard to possible risks that may arise during implementation of an innovative project [11, 30].

The innovative components plays a key role in the system of economic security of the enterprise, it includes a set of measures aimed at protecting innovation potential [17, 18].

The innovative potential of the company is the ability to achieve certain goals in the innovation sphere if they can be accomplished. To ensure the economic security of innovation one must regulate the level of innovative potential to support the innovative development of the enterprise and to reduce, neutralize endogenous and exogenous threats.

Most of the economic theories define innovation as a source of development which means that they must be actively and effectively used in the production and management, as well as the necessary conditions to implement the innovative potential must be created [25, 27].

World experience testifies to the fact that in terms of uncertainty and lack of development of market mechanisms in our country, the main directions of innovative development are first of all directed to minimize the costs when entering the new markets and, secondly, to reduce the risks of the innovative projects, including the development of models and methods for their evaluation [2].

When making any management decision about the implementation of the innovative project, one must take into account the evaluation and analysis of the specific information:

- the required bulk of resources to achieve concrete results in the innovative project,
- the stage of creation (the idea, research, implementation) of an innovative product or technology,
- the ratio of the effect of possible risks and the economic security after the introduction of the specific innovation project.

The author have developed a model of decision-making about the implementation of the innovative project at the machine-building enterprise, which is represented in Fig.1.

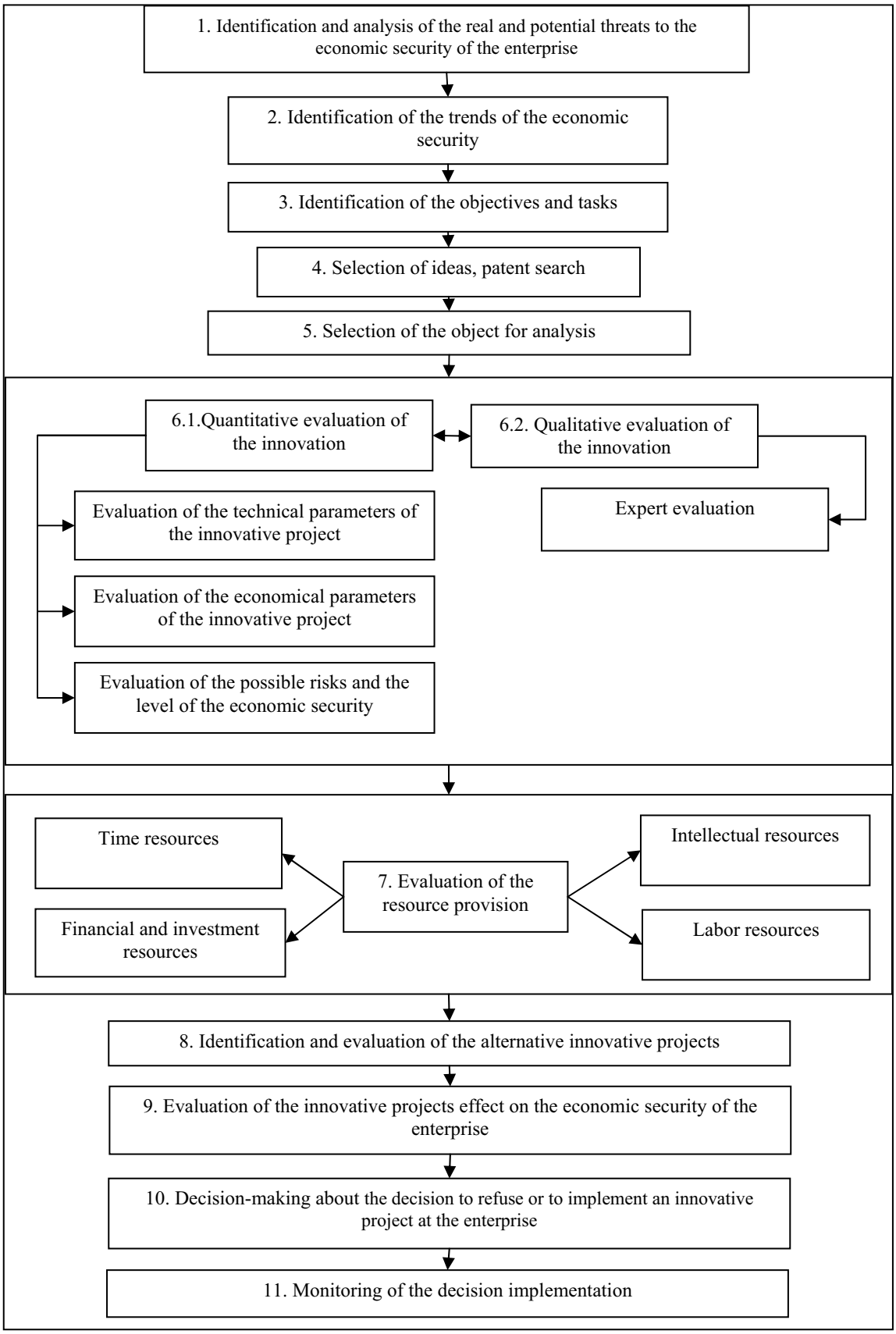

Fig. 1. Model of decision-making about the implementation of the innovative project at the machine-building enterprise

The proposed model of decision-making must contribute to the comprehensive system of innovation management, which will be closely linked with the system of economic security of the enterprise. The control and monitoring of the risks and threats to the innovation will ensure a sustainable development of the enterprise and increase its level of economic security.

One should also take into account that when introducing the innovative project, the factors which have a strong influence on the making management decision are the follows: the budget of the innovative project and financial resources of the enterprise as well as the risks of the acquisition additional external resources. To solve this issue one must have a precise expert evaluation of the innovative project, the procedure of which is described in [23, 24].

Let's consider the application of this algorithm for a specific innovation project in the field of transport engineering – «Device for lubricating of the wheel flange of the rail vehicle» [21, 22].

Innovative design belongs to the railway transport, in particular to devices for lubricating wheel flanges of the wheelset and may be used on the rolling stock.

According to the strategy of the railway transport development, the main directions of innovative development in technical and technological content of the railway transport have been given as follows [20]:

1. Innovations aimed to increase train speeds.
2. Increase in overhaul life of the rolling stock and the service life of the separate units.
3. Energy saving of traditional fuel resources and the use of alternative energy sources.
4. Improvement of the reliability of units and development of the rolling stock design.
5. Improvement of the interaction in the "wheel-rail" system etc.

To eliminate the technological gap in the national transport machine-building with the world level, it is necessary to conduct research and development studies on the following technologies:

a) technologies of high-speed movement:
- rolling stock production,
- rolling stock components production,
- the formation of the high-speed infrastructure subsystem (track, energy saving, management of the movement, and dispatching),

b) technologies of design and production of long aluminum profiles for rolling stock production and technologies of rolling stock design with the use of long aluminum profiles and composite materials,

c) technologies of design and production of double-decker passenger carriages.

The considered an innovative solution is an actual one for implementation since it refers to the three promising directions of the innovative development in railway machine-building, namely: the improvement of the "wheel-rail" interaction, energy saving of traditional resources, and increase in the service life of the rolling stock and its individual components.

A patent search and analysis of the literature showed that the for solid lubrication in the system "wheel flange - rail" are used method of ion-plasma spraying [16] and rotaprintny method [7], for liquid lubrication used method of irrigation free-fall stream [8], spray stream methods [9] and the filing of high-pressure stream of lubricant [10].

However, with increasing the role of resource and energy efficiency in a modern economy the use of different methods of lubricants activation in the " wheel flange - rail" gets a special urgency for railway transport. One of perspective directions is to use the ionized and ozonated air for improving the lubrication process.

Improving efficiency by using ionized and ozonated air as a lubricant in the "wheel flange - rail" may fluctuate in wide range of values from 20 to 300%

It was also found, that surface quality was improved by reducing the coefficient of friction, reducing surface roughness, residual stresses of the material reduction and increasing the durability of the processed surfaces, thereby increasing resource of wheels and rail [6,12,14,15]. Various aspects of the

interaction of contacting surfaces under the influence of activated air is examined by many authors [1,3,4,15].

Technical nature and the function of the device is illustrated by a drawing, which shows a schematic diagram of the device for lubricating wheel flanges of a rail vehicle (Fig. 2).

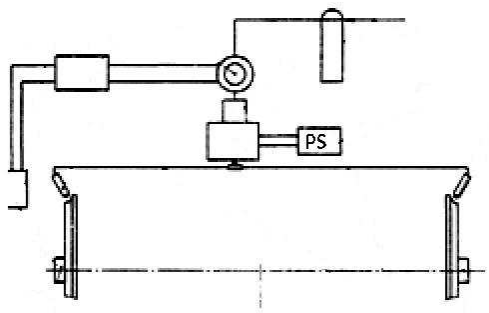

Fig. 2. Device for lubricating wheel flange of a rail vehicle with a mixture of ionized and ozonated air

The experts in the field of railway engineering and economics of transport have estimated the possible effect and cost of implementation of the proposed innovative solutions. The results of the expert evaluation are presented in Table 1 and Table 2.

Table 1. Evaluation of the factors of the innovative solution effect

	Factors of the effect	Min (UAH.)	Max (UAH.)
ES	Energy saving	600	1200
RS	Resource saving	4500	5800
LS	Labour saving	1800	3000
EC	Ecological conservation	1000	1800

Table 2. Evaluation of the factors of the innovative solution costs

	Factors of the costs	Min (UAH.)	Max (UAH.)
IC	Intelligent costs	2400	4800
MC	Material costs	3500	6000
LC	Labor costs	100	150
S	Services	30	60

The evaluation of the level of potential risks of the project has been carried out by means of the Monte Carlo method, which allows to determine the level of economic security when implementing certain innovative solutions in terms of the uncertainty and randomness of the selected factors of the effect and costs (Fig. 3) [26].

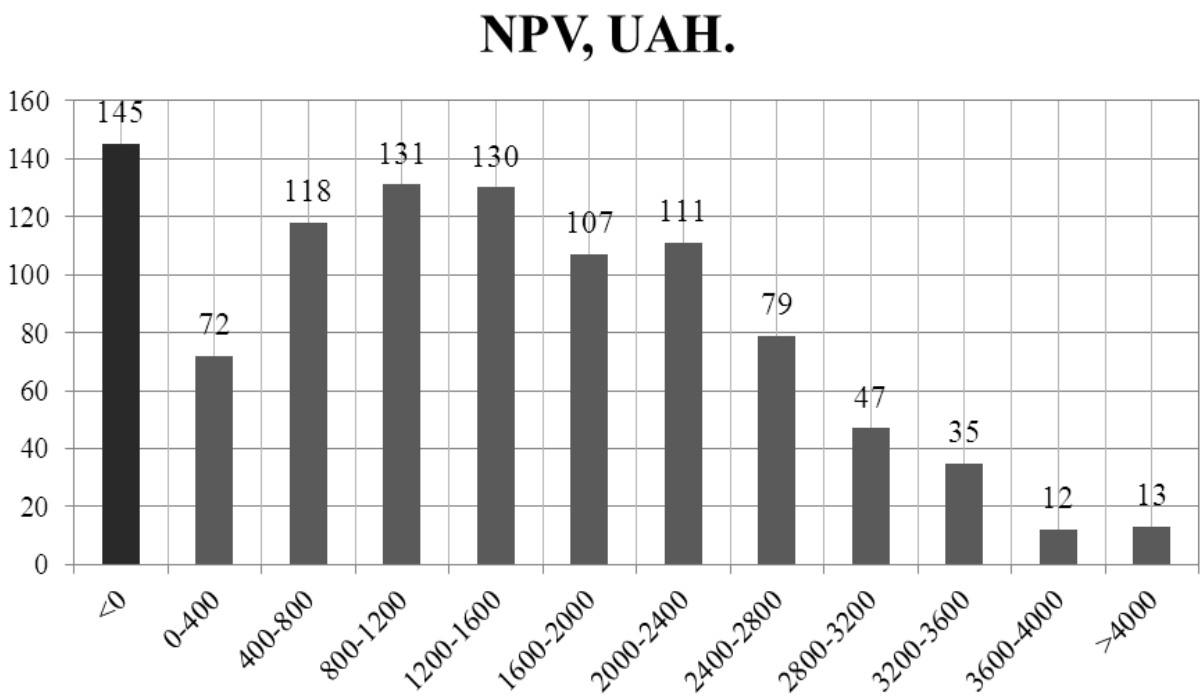

Fig. 3. The results of simulation of the level of risk and economic security Monte Carlo

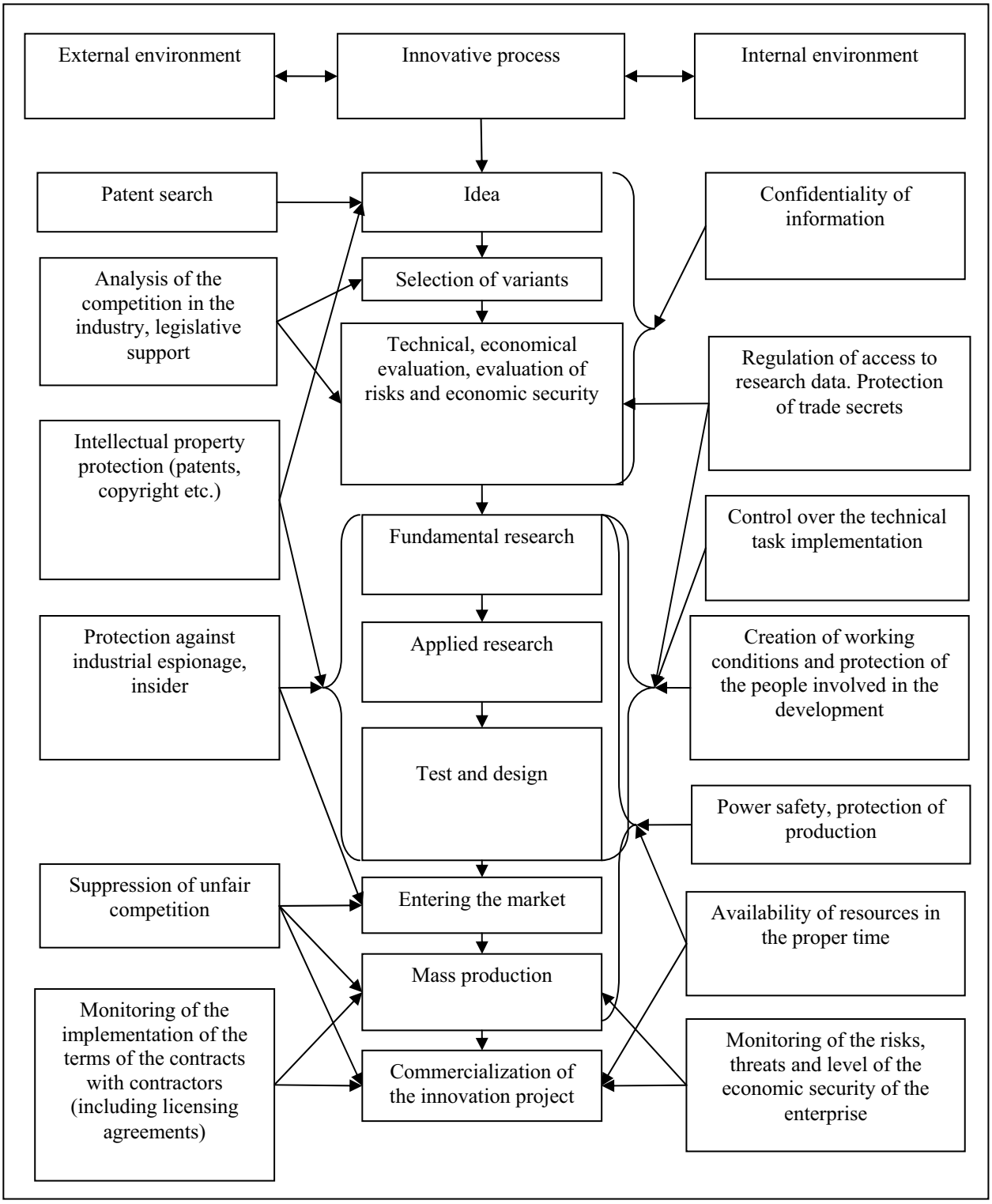

Fig. 4. The main directions of the economic security of the innovation process

The level of economic security of this innovative solution is 85.5% (855 of simulated scenarios from 1000), and the level of the risk of a negative result - 14.5% (145 scenarios from 1000), which indicates a high level of economic efficiency and innovation prospects.

The main advantages of the innovative project in comparison with the alternative developments are:

- increase in efficiency of the lubricating process by reducing the cost of lubricants and provision of the sufficient lubricant capacity,
- increase in traffic safety and reduction in operational risk by reducing pushes, fluctuations and vibration, by reducing slipping and skidding,
- a significant reduction in weight and dimensions of the device,
- a significant environmental effect on the environment as a result of not using traditional types of lubricant, which heavily pollute the roadbed,
- increase in the service life of the both wheels and rails,
- increase in the level of economic security of transport engineering enterprise due to the low cost of the project, its economic and environmental efficiency and protection of the intellectual property.

This innovative project is promising for the implementation, which was noted at the II International Youth Forum "Innovative projects for the development of the regions" (Luhansk), where the project was awarded the first prize [5].

However, besides support of decision-making and evaluation of the level of economic security of the innovative solution to ensure the economic security of the innovation activity of the machine-building enterprise one must determine the main directions of the economic security of the innovation process as a major component of the innovation activity of the enterprise.

Based on the results of [28], analysis of the features of innovation activity and economic security of the enterprise, a process model of economic security for certain stages of the innovation process, beginning from the idea to the commercialization of the innovation project demarcated by the medium of manifestation of internal and external has been presented (Fig. 4).

Economic security of the innovation process involves such components of economic security as power, intellectual, financial, personnel, legal, informational, and political-legal ones. All this points out a need for a systematic approach to ensure the economic security of the innovative activity of the machine-building enterprise.

CONCLUSIONS

1. Application of the proposed procedure of decision-making will improve the economic security of the machine-building enterprise through the implementation of innovative solutions aimed at reducing the real risks and threats to economic security of the enterprise, optimal allocation of resources for the innovation development of the machine-building production.

2. The innovative solution considered concerns several promising areas of innovation development of the railway engineering enterprise, has a high level of economic security and efficiency, which makes it actual to be implemented into production.

3. The implementation of this innovation will have a technical and economic effect, will reduce the consumption of energy resources and increase the service life of the unit, which will increase the competitiveness of its product and the level of economic security of the enterprise on the whole.

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МОДЕЛЬ ПРИНЯТИЯ РЕШЕНИЙ О ВНЕДРЕНИИ ТЕХНОЛОГИЧЕСКОЙ ИННОВАЦИИ НА ПРЕДПРИЯТИИ МАШИНОСТРОЕНИЯ В КОНТЕКСТЕ ЕГО ЭКОНОМИЧЕСКОЙ БЕЗОПАСНОСТИ

Чмелёв Вячеслав

Аннотация. В статье предложена модель принятия решения о внедрении инновации, ориентированная на обеспечение экономической безопасности предприятия машиностроения. Произведено предварительное обоснование и оценка уровня экономической безопасности конкретного инновационного решения из области локомотивостроения. Описаны основные направления обеспечения экономической безопасности инновационного процесса.

Ключевые слова. Принятие решений, машиностроение, инновации, экономическая безопасность.