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SAFETY OF INDUSTRIAL ENTERPRISES DEVELOPMENT: EVALUATION OF INNOVATIVE AND INVESTMENT COMPONENT

Purpose. To form a methodical approach to assess the innovation and investment component of the safety of an industrial enterprise.

Methodology. The methodical approach to the assessment of the innovation and investment component of development security takes into account the peculiarities of all functional areas of activities of an industrial enterprise and their structural transformations. It is based on theoretical consideration of information support and analytical function of enterprise management. The basis of the evaluation of the level of innovation and investment component of the security of industrial development the enterprise is an analytical and informational plane. Depending on the level of the managerial decision, the assessment of the given enterprise is performed the analytical-information plane which can be divided into three interrelated and correlated fields: an informational and analytical field, analytical field, and the field of management decision making. The methodological approach is based on generally accepted analytical methods and techniques with a combination of specific game and mathematical methods for making managerial decisions.

Findings. A methodical approach to the assessment of the level of innovation and investment component of the safety of industrial enterprise development in different economic conditions with the definition of criterion characteristics is proposed. The content and influence of the analytical and informational base in making an optimal managerial decision during the formation of the package of innovations to the implementation with determination of the priority of the directions of activities of the industrial enterprise are determined.

Originality. The originality is to combine concepts such as “safety” and “development” into a single socio-economic definition of “security development”. The theory of “debut” when forming a strategy for the development of an enterprise with the ability to choose the optimal managerial decision on the criterion of minimizing antagonisms is proposed. The model of the priority of the component of innovation and investment security of the industrial enterprise development, based on the Fishbern’s utility is used.

Practical value. The methodological approach suggested in the work is the theoretical basis for solving the scientific and practical problem of choosing the optimal managerial decision to assess the security of the industrial enterprise development and its innovation and investment direction of activities in different economic conditions: from stable to crisis, and vice versa.

Keywords: *development security, innovation-investment component, management decision, theory of debut, utility theory*

Introduction. Owners of any business entity seek to obtain positive results from their activities as long as possible. However, the patterns of market existence and the conditions of interaction that it dictates to its members, do not always correspond to the aspirations of the owners. Therefore, market conditions of operation require from business entities more and more diligent actions to adapt. Comprehensive development must take place at all levels of the national economy, and above all, at the level that forms the largest part of the gross domestic income of the state, namely, industrial enterprises. In addition, crisis phenomena, which are followed by the activities of industrial enterprises, do not allow the use of existing development potential, require the formation of a development security system within the framework of the overall enterprise management system. Along with the existing factors of external and internal influence on the activity of industrial enterprises there are new, additional factors, which in the stable conditions of management did not have a special significance, and in crisis conditions play a significant role. Accordingly, the consequence of this is the escalation of contradictions (antagonisms) between the subjects of market economic relations.

Unsolved aspects of the problem. From the innovation-investment component of the management system of an industrial enterprise, its competitive advantages, access to new mar-

kets and the welfare of owners and co-owners of the enterprise depend to a large extent. The peculiarities of the formation of a security system for the development of an industrial enterprise in the general system of management of an industrial enterprise and as a separate, one of the leading components - innovation and investment - is the specificity of activities and relationships with other subjects of economic relations.

According to the results of statistical observation, it is reasonable to assert that the dynamics of the change in the number of industrial enterprises in Ukraine in the last five years tends to decrease [1]. So, if at the end of 2013 there were 49130 industrial enterprises, then at the beginning of 2018 there was a decrease to 42026 enterprises (Table 1, Fig. 1) [2]. Moreover, the innovative active industrial enterprises in 2013 made 3.49 % of the total number of industrial enterprises, and at the beginning of 2018 their share is only 1.81 %.

Also, it is important to consider the chain of interaction between the extractive industry, part of the production (coal) of which is directed to metallurgical production, part of which, in turn, goes to the production of machinery and equipment. Against the background of a general decline in the innovation activity of industrial enterprises over the past five years, there has also been a decrease in the number of innovative active enterprises in the processing industry (Table 1, Fig. 1). Industrial enterprises, which are aimed at the production and sale of metal products, machine building products, have specific features that are related to the resource-intensive and energy-in-

Indicators of innovative activity of industrial enterprises of Ukraine for 2013–2017 years [2]

Indexes	2013	2014	2015	2016	2017
Number of industrial enterprises, units	49 130	42 187	42 564	38 555	42 026
Number of industrial enterprises engaged in innovation activity	1715	1609	824	834	759
Mining industry, including	38	32	21	20	227
coal mining	12	3	3	1	23
Processing industry, including	1551	1449	751	745	680
metallurgical production	133	158	65	73	69
manufacture of machinery and equipment	160	138	87	77	69

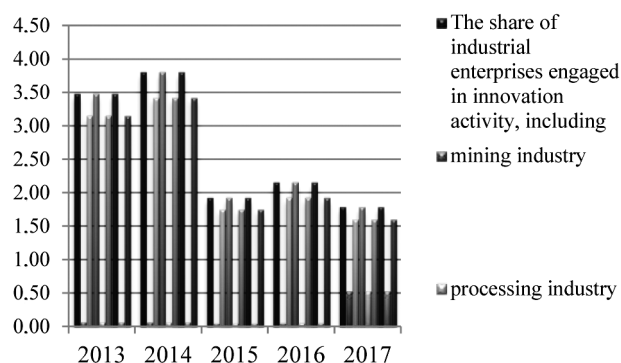


Fig. 1. The part of innovative active industrial enterprises [2]

tensive nature of their activities. This complicates the introduction of innovative processes, products, technologies due to the high cost of all types of resources. In times of crisis, the risks associated with the placement of capital in innovation, which leads to insufficient investment resources. This necessitates the introduction of such methodological approaches to assessing the innovation and investment component of the safety of the industrial enterprise, which would allow at the level of management decision to take into account the above listed features of the functioning of industrial enterprises in different economic conditions.

Literature review. A lot of attention was paid to the development question at all times. But during the last decade, as a result of the aggravation of crisis phenomena at all levels of the economy, the development of management of both levels of the national economy and industrial enterprises separately, is increasingly being considered by domestic and foreign scientists and practitioners such as: Shumpeter Y. A., Aref'eva O. V., Prokhorova V. V., Erohin O. O., Marinenko N. Yu., Vinichenko O. M., etc. Research focuses mainly on developing development models at both the global and macro- levels, as well as on the study of individual aspects of economic development.

Another area of scientific research for today is the issue of security of certain areas of activity of economic entities, primarily economic and financial security. Among them one can distinguish such as: Heyets V. M., Blank I. O., Labunskaya S. V., Lyashenko O. M. and others. However, the conditions of activity of industrial enterprises are in dynamic changes from stable functioning to a crisis state, taking into account tendencies of regressive and progressive development. Therefore, today the combination of the general scientific categories "safety" and "development" of the subjects of economic activity, in the complex scientific category "development security" is actual.

Purpose. The purpose of the study is to form a methodical approach to assess the innovation and investment component of the safety of the industrial enterprise.

Results. The complex conditions in which industrial enterprises operate in recent years in most are associated with crisis

phenomena. At present it is practically impossible to use the potential of their development by industrial enterprises. Accordingly, the performance of each of them has a negative tendency. Therefore, more and more scholars are considering issues of management of enterprise development [3, 4] and security, in particular, economic and financial [5, 6]. Summarizing studies aimed at managing the development of enterprises, they concluded that a combination of concepts such as "security" and "development" in a single socio-economic definition "development security" was necessary [7]. Both concepts from the point of view of the economic etiology of origin are very complex. Their economic essence from a scientific point of view should be considered both on the macro and meso levels, and at the micro level, that is, at the level of economic entities.

Innovative and investment security of industrial enterprise development is today one of the most important directions of its activity. Therefore, we consider it necessary to justify the introduction of a methodological approach for assessing the level of development security as the innovation and investment component. However, in developing the methodological approach, it is necessary to take into account the peculiarities of all functional areas of activity of the industrial enterprise and their structural transformations: financial and economic, personnel (psychological), techno-technological, political-power, informational, ecological – in their interrelation.

Given the generally accepted functions of management of an industrial enterprise, such as: planning, organization, motivation, control and its sub-function - analysis, it should be noted that the development of socio-economic relations in society, requires a fundamental review of the role of analysis and information provision, on the basis of which it is executed. The adoption of a management decision regarding the implementation of innovation projects should be based on a balanced result, based on information support and analytical function of enterprise management. As a result, a methodical approach to the assessment of the innovation-investment component the security of the development of an industrial enterprise is proposed to be carried out in three fields (Fig. 2):

- in the information-analytical field, which provides for obtaining reliable information for the analysis of possible antagonisms between the external and internal environment of the industrial enterprise to select a possible management decision on the criterion of minimizing antagonisms;

- formation of goals of strategic and tactical nature, determination of opportunities and threats of the industrial enterprise should take place in the analytical field of alternative solutions;

- the basis of the field of decision-making is to carry out a critical assessment of the level of safety of the development of the innovation-investment component.

Taking into account the basic principles of the analytical function of management: historicism, reliability, systemicity, adequacy, etc., – making a management decision must be based on an information and analytical platform that requires considerable effort and careful assessment of the environment.

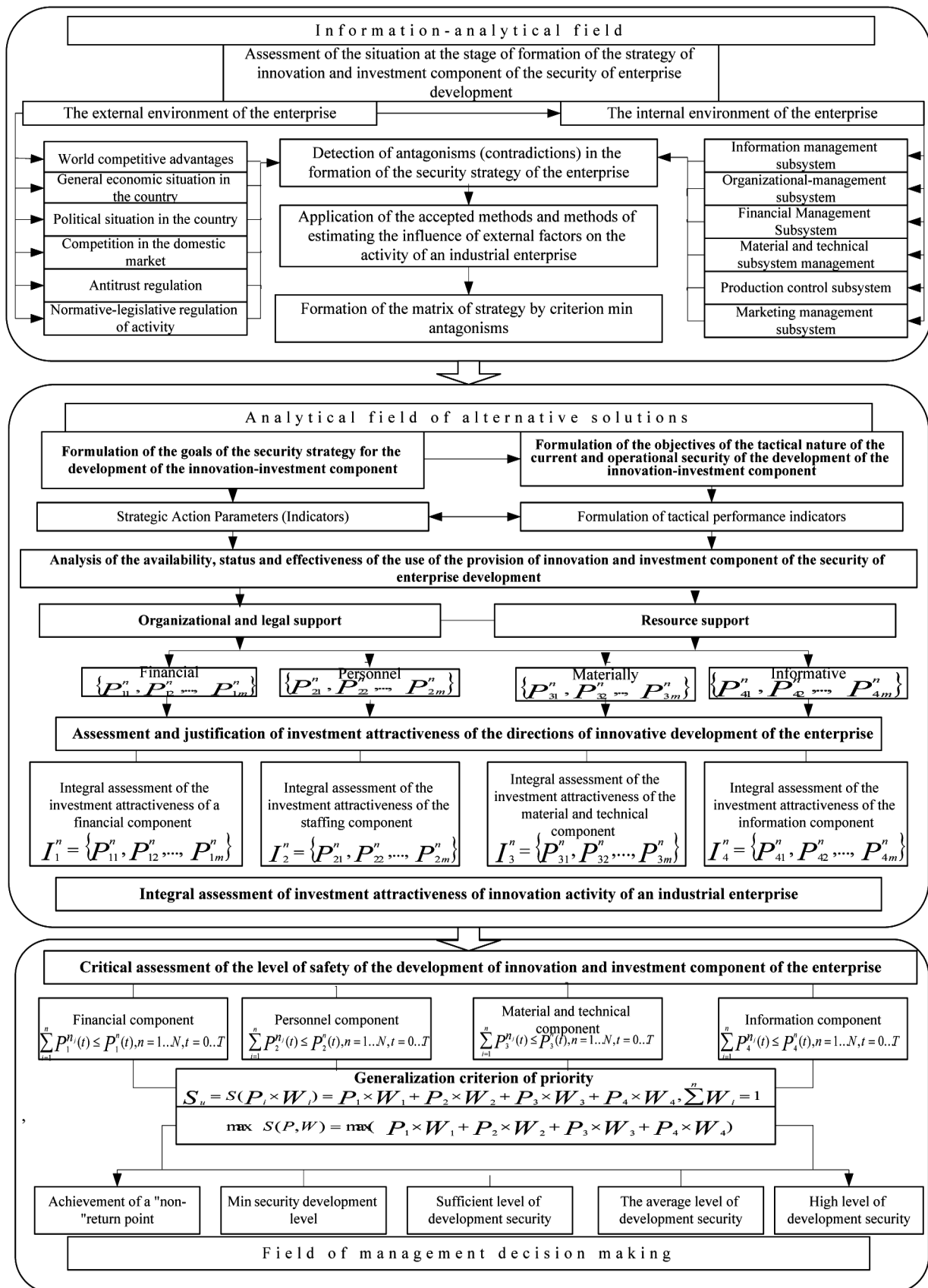


Fig. 2. Methodological approach to assessing the innovation and investment component of the safety of the industrial enterprise

Crisis in the economy is reflected in the exacerbation of antagonisms between industrial enterprises and the outside environment. The main ones are:

- reduction of the capacity of the domestic market, the growth of imports, which leads to a reduction in the volume of national

income, the growth of internal and external debt from the external environment, which, in turn, is reflected in the absence of industrial initiatives by industry and leads to ineffective marketing;

- political instability, tough entry conditions, negative demographic trends, rising unemployment, lower real incomes,

devaluation of the national currency, rising inflation, lowering the solvency of the population, reflected in industrial enterprises, a significant decrease in demand for products, goods, services, failure to reach planned profit volumes for innovative and investment projects, duration of their payback;

- the instability of the regulatory legislation, the tax system, the reduction of the presence of foreign investors leads to a change in the vector of development of the industrial enterprise, the impossibility the introduction of world technological trends, inventions, innovations, which is reflected in the growth of the shadow sector of the economy.

The aforementioned antagonisms have a significant effect on the financial and economic direction of the activity of an industrial enterprise, namely:

- to ineffective financial and investment management, with low investment attractiveness of the enterprise;
- high share of debt and low financial independence of enterprises;
- to ineffective asset structure and low liquidity;
- to an ineffective financial strategy, or the absence of any alternatives in the strategy;
- to high financial risks;
- to the high cost of capital and the complexity of its receipt.

This, in turn, requires the introduction of innovative managerial technologies at the stage of determining the security strategy of the industrial enterprise. One such technology is the kind of game theory, namely, the theory of “debut” [8]. The main content of the debut approach in the management of the security of the industrial enterprise development is to form the optimal strategy for the development of an industrial enterprise on the criterion of minimizing antagonisms between the participants in socio-economic relations. It allows at the stage of development strategy development, in the “first step”, to establish a set of interrelated goals and objectives, both strategic and tactical, that apply to all elements of the system, to determine the vectors of its action within the framework of ensuring dynamic development.

But, in choosing the optimal security strategy for the development of an industrial enterprise, the human factor is largely affected. Every person who decides at any level of management has his own vision of solving the problem and achieving the goal. Therefore, the debut approach imposes very serious requirements for the training of management personnel. He must have knowledge of the main options that are most commonly found on this issue, and the professional manager must know all the “debuts” that are used in practice.

The formulation of the objectives of the industrial development security strategy is foreseen in the analytical field of alternative solutions. In this field, it is envisaged to establish formal connections among alternative solutions based on the formulation and definition of qualitative and quantitative indicators that characterize the organizational and legal and resource support of the main areas of activity of the industrial enterprise.

The peculiarity of this stage of the methodological approach to assess the level of innovation and investment component of the development of enterprise security is to obtain reliable and adequate information regarding all participants in socio-economic relations. Of particular importance is the expert survey on the basic groups of indicators for assessing the level of security of enterprise development.

Relying on the theoretical foundations, financial support is presented by indicators: availability of cash, income and expenses, availability of own financial resources for innovation and attracting funds from external sources of funding, ability to attract, etc. Formalization of the listed indicators can be represented as a system

$$P_1^n \in \{P_{11}^n, P_{12}^n, \dots, P_{1m}^n\},$$

where P_1^n – a general indicator of financial support of the innovative-investment component of the security of enterprise development; $P_{11}^n, P_{12}^n, \dots, P_{1m}^n$ – indicators characterizing the financial support of the enterprise.

Personnel provision, which can be represented by such indicators as: the availability of personnel of the relevant qualification, work experience, labor productivity, etc. – formalized through the system

$$P_2^n \in \{P_{21}^n, P_{22}^n, \dots, P_{2m}^n\},$$

where P_2^n – generalizing indicator of personnel provision of innovation and investment component of enterprise development security; $P_{21}^n, P_{22}^n, \dots, P_{2m}^n$ – indicators characterizing the state of personnel support of the enterprise activity.

Material maintenance of the innovation-investment direction of the industrial enterprise’s activity is represented by the following indicators: availability and efficient use of raw materials, materials, material consumption, level of depreciation of fixed assets, level of renewal of fixed assets, etc. – formalized through the system

$$P_3^n \in \{P_{31}^n, P_{32}^n, \dots, P_{3m}^n\},$$

where P_3^n – general indicator of material support of innovation and investment component of the security of enterprise development; $P_{31}^n, P_{32}^n, \dots, P_{3m}^n$ – indicators characterizing the state of the material support of the enterprise. indicators characterizing the state of the material support of the enterprise.

If the previous system of indicators has, in the majority, a quantitative nature, then the information support of the innovation and investment component of the security of the industrial enterprise development is a set of qualitative indicators: the amount of information received, the reliability of the information, its adequacy, – can be formalized through the system

$$P_4^n \in \{P_{41}^n, P_{42}^n, \dots, P_{4m}^n\},$$

where P_4^n – a general indicator of information provision of the innovation-investment component of the security of enterprise development; $P_{41}^n, P_{42}^n, \dots, P_{4m}^n$ – indicators characterizing the state of information support of the enterprise activity.

Analysis and evaluation of the availability, state and efficiency of resource utilization provides an opportunity to substantiate the ability of the industrial enterprise to attract investment resources into innovation through an integrated assessment of investment attractiveness. It should be used later to make a managerial decision to determine the priority of the directions of innovation activity of the enterprise.

Before a decision maker (PMD), the task of comparing alternatives and their ranking on the degree of preference is usually to select the best option from the set of alternatives under consideration. As a rule, this task of decision-making is multicriteria. His solution involves the use of an integral criterion [9].

The above groups of indicators have both quantitative and qualitative character of their definition. For the formalization of the relationship between the groups of indicators, to determine the integral assessment of the level of security of the enterprise development, in the methodical approach, the model of priority of the component of innovation and investment security of the industrial enterprise development, based on the utility of the philosophy of Fishburn [10], has been used. Determination of the criterial assessment of the level of security development of the enterprise combines an expert assessment of the person who makes a management decision with a quantitative assessment of the level of security development.

The generalization criterion of priority of the directions of innovation and investment component of the development of enterprise security can be defined as

$$S_u = f(P_1, P_2, P_3, \dots, P_n; W_1, W_2, W_3, \dots, W_n).$$

To study the assessment of the level of safety of the development of an industrial enterprise, priority is given to the types of activities using a general indicator of the type

$$S_u = S(P_n \cdot W_n) = P_1 \cdot W_1 + P_2 \cdot W_2 + P_3 \cdot W_3 + P_4 \cdot W_4,$$

where P_n – indicators of assessing the level of security of the development of an industrial enterprise; W_n – weight coefficients of the significance of the group of indicators for assessing the level of security of the development of an industrial enterprise; P_1 – indicators of the financial component in the innovation and investment component of the security development of the industrial enterprise; P_2 – indicators of the personnel component; P_3 – indicators of the material component; P_4 – indicators of the information component.

What should the equation follow

$$\sum_{n=1}^4 W_n = 1.$$

The formulation of the task of assessing the level of safety of the development of an industrial enterprise can be reduced to the definition of the integral indicator, the characteristics of the system and its components, which provide

$$\max S(P, W) = \max (P_1 \cdot W_1 + P_2 \cdot W_2 + P_3 \cdot W_3 + P_4 \cdot W_4).$$

In doing so, it is necessary to fulfill the conditions of the limited resource base. Limitations on the financial component can be represented by the model

$$\sum_{i=1}^n P_1^{n_i}(t) \leq P_1^n(t), \quad n=1 \dots N, \quad t=0 \dots T,$$

where $P_1^{n_i}$ – n^{th} type financial resources used to implement a management decision i for assessing the level of development security, option j , for the selected time period $t, n=1, \dots, N, t=0, \dots, T; N$ – number of types of necessary financial resources; $P_1^n(t)$ – maximum available amount of financial resources n^{th} type (external, internal) for the corresponding period of time $t, n=1, \dots, N, t=0, \dots, T; T$ – the chosen time period for implementing the assessment of the level of development security.

The limitation of the indicators of the staffing component is represented by the model

$$\sum_{i=1}^n P_2^{n_i}(t) \leq P_2^n(t), \quad n=1 \dots N, \quad t=0 \dots T,$$

where $P_2^{n_i}$ – n -type personnel resources that are used to implement a managerial decision i for assessing the level of development security, option j , for the selected time period $t, n=1, \dots, N, t=0, \dots, T; N$ – the number of types of required human resources; $P_2^n(t)$ – the maximum available amount of personnel resources of the n^{th} species for the corresponding period of time $t, n=1, \dots, N, t=0, \dots, T; T$ – the chosen time period for implementing the assessment of the level of development security.

Limitations of material and technical components

$$\sum_{i=1}^n P_3^{n_i}(t) \leq P_3^n(t), \quad n=1 \dots N, \quad t=0 \dots T,$$

where $P_3^{n_i}$ – n^{th} material logistics resources used in the implementation of the management decision i for assessing the level of development security, option j , for the selected time period $t, n=1, \dots, N, t=0, \dots, T; N$ – number of types of necessary logistical resources; $P_3^n(t)$ – the maximum available volume of material resources of the n^{th} species for the corresponding period $t, n=1, \dots, N, t=0, \dots, T; T$ – the chosen time period for

implementing the assessment of the level of development security.

Information constraint limitation

$$\sum_{i=1}^n P_4^{n_i}(t) \leq P_4^n(t), \quad n=1 \dots N, \quad t=0 \dots T,$$

where $P_4^{n_i}$ – n^{th} type information resources used in the implementation of management decision i in assessing the level of development security, option j , for the chosen time period $t, n=1, \dots, N, t=0, \dots, T; N$ – number of types of necessary information resources; $P_4^n(t)$ – the maximum amount of information resources of the n^{th} species for the corresponding period $t, n=1, \dots, N, t=0, \dots, T; T$ – the chosen time period for implementing the assessment of the level of development security.

Estimation of the significance of the indicators by the Fishburn's formula is defined as

$$C_i = \frac{2(N-i+1)}{N(N-1)}, \quad i=1 \dots N,$$

where N – plural of natural numbers.

Based on the obtained value of the generalization criterion of priority, one can determine the level the security of the industrial enterprise development (Table 2).

Obtaining the criterion level of safety of the development of an industrial enterprise provides opportunities for a person who makes a managerial decision to determine the priority directions of innovation development taking into account financial and investment opportunities.

Conclusions and perspectives of further development in this direction. The proposed methodological approach for assessing the level of safety of the development of an industrial enterprise allows:

- take into account the peculiarities of all functional areas of activity of the industrial enterprise and their structural transformations;

- to determine the special role of the informational and analytical plane in decision-making at all levels of management, forming three interrelated and interdependent fields: the information-analytical field, the analytical field of alternative solutions, the field of decision-making;

- to use the theory of "debut" in forming the strategy of enterprise development with the possibility of choosing the optimal managerial decision on the criterion of minimizing antagonisms;

- to use the model of the priority of the innovation-investment component of the safety of the development of an industrial enterprise based on the utility theory of the Fishburne, which combines the expert assessment of the person who makes the management decision with the quantitative assessment of the level of development security.

The methodological approach suggested in the work is the theoretical basis for solving the scientific and practical prob-

Table 2

Criterion assessment of the level of security of the industrial enterprise development

Security development level	Interval development safety criterion
Achievement of the point of "non-return"	$0 < S_u < 0.15$
The minimum level of development security	$0.15 < S_u < 0.35$
Sufficient level of development security	$0.35 < S_u < 0.55$
The average level of development security	$0.55 < S_u < 0.80$
High level of development security	$0.80 < S_u < 1.0$

lem of choosing the optimal managerial decision to assess the security of the industrial enterprise development and as one of the main components of the innovation and investment direction of the enterprise in different economic conditions: from stable to crisis, and vice versa.

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Безпека розвитку промислового підприємства: оцінка інноваційно-інвестиційної складової

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Мета. Формування методичного підходу до оцінки інноваційно-інвестиційної складової безпеки розвитку промислового підприємства.

Методика. Методичний підхід до оцінки інноваційно-інвестиційної складової безпеки розвитку враховує особливості всіх функціональних напрямів діяльності промислового підприємства та їх структурних перетворень. Основою підходу є теоретичний розгляд інформаційного забезпечення та аналітична функція управління підприємством. Проведення оцінки розвитку даного аспекту підприємства відбувається в аналітично-інформаційній площині, що, у залежності від рівня прийняття управлінського рішення, може поділятися на три взаємопов'язаних та взаємозалежних поля: інформацій-

но-аналітичне поле; аналітичне поле альтернативних рішень; поле прийняття управлінського рішення. Методичний підхід ґрунтується на загальноприйнятих аналітичних методах і прийомах з комбінацією специфічних ігрових і математичних методів прийняття управлінського рішення.

Результати. Запропоновано методичний підхід до оцінки рівня інноваційно-інвестиційної складової безпеки розвитку промислового підприємства в різних умовах господарювання з визначенням критеріальних ознак. Визначено зміст і вплив аналітично-інформаційної площини у прийнятті оптимального управлінського рішення при формуванні пакету інновацій до впровадження з визначенням пріоритетності напрямів діяльності підприємства.

Наукова новизна. Полягає в поєднанні таких понять як „безпека“ та „розвиток“ в єдину соціально-економічну дефініцію „безпека розвитку“. Пропонується теорія „дебюту“ при формуванні стратегії розвитку підприємства з можливістю обрання оптимального управлінського рішення за критерієм мінімізації антагонізмів. Використана модель пріоритетності складової інноваційно-інвестиційної безпеки розвитку промислового підприємства, що оснований на теорії корисності Фішберна.

Практична значимість. Запропонований у роботі методичний підхід є теоретичною основою для розв'язання науково-практичної проблеми обрання оптимального управлінського рішення з оцінки безпеки розвитку промислового підприємства та його інноваційно-інвестиційного напрямку діяльності в різних економічних умовах: від стабільних до кризових, і навпаки.

Ключові слова: безпека розвитку, інноваційно-інвестиційна складова, управлінське рішення, теорія дебюту, теорія корисності

Безопасность развития промышленного предприятия: оценка инновационно-инвестиционной составляющей

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Цель. Формирование методического подхода к оценке уровня инновационно-инвестиционной составляющей безопасности развития промышленного предприятия.

Методика. Методический подход к оценке инновационно-инвестиционной составляющей безопасности развития учитывает особенности всех функциональных направлений деятельности промышленного предприятия и их структурных преобразований. Основой подхода является теоретическое рассмотрение информационного обеспечения и аналитической функции управления предприятием. Проведение оценки развития данного аспекта предприятия происходит в аналитико-информационной плоскости, которая, в зависимости от уровня принятия управленческого решения, может делиться на три взаимосвязанных и взаимозависимых поля: инфор-

мационно-аналитическое поле; аналитическое поле альтернативных решений; поле принятия управленческого решения. Методический подход основан на общепринятых аналитических методах и приемах с комбинацией специфических игровых и математических методов принятия управленческого решения.

Результаты. Предложен методический подход к оценке уровня инновационно-инвестиционной составляющей безопасности развития промышленного предприятия в различных условиях хозяйствования с определением критериальных признаков. Определено содержание и влияние аналитико-информационной плоскости в принятии оптимального управленческого решения при формировании пакета инноваций к внедрению с определением приоритетности направлений деятельности предприятия.

Научная новизна. Состоит в объединении таких понятий как „безопасность“ и „развитие“ в единую социально-экономическую дефиницию „безопасность развития“. Предлагается теория „дебюта“ при формировании

стратегии развития предприятия с возможностью выбора оптимального управленческого решения по критерию минимизации антагонизмов. Применена модель приоритетности инновационно-инвестиционной составляющей безопасности развития промышленного предприятия, основанная на теории полезности Фишберна.

Практическая значимость. Предложенный в работе методический подход является теоретической основой для решения научно-практической проблемы выбора оптимального управленческого решения по оценке безопасности развития промышленного предприятия и его инновационно-инвестиционного направления деятельности в различных экономических условиях: от стабильного к кризисному, и наоборот.

Ключевые слова: *безопасность развития, инновационно-инвестиционная составляющая, управленческое решение, теория дебюта, теория полезности*

Рекомендовано до публікації докт. екон. наук К. Ф. Ковальчуком. Дата надходження рукопису 18.01.19.