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O. I. Maslak., Dr. Sc. (Econ.), Prof.,
N. Ye. Grishko, Cand. Sc. (Econ.),
O. O. Hlazunova, Cand. Sc. (Econ.),
K. O. Vorobiova, Cand. Sc. (Econ.)

Kremenchuk Mykhailo Ostrohradskyi National University, Kremenchuk, Ukraine, e-mail: bezruchko.o.a@gmail.com

APPROACHES TO THE MANAGEMENT OF THE COSTS OF INNOVATION ACTIVITY OF MINING ENTERPRISES: ASPECTS OF ECONOMIC SECURITY

О. І. Маслак, д-р екон. наук, проф.,
Н. Є. Гришко, канд. екон. наук,
О. О. Глазунова, канд. екон. наук,
К. О. Воробйова, канд. екон. наук

Кременчуцький національний університет імені Михайла Остроградського, м. Кременчук, Україна, e-mail: bezruchko.o.a@gmail.com

ПІДХОДИ ДО УПРАВЛІННЯ ВИТРАТАМИ ІННОВАЦІЙНОЇ ДІЯЛЬНОСТІ ГІРНИЧОДОБУВНОГО ПІДПРИЄМСТВА: АСПЕКТИ ЕКОНОМІЧНОЇ БЕЗПЕКИ

Purpose. Optimizing the parameters of the management of innovation costs of a mining company for the purposes of preserving its economic security.

Methodology. To achieve this goal the method of multi-objective optimization using analytic superstructure "Finding solutions" of the "Microsoft Excel" software package was applied.

Findings. The results of the evaluation of the effectiveness of the management of innovation costs have been presented. The influence of the correlation of the costs of innovation and the level of economic security has been identified. The basic steps and interrelations in the modeling of the safe development of a mining company have been displayed. The approach to the management parameters optimization of the innovation activity costs was developed. It allows organizing the preventive regulation and current control, timely responding to changes in the external and internal conditions, and it also helps to make an informed decision in the process of enterprise development strategy forming in modern conditions.

Originality. Scientific originality is to develop an approach that adequately describes a dual nature of the impact of investment and innovation activities on the state of economic security of mining companies. The method allows optimizing the parameters of the management of innovation costs that will enable mining companies to control innovation costs in terms of preserving their own economic security.

Practical value. To optimize the economic security of a mining company taking into account the implementation of additional innovative projects, the introduction of information technologies, such as a model of the economic growth parameter optimization using the PP MS Excel "Solver" has been proposed.

Keywords: *innovation activities, economic security, return on innovation*

Introduction. The effective management in any field of enterprise activities, in particular in the sphere of cost management, can be carried out only in the case of controlled links formation between the elements of its integral system which is intended for implementing management functions.

Taking into account this statement, we propose to consider the system of innovation activity cost management as a set of jointly functioning components which are separated from the environment and interact with it as an indivisible whole.

Taking into account the prevention of danger, the process of the innovation cost management should be implemented both at the level of formation of strategic development benchmarks, and in the determination of tactical and operational tasks in order to prevent the devastating effects of the threats of internal and external mining enterprise environments.

Under these circumstances, the problem of strategic alternatives selection in the field of technical re-equipment of industrial enterprises, introduction of the latest technological processes, innovation and investment policy and stimulation of the environmentalization of production processes in the framework of the fixed assets renewal becomes a matter of special significance.

Identification of an unsolved problem. The dual nature of the investment and innovation activity influence on the economic security components is that, on the one hand, the secure enterprise development is impossible without introduction of product and process innovations, technological modifications, investment activities. But, on the other hand, their implementation would increase riskiness of the enterprise functioning while

promoting new products to the market, terms remoteness of investment returns, which, as a result, could lead to the worsening of the economic security of the business entity. The latter has the particular relevance during the crisis phenomena, the decline in the national economy and structural imbalances. Therefore, the reasoning of the innovative development directions and the innovation activity cost management should be considered in terms of preserving the optimum level of the enterprise economic security.

The global financial crisis and its consequences had the negative influence on the industrial production, including the industry of metal ores extraction. During 2013–2015 this industry was showing the steady decline in production. The most successful years for the mining industry were 2003 and 2010, and the worst one was 2009, when the industrial output indeces were 90.9 % in comparison with the previous year (Fig. 1).

According to the metallurgical enterprises association "Metallurgprom", the indeces of metal ores mining had the negative dynamics during 2014–2016. At the same time, 2015 was characterized by a negative global iron ore and steel market conjuncture because of the Chinese demand falling and oversupply. In these conditions in 2015 Ukrainian mining enterprises reduced the iron ore extraction by 2 % in comparison with 2014 (to 80.371 million tons), the volume of pellets production was reduced by 1 % (to 21.657 million tons). As a result, during 2015 the iron and steel production showed a rapid decline in production indices (83 % from the 2014 level), in particular, steel production declined by 16 % from the 2014 level (22.935 million tons) and pig iron – to 21.878 million tons (by 12 %) [2].

The drawdown of production volumes properly influences the state of the business entities' innovation activities, which is quantitatively traced in the negative dynamics of the share of enterprises that introduced innovations (during 2002–2005, 2000–2009 and 2012–2014, respectively). At the same time, it should be emphasized that the implementation of innovation-oriented development is a prerequisite for the structural imbalances overcoming and crisis processes declining in the Ukrainian economy, a basis for ensuring its competitiveness in the international market.

However, the lack of the state financial for the innovation development of the industry is characterized by a negligible share of payments (only 1–2 %) of the total GDP. At the same time, during 2010–2016 the share of expenditures on research and development in the GDP of Ukraine declined from 0.75 to 0.48 % (of which funding from budget funds decreased from 0.33 to 0.16 %, respectively). This negative trend is observed along with the extremely low absolute value of this indicator – the average value for the EU countries exceeded 2.03 % at the end of 2015. World experience notes the cross-border mark of knowledge intensity at a level of 0.9 % of GDP, in excess of which the science can perform a progressive function, aimed at increasing the effectiveness of economic development.

Our research studies highlight that over the past 10 years the availability and interdependence of such components as the cost parameters of innovation activity financing, conservatism and risks are significant for the Ukrainian economy.

During 2001–2015 the ratio of industrial production growth rates and the share of innovation-intensive enterprises indicate a limit on the availability of financial resources for the innovation activities implementation in the post-crisis period. At the same time, the availability of financial resources and the possibility of maneuvering the costs of innovation are the most important factors in ensuring the growth of industrial production volumes, the effectiveness of the business entities activities. Thus, the revival of the enterprises' innova-

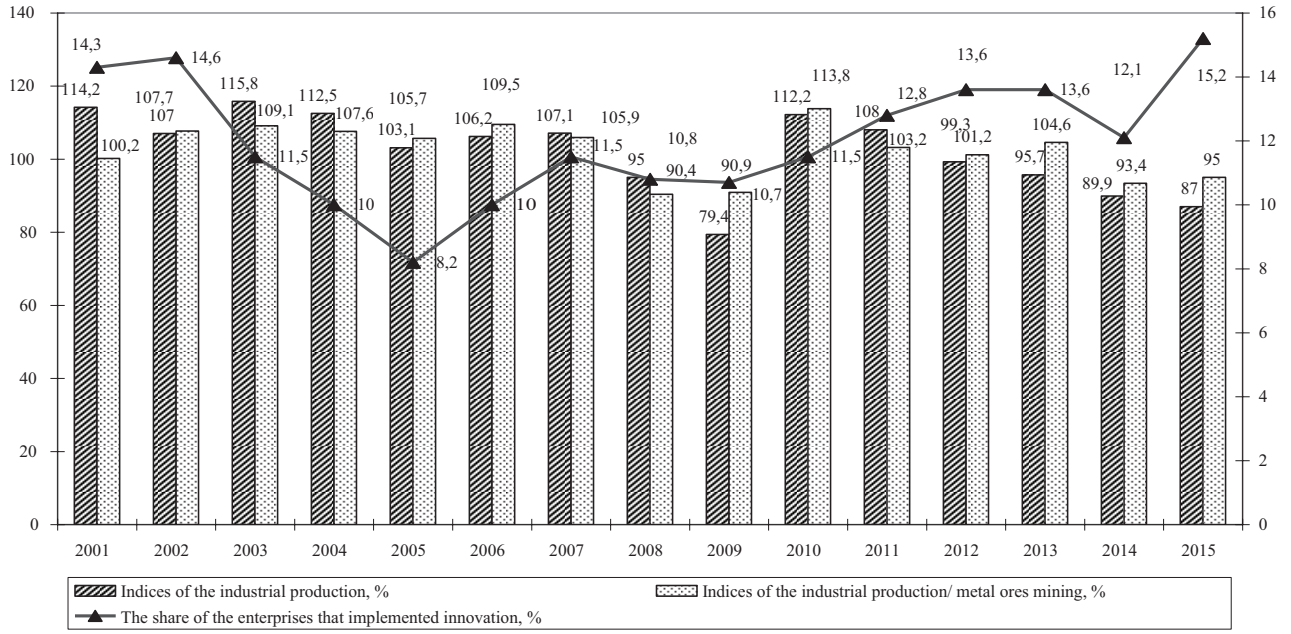


Fig. 1. The ratio of growth rates of industrial production volumes, in particular in the field of metal ore mining, and the share of the innovation-active industrial enterprises of Ukraine (2001–2015) (Calculated according to the data [1])

tion activity during 2015 is expected to lead to the positive changes in the quantitative proportions of Ukrainian industry production output during the next period.

During 2012–2015 the domestic industrial enterprises showed some conservatism, which affected the reduction of the number of names of innovative types of products by 7.8 %, and led to a decrease in the share of implemented innovative products (up to 1.4 %) in industrial volume.

At the same time, during the last five years the number of new technological processes applied to production decreased by 51.5 %. Among them the negative dynamics were also noted in the implementation of low-resource and resource-saving (decrease by 11.4 %) technologies. The low level of the enterprises inventive activity produces a focus on the implementation of finished designs and ideas, rather than the development of innovation potentials within the framework of its own research work.

Absence of risk affects the orientation of industrial enterprises for the purchase of finished technological solutions and the innovation development is mainly realized through the renewal of fixed assets. In this context, it is also worth noting the reduction of production with a high degree of novelty, that is, products that are new to the market.

Analysis of the recent research. Among the scientific works devoted to the problems of economic security management, the development and improvement of its theoretical and methodological principles, the papers of M. M. Yermoshenko, K. S. Horiacheva, H. V. Kozachenko [3], O. M. Liashenko and other scientists should be highlighted. The problems of the evaluation of economic security, diagnostics and modeling of the management process of the complex systems development are investigated in the papers of O. V. Nusinova [4] and J. Moore. The papers of such prominent foreign and domestic scholars as H. V. Kozachenko [3], H. A. Kraiukhin, V. G. Lebedev, A. V. Cherep, O. I. Yashkina [5] were dedicated to the problem of determining methodological bases and developing practical recommendations for the creation of the effective system of company cost management, including the system of innovation management and in the context of safe condition conservation.

Unsolved aspects of the problem. At the same time, a number of issues related to the specific role of innovation activity of the mining enterprise in the strengthening of its economic security, finding ways to improve the effectiveness of the management of the costs of innovations have not been reflected in the scientific literature.

Objectives of the article. The purpose of this article is to substantiate the approach of optimizing the parameters of the innovation cost management of the mining company for the purposes preserving its economic security.

Presentation of the main research and explanation of scientific results. Taking into account the conclusions obtained on the basis of the formation of a regression dependence between the quantitative values of the realized scientific, scientific and technical works [1] and the proportions of effectiveness of the operational activity of industrial sector enterprises, we can state the importance of the innovative component in the formation of prerequisites for profitability and safe development of economic entities. Variation of the effective sign of the constructed model [6] indicates the significance and value of the result to reinforce this thesis.

The analysis of statistical data allows us to conclude that the main part of the cost of innovation is enterprises' own funds (53–73 %) [1, 7]. At the same time, during 2015, the volume of financing from the state budget and by foreign investors decreased by 83.9 and 57.6 %, respectively (Fig. 2).

The main item of domestic enterprise innovations (over 70 % of the total funds, which are directed to the enterprises' innovative development) is the purchasing

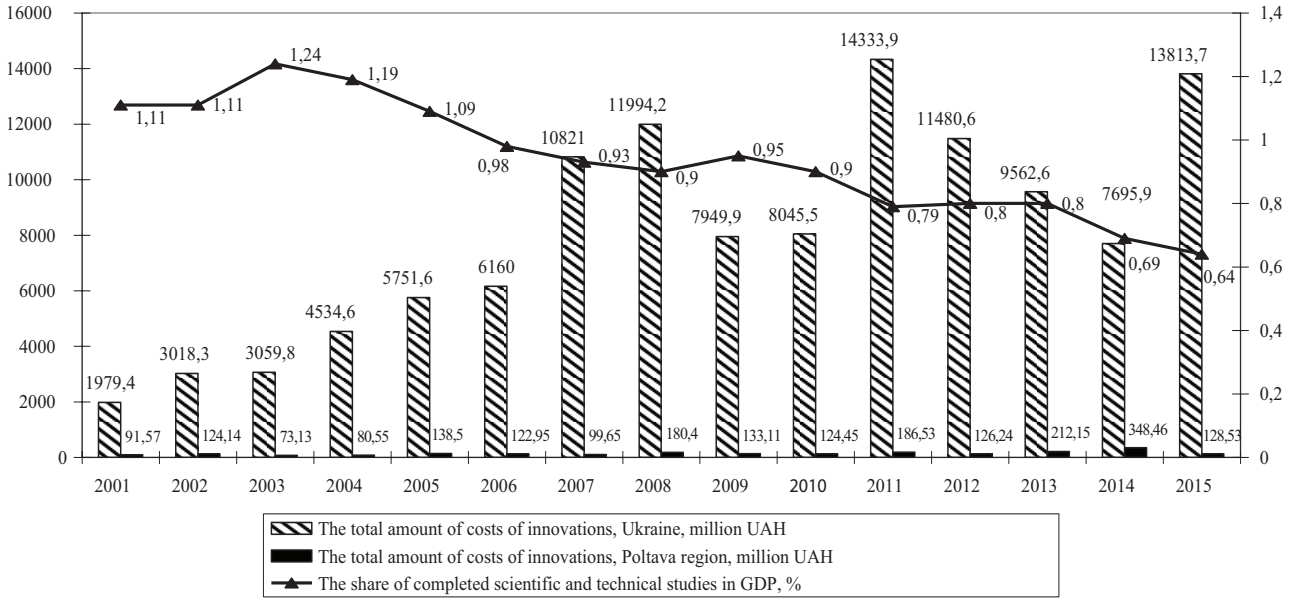


Fig. 2. The ratio of innovation costs and the knowledge-intensity indicator of GDP in the industrial sector of Ukraine, in particular in the Poltava region, during 2001–2015 (calculated according to [1])

of new machinery, equipment and software. During 2015, among the enterprises which were engaged in innovations, the ratio between the cost of purchasing of fixed assets, software and research and development was 5:1 (80.7 and 14.7 %, respectively). This indicates the tendency of domestic enterprises to use mainly external innovative products in comparison with the development of their own potential for the production of innovative developments.

The priority of research work by type of work is shown by the proportion between the share of expenditures aimed at fundamental, applied scientific research studies and experimental development. So, during 2010–2016, 50–59 % of the total expenditures on research and development was spent on science and technology, indicating the practical orientation of innovation costs. But at the same time, the negative trend in the reduction of the proportion of completed scientific and technical studies in GDP of Ukraine is also observed.

The minimization of innovation activity costs should be carried out by types of innovation or their directions. It is necessary to emphasize that the combination of both approaches expands the possibilities of preventive management of costs of business entities' innovation activities. In the long run the cost management should be closely linked to the implementation of the resource conservation program provided that the requirements for the most efficient use of resources of all types are satisfied. It is reasonable to combine the retrospective assessment of costs, in particular innovation costs, with the dynamics of changes in production volume, which makes it possible to obtain a relative assessment of the effectiveness of process management in the relevant field.

Therefore, the reduction of costs per unit of output should be recognized as a target benchmark for the innovation cost management provided the phased implementation of the innovation-oriented enterprise development strategy is ensured.

The effectiveness of the innovation cost management of the Private joint stock company "Poltava Iron Ore Enrichment Works" (until 2016 – Open Joined-Stock Company "Poltava Iron Ore Enrichment Works" – the mining and processing company with a full cycle) is defined by the ratio of loss and costs for its achievement and the index of the evaluation of the innovation cost management effectiveness. It is necessary to have a generalized value of the innovation costs management effectiveness in order to make an efficient decision if the value of various individual indicators has opposite values at a particular time. The profit maximization always has the primary priority for the domestic industrial enterprises, thus in any event the need for reimbursements is recognized. Reasoning from the dualistic nature of the system processes, an approach to the effectiveness determination of the activity of the enterprise as a whole and for individual activity components is based on the comparison of successful and costly components of the economic processes and the comparison of the internal and external factors impact in the system.

The effective indicators for the estimation of the effectiveness of the development and management of the Private joint stock company "Poltava Iron Ore Enrichment Works" innovation costs are shown in Fig. 3.

According to these calculations, we can see that innovation activities are profitable. Although during 2011–2013 the dynamics of the ROI was growing quite slowly, it should be kept in mind that this activity could make a profit only after a certain period of time. And the increase in the rate of the R&D costs return during the 2014–2015 indicates positive proportions of the outrunning of the net income growth rates over the growth rates of the innovation costs. The value of the dynamic criterion of the enterprise innovatization negatively

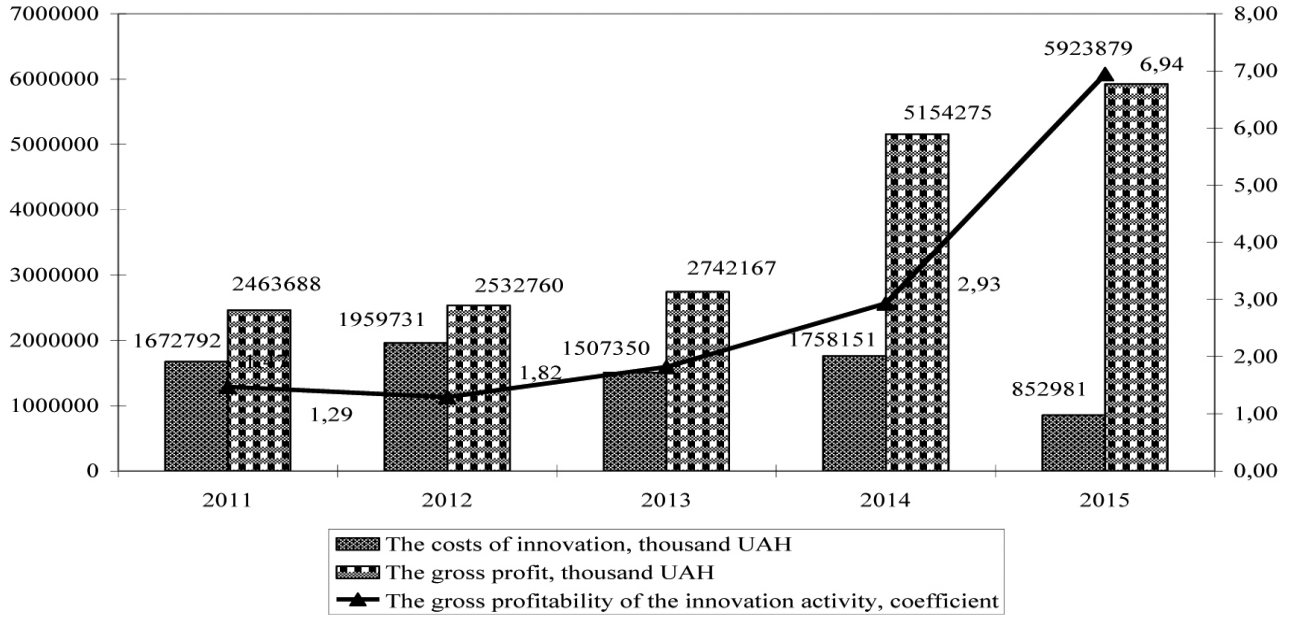


Fig. 3. The formation of gross profitability of innovation activity of the Private joint stock company "Poltava Iron Ore Enrichment Works" (calculated according to the data [2])

characterizes the state of the innovation cost management during 2014–2015.

In the process of preventing the risks of the operating activity within the framework of the cost management mechanism which is used at the Private joint stock company "Poltava Iron Ore Enrichment Works" the indicators of operating profitability, including operational, are calculated and analyzed. Moreover, parity of cost and effective components in determining the break-even volume of production is established.

This model is based on calculating the break-even point of the sales volume, which determines the level of the security of the enterprise's operating activity. The establishing of the optimal ratio between the net income and expenditures, taking into account the probabilistic nature of the findings on the development of events in the prospective period, is expedient to make calculations which are based on predictive estimates. In the proposed context the security reserve (profit margin) should be considered an excess of the break-even volume (its estimated value) of the actual sales [8]

$$Coef_{EC} = (NI_{fs} - NI_{b\text{-}ev\,ac}) / NI_{fs} \cdot 100.$$

During the study period from 2011 to 2015, the net (actual) income of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic activity, the dynamics and absolute value of the economic safety coefficient indicate the effectiveness of the operational activity of the research object and the gradual increase in the safety margin. The emergence of a positive trend over a five-year period is primarily due to an increase in the company's gross profit, which was a result of an increase in sales volumes.

The results of calculations that illustrate the formation of the level of economic security of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic activity are reflected in Fig. 4.

We offer the way to optimize the level of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic security, which will provide an opportunity to control the factors that affect the change in innovation costs, monitoring them in terms of preserving the mining enterprise economic security. This method is based on the verification of the level of economic security in terms of expansion of the portfolio of innovation projects and at the same time the decision to increase the cost of innovation combined with the procedure of complementary and independent projects selection.

The adoption of a certain investment and innovation decision to the implementation is proposed to be carried out according to the criterion of the critical (or desired) value of the economic security coefficient. This will enable to improve the mechanism of strengthening of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic security. The algorithm of the economic security optimization level, taking into account the implementation of additional innovation projects in the Private joint stock company "Poltava Iron Ore Enrichment Works", is shown in Fig. 5.

While managing the enterprise business activity process it should be considered that every indicator depends on its varied and diverse factors which characterize this activity. The more we study the influence of factors on the value of the effective rate, the more accurate results of the analysis and the evaluation of the quality of enterprise activity are. Therefore, the study and the measurement of the impact of economic factors on the value of the studied economic indicators are important for the enterprise management.

The innovation cost management optimization is performed through the use of the regression modeling tools. Based on the conclusions concerning the existence of a relationship between the value of the target function (Y) and the factors influencing it, at the first stage a linear regression dependence with the following variables is formed: the amount of innovation costs, thousand UAH (x_1), the gross profitability of innovation activities, the coefficient (x_2), the dynamic criterion of the enterprise innovatization, the coefficient (x_3), the

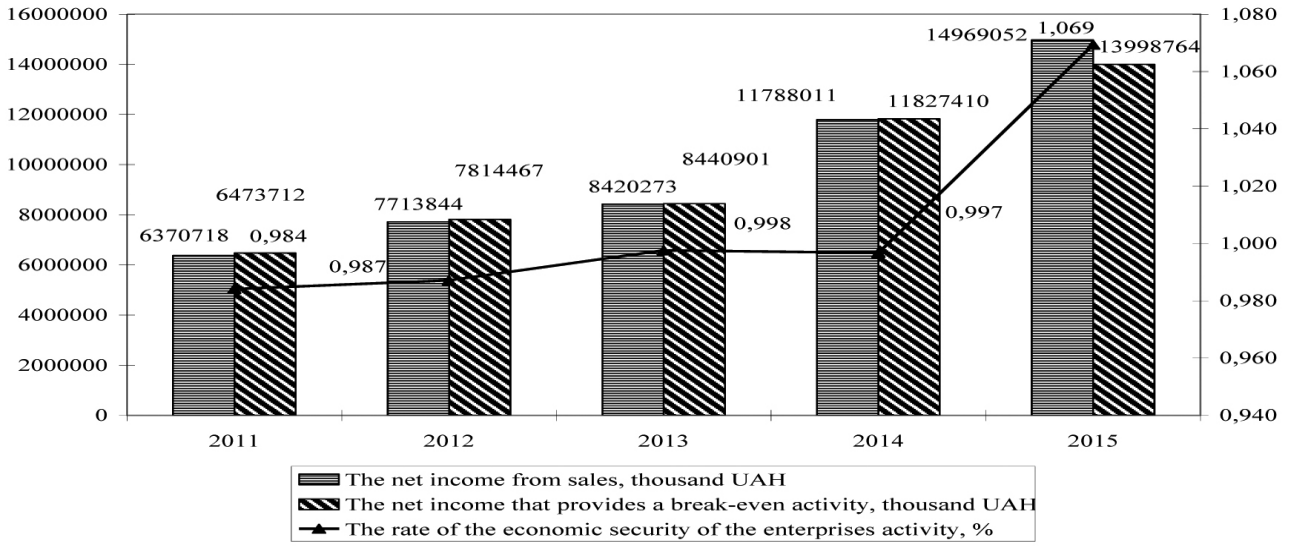


Fig. 4. Proportions of formation of the economic security coefficient of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic activity (calculated according to the data [2])

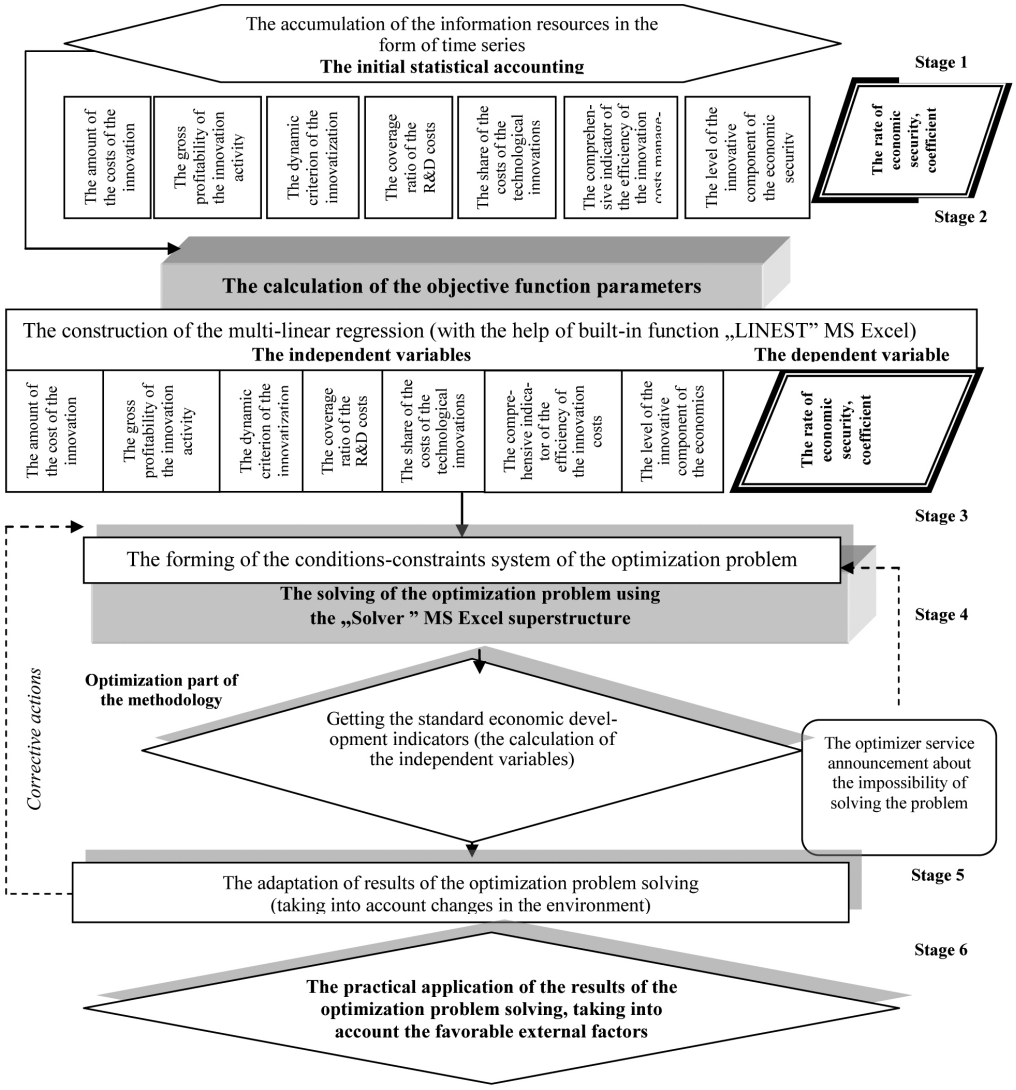


Fig. 5. The algorithm of the economic security optimization level, taking into account the implementation of additional innovation projects of an iron ore enrichment enterprise using MS Excel

coverage ratio of the R&D costs (x_4), the share of the technological innovation costs, the coefficient (x_5), the comprehensive indicator of the effectiveness of innovation costs management, the coefficient (x_6), the rate of innovation component (functional component) of the enterprise economic security, the coefficient (x_7).

The Fisher criterion was used to verify the adequacy of the accepted model with the help of experimental data. The built-in statistical function SUMPRODUCT allows us to find the dispersion of deviations. As $F_{calc} > F_{tab}$ **(**the critical value for $P = 0.95$, $k_1 = 7$, $k_2 = 4$ is 6.09, the calculated value of the criterion is $F_{calc} = 137.81$**)**, we can assume that the model is adequate to the experimental data and it can be used for economic analysis and forecasting with the reliability $P = 0.95$.

The estimations of the multifactor model parameters, which characterize the direction and value of the link between the productive and the factor characteristics, are represented by the coefficients a_0, a_1,a_2, a_3, a_4, a_5, a_6, a_7. The required sums for this and the selective averages "y" and "x" were calculated using the corresponding master-functions. As a result: $a_0 = 0.998$; $a_1 = -0.060$; $a_2 = 0.013$; $a_3 = 0.21$; $a_4 = 0.047$; $a_5 = 0.49$; $a_6 = 0.011$; $a_7 = 0.012$. The search model of the dependence is the following

$$Y = 0.998 - 0.060X_1 + 0.013X_2 + 0.21X_3 + 0.047X_4 + 0.49X_5 + 0.011X_6 + 0.012X_7.$$

We can see that the share of technological innovation costs has the greatest influence on the level of economic security. This is logical, as the introduction of new technologies and processes is always accompanied by a certain increase of the efficiency of mining company operations.

The enterprise innovation activity maintaining during the research period in the dynamics of growth, which affects the absolute value of the dynamic criterion of innovation, should also be considered as a reserve for the security strengthening.

At the same time, it was argued that an increase in the amount of innovation costs must necessarily be accompanied by an increase in return, which illustrates the growth of gross profitability of innovation activity,

which satisfies the needs of the owners of Private joint stock company "Poltava Iron Ore Enrichment Works" in improving the efficiency of work.

Otherwise, a decrease in the profitability of investment and innovation processes may lead to the revision of the feasibility of innovative projects implementation, the abandonment of innovation activity through the review of its own policy of reinvestment and restrictions on the possibility of attracting external investment resources.

The purpose of this study is to find the optimum parameters for the strengthening of the Private joint stock company "Poltava Iron Ore Enrichment Works" economic security level, taking into account the implementation of additional innovation projects and some approaches development to solve it in terms of existing company the Private joint stock company "Poltava Iron Ore Enrichment Works" using PP MS Excel, i.e. stages 3–6 of this algorithm.

At the third stage of the optimization algorithm, the limit of the restrictive parameters for the directed change of the formed multifactor regression elements is established. In our opinion, the necessary and sufficient conditions of the constraints system proposed in the framework of the optimization of the level of economic security should be determined as

$$\begin{cases} L_{ES}^{PR} \to \max \\ L_{ES}^{PR} = L_{ES} + \Delta L_{\text{ES}} \\ \Delta \text{C}_{\text{add innov.}} \to \max \\ Cr_{R\&D} \geq 1 \\ \left[L_{ES}^{PR} \right] = L_{ES} - L_{ES}^{cr} \\ [\Delta \text{L}_{\text{ES}}] > \Delta \text{p} \\ \text{I}_{\text{Eff innov cm}} \geq 1 \end{cases},$$

where L_{ES}^{PR} – the predictable level of the mining enterprise economic security, taking into account the changes in the innovation activity costs; L_{ES} – the current level of the economic security of the enterprise; $\Delta C_{add\ innov}$ – the change of the dynamic criterion of the enterprise innovatization; $Cr_{R\&D}$ – the cover ratio of R&D costs; L_{ES}^{cr} – the integrated indicator of the effectiveness of innovative costs management; $[L_{ES}^{PR}]$ – the reserve of economic security of the enterprise; L_{ES}^{cr} – the critical level of the economic security of the enterprise; Δp – the corrective factor of the enterprise tendency to risk.

Thus, the maximization of the economic security level is the strategic orientation for the mining company innovation cost regulation. The last actual value of the indicator in the retrospective assessment should be taken as the lower limit of this position in the system of restrictions.

At the same time, the increase in the plant environmental responsibility should be taken as expected for the society [9]. This affects the increase in the share of the implemented low-waste and resource-saving technologies, the stimulation of the production ecologization, and ensuring the rational nature management.

The maximization of the value of the dynamic innovation criterion corresponds to the need to shift emphasis towards the increase in the share of the implementation of integrated high technologies in comparison with the traditional ones (which is typical mainly for high and medium technology sectors of the economy). For enterprises in the low-tech sector this condition is reflected in the gradual increase in the rate of innovation activity in the long run.

The ratio of income and expenditure aspects of the business entity research work should be aimed at exceeding the coefficient of coverage of R&D costs per unit. Thus, the basis for the creation of a safety margin of the system of economic security is formed, in which the increase in threats to the external and internal environment will not allow crossing the limit of the maximum (critical) level of security. The absolute value of the safety margin characterizes the type of innovation strategy [8] of the business entity, and thus should not fall below the rate of inclination of the enterprise to risk.

The analytical superstructure "Solver" MS Excel allows ensuring the preservation of economic security by modeling the proportions of directed changes in relevant factors (stage 4) in the process of maximizing the amount of innovation costs.

For financially unsustainable enterprises one should choose the position of moderate conservatism, in order to prevent the permanence of positive changes in the practical implementation of the recommendations of the optimization task. The Optimizer complements the automatic receipt of the result by detailed conclusions in a rather informative tabular form of the Report.

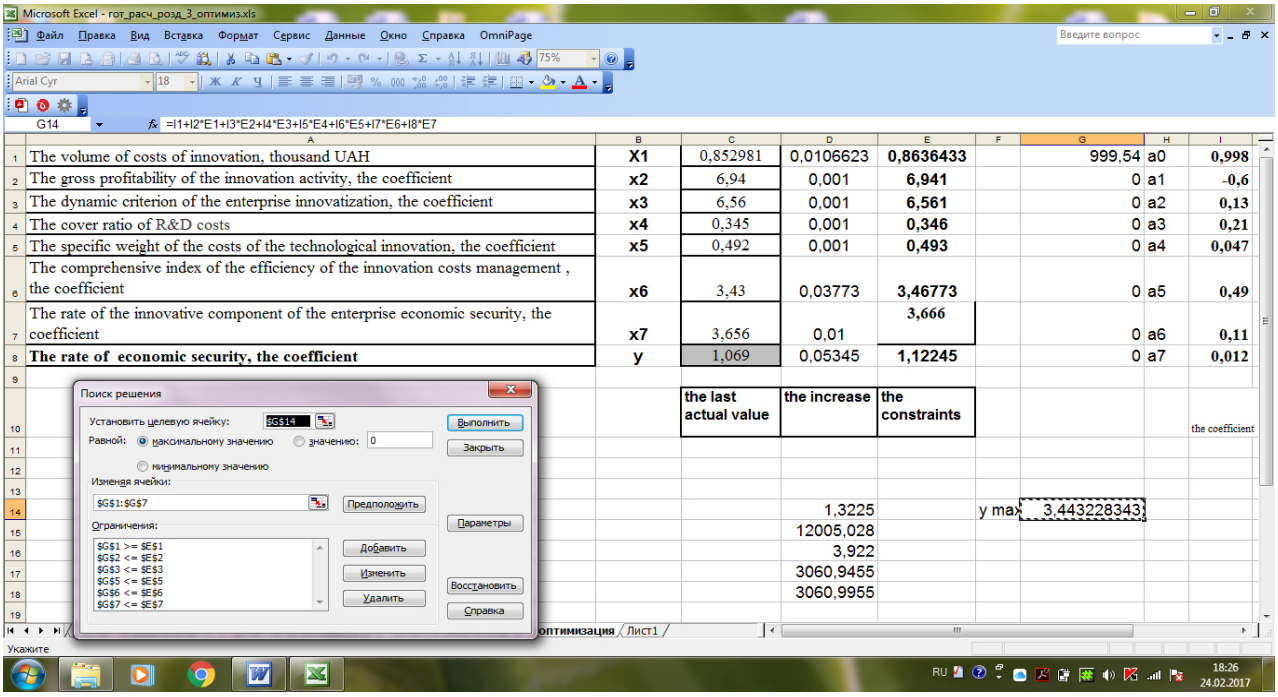
It should be noted that the processing of the results of the optimization problem solution, taking into account the changes in aggressiveness and incomplete certainty of the external environment (stage 5), is carried out in order to guarantee a consistent outcome to the real state (Fig. 6).

Conclusions and recommendations for further research in this area. According to the obtained results, changes in the external and internal environment and their projection on a productive state of the economic security will allow managing a "margin of strength of economic security", the level of which must correspond to the strategic goals of the innovative direction of enterprise development.

In our opinion, the formation of an effective innovation cost management system of Private joint stock company "Poltava Iron Ore Enrichment Works" is possible under the following conditions:

- diversification of sources of innovative projects financing by attracting external resources in terms of the city-forming and export-oriented functions of the plant in the region and existing reserves for the development of raw materials (basic ones – Horyshno-Plavnivske and Lavrykivske deposits, prospective – Eristivske and Bilanivske deposits);

- consideration of specific features of ore raw materials and priority consideration of projects relating to the



1	The volume of costs of innovation, thousand UAH	X1	0,852981	0,0106623	**0,8636433**	999,54	a0	**0,998**
2	The gross profitability of the innovation activity, the coefficient	x2	6,94	0,001	**6,941**	0	a1	**-0,6**
3	The dynamic criterion of the enterprise innovatization, the coefficient	x3	6,56	0,001	**6,561**	0	a2	**0,13**
4	The cover ratio of R&D costs	x4	0,345	0,001	**0,346**	0	a3	**0,21**
5	The specific weight of the costs of the technological innovation, the coefficient	x5	0,492	0,001	**0,493**	0	a4	**0,047**
6	The comprehensive index of the efficiency of the innovation costs management , the coefficient	x6	3,43	0,03773	**3,46773**	0	a5	**0,49**
7	The rate of the innovative component of the enterprise economic security, the coefficient	x7	3,656	0,01	**3,666**	0	a6	**0,11**
8	**The rate of economic security, the coefficient**	y	1,069	0,05345	**1,12245**	0	a7	**0,012**
9								
10			**the last actual value**	**the increase**	**the constraints**			the coefficient
11								
12								
13								
14				1,3225		y max	3,443228343	
15				12005,028				
16				3,922				
17				3060,9455				
18				3060,9955				
19								

Fig. 6. The restrictions system in the process of implementing the procedure of the economic security level optimization of the Private joint stock company "Poltava Iron Ore Enrichment Works" taking into account the realization of the additional innovative projects (Screen Shot)

increasing of the efficiency of iron ore concentrates production during the enrichment stages;

- transition from the position of inertial growth based on traditional imported technologies to the intensification of innovation, intellectual and creative development of the plant;

- taking into account the reserves for increasing the profitability of innovative projects through the implementation of complementary projects in related fields of production;

- monitoring of enterprise financial stability and solvency considering the probabilistic nature of incoming cash flows and increased riskiness of innovation activities.

Thus, the developed procedure of the prediction of the economic security level of the Private joint stock company "Poltava Iron Ore Enrichment Works" permitted us to determine the change in the economic security as a result of changes in the structure and volume of innovation costs. It is important to explore the features of the sectoral structure of costs of research and innovation, mechanism of their impact on the effectiveness of innovation activity in the industry in future.

References.

1. State Statistics Service of Ukraine, 2014. *The main indicators of the development of industry* [online]. Kyiv: State Statistics Service of Ukraine. Available at: <http://www.ukrstat.gov.ua> [Accessed 14 January 2016].

2. Stock market infrastructure development agency of Ukraine, 2016. *Annual financial statements of enterprises* [online]. Kyiv: Stock market infrastructure development agency of Ukraine. Available at: <http://smida.gov.ua> [Accessed 14 January 2016].

3. Kozachenko, G. V., ed., 2012. *The system of economic safety: the state, region and enterprise*: monograph, Vol. 2, Luhansk: Virtualna realnist.

4. Nusinova, O. V., 2012. The foundations of the assessment of companies' economic security: theoretical and practical aspects: monograph, Kyiv: Pantot.

5. Yashkina, O. I., 2013. Innovative activities of enterprises of Ukraine: trends and factors influencing *Marketing and management of innovation*s, 4, pp. 181–189.

6. Grishko, N. Ye., 2015. The development of methodological tools of management of technical and technological subsystem of engineering enterprise's economic security, *Efficient economy*, 2 [online]. Available at: <http://www.economy.nayka.com.ua> [Accessed 08 January 2016].

7. Vagonova, O. H. and Romaniuk, N. M., 2014. Economic justification stages of the investment project of mining and processing enterprise, *Naukovyi Visnyk Natsionalhoho Hirnychoho Universytetu,* 3(141), pp. 159–164.

8. Pirogov, D., Maslak, O. and Grishko, N., 2012. Estimation of an enterprise's economic security in foreign economic activities. *Visnyk Kremenchutskoho natsionalnoho universytetu imeni Mykhayla Ostrohradskoho*, 3/2012 (74), pp. 163–169.

9. Vagonova, O. H. and Kasianenko, L. V., 2014. Socio-economic aspects of investment companies in the field of labor. *Naukovyi Visnyk Natsionalhoho Hirnychoho Universytetu*, 2, pp. 139–145.

Мета. Оптимізація параметрів управління витратами інноваційної діяльності гірничодобувного підприємства в контексті збереження його економічної безпеки.

Методика. Для досягнення поставленої мети застосовано метод багатокритеріальної оптимізації з використанням аналітичної надбудови „Пошук рішень“ програмного пакету Microsoft Excel.

Результати. Наведені результати оцінки ефективності механізму управління інноваційними витратами підприємства. Встановлено вплив співвідношення витрат і результативності інноваційної діяльності на стан економічної безпеки. Показані основні етапи та взаємозв’язки при моделюванні безпечного розвитку гірничодобувного підприємства. Розроблено підхід до оптимізації параметрів управління витратами інноваційної діяльності, що дозволяє організувати превентивне регулювання й поточний контроль, своєчасно реагувати на зміни зовнішніх і внутрішніх умов, сприяє вибору обґрунтованого рішення при формуванні стратегії розвитку підприємства в сучасних умовах.

Наукова новизна. Полягає в розробці підходу, що адекватно описує спосіб урахування дуалістичного характеру впливу інвестиційно-інноваційної діяльності на стан економічної безпеки гірничодобувного підприємства. Метод дозволяє оптимізувати параметри управління витратами інноваційної діяльності, що надасть змогу гірничодобувним підприємствам здійснювати контроль над інноваційними витратами в аспекті збереження безпечного стану.

Практична значимість. Для оптимізації рівня економічної безпеки гірничодобувного підприємства з урахуванням реалізації додаткових інноваційних проектів пропонується впровадження інформаційних технологій, а саме моделі оптимізації параметрів економічного зростання з використанням ПП MS Excel „Пошук рішення“.

Ключові слова: *інноваційна діяльність, економічна безпека, рентабельність інновацій*

Цель. Оптимизация параметров управления затратами инновационной деятельности горнодобывающего предприятия в контексте сохранения экономической безопасности.

Методика. Для достижения поставленной цели был применен метод многокритериальной оптимизации с использованием аналитической надстройки „Поиск решений“ программного пакета Microsoft Excel.

Результаты. Представлены результаты оценки эффективности механизма управления инновационными расходами предприятия. Определено влияние соотношения затрат и результатов инновационной деятельности на уровень экономической безопасности. Показаны основные этапы и взаимосвязи при моделировании безопасного развития горнодобывающего предприятия. Разработан подход к оптимизации параметров управления затратами инновационной деятельности, что позволяет ориентировать превентивное регулирование и текущий контроль, своевременно реагировать на изменения внешних и внутренних условий, способствует выбору обоснованного решения при формировании стратегии развития предприятия в современных условиях.

Научная новизна. Научная новизна заключается в разработке подхода, который адекватно описывает дуалистический характер влияния инвестиционно-инновационной деятельности на состояние экономической безопасности горнодобывающего предприятия. Метод позволяет оптимизировать параметры управления затратами инновационной деятельности, что предоставит возможность горнодобывающим предприятиям оптимально контролировать инновационные затраты в аспекте сохранения собственной экономической безопасности.

Практическая значимость. Для оптимизации уровня экономической безопасности горнодобывающего предприятия с учетом реализации дополнительных инновационных проектов предлагается внедрение информационных технологий, а именно модели оптимизации параметров экономического роста с использованием ПП MS Excel „Поиск решения“.

Ключевые слова: *инновационная деятельность, экономическая безопасность, рентабельность инноваций*

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