

Management of Economic Security in the High-Tech Sector in the Context of Post-Pandemic Modernization

Andriy SHTANGRET¹,
Nataliia KOROGOD²,
Sofia BILOUS³,
Nataliia HOI⁴,
Yurii RATUSHNIAK⁵

¹ Ukrainian Academy of Printing, Lviv, Ukraine, shtang_an@ukr.net

² National Metallurgical Academy of Ukraine, Kyiv, Ukraine, nkorogod@i.ua

³ Ivan Franko National University of Lviv, Lviv, Ukraine, bilous_sof@i.ua

⁴ Vasyl Stefanyk Precarpathian National University, Ukraine, hanushchyn_solo@i.ua

⁵ Ukrainian Academy of Printing, Lviv, Ukraine ratushniak_y@i.ua

Abstract: The accelerated rates of scientific and technological progress and the intellectualization of the main factors of production play a leading role in ensuring the economic recovery of national economies, in particular in the conditions of the existence of today's post-pandemic consequences. The technological development of the leading countries of economic development (USA, some of EU countries, Japan, China) poses difficult tasks for other participants in the world economic space to avoid a significant lag, especially in today's post-pandemic society. For the countries of Eastern Europe, this task is complicated not only by political and social tensions, but also by the lack of effective government regulation instruments that could provide support for the high-tech sector as a locomotive for the modernization of the national economy. Moreover, enterprises of the high-tech sector of the economy, being deprived of state support, must independently ensure their functioning by creating a system of economic security. Ensuring security in a post-pandemic society of such enterprises is characterized by significant differences, which are most related to the need to create safe conditions for the activities of workers - the most valuable resource. The development of enterprises in the high-tech sector of the economy is impossible without taking into account the safety aspects, it requires the intensification of scientific research in this area.

The purpose of the article is to form information support for managing the economic security of enterprises in the high-tech sector of the economy in the context of post-pandemic modernization.

Keywords: *high-tech sector of the economy, post-pandemic modernization, economic security, enterprises, postmodern society.*

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1. Introduction

The current stage of development of the world economic space is characterized by a conditional division of countries into two groups: "innovatively developed", for which the priority is the effective use of the latest unlimited resources - information and knowledge, and "raw materials oriented", whose national economies are based on the extraction and primary processing of natural resources. It is no longer about individual parameters of economic development in countries belonging to one of the groups, but about the standard of living, well-being of each citizen, his ability to develop and feel safe (Bianchi & Labory, 2011).

The basis of the high-tech sector of the economy is a set of enterprises characterized by a number of distinctive characteristics. Let's clarify that a high-tech industrial enterprise (HTE) is a business entity that, due to the use of advanced industrial technologies and the skills of workers in technology-oriented professions, produces high-tech products; as well as systematically using scientific and technical knowledge, carries out the development and launch of new products on the market, receiving high added value (Liu et al., 2019)

Additional signs of HTE are: (Bakun et al., 2019; Nechifor & Winning, 2018).

- the use of intermediate high-tech raw materials, components for the production of the final product of the enterprise;
- production of intermediate high-tech products, which are part of the final high-tech products, competitive in foreign markets;
- investing in technical and technological re-equipment;
- obtaining by the enterprise in the competent authorities for the protection of intellectual property rights of protection documents for objects of intellectual property;
- the company has international certificates, namely: ISO certificates of the 14000 and 9000 series and problems of their social development (Inglehart & Welzel, 2009).

The newest model of economic growth, which is used by developed countries, should include intensive research and development on their basis of the latest technologies, access with them to world markets and the deployment of international integration in the scientific and industrial sphere in the context of the formation of a global economy (Falk, 2009).

2. Review of literature

The strategic development of the industry of the leading countries is carried out through modernization in the conditions of today's postmodern space, which provides for an increase in the production of high-tech products. In the countries of Eastern Europe, indicators are associated with the development of the high-tech sector of the economy, 5-7 times lower than in the leading countries in the conditions of the existence of the consequences of post-pandemic conditions, which are oriented towards the development of the knowledge economy, which is based on the most efficient use of unlimited resources, which are information and knowledge.

The modern development of the world economy is characterized by the deepening of the integration processes of countries, which is determined by the need to develop innovative economies using both internal reserves and factors, as well as external ones. In this area of research, the issues of the development of the most promising high-tech sector of the economy and ensuring economic security in the face of the emergence of new threats and opportunities for using integration processes are becoming especially relevant. The ongoing transition from a unipolar world order to a multipolar one, the active formation and establishment of new centers of power exacerbate the rivalry between countries and the competition between their development models (Aghion et al., 2009; Hatzichronoglou, 1997).

The desire of a number of countries to use more forceful methods of solving problems, economic and resource advantages to advance their development interests remains a source of tension. Therefore, due to the insufficient efficiency of the existing security systems, a tendency towards global instability has emerged. The growing degree of openness of economies, freedom of movement of goods, capital and human resources, interpersonal interaction blurs the line between internal and external economic, social and information processes (Caselli & Coleman, 2006; Naqshbandi et al., 2015)

Reducing the lag of the national economy of Eastern European country from the leading countries is possible through the implementation of postpandemic modernization, the implementation of which should concern absolutely all processes in the country. To accomplish the set tasks, we consider it appropriate to briefly describe the content of the term "modernization". First of all, we note that in a broad sense, the term "modernization" is considered as "a set of processes of technical, economic, social, cultural, political development of society (country and its regions)" (Chvanova et al., 2016).

Since today a fairly significant number of definitions of the term "modernization" are known, it is advisable to use the classification proposed by Solow (2010), highlighting three key approaches: "... the first provides for any progressive changes that occur in accordance with the adopted scale of improvement, the second highlights those , which equates the terms "modernization" and "modernity", and the third is focused on characterizing the processes associated with reducing the backwardness of backward and underdeveloped societies from the most developed countries within a single global society".

All three scientific approaches are noteworthy because they are used at different levels of government and are relevant today for the national economy, because there is a gap that needs to be reduced, which is impossible without significant changes in the activities of each entity and public policy. support and stimulate the development of high-tech production.

It can be argued that the modernization of the economy, and hence each individual enterprise, should be focused on sustainable and efficient development, which involves the use in production of scientific and technological progress aimed at updating the material and technical base and manufacturing innovative competitive products designed not only for consumers in the domestic market, but above all for entering the world market of goods and services. Achieving this goal is possible subject to a change in public policy, which should be focused on structural changes in the economy, in particular through the priority development of enterprises in the high-tech sector.

Another classification of modernization, which was formed by Amoroso, Audretsch, Link (2018), dedicated to the development of high-tech sector of the economy within the countries of Europe involves the definition of two types of it, that is, primary and secondary. Primary modernization is understood as the organic development of the country by making changes in their general structure, politics, culture, and the worldview of citizens to make the transition from an industrial to a post-industrial model of society development. This modernization was carried out by the leading countries of economic development. Secondary, it is also called "catch-up" modernization is used by countries that are trying to reduce the lag behind the leading countries, using the experience they have acquired, buying technologies, patents, licenses, encouraging investors with more favorable conditions for investment. Secondary modernization can be considered the reaction of other countries to the challenges associated with the rapid development of the leading countries. If the primary

modernization is a search for a solution to the problems of the development of civilization, in particular in terms of coordinated coexistence with the natural environment, then the secondary one is the struggle for the survival of countries with lower rates of development.

Skórska (2017) argue that today's modernization is due to industrialization by directly influencing professional specialization, deepening urbanization, raising the level of education, contributing to an increase in life expectancy, creating conditions for faster economic growth. These scientists insist that modernization can be defined as "the process of expansion of scientific and technological knowledge in all spheres of human life".

Summarizing, we consider it appropriate to emphasize the following points (Ternova, 2020):

- orientation in the development of economies to strengthen competitive positions in world markets requires paying maximum attention to the development of production, corresponds to the 5th and 6th technological order;

- the number of enterprises that can develop, produce and promote high-tech products is limited, and their functioning, despite the importance for achieving national interests, with constant political, social and economic instability, significantly complicates the process of state regulation, to the greatest extent depends on the existence of a system of economic safety within each individual business entity;

- from the standpoint of ensuring security, any changes (external and internal), that is, those that are caused by neo-industrial modernization, require adaptation, in particular, first of all, it is the economic security system;

- enterprises of the high-tech sector of the economy are characterized by excellent parameters of financial and economic activities, and, accordingly, certain aspects of security that require consideration in the process of managing them.

The generalizations made form the basis for a more thorough consideration of the features of ensuring the security of enterprises in the high-tech sector of the economy. Note that these enterprises are assigned a special role - a certain locomotive, which should ensure the transition of the national economy to a higher level of development by meeting consumer demand for complex science-intensive products, facilitate the receipt of orders from adjacent branches and create new jobs, thereby slowing down labor migration and increasing purchasing power. In accordance with the above, not only owners and management, but also state and local authorities

are interested in creating safe development conditions for such enterprises, it is impossible to carry out without proper scientific justification.

According to the Wolf and Terrell (2016) the most valuable resource of enterprises in the high-tech sector of the economy is personnel, that is, employees who are able to generalize and analyze large amounts of information with the subsequent generation of new knowledge for the development and production of competitive high-tech products. According to the development safety management of such enterprises, it should be focused both on the formation of safe conditions for personnel and the application of protective measures in order to minimize the possibility of risks and threats due to the discrepancy between their individual interests and the interests of the workforce and the enterprise as a whole.

Yiu, Yeung and Jong, (2020) determine that another feature is that the importance of labor resources in the conditions of enterprises in the high-tech sector of the economy requires a departure from traditional management methods based on the use of administrative methods in favor of new ones that provide for the coordinated achievement of the interests of employees, management and owners.

At the opinion of Gil, Oscar and Paulo (2019), the development of high-tech sector of the economy is inextricably linked with the development of professional skills of workers, as well. Coordination of interests is possible provided that changes in the needs and potential of each employee are identified and tracked, that is, we are talking about the application of an individual approach. It is the individual approach that makes it possible to group all the personnel of those involved in the creation of innovative products, their production and maintenance of the main technological processes. For each group of employees, excellent conditions are created related to their contribution to the creation of high-tech products. The most valuable are employees who, on the basis of processing large amounts of information and existing experience, are able to generate new ideas with their subsequent implementation in the form of competitive products. An important role is played by workers who have the necessary knowledge to operate high-precision machine tools and mechanisms with an automated control system. A group of service personnel is less valuable, but requires due attention to their productivity and compliance with labor discipline.

The carried out grouping creates the basis for diversifying the costs of the enterprise for the development of the individual potential of each employee with the subsequent formalization of their knowledge to increase the group potential. It is about creating conditions for constant self-development, strengthening the exchange of information and knowledge,

organizing collective work on solving the folding problems of keeping traditions heredity and experience transferring. The process of developing innovative products is not subject to standardization, since it is based on a creative approach, requires searching for an idea with its development and considering the possibility of commercialization in a competitive market environment (Bendikov & Frolov, 2007). Concentrating the attention of workers-innovators on solving a specific problem requires eliminating other problems in their professional activities and organizing support in eliminating everyday difficulties. The above should also belong to the tasks of the enterprise security service.

The needs of other groups of workers should also be taken into account, but with a lower level of priority in accordance with their contribution to the final results of the financial and economic activities of the enterprise.

3. Main research

3.1. Methodology for proving the priority of ensuring the economic security of enterprises in the high-tech sector of the economy

The main goal of our study is in the formation of information support for the management of economic security of enterprises of the high-tech sector of the economy in the context of post-pandemic modernization.

Our hypothesis is that when identifying the main risks and threats, it is possible to effectively form information support for managing the economic security of enterprises in the high-tech sector of the economy in the context of post-pandemic modernization.

The main research tool is the process of questioning experts who will contribute to ensuring security.

For the survey of experts, we have chosen the method of questioning. Subsequently, all the information obtained as a result of the questionnaire was systematized using multivariate data analysis, including matrices of pairwise comparisons.

Experts were recruited from Eastern European countries (Poland, Ukraine and Bulgaria). This made it possible to geographically expand the survey. Work experience (industrial or research) in the analyzed area (at least 10 years). The total number of experts is 20 people. 10 experts were drawn from Ukraine, 5 from Poland, and 5 from Bulgaria. The experts were selected by the opportunity sampling. The study was conducted in April 2020. The term of the survey is 7 working days.

The study provides for prioritization of ensuring the economic security of enterprises in the high-tech sector of the economy by summarizing the scientific heritage of scientists with the subsequent identification of key risks and threats to economic security and modeling the management process. To determine the key risks and threats, the method of questioning was used, followed by a sequence of actions (Shtangret et al., 2019; Sun et al., 2017) :

- selection of experts;
- information support for the work of experts;
- ranking of alternatives;
- checking the consistency of expert opinions;
- development of questionnaires;
- conclusions on the priority risks and threats to the security of enterprises in the high-tech sector of the economy.

At the first stage, the choice of experts is proposed to be carried out according to the criterion that determines the level of the expert's competence (Zachosova, 2019). An expert must meet a number of requirements: a high level of general erudition; deep specialized knowledge in the assessed area; the ability to adequately reflect the predicted object, the presence of a technological orientation for the future, the presence of scientific interest in the subject being assessed, the absence of personal interest in assessing the forecast; experience (production or research) in the analyzed area (at least 10 years). Data on experts, including their self-esteem, are summarized in a questionnaire. The results of its processing provide an assessment of the expert's competence.

$$K = 0,5 \left(\frac{\sum_{j=3}^m v_j}{\sum_{j=1}^m v_{j\max}} + \frac{\lambda}{P} \right),$$

where v_j - gradation, correspondence of the expert to the j -th characteristic in points;

$v_{j\max}$ - maximum weight (scale limit) of the j -th characteristic in points;

m is the total number of characteristics of competence in the questionnaire;

λ is the weight of the characteristic determined by the expert in the self-assessment scale in points;

P is the limit of the expert's self-assessment scale in points.

The second stage provides for the formation of information support. The basis of information support is external and internal, open and closed (with limited access) sources of information (Zhang et al., 2019). It take into account the information contained in the financial statements of the enterprise, reports, employee surveys, and the results of inspections by state and local authorities.

The “ranking” stage involves identifying m -factors (risks and threats) by interviewing n experts. Each expert sets the rank of the j -th factor ($j = 1, 2, \dots, m$). For the j -th factor, the rank R_{ij} is determined by the formula:

$$R_j = \sum_{i=1}^n R_{ij},$$

where R_{ij} is the rank assigned by the i -th expert to the j -th factor. Next, the weight of the factors W_j is calculated:

$$W_j = \frac{R_j}{\sum_{j=1}^m R_j},$$

where W_j is the average weight of the j -th factor for all experts; m is the number of factors.

Initial estimates, determined by experts on the influence of each factor P_{ij} on the state of the economic security of the enterprise, are reduced to the form:

$$\overline{P}_{ij} = \frac{P_{ij}}{\sum_{i=1}^n P_{ij}}.$$

Next, the normalized estimate of the j -th factor is determined:

$$\overline{W}_j = \frac{\sum_{i=1}^n \overline{P}_{ij}}{\sum_{i=1}^n \sum_{j=1}^m \overline{P}_{ij}}.$$

For paired comparison, the average weight of each factor (risk and threat) is determined, the impact of which on the state of the economic security of the enterprise is being considered. Serial comparison is performed according to the obtained weights (Ding, 2019).

After obtaining expert estimates W_{ij} and W_p , the statistical analysis of the obtained data is carried out, this involves determining the degree of agreement of the opinions of the entire group of experts participating in the study with the relative importance of the factors under consideration. As far as consistency is concerned, the coefficient of concordance is calculated using a matrix that is compiled from the results of expert interviews. The concordance factor is one of the main criteria for checking the consistency of experts.

$$K_k = \frac{12S}{n^2(m^3 - m)}, \text{ где } S = \sum_{i=1}^m \left\{ \sum_{j=1}^n x_{ij} - \frac{1}{2} n(m+1) \right\}^2$$

The value of the coefficient of concordance varies from 0 to 1. The thoughts of the expert group are coordinated if the condition had met: $K_k > 0.8$

Obtaining and processing individual opinions of experts on the presence and possible impact of certain risks and threats on the security of the enterprise is carried out in compliance with the following principles:

- the question in the questionnaires is formed in such a way that the answers can be given in quantitative form;
- the survey is conducted in several (4-5) rounds, all experts after each round get acquainted with the results of the previous round of the survey;
- in the next rounds, questions and answers are clarified, experts substantiate assessments and opinions that differ from the majority opinion;
- statistical processing of answers is carried out after each round with the establishment of generalized characteristics.

The questionnaires included the following blocks of questions:

1. How high is the safety level in the enterprises where you work?
2. In your opinion, the risks associated with the activities of these enterprises have a negative impact?
3. Could you indicate which risks affect more (list).

Questionnaires can be processed using a variety of methods, among which pairwise comparison matrices are the most trusted. It is they who are

advisable to use with the subsequent determination of the significance of external threats to ensure the economic security of the enterprise. When constructing matrices of pairwise comparisons, the following condition must be met:

$$a_{ij}^s = \begin{cases} 1, & r_i^s \leq r_j^s \\ 0, & r_i^s > r_j^s \end{cases},$$

Where r_i^s and r_j^s are the ranks of the i -th and j -th threat, respectively.

Conclusions on the priority risks and threats to the security of enterprises in the high-tech sector of the economy are made according to the resulting assessments of each risk and threat. With the same value of expert opinions, these estimates are determined as follows:

$$R_i = \frac{\sum_s \sum_j a_{ij}^s}{\sum_i \sum_s \sum_j a_{ij}^s}.$$

The threat is considered more significant to the economic security of enterprises in the high-tech sector of the economy if the calculated value of R is the maximum.

In each group of threats to the economic security of an enterprise, based on the results of the examination, a balance must be ensured between the scale of description and aggregation, which will form the conditions for reducing the number of threats and selecting from among the most significant ones (Cherevko et al., 2019).

3.2. The results of using the methodology for proving the priority of ensuring the economic security of enterprises in the high-tech sector of the economy

Managing the security of enterprise development requires deepening the interaction of the security service with other departments, in particular, the personnel department, the planning and economic department, the internal control department, the accounting department and the legal department. This is based on the fact that a significant number of threats can arise in those areas that are in the scope of one of the listed units. For example, the career development system is the responsibility of the personnel service, the personnel department and the planning and economic

department (Babenko, 2013). A significant shortcoming in this system, or its actual absence, negatively affect their labor productivity, reduces the employees' interest in achieving results, and inhibits their individual development. It is impossible to ignore the facts of abuse of official position on the part of managers of various management levels, the consequence of which is the direct losses of the enterprise and lost opportunities, including the development and production of high-tech products. Such threats can be detected only in close cooperation between the enterprise security service and the internal control department. An insufficiently high level of qualifications of workers and shortcomings in the system of labor motivation can also be considered a significant threat; do not contribute to the maximum use by workers of their individual potential in the performance of tasks.

Flexibility, taking into account the safety aspects, should be manifested at all stages of interaction between the enterprise and the employee, which is: selection and recruitment, assessment, development, motivation, control and release. The security service of the enterprise should be focused on the timely identification and reduction of possible risks and countering the negative impact of threats (Bianchi & Labory, 2011).

Each of the stages of interaction is characterized by its own distinct risks and threats. Since the development of enterprises in the high-tech sector of the economy is largely related to the development of personnel, we detail the risks at this stage of interaction (Fig. 1).

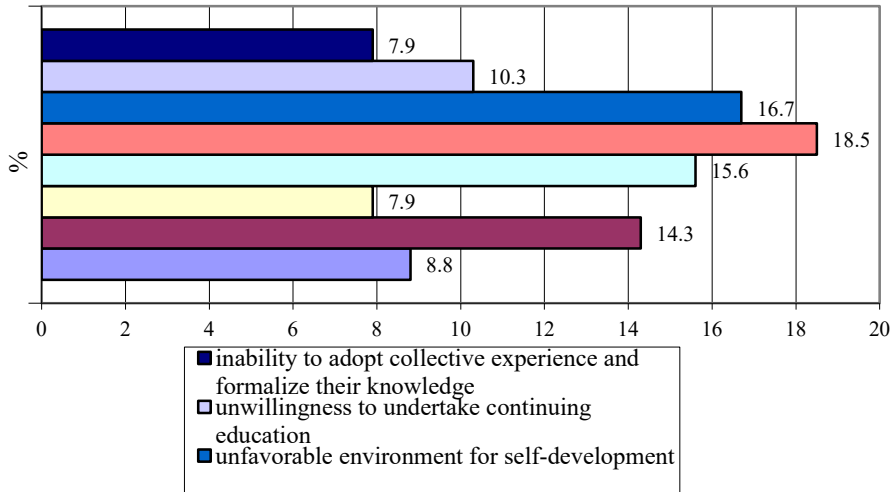


Fig. 1. Results of a survey of experts on the most significant risks to the security of enterprises in the high-tech sector of the economy.

In accordance with the methodology discussed above, a study was carried out, the results of which were the establishment of experts' opinions about possible risks at such a stage of interaction between employees and the enterprise as "development". By agreeing the points of view of experts, eight more significant risks were identified. In addition, the use of the mathematical apparatus made it possible to rank each of the risks. Thus, experts believe that the most significant risk is associated with the lack of incentives for development in relation to each employee (18.5%).

In the absence of actions on the part of security subjects to minimize the listed risks, or the low efficiency of their implementation, negative consequences can also cause an increase in the negative impact of such threats (Fig. 2):

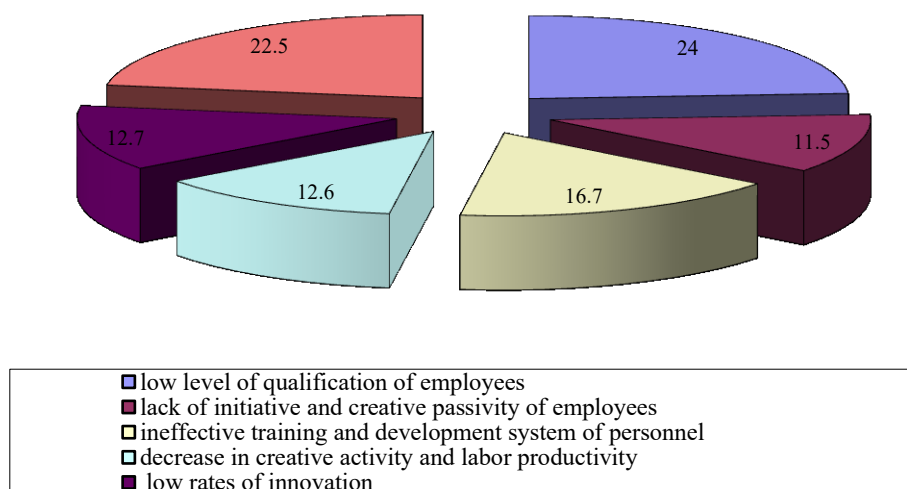


Fig. 2. Results of a survey of experts on the most significant threats to the security of enterprises in the high-tech sector of the economy

The experts identified six of the most significant threats to the economic security of an enterprise in a high-tech sector of the economy. In accordance with the ranking, security subjects should focus on countering the threat associated with a low level of qualifications of workers (24%).

The result of the creative work of workers must be protected both through the definition of their trade secret and patenting. Clarity in the legal design of innovative products contributes to the achievement of expected financial results. These legal aspects are important from the position that any

employee, being one of the performers of an innovative project, when freed from the enterprise, takes with him all the information about its implementation in the form of at least knowledge (Miller & Upadhyay, 2000). The release of each employee should be considered in the context of not only the loss of a part of the overall potential, but also the realization of the threat of disclosing trade secrets. If a certain employee goes to work for a competitor, then the latter receives additional competitive advantages in the form of knowledge at insignificant costs of their creation (better working conditions for a new employee). According to the development safety management, it should provide for the development of technology for dismissing employees in order to reduce the risks of losing trade secrets, maximize the formalization of individual knowledge, spread the practice of transferring experience and adhere to the policy of inheritance of traditions (Tsvetkova et al., 2014).

The features of the process of ensuring security at enterprises of the high-tech sector of the economy, which are directly related to its personnel, can be distinguished as follows:

- focus on creative individuals capable of generating new ideas with the subsequent creation of an innovative product;
- creation of favorable conditions for teamwork on a project with the formalization of knowledge and heredity of traditions and the transfer of experience;
- taking into account the individual characteristics of each employee;
- stimulating the development of the individual potential of each employee;
- an individual approach to the formation of safe working conditions for groups of workers with different participation in the development and production of high-tech products;
- protection of the results of the creative work of employees to create high-tech products;
- the application of a collective security policy, when each participant, taking into account security aspects in current activities, creates conditions for the formation of safe conditions for himself and others.

4. Research limits

The article is not without limitations. Only 20 experts were recruited for the study. This is due to the fact that in conditions of pandemic danger, not all experts were able to take part in the survey given the difficult working conditions.

In addition, we have chosen to analyze the economic security of the most highly developed enterprises. In the future, we plan to develop this methodology in all types of enterprises. Considering the geographic and linguistic convenience, we have chosen the enterprises of Eastern Europe.

In our opinion, this study will be especially interesting today, as practically all enterprises in the world have faced problems of post-pandemic restoration of their functioning. With this in mind, the use and implementation of this methodology will be beneficial in this process.

5. Conclusions

In the countries of Eastern Europe, the problem of ensuring economic security is acute for each business entity, to the greatest extent caused by the rapid changes in the operating conditions and the difficulty of ensuring the required level of performance of financial and economic activities, especially in the context of the implementation of today's post-pandemic modernization. The development of the high-tech sector of the economy creates real conditions for the implementation of post-pandemic modernization of the national economy, which should help reduce the lag of the countries of Eastern Europe from the leading countries.

Despite the importance of the operation and increase in the production of high-tech products by enterprises in this sector, the solution of security problems is fully entrusted to their security service.

Managing the economic security of enterprises in the high-tech sector of the economy requires paying maximum attention to employees as the most valuable resource. There should be a flexible security policy with a focus on the mutually agreed pursuit of the interests of employees, management and owners. There is a need for a grading of employees according to the level of contribution to the creation of competitive innovative products with the subsequent determination of priorities for the formation of safe working conditions and the achievement of individual interests. Creating a safe working environment for employees contributes to the generation of new knowledge as the basis for the development and production of high-tech products requires the use of excellent management methods and technologies that are focused not on administrative pressure and regulation of each action of performers, but on a creative approach with the possibility of more effective use of individual potential.

As a result of the study, we have confirmed the hypothesis that by promptly identifying the main risks and threats, it is possible to effectively form information support for managing the economic security of enterprises

in the high-tech sector of the economy in the context of post-pandemic modernization.

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