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LOGISTICS APPROACH TO THE ASSESSMENT OF THE RISKS OF A METALLURGICAL ENTERPRISE USING ARTIFICIAL INTELLIGENCE

ОСОБЛИВОСТІ ПРИЙНЯТТЯ РІШЕНЬ З УРАХУВАННЯМ РИЗИКІВ В МЕЖАХ ВИРОБНИЧОЇ ЛОГІСТИКИ

Summary. *Introduction. The modern process of making managerial decisions cannot be imagined without considering risks. Risks, emerging in any part of production logistics, are the cause of potential losses for the entire logistics system of an enterprise, and decision-making regarding their minimization is a criterion for ensuring production efficiency. Adequate risk assessment allows for increasing the soundness of managerial decisions regarding the selection of measures aimed at reducing the*

frequency of risk events and the scale of potential losses. The significant increase in the number of works on risk management in recent years indicates a growing need for practical and theoretical understanding of this issue. However, it should be acknowledged that the management of production risks in the logistics system is currently insufficiently researched.

Purpose. The aim of the research is to disclose conceptual approaches to making managerial decisions considering risks within the scope of production logistics, which includes three mechanisms: assessment of economic consequences, forecasting the magnitude of expected consequences, and monitoring subsystem.

Materials and methods. The research materials consist of the principles of economic theory and scientific works by domestic and foreign scholars on risk management issues. During the research process, the following scientific methods were utilized: theoretical generalization and grouping (for assessing risks and their impact on economic consequences, as well as identifying various risk factors, risk types, and for grouping risk management methods)

Results. Decision-making with consideration of risks within the scope of production logistics involves the use of the following mechanisms: the mechanism for assessing the consequences of risks in production logistics that occurred during the reporting period; the mechanism for forecasting the consequences of risks in production logistics; monitoring the consequences of risks in production logistics. The aim of making managerial decisions with consideration of risks within the scope of production logistics is aimed at adequate assessment of the consequences resulting from risk events and includes three mechanisms: assessing the economic consequences of events that have occurred and selecting measures to reduce them; forecasting the magnitude of expected consequences considering preventive measures and evaluating their impact on financial results; a monitoring subsystem that allows for controlling actual and potential losses and additional costs for all elements of logistic flows.

Discussion. In further scientific research, it is proposed to focus on the implementation process of a monitoring system to ensure quick and effective decision-making with consideration of risks within the production logistic system.

Key words: *decision-making, risk, production logistics, monitoring.*

Анотація. *Вступ. Сучасний процес прийняття управлінських рішень неможливо уявити без врахування ризиків. Ризики, виникаючи в будь-якій частині виробничої логістики є причиною можливих втрат всієї логістичної системи підприємства, а прийняття рішень щодо їх мінімізації є критерієм забезпечення ефективності виробництва. Адекватна оцінка ризиків дозволяє підвищити обґрунтованість управлінських рішень щодо вибору заходів спрямованих на зниження частоти виникнення ризикових подій і масштабів можливих збитків. Суттєве збільшення останніми роками кількості робіт з питання управління ризиком свідчить про зростання потреби практики в теоретичному усвідомленні цієї проблеми. Проте слід визнати, що управління виробничими ризиками логістичної системи на даний час досліджено недостатньо повно.*

Мета. Метою дослідження є розкриття концептуальних підходів до прийняття управлінських рішень з урахуванням ризиків межах виробничої логістики, що містить три механізми: оцінки економічних наслідків; прогнозування розміру очікуваних наслідків; підсистеми моніторингу.

Матеріали і методи. Матеріалами дослідження є положення економічної теорії, наукові праці вітчизняних і зарубіжних учених щодо питань управління ризиками.

В процесі здійснення дослідження було використано наступні наукові методи: теоретичного узагальнення та групування (для оцінки ризиків і їх впливу на економічні наслідки, а також визначення виділення різних факторів ризику, ризикових а також для групування методів управління ризиками.

Результати. Прийняття рішень з урахуванням ризиків в межах виробничої логістики відбуватись з використанням наступних механізмів: механізм оцінки наслідків ризиків виробничої логістики, що сталися в звітному періоді; механізм прогнозування наслідків ризиків виробничої логістики; моніторинг наслідків ризиків виробничої логістики. Прийняття управлінських рішень з урахуванням ризиків межах виробничої логістики націлено на адекватну оцінку наслідків, що зумовлені ризиковими подіями і містить три механізми: оцінки економічних наслідків за подіями, що сталися, та вибору прийомів і заходів їх зменшення; прогнозування розміру очікуваних наслідків з врахуванням превентивних заходів та оцінку їх впливу на фінансовий результат; підсистеми моніторингу, що дозволяє контролювати фактичні та можливі втрати та додаткові витрати за всіма елементами логістичних потоків.

Перспективи. В подальших наукових дослідженнях пропонується зосередити увагу на порядку впровадження інформаційної системи моніторингу що забезпечить швидке та ефективне прийняття рішень з урахуванням ризиків виробничої логістичної системи.

Ключові слова: *прийняття рішень, ризик, виробнича логістика,. моніторинг.*

Problem Statement. The modern process of managerial decision-making cannot be envisioned without considering risks. Risks, arising in any part of production logistics, are the cause of potential losses for the entire logistics system of an enterprise, and decision-making regarding their minimization is a criterion for ensuring production efficiency. Adequate risk assessment allows for increasing the soundness of managerial decisions regarding the selection of measures aimed at reducing the frequency of risk events and the scale of potential losses.

Analysis of Recent Research and Publications. Scientific works by both foreign and domestic scholars have been dedicated to the problems of the im-

pact of risks on managerial decision-making. Among them are V. V. Vitlinsky [1], N. M. Vnukova [2], L. Donets [3], T. Mostenska [4], and others. The significant increase in the number of works on risk management in recent years indicates a growing need for practical and theoretical understanding of this problem. However, it should be acknowledged that the management of production risks in the logistic system is currently insufficiently researched.

The aim of the article is to disclose conceptual approaches to making managerial decisions considering risks within the scope of production logistics, which includes three mechanisms: assessment of economic consequences, forecasting the magnitude of expected consequences, and monitoring subsystem.

Materials and Methods. The research materials consist of principles from economic theory and scientific works by domestic and foreign scholars on risk management issues. During the research process, the following scientific methods were utilized: theoretical generalization and grouping (for assessing risks and their impact on economic consequences, as well as identifying various risk factors, risk types, and for grouping risk management methods).

Presentation of the main material. When making decisions within production logistics, it is necessary to consider that all risk objects are not equivalent, meaning they participate in the production of goods to varying degrees and can be divided into four types.

The first type includes equipment directly involved in the technological process, and the probability of its failure cannot be accurately predicted because it depends on many variable parameters of the technological process and can vary widely.

The second type includes equipment that is related to the parameters of the technological process, but this relationship is smoothed (welding machine transformers, electric drive systems, benches, and power tables). The probability of failure of such equipment can be relatively accurately forecasted.

The third type includes auxiliary equipment whose load is almost unrelated to the processing process (filtration-pump devices). The wear of such equipment has a stable character, and the probability of failure is easily predictable.

The fourth type consists of control units, including electrical, electronic, optical, and physicochemical devices, the reliability indicators of which have qualitatively different characteristics. The wear of elements of numerical program control, controllers, microprocessors, etc., has a constant "background" associated with aging and changes in the structure of materials at the molecular level, overlaid with an unstable flow of sudden failures. Therefore, precise failure forecasting cannot be ensured.

This classification allows for different approaches to risk objects. The indicators of material flow in production logistics depend on equipment, each with its own characteristics. Therefore, all its components are divided into groups.

The first group includes parts whose failure (violation of technical conditions) does not affect the operation of the equipment (deformation of the casing, change in surface color, etc.). Failures of these elements can be considered independently of the production logistics system.

The second group includes parts whose reliability of operation remains almost unchanged over a certain period (frames and casing parts, lightly loaded elements with a large strength reserve).

The third group includes parts whose repair or adjustment is possible during equipment operation or during its stoppage without affecting its efficiency (tool adjustment and replacement).

The fourth group includes parts whose failure leads to equipment failure.

Making management decisions within production logistics cannot be done without considering the potential degree of risk, minimizing losses in the event of a risky event, and seeking ways to obtain or increase revenue (profit).

Scientifically substantiated solution to the problem of risk minimization in the operation of main and auxiliary flows of micro-logistics system requires systematization of methods and measures to minimize risks in the conditions of logistics management of an enterprise, largely determined by industry-specific characteristics, the dynamics of internal and external environment factors affecting equipment operation, as well as the complexity of functional relationships between production and service subsystems of the micro-logistics system of the enterprise. Improving methodological support involves forming cross-indicator risk assessments along logistic chains and justifying measures to minimize losses and costs.

The main functions of production risk management are: organization, planning (forecasting), control, motivation, and coordination. The organization function in risk management involves the formation and implementation of a program of actions aimed at reducing risk based on defined rules and procedures. Forecasting involves the development of prospective changes in the state of the risk object as a whole and its individual parts. Control consists of checking the organization of work to reduce the degree of risk and the size of economic consequences, requiring an analysis of the effectiveness of measures to assess the efficiency of actions. Motivation in risk management is the process of encouraging subjects to be interested in the results of their work. Coordination ensures the unity of the object and subject of management, involving the coordination of actions of all links in the risk management system, management apparatus, and specialists at the enterprise.

Depending on the priorities and strategy of the enterprise, risk planning and control are carried out based on the following assumptions:
- control over the state and functioning of the enterprise;
- systematic improvement of the qualification of production personnel through training;
- clarification of functional duties;
- introduction of mandatory briefings for production personnel before the start of the work shift with a check of the reliability of signaling and notification means;
- development and implementation of schedules and instructions for organizing and conducting planned technical maintenance (TM) and safety control on production;
- development and implementation of comprehensive risk management programs;
- monitoring of external and internal environments;
- forecasting the possibility of preventable risks;
- anticipating the timely development of rescue, evacuation, and recovery work options;
- timely accumulation of the necessary quantity of individual and collective protection means for production personnel in case of emergency;
- creation of effective systems of technological control and diagnosis for trouble-free production shutdown and avoidance of emergency situations;
- implementation of organizational-technical, financial-contractual, and innovative measures aimed at risk prevention.

Effective decision-making with consideration of risks within production logistics is possible within a system that is a set of temporally and spatially interconnected elements (subsystems) and their components integrated into a certain integrity, having a specific organizational structure, a complex of economic techniques, norms, models, and indicators of risk impact on production and service processes, as well as directions for decision-making to minimize economic consequences to ensure the effective functioning of the enterprise's logistics system under conditions of uncertainty.

The developed structure of the decision-making system with consideration of risks within production logistics is shown in Fig. 1.

Decision-making with consideration of risks within production logistics occurs using the following mechanisms:
- mechanism for assessing the consequences of risks in production logistics that occurred during the reporting period;
- mechanism for forecasting the consequences of risks in production logistics;
- monitoring the consequences of risks in production logistics.

The methodological tool for diagnosing risks, assessing actual damage in the event of a risk occurrence is the monitoring subsystem, which is created within the existing information system of the enterprise and ensures continuous monitoring of risk objects, analysis, and control of their performance indicators and impact on financial results in conditions of uncertainty.

According to [6], theoretically, there are three possible concepts of monitoring:

1. Target-oriented: Monitoring is defined as a problem-oriented system.

2. Instrumental: Monitoring is distinguished among other information processing systems by the type of tools and methods.

3. Integrative: Monitoring is interpreted as a result of the reorganization of traditional information-management functions, integrating elements of statistics, analysis, and diagnostics.

The subject of risk management in production logistics is a group of people, a department, or an individual specialist who implements risk management measures based on practical recommendations for implementing the mechanism in a specific enterprise, whose purpose is to ensure the validity of management decisions.

The organizational form of risk management in production logistics in a particular enterprise is determined by the scale of production, strategic goals, financial and informational capabilities, as well as the state of the risk management system existing within the enterprise. The main organizational forms of risk management in production logistics, the choice of which depends on the scale of activity and the risk management strategy, are:

1. Target risk management department, which manages all business risks, including those in production logistics, alongside functional structural units of the enterprise performing management functions.

2. Specialized risk management department for production logistics.

3. Separate bureau (sector) within one of the technical profile departments existing in the organizational structure of the enterprise, which is given authority and responsibility for monitoring risks in production logistics.

4. Target team that combines qualified specialists from different professions to promptly manage risks in production logistics and develop measures to minimize losses, independently planning and organizing its activities.

For large and medium-sized enterprises, it is advisable to establish a specialized risk management unit — a department or bureau — within the management structure. When organizing a risk management unit, certain principles should be followed. Firstly, the functions of risk control and decision-making regarding risks should be separated. Secondly, risk managers need direct access to top management to ensure timely response to risk situations.

Thirdly, risk managers should always be informed about risks, meaning they should have direct access to the monitoring system.

In small enterprises, one of the key managers (the CEO or their deputy) typically takes on the responsibility for managing all business risks. Therefore, only they can use a more effective form of risk management organization, such as services from a specialized consulting organization.

Regardless of the chosen organizational form of management, the sequence of actions, availability of monitoring information, and the individuals making management decisions to minimize consequences ensure the integration of the risk management system into the enterprise's management structure.

The main methods of information gathering at enterprises include [6]:

- standardized questionnaire (survey);
- review and analysis of primary management, accounting, and tax records;
- analysis of data from quarterly and annual financial reports;
- formation and analysis of maps of technological flows of production and economic processes;

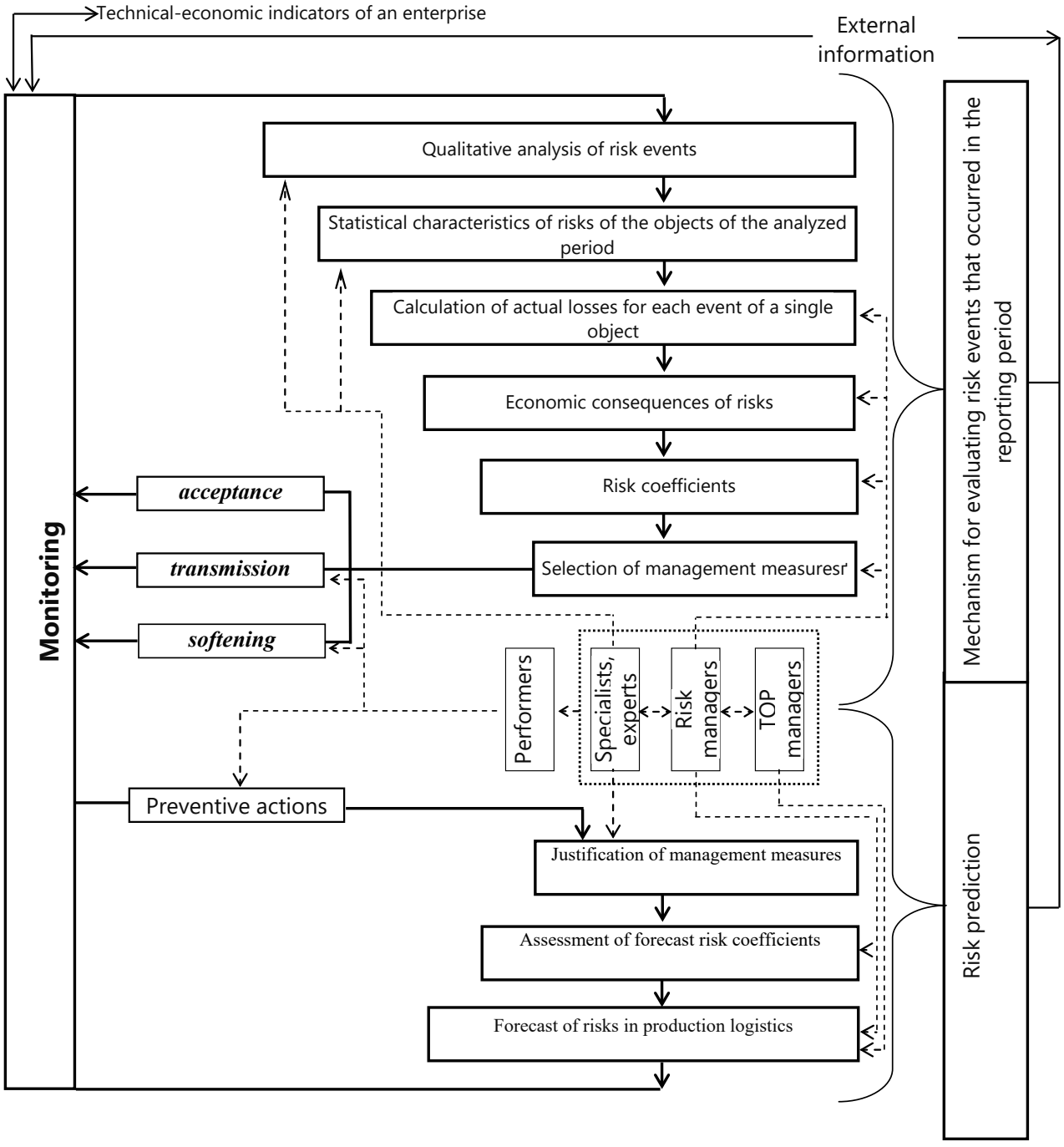

Fig. 1. Structure of the decision-making system with consideration of risks within production logistics

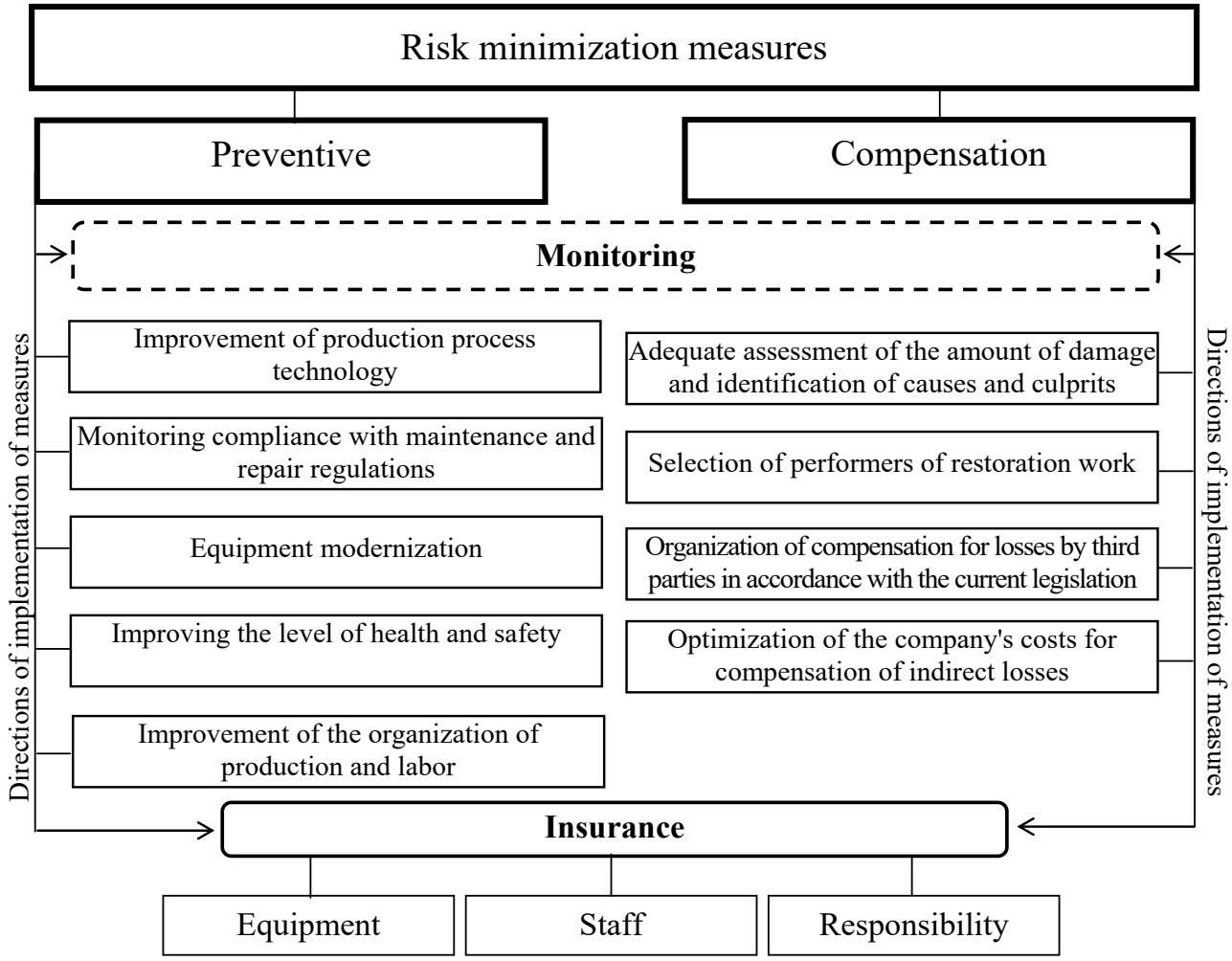

Fig. 2. Classification of Risk Minimization Measures

- inspection and visits to production and service departments of the enterprise;
- expert surveys and consultations with external experts on the production and economic characteristics of machine-building enterprises;
- document examination by specialized consulting companies.

The organization of work on systematic reduction of the level of production risks within the logistic system is carried out based on monitoring, which is ensured through the execution of information-analytical operations:

1. Formation of risk registration arrays in the links of the logistic system.

2. Registration of operations by functional links with data on costs for their execution.

3. Generalization of data on operations within average functional links.

4. Systematization of economic consequences by types and scales of losses.

5. Ranking of risk objects and production operations by the size of damage and frequency.

6. Analysis of the effectiveness of preventive measures by objects (operations) according to the risk rank.

7. Selection of risk situations with catastrophic, critical, and acceptable economic consequences for the implementation of preventive measures.

8. Development of a plan for implementing preventive measures.

8. Lection of performers and implementation of preventive measures.

9. Controlling the process of adjusting the economic consequences of risks.

The classification provided in Fig. 2 allows coordinating and increasing the target orientation of measures developed by specialists from various services, contributing to minimizing losses both in the planning stage and in the damage adjustment stage. Therefore, some measures have a preventive character, aimed at minimizing losses when risks occur, while others have a comprehensive nature and affect the company's expenses both in the forecasting and in the damage adjustment stages, for example, insurance.

Preventive Measures require investment at the planning stages and are aimed at preventing production risks and reducing potential losses. They are associated with improving production process tech-

nology, monitoring compliance with technical and maintenance regulations, equipment modernization, increasing safety and occupational health standards, and improving production and labor organization.

Compensatory Measures are aimed at restoring the operability of risk objects and minimizing losses. They involve adequately assessing the extent of losses and determining causes and culprits, selecting contractors for restoration work, organizing compensation for losses by third parties in accordance with existing legislation, and optimizing enterprise expenses to compensate for indirect losses.

Decision-making on Insurance as a way of minimizing damage in risk management has a dual nature: on the one hand, it is a preventive measure that requires the enterprise to spend on insurance protection, and on the other hand, it serves as external financing for losses incurred in the event of a risky event. The universal nature and widespread use of insurance in global practice are due to the fact that responsibility for one's own losses arising from risks is transferred to specialized organizations for a certain fee.

Conclusions and prospects for further research. Making management decisions taking into account the risks within the limits of production logistics is aimed at an adequate assessment of the consequences caused by risky events and includes three mechanisms: assessment of the economic consequences of the events that have occurred and the selection of methods and measures for their reduction; forecasting the size of the expected consequences, taking into account preventive measures and assessing their impact on the financial result; monitoring subsystem, which allows you to monitor actual and possible losses and additional costs for all elements of logistics flows.

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