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IDENTIFICATION OF SECURITY MANAGEMENT RISKS IN LOGISTICS ENTITIES: A PRACTICAL FRAMEWORK IN THE CONTEXT OF EMERGING THREATS

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ВИЗНАЧЕННЯ РИЗИКІВ УПРАВЛІННЯ БЕЗПЕКОЮ В ЛОГІСТИЧНИХ ОРГАНІЗАЦІЯХ: ПРАКТИЧНА ОСНОВА В КОНТЕКСТІ НОВИХ ЗАГРОЗ

Abstract. This study examines the risk of security management of logistics entities. It highlights that the key functions of effective risk management include innovative, regulatory, protective, compensatory, socio-economic, and analytical aspects. The research demonstrates that the framework for quantitative assessing risks in the security systems of logistics entities combines both absolute values (such as variance, standard deviation, semivariance, and standard deviation) and relative values (including probability, coefficient of variation, and risk ratio). The primary methods for regulating the risk levels of logistics entities are identified as follows: risk avoidance, risk compensation, forecasting, monitoring, risk management, establishment of special reserve funds, external resourcing, risk transfer, hedging, and risk reduction. Based on this framework, it is demonstrated that mitigating security management risks in logistics entities can be considered a holistic approach to counteracting both potential and actual threats, while simultaneously ensuring the future sustainable development potential of the organizations under research.

Keywords: logistics, security, security system, safety-oriented management, logistics management, logistics systems, security management risks.

Анотація. У цьому дослідженні розглядається ризик управління безпекою логістичних підприємств. Підкреслюється, що ключові функції ефективного управління ризиками охоплюють інноваційні, регуляторні, захисні, компенсаційні, соціально-економічні та аналітичні аспекти. Дослідження демонструє, що система кількісної оцінки ризиків у системах безпеки логістичних підприємств поєднує як абсолютні величини (такі як дисперсія, стандартне відхилення, напівдисперсія та стандартне відхилення), так і відносні величини (у тому числі ймовірність, коефіцієнт варіації та коефіцієнт ризику). Основні методи регулювання рівнів ризику логістичних підприємств визначені наступним чином: уникнення ризику, компенсація ризику, прогнозування, моніторинг, управління ризиками, створення спеціальних резервних фондів, зовнішнє фінансування, передача ризику, хеджування та зменшення

ризику. На основі цієї системи показано, що зменшення ризиків управління безпекою в логістичних підприємствах можна розглядати як цілісний підхід до протидії як потенційним, так і фактичним загрозам, одночасно забезпечуючи потенціал сталого розвитку досліджуваних організацій у майбутньому.

Ключові слова: *логістика, безпека, система безпеки, управління, орієнтоване на безпеку, управління логістикою, логістичні системи, ризики управління безпекою.*

Logistics entities cannot operate without risk exposure in the current business environment. Risks must be quantified within the boundaries of the maximum permissible limits. From a practical standpoint, market risk assessments vary considerably. Therefore, business entities must recognize that errors in market activities are inevitable, as no entity is completely immune to them. More importantly, these entities must continuously refine and adapt their operational strategies to enhance the efficiency and resilience of the logistics system.

O. Vivchar, V. Zakharchenko, M. Yermoshenko, E. Krykavskyi, L. Larina, M. Oklander, G. Pasternak-Taranushenko, O. Trydida, M. Fleichuk, U. Shchurko, and others have studied the problematic aspects of security management risks of logistics entities.

The objective of this article is to conduct a comprehensive evaluation of the various types of security risks faced by logistics entities under contemporary conditions and to develop a corresponding model to support this assessment.

The research findings indicate that the primary objective of logistics security management is to minimize abrupt fluctuations in their operations. Consequently, significant emphasis should be placed on the ongoing enhancement of risk management practices. In the context of logistics entities, risk management is a decision-making process that involves the implementation of measures designed to minimize risks to the lowest possible level [2, p. 88].

In our opinion, risk management in logistics should be defined as a comprehensive set of economic, organizational, and technical activities designed to identify risk types, factors, and sources, assess their magnitude, develop and implement strategies to mitigate risk levels, and prevent potential destructive outcomes. This process must also account for external environment factors such as competitors, suppliers, governmental policies, public opinion, market conditions, and the absence of complete and relevant information. A typical diagram illustrating the risk management process in logistics is presented in Fig. 1.

Thus, it is determined that risk catalyzes exploring innovative solutions to challenges encountered by logistics entities. Most logistics entities enhance economic efficiency and competitiveness through strategic engagement in risk-driven innovation. This model effectively illustrates the primary objective of security management in logistics entities–risk minimization–to prevent or mitigate potential financial, material, and other losses associated with uncertainties [8].

The article highlights that scientific literature identifies the following key functions of risks: innovative, regulatory, protective, compensatory, socio-economic, and analytical. The innovative function of risk drives the pursuit of unconventional solutions to challenges encountered by logistics entities. Consequently, logistics entities enhance their competitiveness and achieve economic success through strategic engagement in risk-driven innovation.
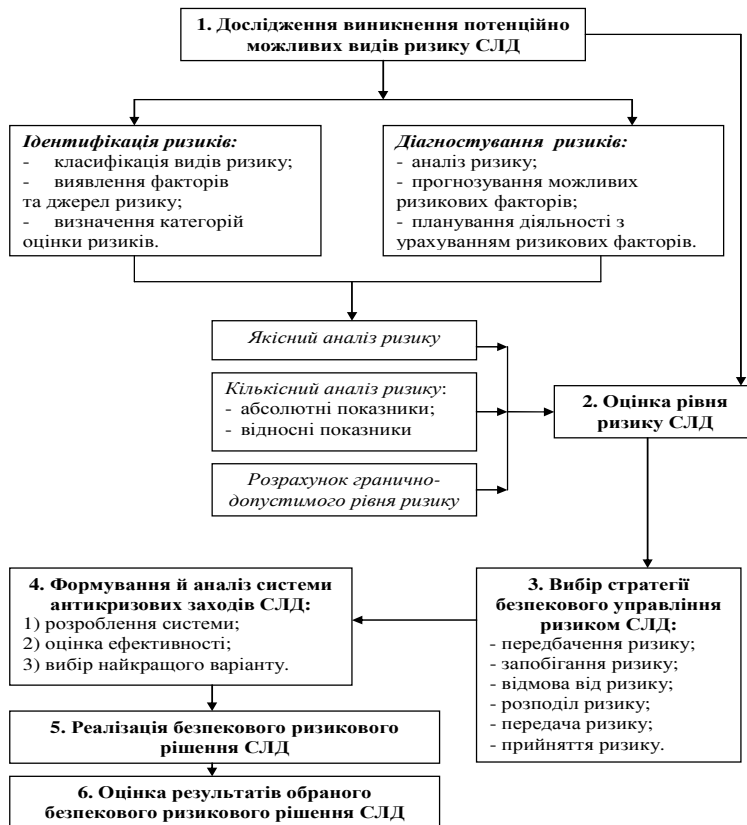
Fig. 1. Risk model of security management of a logistics entity (LE)

Source: own elaboration

A crucial prerequisite for an efficient logistics security management system is strict compliance with fundamental principles, the most critical of which encompass:

− informed risk acceptance, ensuring that decision-makers recognize and evaluate the implications of assumed risks,

− precise definition of security management objectives for logistics entities, along with the capability to influence risk characteristics that facilitate the achievement of these objectives,

− ensuring objectivity, credibility, comprehensiveness, and reliability of information within the logistics security framework,

− integrating risk management across all horizontal and vertical hierarchical levels of logistics entities, establishing an interconnected and systematic approach to managing business risks,

− maintaining the autonomy of security management in addressing individual risks faced by logistics entities,

− reducing the spectrum of potential risks and mitigating their impact,

− enhancing the responsiveness of logistics entities to internal and external dynamics that contribute to risk materialization,

−incorporating the time factor as a critical component in the secure risk management of logistics entities,

−optimizing cost efficiency in the organization and protection of risk management processes within logistics entities,

−implementing an innovative framework for the secure and effective risk management of logistics entities [1, p.333].

The assessment of security risk levels in the risk management of logistics entities represents the most critical and methodologically intricate phases of the logistics management process. The quality of this assessment directly influences the overall effectiveness of risk management and necessitates both quantitative and qualitative evaluations. The justification for making specific business decisions involving inherent risks can be determined through a comprehensive quantitative and qualitative analysis of these risks. The system of indicators for the quantitative assessment of risks within the security framework comprises absolute measures (such as variance, standard deviation, and semivariance) and relative measures (including probability, coefficient of variation, and risk factor) [4, p. 55]. This study aims to formulate a methodological approach for calculating the risk factor:

$$K_R = \frac{SS_{VAR}^-}{SS_{VAR}^+} \tag{1}$$

The calculation results are presented in Table 1.

Table 1

Risk factors of security management of the logistics entity

Logistics security strategies, Si	Logistics expenses					RF
	1	2	3	4	5	
S1	17	5	24	10	4	2,06
S2	11	20	14	32	46	0,34
S3	35	5	3	37	2	6,42
S4	15	14	10	30	6	0,32
S5	17	23	20	9	12	0,59
S6	19	4	16	2	1	2,21

A lower risk factor (RF) corresponds to a lower risk level. Based on this metric, the S4 logistics security strategy is identified as the most optimal. An interval-based evaluation is conducted to assess the effectiveness of each logistics strategy and classify the associated security risk type. This classification requires calculating the margin of error, which serves as an absolute indicator in the comprehensive risk assessment [6, p. 235]. The results of the calculations are presented in Table 2.

Table 2

Marginal errors of security management of a logistics entity

Logistics security strategies, Si	Logistics expenses					Δi
	1	2	3	4	5	
S1	17	5	24	10	4	15,61
S2	11	20	14	32	46	25,53
S3	35	5	3	37	2	38,86
S4	15	14	10	30	6	13,42
S5	17	23	20	9	12	10,08
S6	19	4	16	2	1	20,43

$$\Delta_i = t \times \lambda_{krut} \times \delta_i \qquad (2)$$

where t stands for the Student's *t*-test (tabulated value); λ -for the significance level or the probability at which the margin of error deviates. Adding the margin of error to the average efficiency (mathematical expectation) yields the maximum possible level of efficiency with a given probability: $a_i \max = M_i + \Delta_i$. As a result of subtraction, we obtain the minimum possible value of the expected efficiency. The smaller the margin of error (limit deviation), the safer and more reliable is the logistics security strategy for the logistics entity. The S5 logistics strategy meets this criterion.

The results of the calculations are presented in Table 3.

Table 3

**Maximum and minimum possible level of efficiency
of the security management of the logistics entity**

Logistics security strategies, Si	Logistics expenses					aimax	aimin
	1	2	3	4	5		
S1	17	5	24	10	4	29,59	− 1,63
S2	11	20	14	32	46	41,73	− 9,33
S3	35	5	3	37	2	65,37	− 12,35
S4	15	14	10	30	6	28,74	1,90
S5	17	23	20	9	12	27,42	7,26
S6	19	4	16	2	1	34,32	− 6,54

Table 3 allows us to analyze the changes in the boundary intervals of efficiency of logistics strategies to ensure the security of the logistics entity:

– aimax characterizes the maximum limit of the efficiency interval; in this case, the S3 logistics strategy for ensuring the security of the logistics entity is preferable;

– aimin represents the minimum value of the efficiency interval; when negative, it indicates the magnitude of losses. Considering these conditions, the S5 logistics strategy proves to be the most profitable, as it achieves breakeven and presents the highest positive value [3, p. 67].

Let's define risk based on the range of variation:

$$R_{iVAR} = a_i \max - a_i \min \tag{3}$$

An increase in the range of variation corresponds to a higher level of risk associated with the logistics strategy. Consequently, the S5 logistics strategy is considered the least risky for the logistics entity.

Table 4

**Range of the variation of the logistics strategy
for ensuring security of the subject of logistics**

Logistics security strategies, Si	Logistics expenses					Ri VAR
	1	2	3	4	5	
S1	17	5	24	10	4	31,22
S2	11	20	14	32	46	51,05
S3	35	5	3	37	2	77,72
S4	15	14	10	30	6	26,85
S5	17	23	20	9	12	20,16
S6	19	4	16	2	1	40,86

To trace the dynamics of the security strategies of a logistics entity, let's graphically depict the last three indicators (Fig. 2).
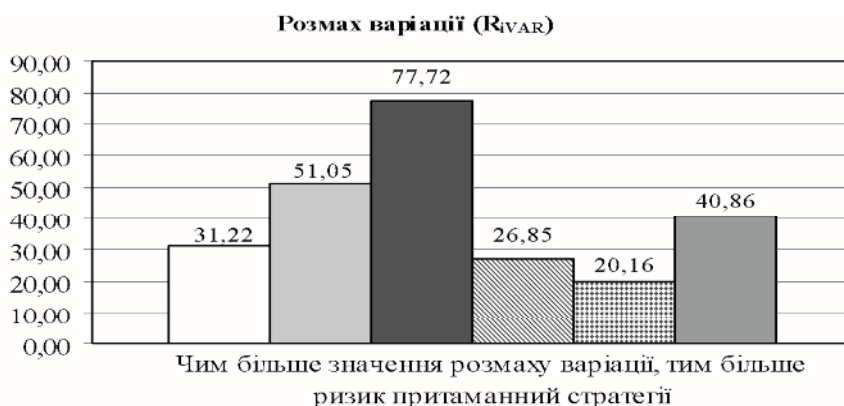

Fig. 2. The dynamic variability in the scale of logistics strategy adaptation for ensuring the security of logistics entities.

Source: calculated by the author

Let's calculate the risk type of a logistics entity by calculating the percentage of losses for each logistics strategy (Table 5).

Thus, the S5 logistics strategy proves to be the most economically advantageous across all key parameters. Evaluating business risk necessitates creating a risk curve for a logistics entity, an inherently complex process. Consequently, practical application often relies on simplified methodologies, where risk is assessed using one or more key indicators.

The final decision regarding the selection of a specific logistics component requires defining the threshold level of business risk. This can be guided by reference values such as 0.1, 0.01, and 0.001, corresponding to acceptable, critical, and catastrophic risk levels, respectively [5, p.115].

Table 5

Type of security risk of the logistics entity

Logistics security strategies, Si	Logistics expenses					Losses, %	Types of risks
	1	2	3	4	5		
S1	17	5	24	10	4	– 11,68	Permissible
S2	11	20	14	32	46	– 57,56	Critical
S3	35	5	3	37	2	– 46,58	Permissible
S4	15	14	10	30	6	12,37	Permissible
S5	17	23	20	9	12	41,86	Permissible
S6	19	4	16	2	1	– 47,1	Permissible

The selection of methods and instruments for regulating the risk level of logistics entities represents a critical stage in the security management process. The primary approaches to risk regulation and mitigation in logistics entities include: risk avoidance, which involves rejecting unreliable partners and suppliers, as well as refraining from engaging in high-risk projects or decisions; and risk compensation, which encompasses strategic activity planning and forecasting of external economic conditions to mitigate potential uncertainties, monitoring of the economic and legal environment, as well as the implementation of active, targeted marketing strategies, plays a crucial role in risk regulation. Risk-retention involves refraining from compensatory measures while establishing dedicated reserve funds in the form of tangible assets or financial resources (self-insurance or risk funds) and leveraging external financial sources such as loans, credits, or government subsidies to offset losses and restore operations. Risk transfer is achieved through mechanisms such as insurance, the delegation of risk via factoring agreements, hedging through exchange transactions, and other financial instruments designed to redistribute risk exposure [7].

Conclusions. In summary, the reduction of security management risks in logistics entities aims to implement a comprehensive strategy for counteracting both potential and actual threats. The effective mitigation and elimination of these risks ensure the sustainable and highly efficient operation of business entities under dynamic internal and external environmental conditions. Furthermore, such risk management measures contribute to fostering the long-term development potential of logistics entities.

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