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RISK MANAGEMENT IN ELECTRONIC LOGISTICS

The article investigates the actual problem of managing risks in electronic logistics. The authors offer definitions of the notions of risk and risk management in electronic logistics, their object, subject and sources. The authors' vision of electronic logistics risks classification is described. An algorithm the process of risk management in electronic logistics are defined.

Keywords: risk; risk management; electronic logistics (e-logistics).

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РИЗИК-МЕНЕДЖМЕНТ В ЕЛЕКТРОННІЙ ЛОГІСТИЦІ

У статті досліджено актуальну проблему управління ризиками електронної логістики. Запропоновано авторські визначення понять «ризик» та «ризик-менеджмент» в електронній логістиці, їх об'єкт, суб'єкт та джерела. Розроблено класифікацію ризиків електронної логістики. Сформульовано алгоритм процесу ризик-менеджменту в електронній логістиці.

Ключові слова: ризик; ризик-менеджмент; електронна логістика.

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РИСК-МЕНЕДЖМЕНТ В ЭЛЕКТРОННОЙ ЛОГИСТИКЕ

В статье исследована актуальная проблема управления рисками электронной логистики. Предложены авторские определения понятий «риск» и «риск-менеджмент» в электронной логистике, их объект, субъект и источники. Разработана классификация рисков электронной логистики. Сформирован алгоритм процесса риск-менеджмента в электронной логистике.

Ключевые слова: риск; риск-менеджмент; электронная логистика.

Problem statement. Humanity has always needed to receive information, throughout the whole period of its existence. Information helps people make decisions. And it is the completeness and correctness of information and speed of its reception that the effectiveness of decisions people make depends on. In ancient times doves or foot carriers were used for exchanging information. Doves could not carry anything except for a small piece of paper with a note, and carriers could accompany the letter with words. However, one could catch a dove or carrier, learn the information and prevent it from being delivered, or let them go having changed the information, but the bird cannot tell anything about the change in the note and the carrier can reveal the truth. Of course, such problems predetermined encrypting of such notes. When technologies developed and carriers began to use horses and later other means of transport (carriages, ships etc.), the speed, the size and the complexity of encryption significantly increased too.

Let us recall a well-known statement "Who owns information owns the world" the author of which according to various sources is Francis Bacon (1561–1626), Nathan Rothschild (1777–1836) or Winston Churchill (1874–1965) and which hasn't lost its actuality now, quite the contrary. However, now it is not enough just to own information, it is necessary to be the first to receive it. In particular, the use of various up-to-date information and telecommunication tools and technologies allows exchanging

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information in electronic form practically immediately and at any scale. However, as thousands of years ago, today the issues of accuracy, filtration, completeness and relevancy of information are crucially important. Besides, we can argue that by the essence the problems haven't changed and will not change in the near future, although the form of presenting information has changed and will change in future.

Contemporary information and telecommunication tools and technologies have acquired wide usage in logistics, facilitating the occurrence of the new notion – "electronic logistics". As of today there is no unambiguous definition of this concept, but in this article we understand under "electronic logistics" (e-logistics) the subsystem of management for forecasting, planning, taking decisions, coordination and control of electronic information flows with the help of information and telecommunication systems and technologies and with application of mathematical methods and models (in reconciliation with material, service, financial flows and the flow of intellectual and labor resources) on mezo-, macro- and microeconomic levels.

Information and telecommunication means and technologies are innovations which are constantly changing (improving), and the use of any innovation in business is always accompanied with different risks which should be taken into account while making managerial decisions. Thus, it is necessary to be able to analyze, model and manage risks which occur, in particular, in the field of electronic logistics.

Latest research and publications analysis. At present there are very few comprehensive scientific or practical works in which the problems of risks in e-logistics are investigated. There is a number of papers, in particular, by R.K. Ayupov (2011), G.L. Brodetskiy et al. (2010), H. Fuchs and J.W. Wohinz (2009), V.M. Goncharov et al. (2013), N.O. Kondratenko and O.O. Lobashov (2012), M. Korecky (2012), N.V. Korolenko (2013), M.V. Rovenskih (2008), K. Sterlingov (2014), Y.V. Yenchenko (2006), which to some cover the above issues and in which various aspects of managing risks in (traditional) logistics are investigated. One of the most researched aspects is managing the risks in transporting, in particular, in foreign economic relations where there is a great number of intermediaries (participants in a chain) and where the specification of boundaries for their responsibility is always critical. In majority of cases scientists and practitioners focus on the risks associated first of all with material flows. Taking into consideration the wide use of information and telecommunication technologies and tools in the activity of any enterprise, the influence of information constituent on the result is becoming more and more essential, requiring the corresponding investigations.

The aim of this research is to analyze and specify the existing principles of risk management in e-logistics and develop the new ones, in particular: definitions, classification, methodology of analysis and modelling of e-logistics risks.

Key research findings.

1. The essence of risk and risk management in e-logistics. One of the tasks of management in economics is the effective use of all company's resources with the goal of receiving income. Different types of management show resources in their names (or spheres, aspects of company's activity) by which management is carried out in the first turn.

There is a number of definitions and explanations of the notions "risk" and "risk management". For example, in ISO Risk Management (2009) there are the following

definitions: "risk management is coordinated activities to direct and control an organization with regard to risk", and "risk is the effect of uncertainty on objectives". According to V.V. Vitlinsky and G.I. Velykoivanenko (2004) "risk is an economic category which reflects the peculiarities of perception by the interested subjects of economic relations of the objectively existing uncertainty and conflictness which are peculiar of the processes of goals setting, management, decision-making and evaluation which are burdened by possible threats and unused opportunities"; "risk management is a necessity to use in management activity various approaches, processes, measures which allow to some extent (as accurately as possible) forecasting the probability of occurrence of risk events and achieving the decrease of the stage of risk to the acceptable level".

All the stages of information flow in logistics are burdened with probable occurrence of various unfavorable situations or phenomena which first of all are associated with the delay of receiving information, its truthfulness, accuracy, confidentiality, completeness etc. Information and telecommunication tools and technologies through which information transfer is carried out cannot be considered as those that have 100% credibility, even devices having a lifetime warranty may break down. However, it should be noted that information and telecommunication technologies and tools are developing so quickly that it is necessary to constantly upgrade them. Company staff also needs constant training and qualification improvement with the aim of receiving knowledge and skills in up-to-date technologies they use in everyday work. Besides, any action or decision taken in logistics are quite uncertain due to the impossibility of forecasting their consequences absolutely accurately. All these statements and others stipulate the occurrence of the corresponding risks in electronic logistics.

Based on the existing definitions of logistic risk, in particular, in the works of H. Fuchs and J.W. Wohinz (2009), M.M. Mamchyn and O.A. Rusanovska (2011), M.V. Rovenskih (2008), V.V. Vitlinsky and V.I. Skitsko (2013), we consider the following definition as appropriate: the risk of e-logistics is the economic category which reflects the peculiarities of perception by company management of objectively existing dangers and threats, unreliability of tools and technologies, the level of knowledge, uncertainty and conflictness in the process of generation, transfer and reception of information which effect reaching the goal of electronic logistics which lies in facilitating the delivery of the needed products in the required volume, of good quality, for the agreed price, to the agreed place and time the consumer needs.

The object of risk in e-logistics is the logistics system of a macro-, mezo-, micro-economic level, in which it is hard to assess the effectiveness and functioning conditions (generation, flow and reception) of information flows with the help of information and telecommunication tools and technologies in future.

The subject of risk in e-logistics is management of the corresponding level which is interested in effective functioning of the object of risk in electronic logistics.

The sources of risk in e-logistics are the factors (processes, phenomena), which precondition the occurrence of dangers and threats, unreliability of tools and technologies, uncertainty and conflictness etc. at the moment of making decisions in the logistics system or taking actions which require definite information.

Risk management in e-logistics is the system of managing risks in electronic logistics which agreed upon, organized, controlled by top management of a company (or

companies – participants of a logistics chain), functions uninterruptedly and in coordination with other sphere of the company's (companies') activity. The aim of risk management in e-logistics is to facilitate the formation of company's (companies') income through achieving the goals of e-logistics. For this purpose the management of risks generated by a number of aspects of uncertainty and conflictness which can differently effect the achievement of goals is performed (Starostina and Kravchenko, 2004).

The object of management is the object of risk in e-logistics and the subject of management is the subject of risk in e-logistics.

In managing risks of e-logistics one should stick to the following principles (Cherkasov, 1999):

1) the principle of maximization. It is necessary to carry out the comprehensive analysis of possible reasons and factors of occurrence of electronic logistics risks, thus minimizing the uncertainty in taking the corresponding actions and decisions;

2) the principle of minimization. Company's management wants to decrease the number of possible risks in electronic logistics and minimize the effects of risks;

3) the principle of reaction relevance. It is necessary to quickly and appropriately react to any changes in company's activity or the activity of companies – participants of a logistics chain, in economics, law, politics of a country etc. which can stipulate fundamental changes in the existing risks in electronic logistics and the occurrence of new ones;

4) the principle of accepting. Company management can only accept the justified risk.

Besides, in e-logistics it is necessary to follow the principles mentioned in ISO Risk Management (2009): 1) e-logistics risk management creates and protects value; 2) e-logistics risk management is an integral part of all organizational processes; 3) e-logistics risk management is part of decision making; 4) e-logistics risk management explicitly addresses uncertainty; 5) e-logistics risk management is systematic, structured and timely; 6) e-logistics risk management is based on the best available information; 7) e-logistics risk management is carried out according to external and internal requirements of the object of investigation (logistics system, the delivery chain of macro-, mezo- and microlevel); 8) e-logistics risk management should take into account the opportunities, considerations and intentions of company management or companies – participants of a delivery chain which can facilitate or interfere with the achievement of the e-logistics aim; 9) e-logistics risk management is transparent and inclusive; 10) e-logistics risk management is dynamic, iterative and responsive to change; 11) e-logistics risk management facilitates continual improvement of its organization.

Having adapted the material from (Ivanov, Oleinikov and Bocharov, 2008) for common risk management of company to risk management in e-logistics we can state the following.

Risk management in e-logistics performs certain functions which can be divided into: 1) functions of the object of management (organization of the process of accounting risk in logistics system or chain; taking measures on the decrease of risk level; assessment of risk conditioned by changes in the existing logistic operations and/or the appearance of new ones; organization of work among companies – participants of the logistic chain and others); 2) functions of the subject of management

(forecasting – the assessment of the scale of risks in e-logistics in future; organization – connection of interested persons (managers) from the companies which are the participants of the logistic chain or system; regulation – the influence on the object of management with the aim of achieving its stable state in case of deviation of real indices of activity from normative or set; coordination – coordination of actions among all participants of the process of e-logistics risk management and according to business processes of company and/or companies – participants of a logistic chain; control – analysis of the results of measures on the decrease of scale of probable e-logistics risks etc.).

2. Classification of e-logistics risks. One of the main roles in management of e-logistics risks is occupied by their classification with the help of which one can divide risks into certain groups by some properties and criteria on the basis of the system approach. In our opinion, all risks in e-logistics can be presumably referred to the category of information risks which characterize the level of probable deviations in company's activity due to the level of completeness and credibility of the used information (Ivchenko, 2004). However, information transforms within the frames of e-logistics (from verbal to electronic, from electronic to visual – the barcode etc.) and interacts with various elements of a logistic system and a delivery chain. This preconditions the occurrence of a number of risks among which not only information risks may be.

Conceptually, the risks of e-logistics may be grouped into operational, business and market.

To *operational e-logistics risks* we will refer:

1) technological and technical risks – connected with the correctness of functioning of information and communication means, networks and technologies, possible break downs and human errors, lost Internet connection etc. Thus, we can point out the risk of the apparatus break down, the risk of incorrect barcode reading, the risk of incorrect barcode printing, the risk of network malfunctioning etc.;

2) organizational risks – conditioned by the occurrence of possible flaws in organization of information flows and in the chain of deliveries and electronic data exchange, errors made by company management or responsible personnel in a delivery chain etc.

To *business risks of e-logistics* we can refer the risks occurring in interrelations of companies in delivery chains. These risks occur, in particular, in the case when logistic providers of the third or the fourth level or specialized providers of electronic data exchange are engaged. It means there is a problem of selection of such a provider on the basis of reputation, competition and market condition.

Market risks of e-logistics are the risks of possible changes of market prices of the abovementioned providers, Internet connection, mobile networks etc. which can be conditioned, in particular, by the change of currency rate.

From the other point of view the risks of e-logistics may be classified by the following properties (Ivchenko, 2004; Shegda and Golovanenko, 2008; Starostina and Kravchenko, 2004; Vitlinsky and Velykoivanenko, 2004):

1) by scale and size (global risk – on the level of the logistic system or delivery chain at large within the boundaries of a country or the world; local risk – on the level of company, department or employee of a company – the participant of a delivery chain);

2) by aspects (psycho-emotional risk as a stage in the perception of information by the person who makes decisions on further actions; social risk – associated with the probability that personnel within a delivery chain will not do their work appropriately due to dissatisfaction with social security; economic risk is conditioned by possible changes in the field of e-commerce and national economy as a whole; legal risk is the correspondence of information to generally accepted laws and regulations, international standards etc.);

3) by the level of risk intension of decisions or by the level of probable losses (minimal risk; medium risk; optimal risk; maximal or allowable risk; critical risk; catastrophic risk);

4) by the level of sufficiency (justified risk; non-justified risk; adventurous risk);

5) by situation (stochastic risk – under the conditions of eventuality, probability of occurrence; uncertain risk – under the conditions of uncertainty; competitive risk – under the conditions of conflict and competition; fuzzy risk – under fuzzy conditions of decision making);

6) by the nature of occurrence (objective – conditioned by circumstances independent from the person making decisions (PMD); subjective – conditioned by individual perception of PMD of the problem of decision making; imaginable – can be considered a partial case of subjective risk in case when PMD exaggerates the level of threats, i.e. there are no threats, but PMD considers that there are);

7) by the sphere of occurrence (external and internal risks). In this case the criteria of division is the object of investigation and risk assessment: threats inside such object correspond to internal risks, and threats from outside – external risks;

8) by the number of people taking part in decisions-making which are connected with electronic logistics functioning (individual risk; group risk; massive risk);

9) by duration (short-term and long-term risks).

We argue that, the majority of e-logistics risks types are speculative as they allow receiving both probable positive result (reaching the aim of e-logistics) and the negative one (not reaching its aim).

3. The scheme of the process of e-logistics risk management. Applying the conceptual statements pointed out, in particular, in ISO Risk Management (2009), Risk Management Standard (2002) and the works of A.O. Starostina and V.A. Kravchenko (2004), V.V. Vitlinsky and V.I. Skitsko (2013) we can distinguish the following steps in the process of e-logistics risk management.

Step 1. Establishing the context. On this stage one defines strategic, tactical and operational goals of e-logistics risk management. Operational goals refer to every day activities or connected with certain delivery of products in the logistics system. Reaching the goals at this stage should facilitate the achievement of tactical goals. Tactical goals are certain tasks which are necessary to complete for the achievement of the strategic goal, for example: evaluation of the number of factors of e-logistics risks, specification of their boundaries and criteria etc. Strategic goal is a global aim which company management wants to achieve. For example, we can set the following strategic goal of e-logistics risk management: to provide the maximal number of product deliveries in necessary quantity and of good quality at agreed price to agreed places and at agreed with consumers time with the aim of receiving the maximal (or set) level of income at the acceptable level of e-logistics risk.

Step 2. Risk evaluation. This stage consists of identification, analysis and calculation (or evaluation) of risk (risk identification, risk analysis, risk evaluation). Identification of risks means discovering the number of factors (events and circumstances) which condition the occurrence of corresponding risks. The list of the pointed out risks should be enough to achieve the goals of risk management. At the stage of risk analysis different types of information are specified on each risk under investigation, its description is carried out including, in particular: the type of risk, the sphere of risk occurrence, the risk factor, the characteristic of the person interested in the elimination of risk under investigation. Further on, this description is amended by quantitative evaluations of risk (the stage of risk evaluation), the desired risk level, possible mechanisms of managing risk and controlling it. At this stage recommendations on managing the corresponding risk are formulated.

Step 3. Risk treatment. Risk treatment is a process which consists of estimation of risk management results, making a decision on the boundaries of the allowable risk level, and in case of necessity the development and introduction of new methods and mechanisms of elimination of the risk level, evaluation of effectiveness of risk elimination methods. Measures taken at this stage should provide reliable and effective activity of companies which participate in the delivery chain corresponding to laws and regulations, international standards etc.

4. Quantitative evaluation of the level of e-logistics risks. Quantitative evaluation of the risk level allows using the language of digits to show the probable result of making decisions in which it is necessary to take into account the probability of superposition of several circumstances (favorable or unfavorable) and specify the scale of a probable economic result (income or loss). The aim of quantitative risk evaluation is the elimination of uncertainty and conflict with the help of transfer from non-measurable uncertainty to measurable. For quantitative evaluation of risks the instruments of the theory of probability and mathematical statistics, the theory of utility, the fuzzy sets theory, genetic algorithms theory etc. are used.

The quantitative indices of risk may be calculated both in relative and absolute values. In absolute terms the risk of e-logistics can be stated by the expected value of a probable loss. If losses are described by a discrete random variable Z , then the expected value of probable losses can be calculated by the following formula as mathematical expectation:

$$M(Z) = \sum_{j=1}^m z_j p_j, \quad (1)$$

where z_j – specific value (probable consequence of a separate event) of random variable Z ; p_j – the probability of occurrence of the corresponding value of random variable Z ; $j = 1, m$, m – probable number of various values of random variable Z .

A dispersive approach has acquired a wide use in quantitative evaluation of risk. In this case the random variable Z corresponds to some investigated economic index (for example, the volume of sales, income etc.) and risk will be evaluated by dispersion and mean square deviation from the expected value Z . It is considered that the bigger is this deviation – the larger is the level of risk.

If random variable Z is discrete, then dispersion D and mean square deviation can be calculated by the formulas:

$$D(Z) = \sum_{j=1}^m (z_j - M(Z))^2 p_j = \sum_{j=1}^m (z_j)^2 p_j - \left(\sum_{j=1}^m z_j p_j \right)^2; \quad (2)$$

$$\sigma(Z) = \sqrt{D(Z)}. \quad (3)$$

Any risk is in the first place associated with unfavorable situations and for its evaluation it is enough to take into account only unfavorable deviations from the expected value, and not all the deviations to any direction. That is why as a risk level can be taken a semi variation *SV* and corresponding to it semi square variable *SSV*, for which the calculation formulas in the case of discrete random variable will look as follows (Vitlinsky and Velykoivanenko, 2004):

$$SV(Z) = \sum_{j=1}^m \alpha_j (z_j - M(Z))^2 p_j; \quad (4)$$

$$SSV(Z) = \sqrt{SV(Z)}, \quad (5)$$

where α_j – the indicator of unfavorable deviations from the center of grouping of random variable equal to 0, in case of favorable deviation z_j from mathematical expectation $M(Z)$, and equals to 1, in case of unfavorable deviation z_j from mathematical expectation $M(Z)$.

Formulas for calculations of the abovementioned indices in case of the continuous random variable Z are put, in particular, in the monograph by V.V. Vitlinsky and G.I. Velykoivanenko (2004).

In relative expression the risks of e-logistics can be evaluated with the help of the coefficient of variation *CV* and the coefficient of semi variation which are calculated correspondingly by the formulas:

$$CV(Z) = \frac{\sigma(Z)}{M(Z)} \quad (6)$$

and

$$CSV(Z) = \frac{SSV(Z)}{M(Z)}. \quad (7)$$

If random variable Z expresses the probable income, then the coefficient of variation shows the value of risk deviations which falls on the unit of the expected income, and the coefficient of semi variation characterizes the variable of risk of unfavorable deviations which falls on the unit of the expected income.

In general risk theory there is the so-called *effective value* of economic indicator which takes into account the level of inclination of the person making decisions on risk (Vitlinsky and Velykoivanenko, 2004). Let's assume that the investigated economic indicator (Z) is the income we want to maximize, then its effective value (expected utility) can be calculated by the formula:

$$B^+ = M(Z) - \tau SSV(Z), \quad (8)$$

where τ – the coefficient which depends upon the subjectively selected confidence coefficient (the cost of risk).

Let's designate through γ the probability that the value of random variable Z will be with the frames of the corresponding confidence interval. Then $\beta = 1 - \gamma$ – is the probability that the value of random variable Z will be outside the frames of the cor-

responding confidence interval. Thus, τ is the function from β , i.e. $\tau = \tau(\beta) > 0$; and β is one of the indicators of the risk level.

Therefore, with the probability no less than γ , the following inequality will be true:

$$Z \geq M(Z) - \tau SSV(Z). \quad (9)$$

I.e. the risk of interruption of this inequality will be no more than β .

If we know some defined normative value of the investigated economic indicator, then comparing it to the corresponding effective value, we can draw a conclusion on making a decision with account of risks.

5. Modelling of e-logistics risks. Quantitative evaluation of e-logistics risks will be more accurate in case of using relevant economic and mathematical methods and models to which can be referred, in particular: the analogue method, sensitivity analysis, simulation modelling, games theories and statistical decisions, hierarchy analysis and decision trees, instruments of artificial intelligence (fuzzy sets and fuzzy logic, genetic algorithms, artificial neuron networks) etc. To these and other methods of modelling a great number of scientific and applied works are dedicated, in particular (Yenchenko, 2006; Vitlinsky and Skitsko, 2013; Vitlinsky and Velykoivanenko, 2004), among which there are practically no works that could be referred to the field of e-logistics risks modelling. That is why this can be a subject of further investigations.

6. Management of e-logistics risks. Traditional methods of managing risks can also be referred to the risks of e-logistics, in particular, the following ones (Starostina and Kravchenko, 2004; Vitlinsky and Velykoivanenko, 2004):

1) avoiding the risk. Means avoiding taking certain actions burdened by risks. However, total rejection from taking risky actions in business does not mean complete avoidance of them, as such situation conditions the occurrence of the risk of unused opportunities;

2) risk prevention. Means taking "preventive" measures in risky situations, for example, in e-logistics this can be a periodic check of connection networks, information and telecommunication tools, software update etc.;

3) company's taking risk on itself;

4) risk transfer (external methods of risk level elimination): allocation of risk among participants of a logistic chain; external risk insurance;

5) internal methods of risk level elimination: limitation presupposes setting of the limit by certain indicators (time, cost etc.); diversification presupposes the allocation of money (for example, in e-logistics for providing the reliability of information transfer not only one, but several channels can be used); creating reserves for covering probable losses (in e-logistics this can be money for covering probable losses in consequence of low quality delivery of products to a consumer as well as information and telecommunication tools which can quickly replace those that broke down); acquiring additional information.

Any method of e-logistics risks management requires some financial losses. That is why it is necessary to attentively approach risk management, to assess the effectiveness of measures on risk elimination and select the best available option from all possible ones.

Managing e-logistics risks presupposes taking responsible decisions which can be grouped by the following properties: by selection the goals in e-logistics risk management; by selection of methods (prevention, decrease, compensation etc.) or instruments (technological, technical, organizational etc.) of e-logistics risk management; maintenance of balance in the triad "PMD-resources-goals" in the process of achieving the burdened by risks goals of e-logistics with the help of selected instruments and their management.

A central role in managing e-logistics risks is played by the people whose decisions directly influence the achievement of e-logistics goals. That is why they should be motivated and stimulated, just like all other employees.

Conclusions. Summarizing the results of this investigation of e-logistics risk management, we can draw the following conclusions. Innovativeness of e-logistics stipulated the occurrence of various risks which should not be ignored. They should be taken into account in company's activity managed within the frames of the corresponding risk management. This brings forward the necessity of solving a number of problems, in particular: definition and specification of the essence of risk and risk management in e-logistics; classification of e-logistics risks by various criteria; development of the scheme for risk management process in e-logistics; analysis, modeling and managing the risks of e-logistics.

This article is devoted to risks and risk management in e-logistics which is rapidly developing and spreading and thus needs comprehensive research. In particular, we are planning to devote our further investigations to development and application of mathematical methods and models in e-logistics risk management.

References:

- Аюлов Р.К.* Анализ рисков и управление рисками в логистике. – Алматы, 2011. – 70 с.
- Бродецкий Г.Л., Гусев Д.А., Елин Е.А.* Управление рисками в логистике: Учеб. пособие для студ. учреждений высш. проф. образования. – М.: Академия, 2010. – 192 с.
- Вітлінський В.В., Великоіваненко Г.І.* Ризикологія в економіці та підприємстві: Монографія. – К.: КНЕУ, 2004. – 480 с.
- Вітлінський В.В., Скіцько В.І.* Концептуальні засади моделювання та управління логістичним ризиком підприємства // Проблеми економіки.– 2013.– №4. – С. 246–253.
- Єнченко Є.В.* Моделювання і управління системними ризиками в логістиці: Дис... канд. екон. наук: 08.03.02 – Економіко-математичне моделювання. – К., 2006. – 229 с.
- Іванов А.А., Олейников С.Я., Бочаров С.А.* Риск-менеджмент: Учеб.-метод. комплекс. – М.: ИЦ ЕАОИ, 2008. – 193 с.
- Івченко І.Ю.* Економічний ризики: Навч. посібник. – К.: Центр навчальної літератури, 2004. – 304 с.
- Кондратенко Н.О., Лобашов О.О.* Інструменти управління та методи оцінки ризиків у логістичних системах // Комунальне господарство міст: Наук.-техн. збірник.– Серія: Економічні науки.– 2012.– Вип. 102. – С. 343–350.
- Короленко Н.В.* Управление рисками логистической системы предприятия: теоретические аспекты // Эффективная экономика.– 2013.– №10 // www.economy.nauka.com.ua.
- Мамчин М.М., Русановська О.А.* Вплив логістичних ризиків на підвищення ефективності діяльності підприємств // Вісник Національного університету «Львівська політехніка».– Серія: Менеджмент та підприємництво в Україні: етапи становлення і проблеми розвитку.– 2011.– №720. – С. 45–51.
- Ровенских М.В.* Управление рисками логистической системы промышленного предприятия: Дис... канд. экон. наук: 08.00.05 – Экономика и управление народным хозяйством: логистика. – СПб., 2008. – 261 с.
- Старостіна А.О., Кравченко. А.О.* Ризик-менеджмент: теорія та практика: Навч. посібник. – К.: Політехніка, 2004. – 200 с.

- Стерлигов К.* Механізми управління ризиками в логістиці, 2014 // www.logists.by.
- Управління ризиками в логістиці: Навч. посібник / В.М. Гончаров, Р.Р. Ларіна, О.В. Балусева та ін. – Львів: Магнолія 2006, 2013. – 253 с.
- Черкасов В.В.* Проблемы риска в управленческой деятельности: Монография. – М.: Рефабук; К.: Ваклер, 1999. – 288 с.
- Шегда А.В., Голованенко М.В.* Ризики в підприємстві: оцінювання та управління: Навч. посібник. – К.: Знання, 2008. – 271 с.
- A Risk Management Standard // IRM/Alarm/AIRMIC, 2002 // www.theirm.org.
- Fuchs, H., Wohinz, J.W.* (2009). Risk management in logistics systems. *Advances in Production Engineering & Management*, 4(4): 233–242.
- ISO. Risk Management – Principles and guidelines ISO 31000. Switzerland: ISO, 2009. 24p.
- Korecky, M.* (2012). Risk management in logistics. Carpathian Logistics Congress, 7–9.11.2012, Jeseník, Czech Republic, EU // konsys2.tanger.cz.

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