UDC 656.338.12
DOI: 10.15587/1729-4061.2025.329994

DEVISING A METHOD FOR STRATEGIC-ORIENTED EVALUATION OF THE ACTIVITIES OF LOGISTICS PERSONNEL TAKING INTO ACCOUNT THE EFFECT OF RISK AND UNCERTAINTY FACTORS

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The object of this study is the process of strategically-oriented assessment of the activities of an employee at an entity involved in the rendering of logistics services to internal and/or external clients (consumers) of the organization, taking into account the effects of risk and uncertainty factors. The task addressed is to improve the efficiency of decisions (according to a specified optimization criterion) in the field of logistics personnel management in the organization based on the further development of methodological approaches to assessing the activities of logistics personnel.

A structural model of an integral indicator for strategically-oriented assessment of the activities of an employee of the organization involved in the provision of logistics services has been built. The hierarchical structural model involves establishing a connection between the system for assessing the activities of logistics personnel with the strategic goals of the organization.

The study also reports a constructed mathematical model of an integral indicator for strategically-oriented assessment of the activities of an employee of the organization involved in the provision of logistics services, taking into account the effects of risk and uncertainty factors. A procedure for the interaction of these models has been proposed, owing to which a method of strategically oriented assessment of the activities of logistics personnel was suggested, taking into account the action of risk and uncertainty factors.

Applying the method could make it possible to form integral and complex indicators for assessing the activities of logistics personnel, aimed at achieving the strategic goals of the organization. This would also enable determining general directions and building individual trajectories for the training and development of logistics personnel. The specified method is advisable to use when developing software for planning the logistics activities of enterprises

Keywords: strategically oriented assessment of personnel activities, logistics personnel, functional areas of logistics

Received 04.03.2025
Received in revised form 16.04.2025
Accepted 06.05.2025
Published 30.06.2025

How to Cite: *Vorkut, T., Volynets, L. (2025). Devising a method for strategic-oriented evaluation of the activities of logistics personnel taking into account the effect of risk and uncertainty factors. Eastern-European Journal of Enterprise Technologies, 3 (3 (135)), 57–66. https://doi.org/10.15587/1729-4061.2025.329994*

1. Introduction

The BSC concept (abbreviation for the English Balanced Scorecard) has four barriers to the successful implementation of organizational strategy. The first barrier is vision – only 5% of employees understand the strategy. The second barrier is the human factor – only 25% of managers have incentives related to the strategy. The third barrier is management – only 15% of organizations spend more than one hour per month discussing strategy. The fourth barrier is resources – only 40% of organizations have a connection between budgets – current and capital – and strategies [1]. At the same time, the issue of the consistency of incentives for all employees of the organization with the degree of success in implementing the organizational strategy is usually not singled out.

At the beginning of its emergence, the BSC concept was considered at organizations in a fragmentary way. In particular, in the context of the possibility of its application in the formation of a system of indicators for disseminating information about the strategy, substantiating a single direction in work, determining priorities for resource allocation, etc. The modern understanding of the BSC concept sees it, first of all, as a mechanism for the effective and efficient implementation of organizational strategy. Within the framework of this mechanism, it is assumed to determine goals, indicators for their measurement, target (normalized) values of these indicators, as well as measures aimed at overcoming differences between the current and target values of such indicators [2]. Following the BSC concept, the system of organizational goals and their corresponding indicators is determined at the following levels – corporate (general organizational level), business unit level, structural unit level (departments, groups, etc.). At the same time, indicators of a relatively lower level should be consistent with indicators of a relatively higher level to track the contribution to achieving the general goals of the organization and its organizational structural units. This is termed cascading. The BSC concept covers various aspects (areas) of the organization's activity. In the general case, this is an orientation towards meeting the needs of consumers (clients), internal business processes, financial results, as well as innovation,

training, and personnel development [3]. It can be expected that the conditions for forming systems for evaluating personnel performance in general, and logistics performance in particular, in an organization implementing BSC should also take into account the cascading principle.

In a number of studies on organizational management, the BSC concept is interpreted as a certain further development of the MBO method (abbreviation for Management by Objectives) [4]. At the same time, the emergence of KPI (abbreviation from the English Key Performance Index – a key indicator of the result of the activity, in the sense of effectiveness and/or efficiency. Activities in the professional literature on organizational management are also often associated with the MBO method. The contribution to the development of the MBO method is combined with both the development of the BSC concept itself and KPI systems. The application of the MBO method, as well as its later modifications and related developments, is currently one of the main contexts of the formation of employee motivation systems. Under the conditions of application of the MBO method, and, accordingly, the BSS concept, individual KPIs are usually considered as deterministic values. This limits the possibility of taking into account through these indicators the effect of risk factors and uncertainty regarding the work of structural units of the organization and their individual employees. Hypothetically, these factors can be taken into account through the introduction of individual additional indicators.

Parallel to management theory, an important component of which is the management by objectives method, management theory has evolved. The latter, its author defined in a number of his works as the theory of statistical thinking [5].

Conventional, so to speak, management generates a rather rigid organizational structure. The organization is divided into functional units, each of which has its own, different from the others, tasks, functions, areas for work, etc. Management theory sees in the hierarchy only a tool for building a horizontal organization in the company and a mechanism for maintaining the normal functioning of the new organizational structure. The manager should help build horizontal relationships in the system based on processes, contribute to the erasure of barriers between structural units caused by the hierarchy, and provide authority to those employees who can perform them at a professional level. The hierarchy, according to management theory, builds a flexible, self-adapted to the needs of the client and changing business conditions, structure. It, that is, the hierarchy, organizes and supports the process structure, in particular, leadership in processes, creates an environment for improvement. In general, we can note that this kind of hierarchy should serve to simplify and improve processes, not to complicate them [6].

In modern business, ideas are associated with the "quality revolution" for most people, when the consumer (client) began to be considered as an obligatory component of any organizational system, which determines the meaning of the latter's existence. This was a contrast to the view of business organizations only as a "machine that produces money". It seems that under current conditions, business organizations have already fully accepted the basic ideas of quality management, which are reflected in the concept of TQM (abbreviation from English Total Quality Management), international quality standards ISO 9001 (abbreviation from English International Organization for Standardization). At the same time, according to [5], the quality revolution should only be a precursor to the time when profound changes will occur in the theory and methods of management. Such changes are caused by objective trends in socio-economic development. At the heart of such changes is the problem of humanizing the economic life of society, the perception of business as an activity that is carried out by people and for people [6].

In the works by many famous scholars related to organizational management, in particular Japanese, as well as practicing managers, the red line is the idea that the theory of quality goes far beyond the boundaries of organizational management. This theory encompasses "strategy and tactics of lifestyle management".

Management theory proposes, based on its "statistical component", 14 points for management [5]. One of these points, namely the 11th, provides for "the exclusion of management by objectives, the suspension of management by numbers and quantitative results". It is proposed to introduce leadership instead. That is, we are talking about the abolition of quantitative goals for employees, organizations. As the author of [5] notes: "A natural fluctuation in the right direction, which usually occurs due to inaccuracy of data, is regarded as success. Fluctuations in the opposite direction force one to rush around in search of explanations and hastily solve the problem, which becomes a source of even greater disappointment and the emergence of new problems".

At the same time, managers of organizations that apply various aspects of management theory in their work practice believe that the latter does not eliminate the need for them to evaluate the activities of individual structural units and their employees. In particular, to assess the contribution of an individual employee to the implementation of organizational strategic goals, tracked by structural divisions of the organization to its highest level. This requires devising appropriate methodological approaches. Thus, research aimed at searching for new and improving and developing existing methodological approaches to strategically oriented assessment of personnel activities, in particular, logistics, in organizations that apply management theory, is relevant.

2. Literature review and problem statement

In [4], a management concept is described, which is based on the accuracy of the production process and describes the effectiveness of quality control. The shortcomings of the proposed concept include the lack of assessment of the effectiveness of the work process.

In [5], it is described that, according to management theory, the results of any process are characterized by variability. At the same time, the conditions for managing this variability involve the separation of two types of variability. This is random variability, which arises due to random, or, as they are also defined, "ordinary" causes. And non-random variability, which arises due to non-random, or, as they are also defined, "special" causes.

Random variability is due to the presence of a wide list of causes. These causes are present constantly and each of them constitutes a very small share of the total variability, without being significant in itself. However, the sum of all these causes is measurable, and it is believed that it is the internal essence of the process. Reducing the impact of common causes requires management decisions, allocation of resources, to improve the process and/or system. Regarding the second type of variability, that is, non-random variability, it is interpreted as real "real" changes in the analyzed process. These changes

may be the result of some conditioned causes that are not inherent in the process internally. They can be eliminated, at least theoretically.

A stable process, that is, one in which there are no signs of special causes of variations, the theory of variability of which became the forerunner of the theory of control, is called statistically controlled. This is a random process. It is predictable, although it is obvious that some unforeseen circumstances can take this process out of the state of statistical control. The disadvantages include the fact that the presence of the above two types of variability is what is at the heart of two types of errors when making management decisions. Each of these errors leads to significant costs for the organization. The error of the first type consists in considering any defect, complaint, failure, accident, shortage of anything as a special case. When, in fact, nothing special happens. That is, all this is a manifestation of random variations in the process, caused by general causes. The second type of error is to attribute any defect, complaint, error, failure, accident, shortage of anything to general, i.e., ordinary, process variations. When, in fact, this is a manifestation of some special reason.

In work [6], an improvement of the management process is proposed, which can be divided in time into three phases: Phase 1 – stabilization of the process, i.e., bringing it to a statistically controlled state by identifying and eliminating special causes of variations. Phase 2 – active actions to improve (improve) the process, i.e., "reducing" the usual causes of variations. Phase 3 – monitoring the process to maintain the achieved improvements. The disadvantages of the specified management process include the fact that a number of specialists in the field of statistics are not ready to accept the actual statistical aspect of management theory, primarily due to the fact that in which the classical theory of statistical inference is radically revised.

In [7] it is justified that if, when developing KPIs used to evaluate personnel performance, we rely on management theory, we shall have the following: instead of one deterministic KPI value, the mathematical expectation (m_x), variance (D_x), and also the limits for the type of indicator should be given $m_x \pm 3\sqrt{D_x}$. Initiatives aimed at improving the process can be represented in two groups, according to the process improvement phase in which the process is located. These are initiatives that have as their goal the stabilization of the process. And these are initiatives that have as their goal the actual improvement of the process, that is, improvement in terms of reducing the usual causes of variations. The disadvantages of the specified approach include that the specified initiatives require specification of their content. According to the terms of management theory, normalized KPI values should not be introduced since their very existence contradicts the provisions of this theory. Actually, the very essence of KPI in the context of applying management theory needs to be reconsidered.

In [8], Deminck and Taylor's quality control of the scientific organization of labor is described, which operate identically. At the same time, the shortcomings include the fact that statistical methods, "television" and "computer modeling" taken by themselves cannot explain the full multifaceted nature of management theory. These changes should restore individuality, abolish grades and gradations at all levels – from schools to universities.

In [9], the processes of interaction between the goals of sustainable development and the strategy of financial support of the concept of sustainable development of passenger transport enterprises are determined. The strategies of financial support of the concept of sustainable development of passenger transport enterprises are proposed and a generalized scheme of the strategy of financial support of the concept of sustainable development of passenger transport enterprises is developed. The disadvantages of the above strategies of the concept of sustainable development of passenger transport enterprises include the lack of the possibility of the main stages of formation and evaluation of the strategy of financial support of logistics enterprises in conditions of risk and uncertainty.

In [10], the features of modern realities of business administration are determined, which are characterized by variability, uncertainty, complexity, and ambiguity. A conceptual model of business administration in the VUCA world is built. The components of the VUCA world and their impact on business administration are described. The study was conducted to determine the factors that affect the effectiveness of management in conditions of variability, uncertainty, complexity, and ambiguity. The disadvantages of this model include the fact that the goals of entrepreneurial activity are only from the point of view of marketing approaches and the interests of stakeholders.

In [11], the proposed scientific and methodological recommendations relate to the implementation of a comprehensive approach to improving transport and logistics business processes, which involves the use of methods of the quality management system, continuous process management, process optimization and, if necessary, reengineering. The disadvantages include the lack of consideration of risks and uncertainty when using methods of the quality management system, continuous process management.

In [12], a strategy and mechanism for managing the financial and economic security of an enterprise were developed. The disadvantages of the proposed strategy include the impossibility of assessing the activities of an employee at the organization involved in the provision of logistics services.

In [13], problems in the development of the transport industry were identified and an assessment of its condition was provided. Stimulation of innovative activity was proposed as a tool for ensuring the strategic development of motor transport enterprises. The disadvantages of the specified tool include the lack of the possibility of adjusting conditions and factors that may appear during the management process.

In [14], the main trends in digitalization were identified and the types of digital technologies used in transport and logistics were highlighted. In the context of the digitization market, strategic development and ensuring the competitiveness of transport organizations were proposed. The disadvantages include the impossibility of predicting risks in the logistics management of organizations and organizational networks.

In [15], a logistical approach to organizations of unbalanced cargo transportation was devised. The disadvantages include the lack of analysis and systematization of indicators that can be used as partial indicators according to the proposed integral criterion.

In [16], practical measures are proposed to improve logistics solutions in transport and customs services in international traffic to ensure the efficiency and reliability of the national economy of Ukraine. The shortcomings of the proposed measures include the lack of assessment of the results of drivers' work taking into account the effects of risk and uncertainty factors.

In [17], the relationship between the efficiency of cargo delivery and the quality of transport service is characterized. The structure of the quality management system is proposed and a set of parameters that form the assessment of the quality of transport service is determined. An expert system based

on a fuzzy-multiple model of route selection using the criterion of "route attractiveness" is also built. The model makes it possible to take into account different requirements for the level of quality of transport services when finding the optimal solution that harmonizes the interests of all participants in the transportation process. However, this model does not take into account the efficiency of organizing the work of drivers on delivery routes.

In [18], increasing the reliability of information in real-time management systems in road transport is considered. The use of information redundancy is proposed, the influence of the probability of a controlled event, as well as the number and quality of information sensors on the reliability of information is investigated. The disadvantages of the proposed study include the impossibility of mathematical modeling calculations taking into account the probability of uncontrolled events in conditions of risk and uncertainty.

Our review of the literature [4–18] demonstrates that the scientific gap is identified in the lack of methods, models, and mechanisms that would allow for a strategically oriented assessment of personnel activities, in particular, logistics, taking into account the variability of the results of this activity. Recognition of the presence of such variability corresponds to the conditions for the functioning and development of organizations that use the theory of management in their practice.

The task that needs to be solved is to increase the effectiveness and efficiency of decisions in the field of logistics personnel management in the organization based on the further development of methodological approaches to assessing the activities of logistics personnel. This development involves taking into account the conditions for the variability of the results of this activity and its compliance with the directions of the organization's strategic development.

3. The aim and objectives of the study

The purpose of our study is to devise a method for strategically oriented assessment of the activities of the logistics personnel of the organization, taking into account the variability of the results of this activity under the influence of risk and uncertainty factors. This will improve the efficiency of the activities of the logistics personnel of the organization. This will make it possible to create prerequisites for the formation of incentives in the activities of the logistics personnel, related to the implementation of the organizational strategy, on the one hand, and the construction of individual trajectories of training and development of logistics personnel, on the other.

To achieve the goal, the following tasks were set:

– to build a structural model of an integral indicator for strategically oriented assessment of the activities of an employee at the organization involved in the provision of logistics services;

– to build a mathematical model of an integral indicator for strategically oriented assessment of the activities of an employee at the organization involved in the provision of logistics services, taking into account the influence of risk and uncertainty factors.

4. The study materials and methods

The object of our study is the process of strategically oriented assessment of the activities of an employee at the organization involved in rendering logistics services to internal and/or external clients (consumers) of the organization, taking into account the action of risk and uncertainty factors.

The subject of the study is methods, models, and mechanisms for assessing the activities of logistics personnel, which are based on the concepts of management by objectives [4] and statistical thinking [5] – as alternatives, as well as the concept of BSC [2, 3].

The hypothesis of the study assumes the possibility of increasing the effectiveness and efficiency of logistics personnel management at the organization based on the development of strategically oriented systems of indicators for assessing personnel activities, taking into account the variability of the results of their activities.

The model of the integral indicator in this study means the procedure for calculating the integral indicator, that is, the procedure for calculating the specified integral indicator.

When building a structural model of an integral indicator for strategically oriented assessment of the activities of an employee of an organization involved in rendering logistics services, the following research methods were used. These are a systemic approach, the theory of logistics management, the approach of an integral criterion – as an approach to solving multi-criteria tasks, the BSC concept. The main personnel involved in rendering logistics services to internal and/or external clients (consumers) of the organization are defined as logisticians in the work.

The application of the proposed method should enable organizations to form systems of indicators for strategically oriented assessment of logistics personnel activities, taking into account the variability of the results of this activity. These systems provide for the determination of an integral indicator by assigning weights to complex indicators. The latter, in turn, are determined similarly, based on indicators of a relatively lower level. It is envisaged to establish such levels as the level of processes, identified within the functional areas of logistics – transportation, warehousing, cargo handling, order fulfillment, etc.; the level of activities, identified by processes according to the BSC concept; the level of partial (local) indicators – as the lowest level. Partial indicators are objective, in the sense of statistical. The number and content of the lowest level indicators for different organizations may be different and vary within fairly wide limits.

The strategic orientation of indicator systems for assessing personnel activities is achieved by two prerequisites. Firstly, by determining partial indicators using the cascading principle, in accordance with the strategic goals of the organization. Secondly, by assigning weights to complex and partial indicators, in accordance with the priorities in the areas of strategic development of the organization.

When constructing a mathematical model of an integral indicator for a strategically oriented assessment of the activities of an employee of the organization involved in rendering logistics services, taking into account the effects of risk and uncertainty factors, the following research methods were used:

– general scientific methods of scientific knowledge, such as analysis and synthesis – to determine the patterns of influence of conditions and factors of logistics personnel management, to devise approaches to increase the effectiveness of approaches to its management;

– method of hierarchy analysis – to decompose the structure of a logistics enterprise to detail the influence of conditions and factors on the effectiveness of logistics personnel management;

– methods of probability theory – to substantiate ways to improve the effectiveness of logistics personnel management;

– mathematical statistics – for the validity of the conclusions of the study;

– method of analogies – for a comparative assessment of the effectiveness of the approach proposed in the study.

TOV "DSV-UKRAINE" was chosen as the base enterprise for conducting the study. The initial data for conducting an analysis of the effectiveness of the approach proposed in the study are given in Tables 1–6.

Table 1

Initial data for conducting the study

Indicator ID	Dynamics, a.u.		
	2022	2023	2024
Volume of products sold, services provided	10,961.5	11,632.2	12,536.1
Profit from sales of products, provision of services	1,649.3	2,081.9	2,453.4
Cost of fixed assets at the beginning of the year	2,182.9	3,023.32	3,386.1
Cost of fixed assets at the end of the year	3,023.3	3,386.1	3,640.5
Average number of employees (persons)	507	543	587

Table 2

Characteristics of fixed assets of the enterprise TOV "DSV-UKRAINE"

No.	ID	Quantity at the end of the year, pcs.			Number at the end of the year, a.u.			Structure, %		
		2022	2023	2024	2022	2023	2024	2022	2023	2024
1	Land	1	1	1	14	14	14	0.44	0.39	0.36
2	Buildings, structures	3	4	5	669	747	908	22.12	22.06	24.94
3	Machinery and equipment	360	393	397	1,872	2,045	210	61.93	60.39	56.85
4	Vehicles	243	306	354	295	372	431	9.77	11.00	11.83
5	Tools, devices, inventory	93	110	116	101	120	126	3.34	3.54	3.46
6	Other fixed assets	32	43	45	1,310	1,761	1,875	1.04	1.25	1.24
7	Low-value non-current tangible assets	37	41	42	1,721	1,929	1,991	1.37	1.37	1.31
Total		769	898	959	5,982	6,988	5,555	100.00	100.00	100.00

Table 3

Characteristics of working capital of the enterprise TOV "DSV-UKRAINE"

No.	ID	Number at the end of the year, a.u.			Structure, %		
		2022	2023	2024	2022	2023	2024
1	Inventories	151	124	133	9.52	10.18	10.23
2	Work in progress	16	27	33	1.03	2.23	2.53
3	Finished goods	42	64	36	2.65	5.27	2.78
4	Goods	76	96	114	4.81	7.08	8.73
5	Trade receivables	584	748	771	36.82	61.30	58.93
6	Account receivables	30	35	59	1.91	2.83	4.48
7	Other current receivables	15	30	8	0.96	2.45	0.61
8	Cash	67	103	153	42.13	8.43	11.71
9	Other current assets	2.5	3	0.1	0.16	0.23	0.01
Total		983,5	1230	1307.1	100.00	100.00	100.00

Table 4

Characteristics of labor resources of the enterprise TOV "DSV-UKRAINE"

No.	ID	Number at the end of the year, a.u.			Growth index, %		
		2022	2023	2024	2022	2023	2024
1	Average number of employees, (persons)	507	543	587	102	107	103
2	Wage fund	853.99	1,114.17	1,470.99	118	130	132
3	Labor productivity	21.62	21.4	21.36	99	98	99

Table 5

Characteristics of the financial condition of the enterprise TOV "DSV-UKRAINE"

No.	ID	Number at the end of the year			Growth index, %		
		2022	2023	2024	2022	2023	2024
1	Cost of sales of products, provision of services, a.u.	4,677.65	7,704.69	9,979.3	–	135.70	129.52
2	Profit from sales of products, provision of services, a.u.	1,649.27	2,081.85	2,453.39	–	101.46	104.87
3	Profitability,%	29.05	27.02	24.58	–	93.01	90.97

Table 6

Dynamics of liquidity and financial stability indicators of the enterprise TOV "DSV-UKRAINE"

No.	Indicator ID	Indicator dynamics			Growth indices, %		
		2022	2023	2024	2022	2023	2024
1	Coverage ratio	1.3	1.05	1.29	–	80.77	122.86
2	Quick liquidity ratio	1.1	0.94	1.17	–	85.45	124.47
3	Absolute liquidity ratio	0.09	0.09	0.15	–	100.00	166.67
4	Autonomy ratio	0.62	0.59	0.67	–	95.16	113.56
5	Financial stability ratio	1.65	1.48	2.03	–	89.70	137.16

5. Devising a method for strategically-oriented assessment of logistics personnel activities taking into account risk and uncertainty

5. 1. Construction of a structural model of an integral indicator for strategically-oriented assessment of the activities of an organization employee

The conditions for constructing a structural model of an integral indicator for strategically-oriented assessment of the activities of the *r*-th employee in the *s*-th functional area of logistics of the organization – KPI^{r_s}, $r=\overline{1,R}$, $s=\overline{1,S}$, the following are assumed. The indicators that are selected as partial and on the basis of which KPI^{r_s}, $r=\overline{1,R}$, $s=\overline{1,S}$, are built must be consistent with the indicators by which the activities of the entire hierarchy of levels of the organization are assessed. That is, in the context of applying the BSC concept, cascading must take place. The obtained, using the cascading principle, system of indicators for assessing the activities of logistics personnel makes it possible to coordinate the results of the activities of individual employees with general organizational strategic goals. According to the BSC concept, partial indicators should be formed according to the following aspects (areas) of the organization's activities: focus on meeting the needs of consumers (clients), internal business processes, financial results, as well as innovation, training, and development of personnel.

Taking into account the above assumptions, it is possible to build a structural model of an indicator KPI^{r_s} for strategically oriented evaluation of the activities of an employee involved in rendering logistics services (Fig. 1).

Integral indicator for evaluating the performance of the r_s-th employee in the s-th functional area of logistics provided by the organization, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$

Integral indicators for evaluating the performance of the r_s-th employee in the n_s-th process, distinguished by the s-th functional area of logistics provided by the organization, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$

Composite indicators for evaluating the performance of the r_s-ro employee in the m_{n_s}-th area of activity identified according to the BSC concept within the n_s-process distinguished in the s-th functional area of logistics provided by the organization, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$

Partial indicators for evaluating the performance of the r_s-th employee, distinguished within the m_{n_s}-th area of activity defined according to the BSC concept, in the n_s-my process identified within the s-th functional area of logistics provided by the organization, $j_{m_{n_s}}=\overline{1,J_{m_{n_s}}}$, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$

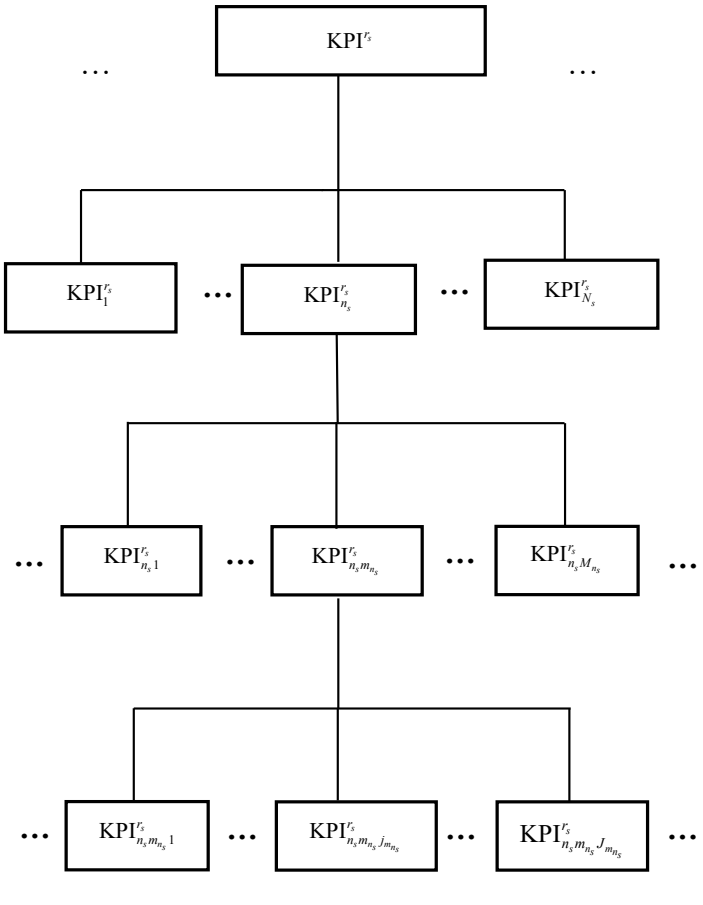

Fig. 1. Model of the structure of an integral indicator for strategically oriented evaluation of the activities of an employee at an organization involved in rendering logistics services

The designations of integral, complex, and partial indicators shown in Fig. 1 can be used as identifiers under the conditions of providing information support for relevant management decisions.

Based on the analysis conducted in [19–22], it is possible to distinguish the main functional areas of logistics. In particular, such as transportation, warehousing, cargo processing, order fulfillment, etc. In the general case, within each such functional area of logistics, a certain set of N_s processes can be distinguished $s=\overline{1,S}$. In partial cases, a separate functional area of logistics can be identified with only one process. For example, transportation using road transport. That is, $n_s=1$, $s=\overline{1,S}$. At the same time, in the same transportation, certain processes (subprocesses) can be distinguished, according to such characteristics as: technical support of transportation; cargo characteristics; shipment characteristics; type of connection.

Within each n_s-th process, it is assumed to isolate the areas of activity by which the result of the implementation of this process is evaluated m_{n_s}, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $s=\overline{1,S}$. Under conditions when these areas of activity are isolated using the concept of ZSP, $m_{n_s}=\overline{1,4}$, $n_s=\overline{1,N_s}$, $s=\overline{1,S}$.

In turn, within each area of activity m_{n_s}, isolated by the n_s-th process, partial indicators $j_{m_{n_s}}$ are isolated, $j_{m_{n_s}}=\overline{1,J_{m_{n_s}}}$, $m_{n_s}=\overline{1,m_{n_s}}$, $n_s=\overline{1,N_s}$, $s=\overline{1,S}$. According to these indicators, statistical data should be accumulated on the activities of each r_s-th employee of the organization, who provides the n_s-th process $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$. If it is assumed to apply the management theory by E. Deming under the conditions of implementing the structural model for KPI^r, $r=\overline{1,R}$, $s=\overline{1,S}$, then maps are constructed using the aforementioned statistical data [23].

5. 2. Construction of a mathematical model of an integral indicator for strategically-oriented assessment of an employee's performance

When determining an integral indicator for strategically-oriented assessment of an employee's performance of an organization involved in rendering logistics services, KPI^{r_s}, $r=\overline{1,R}$, $s=\overline{1,S}$, a number of partial indicators are taken into account (Fig. 1). The construction of an appropriate mathematical model can be considered in the context of solving multi-criteria problems. Under these conditions, such an approach to solving multi-criteria problems as the weighted criteria approach can be applied. These models, as is known, provide for the determination of the priority of each criterion by which the object is analyzed by giving the criterion a certain weight.

The integral indicator for strategically-oriented assessment of an employee's performance of an organization involved in rendering logistics services (Fig. 1) can be written as follows:

$$KPI^{r_s}=\sum_{n_s=1}^{N_s}\sum_{m_{n_s}=1}^{M_{n_s}}\sum_{j_{m_{n_s}}=1}^{J_{m_{n_s}}} w_{n_s} w_{m_{n_s}} w_{j_{m_{n_s}}} KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}},$$

$$j_{m_{n_s}}=\overline{1,J_{m_{n_s}}},$$

$$m_{n_s}=\overline{1,M_{n_s}},\ n_s=\overline{1,N_s},\ r_s=\overline{1,R_s},\ s=\overline{1,S}, \quad (1)$$

where w_{n_s} is the value of the weight coefficient for the n_s-th process, which is separated by the s-th functional area of logistics provided by the organization

$$\sum_{n_s=1}^{N_s} w_{n_s}=1,\ w_{n_s}\geq 0,\ n_s=\overline{1,N_s};\ s=\overline{1,S}, \quad (2)$$

$w_{m_{ns}}$ is the value of the weight coefficient for the m_{ns}-th area of activity, identified according to the BSC concept, in the n_s-th process, which is identified according to the sth functional area of logistics provided by the organization

$$\sum_{m_{n_s}=1}^{M_{n_s}} w_{m_{n_s}}=1,\ w_{m_{n_s}}\geq 0,\ m_{n_s}=\overline{1,M_{n_s}};\ n_s=\overline{1,N_s};\ s=\overline{1,S}, \quad (3)$$

$w_{j_{m_{ns}}}$ is the value of the weight coefficient for the $j_{m_{ns}}$-th partial indicator, separated by the m_{ns}-th field of activity, separated by the BSC concept in the n_s-th process, which is separated by the s-th functional area of logistics provided by the organization

$$\sum_{j_{m_{n_s}}=1}^{J_{m_{n_s}}} w_{j_{m_{n_s}}}=1,\ w_{m_{n_s}}\geq 0,\ j_{m_{n_s}}=\overline{1,J_{m_{n_s}}},\ m_{n_s}=\overline{1,M_{n_s}};$$

$$n_s=\overline{1,N_s};\ s=\overline{1,S}, \quad (4)$$

$KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}}$ is the value of the partial indicator $j_{m_{n_s}}$ for evaluating the activity of the r-th employee, identified according to the BSC concept, in the n_s-th process, which is identified according to the s-th functional area of logistics, provided by the organization, $j_{m_{ns}}=\overline{1,J_{m_{ns}}}$, $m_{ns}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$,=$r_s=\overline{1,R_s}$, $s=\overline{1,S}$; $J_{m_{nS}}$ is the number of partial indicators, identified according to the m_{nS}-th area of activity, identified according to the BSC concept, in the n_s-th process, which is identified according to the s-th functional area of logistics, provided by the organization, $m_{ns}=\overline{1,M_{n_s}}$; $n_s=\overline{1,N_s}$; $s=\overline{1,S}$; M_{n_s} is the number of activities, identified according to the BSC concept, in the n_s-th process, identified according to the s-th functional area of logistics, provided by the organization, $n_s=\overline{1,N_s}$; $s=\overline{1,S}$; N_s is the number of processes, identified according to the s-th functional area of logistics, provided by the organization, $s=\overline{1,S}$; S is the number of functional areas of logistics provided by the organization.

According to the proposed model of the integral indicator (Fig. 1), complex indicators can be distinguished at the appropriate levels. Firstly, this is the level of areas of activity according to the BSC concept, which are distinguished for each process, which is distinguished for each functional area of logistics provided by the organization. That is, in the general case, four values of such complex indicators are distinguished for each process when we apply the BSC concept. Secondly, this is the level of processes, distinguished for each functional area of logistics provided by the organization. Based on the complex indicators of the second, of the above-mentioned, level, the indicator KPI^{r_s}, $r=\overline{1,R}$, $s=\overline{1,S}$ is already directly determined (Fig. 1).

Establishing weight coefficients for each element (object) of the formed model (Fig. 1) requires choosing the appropriate method. In particular, the method of hierarchy analysis, which was proposed to substantiate multi-criteria decision-making processes, can be used [24]. Note that, as well as the selection of partial indicators according to the integral indicator model (Fig. 1), the establishment of the value of weight coefficients should ensure the coordination of the activities of individual employees with the overall organizational strategic goals.

Of particular interest is the choice of approach to determining $KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}}$, $j_{m_{ns}}=\overline{1,J_{m_{ns}}}$, $m_{ns}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$. The presented structural model of the integral indicator (Fig. 1) and expression (1), hypothetically, can be used by organizations within the framework of the implementation of management theories as (management by objectives) [8] and [5].

Conditions for evaluating personnel performance according to the first of the mentioned theories, which usually involves establishing a rating. At the same time, when determining the actual integral indicator, represented by expression (1), the following should be taken into account. In particular, statistical and/or expert data can have both a different order and different units of measurement. Thus, there is a need to use appropriate methods of statistical transformations – normalization and scaling. Among the scaling methods, in particular, the interval method, rank method, and point evaluation method can be applied. When choosing partial indicators that are considered as logistic, one can refer to work [25]. When there are no objective prerequisites for direct evaluation of logistics personnel based on the proposed partial indicators, the method of hierarchy analysis can also be used [10].

According to the essence of management theory [5, 6], the results of any process are characterized by variability, that is, random fluctuations occur. Thus, the proposed integral indicator, expression (1), in accordance with the specified theory, should provide an opportunity to take into account the conditions of variability of logistics processes, in the implementation of which the r_s-th $r_s=\overline{1,R_s}$, $s=\overline{1,S}$, employee is involved. That is, to answer the question of whether the activities of the r_s-th, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$, employee, evaluated by partial indicators, should be considered in the context of special or ordinary causes of variation. It is proposed to evaluate the result achieved by the employee for each partial indicator as "1" – if the value of the indicator turned out to be such that it did not go beyond the control values. That is, the lower and upper control limits according to control charts [23]. The specified limits can be established by analyzing the statistical data of the work of all employees involved in the implementation of the relevant processes, identified by the s-th functional area of logistics $s=\overline{1,S}$. Groups of employees can be identified, based on the assumption of insignificant differences in working conditions for the n_s-th process, $n_s=\overline{1,N_s}$, $s=\overline{1,S}$, individual employees. When the result of an employee involved in the n_s-th process $n_s=\overline{1,N_s}$, $s=\overline{1,S}$, for a separate partial indicator went beyond the control limits, then it can be estimated as "0".

Thus, for each r_s-th $r_s=\overline{1,R_s}$, $s=\overline{1,S}$, employee, it can be written:

$$KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}} = \begin{cases} 1,0, \text{ if } KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}} \in \left[h^d_{n_s m_{n_s} j_{m_{n_s}}} ; h^u_{n_s m_{n_s} j_{m_{n_s}}} \right], \\ 0, \text{ if } KPI^{r_s}_{n_s m_{n_s} j_{m_{n_s}}} \notin \left[h^d_{n_s m_{n_s} j_{m_{n_s}}} ; h^u_{n_s m_{n_s} j_{m_{n_s}}} \right], \end{cases}$$

$$j_{m_{ns}}=\overline{1,J_{m_{n_s}}}, m_{n_s}=\overline{1,M_{n_s}},$$

$$n_s=\overline{1,N_s}, r_s=\overline{1,R_s}, s=\overline{1,S}, \quad (5)$$

where $h^d_{n_s m_{n_s} j_{m_{n_s}}}$ – the lower control limit according to Shewhart control charts, $j_{m_{ns}}=\overline{1,J_{m_{n_s}}}$, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$; $h^u_{n_s m_{n_s} j_{m_{n_s}}}$ – the upper control limit according to Shewhart control charts, $j_{m_{ns}}=\overline{1,J_{m_{n_s}}}$, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$.

Measures that correspond to the presence of special reasons for variations should be taken in cases where the plotted points for partial indicators go beyond the control limits.

Based on the above, employees involved in the organization's activities in the s-th functional area of logistics $s=\overline{1,S}$, can be divided into two groups. This division depends on the values provided by these employees for each of the partial indicators used. These are those employees for whom the value of all individual partial indicators is 1. And these are those employees for whom the value of individual, or even all partial, indicators is 0. Accordingly, a separate complex indicator, and, as a result, an integral indicator for a separate r_s-th employee, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$, can either be equal to 1 or be less than 1 (or even equal to 0). The second case indicates that for some of the partial indicators the employee who is responsible for it is outside the above-described control limits for the organization. The value "0" is assigned in cases where the value of the partial indicator exceeds the control limits in both the negative and positive sense.

Accordingly, further analysis requires, first of all, identifying the sources of such a difference. If the difference is not related to the principles of homogeneity, in the understanding of the working conditions of individual employees, then positive differences, especially in the long term, can be considered as leadership [11, 12]. This requires the implementation of measures aimed at spreading these positive differences. Negative differences require the implementation of measures in relation to employees aimed at overcoming these negative differences. For employees-leaders, according to a certain partial indicator, that is, those employees whose work result according to this indicator went beyond the control limits in a positive sense, is set to "1".

Partial indicators should be previously, before their values for individual employees are evaluated within the framework of expression (5), the center line, upper limit, and lower limit according to the maps [23]. This determination is made based on statistical data that characterize the work of employees in the s-th functional area of logistics $s=\overline{1,S}$, in established time periods according to selected partial indicators. The obtained upper and lower limits allow us to further conclude which employees' activities, assessed by the corresponding partial indicator, are "in the system" in relation to the organization, and which have gone beyond the "system". When there are no values other than "1", then, from the organization's point of view, the activities of the r_s-th, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$, employee in individual processes are in a state of statistical control.

According to the concept from [5], the results of the assessment, in this case of the activities of employees, cannot be rating. At the same time, if for some partial indicators there is a departure beyond the control limits and according to the expression (2) for them "0" is obtained, then the complex indicators and/or the integral indicator can act, hypothetically, as rating ones. These complex indicators and/or the integral indicator indicate at the same time whether the activity for the s-th, functional area of logistics and the corresponding n_s-th, process and m_{n_s}-th, area of activity for the BSC, which is controlled by the r_s-th, employee, is within the control limits or, depending on the formulation of the relevant question, outside the control limits, $m_{n_s}=\overline{1,M_{n_s}}$, $n_s=\overline{1,N_s}$, $r_s=\overline{1,R_s}$, $s=\overline{1,S}$.

6. Discussion of results related to devising a method for strategically oriented assessment of logistics personnel activities

A method for strategically oriented assessment of logistics personnel activities has been devised, taking into account the effects of risk and uncertainty factors.

Advantages of the proposed method:

– using the integral indicator model for strategically oriented assessment of the activities of an employee at the organization involved in rendering logistics services will make it

possible to identify integral, complex, and partial indicators of making relevant management decisions (Fig. 1), formula (1);

– using the integral indicator model (Fig. 1) can identify complex indicators at the appropriate levels, such as the level of areas of activity according to the BSC concept, which are identified for each process, which is identified for each functional area of logistics. As well as the level of processes identified for each functional area of logistics provided by the organization;

– the possibility of isolating a certain set of processes within each functional area of logistics [22];

– the universality of the isolation of a certain functional area of logistics, which is identified with only one process, certain processes (subprocesses) can be isolated (Fig. 1);

– the use of a mathematical model of an integral indicator for a strategically oriented assessment of the activities of an employee of an organization involved in rendering logistics services will make it possible to take into account the effects of risk and uncertainty factors, expression (5).

The proposed method is advisable to use to solve the tasks of assessing the activities of logistics personnel, taking into account the effects of risk factors and uncertainty of the internal and/or external environment of the organization, when developing software for planning the logistics activities of the organization.

The limitations of our study are:

– the introduction of the theory of management as strategic thinking into the practice of the organization's work;

– the need to have an initial database of the activities of employees of the logistics organizational structure according to the partial indicators selected for assessment;

– the identity of the working conditions of logistics personnel in the organization according to the functional areas of logistics.

The disadvantages of the proposed method include:

– less accuracy in assessing the activities of logistics personnel compared to other assessment approaches;

– loss of reliability of management decisions when searching for them in several directions simultaneously.

The use of this method will make it possible:

– to improve the effectiveness and efficiency of implementing the organizational strategy;

– to form integral and complex indicators for assessing the activities of logistics personnel, aimed at achieving the strategic goals of the organization;

– to form integral and complex indicators that will make it possible to, objectively, based on statistical data, and also taking into account the strategic development directions established in the organization, assess the activities of logistics personnel;

– to take into account the effect of risk factors and uncertainty of the internal and external environment of the organization when assessing the activities of logistics personnel;

– to determine general directions, as well as build individual trajectories for the training and development of logistics personnel;

– to form incentives in the activities of logistics personnel related to the implementation of the organizational strategy.

The proposed research is advisable to develop both in organizations, organizational structures, in individual territorial structural units and in functional structural divisions of various areas of activity with strategic goals of the organization, when developing software for the relevant structures or structural divisions.

7. Conclusions

1. A structural model of an integral indicator for strategically oriented assessment of the activities of an employee at an organization involved in rendering logistics services has been constructed.

This model of a hierarchical structural structure provides for establishing a connection between the system for assessing the activities of logistics personnel and the strategic goals of the organization. This is achieved through the possibility of determining partial indicators taking into account the cascading principle, as well as establishing weight coefficients in accordance with the strategic priorities of the organization. Based on the proposed structural model of an integral indicator, mathematical models can be built for multi-criteria assessment of the activities of logistics personnel.

These mathematical models, hypothetically, can use different approaches to different management theories for determining weight coefficients and partial indicators used to assess the activities of logistics personnel.

2. A mathematical model of an integral indicator has been built for strategically oriented assessment of the activities of an employee at an organization involved in rendering logistics services, taking into account the action of risk and uncertainty factors. Within the framework of building this mathematical model, two alternative approaches to the interpretation of partial indicators are considered – either as deterministic or random variables. The features of this model are that employees of an organization involved in rendering logistics services, taking into account the action of risk and uncertainty factors, can be divided into two groups: the first – for whom the value of the above-mentioned factors is from 1 to 0; the second – under the above-mentioned circumstances, are outside the above-described control limits for the organization, that is, the value "0".

This model defines the central line, upper limit, and lower limit, which can be calculated on the basis of statistical data characterizing the work of employees of the functional area of logistics services in established time periods according to selected partial indicators. The proposed model will allow for effective assessment of employee performance within and outside the system.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study, as well as the results reported in this paper.

Funding

The study was conducted without financial support.

Data availability

The manuscript has associated data in the data warehouse.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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