Seminar 4

Topic: Methods of analysis in logistics. Methods and algorithms of logistics.

1. Analysis of logistics systems: purpose, objectives, necessity of implementation.
2. Stages of analysis of logistics systems.
3. System, economic, financial analysis, full cost analysis in the study of logistics systems.
4. General characteristics of research methods for logistics systems.
5. Graphical method in logistic research: disadvantages, advantages.
6. Modeling of processes in a logistics system: isomorphic and homomorphic models.
7. Material and abstract models in logistics.
8. Mathematical modeling: types, stages, disadvantages, advantages.

1. **Analysis of logistics systems** is a procedure for research, development, justification and decision-making in the process of designing or reengineering (redesigning) the logistics system of an enterprise.

Includes a set of methods for generating and processing data on activities in the field of logistics, which ensures the receipt of objective assessments of the state of macro- and micrologistics systems, the determination of their development trends, and the identification of reserves for increasing the efficiency of physical movement of goods.

The main thing in the analysis of logistics systems is to turn the complex into the simple or to turn a difficult to understand logistics problem into a set of tasks that have a solution, as well as to search for effective means of research and management of material flows.

The most difficult part of analyzing logistics systems is correctly setting the goal and drawing up a program to achieve it by defining the corresponding tasks.

The need to analyze logistics systems arises: when solving global, general and local logistics problems at the level of groups of enterprises, the enterprise as a whole and in the functional areas of logistics; designing and forming logistics systems when creating an enterprise; when modernizing the material flow management system at an enterprise; developing a strategic plan in the field of enterprise logistics for the long term.

The purpose of the analysis of logistics systems is to identify existing shortcomings or “bottlenecks” in the interaction between individual participants in the process of physical movement of goods at the macro and micro levels.

To achieve the set goal, the following main tasks are solved: to develop a program for the development of the enterprise's logistics system; to check the efficiency of interaction between links and elements of the system, to identify "bottlenecks" and eliminate them; to identify the efficiency of the enterprise management organization, the functions and structure of management bodies; to determine specific indicators of the functioning of the enterprise's logistics system.

Thus, the analysis of logistics systems ensures the identification of problems and the selection of directions for changing the current situation at the enterprise and in the supply chain.

In general, the algorithm for improving the operation of a logistics system is as follows: the logistics system is divided into subsystems, links and elements in order to identify tasks that are more accessible for solution (analysis); the most suitable special methods are selected and applied to solve individual tasks; individual solutions are combined in such a way as to ensure the achievement of the global goal of the enterprise or supply chain (synthesis).

Analysis and synthesis occupy a special place in the improvement of logistics systems. Analysis allows for a comprehensive study of the enterprise's activities, and synthesis allows for the identification of existing relationships between enterprise divisions, logistics functions, and between material, information, and financial flows.

Logistics analysis is performed in stages.

Stage 1. Collecting data on the logistics system. It is necessary to study the structure of the physical model of the enterprise and the stable paths of movement of material flows, the composition of logistics functions and operations.

Stage 2. Correct and clear description of the logistics system. This action can be performed by the company's employees or by specialists involved in the logistics audit.

In this case, depending on the set goal, all or part of the components of the logistics system are characterized: physical components of the system (warehouses, transport, transport routes, lifting and transport equipment); management structure of the enterprise divisions that participate in the physical movement of goods; information support for logistics functions and operations; detailed indicators of the values of material and service flows; characteristics of the functional services of the enterprise and the features of their interaction with each other or, when analyzing the macrologistics system, the features of the interaction of enterprises. Close attention must be paid to the detailing of stocks.

Stage 3. Establishing the relationship between the goals of the logistics system and the means of achieving them.

Stage 4. Development and evaluation of several options for the development of the logistics system, taking into account the expected management impacts based on the results of the analysis.

Stage 5. Selecting the optimal option for developing the logistics system.

Stage 6. Development of a detailed program for improving the logistics system based on the selected option.

When analyzing a logistics system at an enterprise, a systems approach is used. In relation to logistics, a systems approach is a way of perceiving or organizing (structuring) a logistics system. A logistics specialist first records visible structures, and then, through synthesis, reveals hidden connections between links and elements of the system, which determines its new quality.

Depending on the level of structuring, three classes of logistics systems are distinguished: well-structured or quantitatively formulated; unstructured or qualitatively expressed; weakly structured or mixed, containing qualitative and quantitative indicators.

After changes in the enterprise's logistics system, an economic and financial analysis is carried out. This allows for an assessment of the management decisions taken, which are reflected in the level of total costs, profit, profitability and other resulting indicators.

Full cost analysis. This method is used to make decisions related to transportation, warehousing, and other logistics functions. For example, choosing an in-house warehouse or a shared warehouse; choosing one centralized warehouse or several decentralized distribution centers; choosing a transportation option.

After conducting an analysis of the logistics system, it is necessary to carry out a synthesis. Analysis allows you to divide the object under study into its constituent links and elements, to find out their role and place in the system, that is, to determine the structure of the system. Synthesis consists of reuniting links and elements into a single functioning system.

Logistics methods

Improvement of the work of logistics systems is carried out on the basis of collecting reliable information and its subsequent analysis. Therefore, in the general theory and practice of logistics, attention is paid to logistics research.

Logistics research uses the scientific basis of such disciplines as economic theory, marketing, management, mathematics, statistics, etc.

The main methods used to solve scientific and practical problems in the field of logistics include: methods of system analysis; methods of operations research; forecasting.

Research into logistics systems includes: the study of approaches to managing logistics systems, which include economic, social, and communication

processes at the macro and micro levels; systematic collection of information on material flows.

Analysis of the obtained information about the links and elements of the logistics system allows for the application of well-founded management decisions at the enterprise. Analysis methods facilitate the work of logisticians when studying large arrays of information (for example, when managing stocks).

In the context of improving logistics systems, close attention is paid to optimization tasks that are used in various areas of the enterprise's activities.

When optimizing the movement of material flows, **economic and mathematical methods and modeling are used.** This set of tools can be implemented in software products used to solve optimization problems in logistics. Optimization methods are used to solve the following logistics problems: placement of a warehouse network in wholesale trade; drawing up routes for the movement of vehicles; placement of goods in a warehouse.

widely used in the analysis of logistic systems **.** It is used to describe the configuration of material flows, identify the general structure and functions of the logistic system, and determine ways to improve it. The graphical diagram of the movement of material flows allows you to trace the paths of their movement, identify the places of origin, transformation and absorption, and also determine the logistic operations that are carried out with them.

As a result of the analysis of the graphical flow **diagram, it is possible to establish the volume, nature and timing of work for each element of the logistics system, the presence of control over the execution of work or its complete absence, to identify the reasons for excessively long storage of products and unjustified delays in sending them to the consumer.**

The simplicity, versatility, clarity and economy of the graphical method contribute to its popularity and frequency of practical use.

At the same time, there are **disadvantages of the graphical method:**

✓ as the number of links in a logistics system increases, the graphical diagram can become so large that it loses its value as a means of studying and analyzing material flows;

✓ the preparation of graphical diagrams of material flows is characterized by significant labor intensity, which, given the dynamic nature of logistics processes, affects the timing of the study and the reliability of its results;

✓ Graphic diagrams do not allow for a qualitative and quantitative assessment of the effectiveness of the measures used to optimize the movement of material and related flows.

Thus, the complexity of formalizing logistics processes using the graphical method can make it difficult to use in practice.

When studying logistics systems at the macro and micro levels, the method of graph theory is also used (it allows one to reproduce and analyze the structure of an economic process or phenomenon; a graph consists of a set of points and a set of segments connecting some of them) and network models (based on graph theory and allowing one to represent and analyze problems in the form of networks that help answer two main questions: what place should one reach (the goal) and what path should one choose).

These methods provide visibility of the flow of flows, it becomes possible to track the dynamics of material flows, rationalize business connections, and draw up a schedule for the delivery of goods to consumers.

Modeling of processes in the logistics system

Modeling is based on the similarity of the model to real systems or processes, which can be complete or partial.

The main goal of modeling **is to predict the development of a process or the behavior of a system** . An essential characteristic of any model is the degree of completeness of similarity of the model to the modeled object. According to this feature, all **models can be divided** into **isomorphic and homomorphic.**

Isomorphic models. Include characteristics of the original object and are capable of essentially replacing it. If an isomorphic model can be created and observed, then our knowledge of the real object will be accurate.

Homomorphic models. They are based on incomplete or partial similarity of the model to the object being studied. In this case, some parts or functions of the real object are not modeled at all. As a result, the construction of the model and interpretation of the research results are simplified. Homomorphic models are more often used in logistics.

In logistics research, **material and abstract models are created.**

Material models reproduce the main geometric, physical, dynamic and functional characteristics of the phenomenon or object being studied. For example, reduced models of wholesale trade enterprises, allowing to solve problems of optimal placement of equipment and organization of material flows. Material models can be isomorphic and homomorphic.

Abstract modeling is often the only way of modeling in logistic research. It is divided into symbolic and mathematical. Symbolic models include language and sign models.

Language models are verbal models based on a set of words (vocabulary) cleared of ambiguity.

Symbolic models. If we introduce a symbolic designation of objects, i.e. signs, and also agree on the types of connections between these signs, then we can give a symbolic description of the logistics system. Symbolic models can be used in the graphic method.

Mathematical modeling is the process of establishing a correspondence between a real object and some mathematical object, called a mathematical model.

In logistics, two types of mathematical modeling are used: **analytical and simulation.**

Analytical modeling is a mathematical technique for studying logistics systems that allows obtaining accurate solutions to logistics problems.

Analytical modeling is carried out in the following order:

Stage 1. Mathematical laws that connect the parts of the system are formulated. These laws are written in the form of equations (algebraic, differential, etc.).

Stage 2. Solving equations and obtaining theoretical results.

Stage 3. Comparison of the obtained theoretical results with practice (adequacy testing).

As logistics systems become more complex, research using analytical methods becomes difficult. *The advantages of analytical modeling include greater generalization power and multiple use.*

Simulation modeling. Logistics systems operate in conditions of environmental uncertainty. Therefore, when managing material flows, many factors must be taken into account, some of which are random. Under these conditions, the creation of an analytical model establishing clear quantitative relationships between various logistic processes may be either impossible or too expensive. In simulation modeling, the patterns determining the nature of quantitative relationships within logistic systems remain unknown. In this regard, the logistic system remains a "black box" for the experimenter.

Simulation modeling includes two main processes: the first is the construction of a model of a real system; the second is the setting up of experiments on this model.

The main advantage of simulation modeling is that this method can solve complex problems, since random effects that create difficulties in analytical modeling are taken into account quite simply.

In addition to its advantages, **simulation modeling has significant disadvantages.**

Disadvantage 1. Research using this method is expensive because: a highly skilled programmer is needed to build the model and experiment on it; a large amount of computer time is required because the method is based on statistical tests and requires multiple runs of the program; models are developed for specific conditions and, as a rule, are not replicated.

Disadvantage 2. The probability of false imitation. Processes in logistics systems are probabilistic in nature and can be modeled only by introducing certain types of assumptions.

Thus, the methodology of logistics research combines material and abstract models. Methods in logistics should be used comprehensively, which makes it possible to eliminate the limitations of each method separately . This promotes the integration of functional areas of logistics and increases the efficiency of work in each of these areas.