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**METHODS OF LOGISTICS FOR MANAGING GOODS  
TRANSPORTATION BY WATER TRANSPORT**

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**Abstract**

The purpose of the work is to study the specific character of goods transportation by water transport, to find ways to reduce costs and increase the efficiency of activities on the basis of logistics methods. Special attention is paid to the study of the specifics of transport, which made it possible to highlight a number of special characteristics. The theoretical basis of the problems of cargo transportation by water transport is studied and generalized, the specific character of the indicators of water transport and the peculiarities of the organization of transportation process are revealed. In the course of the analysis, the factors that have the greatest influence on the size of the net profit of the transportation company were identified. To increase the profitability of transportation of goods by water transport it is proposed to use the method of assignments, which is a kind of transportation task. On the basis of the organization's real data, an algorithm for calculating and interpreting of results with the use of the method of assignments for water transport and choosing of the optimal distribution of ships to fulfill customer orders is presented. The practical value of this study is the development of business based on the optimization of the total costs of a company engaged in water transportation of goods with the use of logistics methods.

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## **1. Introduction**

Logistics is a universal tool for optimizing of business processes in various business areas, including cargo transportation. Transport ensures the movement of goods to the places of destination, maintaining the continuity of the processes of reproduction of values, having a significant impact on the cost of the product. According to experts, transport should be attributed to the production of material services as the creation of a material product depends on the timely delivery of each component and can be suspended in case of late arrival of the required consignment (Buyanova & Korolyova, 2017). The role of transport is especially important if we take into account the share of transport costs in the cost of the finished product as well as in the cost of transportation of raw materials and components. Essentially, the functioning of any logistics system is supported by continuous traffic flows, and transportation costs management is a key tool in logistics management. In this regard it seems relevant to consider the specific issues of the logistics approach to planning of goods transportation with the use of water transport. Mechanisms for logistics costs reduction when using water transport, identification of factors that determine the cost of transportation and ways to reduce operating costs when transporting goods are considered the research area.

## **2. Problem Statement**

Logistics solution methods have shown their applicability in various fields of activity and make it possible to find more rational management decisions. The basis for making logistics decisions is the total costs of the process; their optimization is a key parameter for substantiating acceptable approaches to organizing a business based on customer requests and the capabilities of the supplier organization. These technologies are primarily focused on increasing the speed and reliability of delivery (Karpova & Evtodieva, 2020).

To carry out the research, we used methods of theoretical provisions of logistics generalization based on the study of the works of leading scientists and specialists. The development of transport logistics is largely determined by the nature of transported goods and requirements for transportation (Kirillova & Evtodieva, 2019). In this regard, the peculiarities of transport logistics in relation to water transportation of goods were analyzed and generalized. Certain specific features of water transportation organization became the basis for studying and searching for solutions to optimize the costs of cargo transportation with the use of logistics methods. To preserve commercial secrets the code name of the company Volga LLC is used in this work. When analyzing the reporting data of the company, methods of economic and statistical processing of quantitative data, construction of a correlation and regression dependence of the factors under study and an assessment of logistics costs were used. The conclusions and recommendations presented in the research can be useful for the development of the theory and practice of logistics activities.

## **3. Research Questions**

Transport is an independent branch of the economy; it has significant differences from other industries. There are several types of transport in the transport structure, including railway transport, automobile transport, water transport, air transport and pipelines. Water transport combines sea and river ways of transporting goods and passengers on waterways, using both natural and artificial reservoirs (rivers,

seas, lakes and oceans, water reservoirs, canals and channels). Water transport has certain peculiarities. The main differences are seasonal character of activities due to the change of seasons and the presence of a long period between navigation. The specific character of the technology of the transportation process of water transport requires the demand for the carriage of goods or passengers, and its absence means a complete absence of activities and high costs of ships maintenance during the period of downtime. A significant difference is the state regulation of tariffs for transportation by water transport, which limit the cost of activities for certain types of services, including loading and unloading operations in ports as well as port dues. Water transport operates on inland waterways, while it can also be used in mixed river-sea transportation. The advantages of water transport are low cost of the tariff for transportation, high carrying capacity of the vessel, low capital costs for organizing of shipping. The disadvantages of water transport are low speed of transportation and limited availability in the geographical aspect as well as seasonality of navigation. The specific character of transport stipulated the allocation of a separate functional area of logistics - transport logistics, which has its own goals, objectives and subject of study. Making decisions on optimization of costs of shipping goods by water transport, taking into account the above-mentioned peculiarities require special methods and techniques of solving managerial problems (Galai, 2015).

#### **4. Purpose of the Study**

The goal of transport logistics is to organize the delivery of goods to the place of destination with minimum total costs while preserving the quality of services. Transport logistics includes a set of tasks for organizing of goods transportation that meet the interests of participants of transportation process. Organization of cargo transportation by water transport based on logistics methods requires understanding of specific indicators of water transport use. These indicators include: vessel water displacement, gross tonnage, net tonnage, ship tonnage and others.

Water transport is very specific in terms of operating conditions which affects the nature of optimization solutions on managing costs and increasing the profitability of activities. When organizing transportation and choosing a type of transport, the cost of transportation and specific capital costs are most often taken into account. These indicators depend on many different factors, both general and specific for a particular type of transport. The general factors influencing the cost of transportation are: load capacity, utilization rate of equipment, cost of fuel and electricity, wages, etc. For water transport, when determining operating costs, specific indicators are taken into account, such as carrying capacity of a vessel, the nature of transported goods (bulk carriers, tankers, containers), speed of delivery of goods, duration of navigation period, etc. Thus, type of transport can be considered as a specific characteristic of transportation process which determines the parameters of the quality of customer service and operating costs. Logistic methods of increasing the efficiency of transport work, on the one hand, are a universal tool for finding rational management decisions, and on the other, they require adaptation because of peculiarities of organization of transportation by a specific type of transport, taking into account cargo characteristics. This circumstance determined the research goal as optimization of transportation of goods by water transport on the basis of logistics. The study of the problems of organizing water transportation of goods was carried out on the example of the activities of Volga LLC (code name) which specializes in the transportation of oil products on the inland waterways of the Russian Federation. Among the largest shipping companies in Russia, the

company holds a share of about 4% in the field of river cargo transportation. The study of the indicators of commercial activities of the company showed an increase in the cost of transportation during the period of three consecutive years which is associated with an increase in costs of overhaul of ships, an increase in the cost of materials and services of ship repairment enterprises and an increase in the cost of fuel. Analysis of the cost structure of Volga LLC and its revenues during the period of three years showed a constant increase in the cost price, and the average cost price level in the revenues was about 85%. This state of affairs indicates the need to set the goal of searching for reserves to reduce costs when organizing the transport process with the use of logistics methods.

## 5. Research Methods

The study of the structure of the annual costs of Volga LLC in the context of individual elements made it possible to identify the most significant costs, including the costs of fuel and lubricants - 18.9%, the cost of repairing of the transport fleet - 16.26%, salaries of the ship crew - 13.7%, depreciation of fixed assets - 8.25%. Taken together, these costs make up 57.11% of all company costs and, therefore, their optimization can give the greatest economic effect.

The specific character of water transport requires analysis of the costs of transporting one ton of cargo per one kilometre. This information allows you to compare different delivery options, taking into account the operating conditions of different vessels. The calculations carried out on the costs of transportation of goods by Volga LLC on various routes allow us to draw a number of conclusions about the current situation:

- vessel traffic is constrained by the operation of traffic control locks because of carrying capacity limitations;
- the current tariffs do not cover the company's needs for the reproduction and renewal of fixed assets. Regulation of tariff rates does not take into account the rates of growth of the cost of consumables and fuel.
- the increase in operating costs leads to the increase in production costs and the decrease in the profitability of activities.
- there is serious competition with rail and road transport in terms of delivery speed and the quality of transportation services.

For a detailed study of the reasons and factors that determine the success of the enterprise a correlation and regression analysis of the main operational indicators of Volga LLC was carried out. The following indicators were used as the initial data: net profit, average income rate, duration of transport downtime, duration of a trip. The research showed that the size of net profit is influenced mostly by the average income rate. Using the Excel - Regression analysis package, the coefficient of determination was calculated as 84.5% which characterizes the share of the influence of the average income rate, the number of downtime days and the optimal duration of the trip per net profit. The rest of the factors not taken into account in the model have the influence of 15.5%. So, the following regression equation was obtained:

$$Y = -93.512,93 + 108.162,99X_1 - 1.877,86X_2 + 2.375,2X_3 \quad (1)$$

The presented equation shows that the relationship between the factors is linear, and according to Fischer's F-statistics at a 10% significance level the model is adequate (Fisher, 1922). The presented model

can become a tool for forecasting the economic indicators of Volga LLC (Transporank, 2020). In particular, equation shows that an increase in the average income rate by 1 ruble / ton-km, other features being equal, will lead to an increase in net profit by 108.162.99 rubles. If the duration of the trip increases by one day, then net profit will increase by 2.375.19 rubles. Every downtime day reduces net profit by RUB 1.877,86. This method of factor analysis is a convenient tool for planning income in a changing competitive environment and makes it possible to plan the negotiation process with clients competently.

## 6. Findings

Increasing of profitability of economic activities is an urgent problem in any sphere of business. Within the framework of the research this issue was studied in detail, taking into account the specific character of organizing of business in the field of water transportation of goods. The main cargo transported by Volga LLC is oil products delivered to specialized enterprises for processing. This determines the choice of routes and conditions for making profit. If we take the fleet of ships that the organization has as the initial data, then the problem of profitability can be solved by the optimization of the capacity utilization, taking into account transportation plans and associated operating costs, which differ depending on the type of ships. The search for an optimal cargo transportation scheme was carried out by solving the assignment problem, the ultimate goal of which is to distribute ships along routes in such a way that makes the total profit maximum. The initial data for solving the assignment task included:

- the planned volume of cargo transportation of Volga LLC for 2020 by directions and types of cargo;
- planned revenue and navigation costs for 2020;
- the presence of four oil tankers and three planned directions of cargo transportation.

Conditions for solving the assignment task have a number of restrictions:

- the optimization criterion is the maximum profitability of the work performed during the navigation period;
- each performer can participate in the implementation of more than one kind of work;
- each work can be performed by more than one performer.

The assignment problem is a kind of transportation problem solved by simplex method. The specific character of the sphere of application for water transportation of goods determines the specific features of the algorithm of actions for choosing the best option for the distribution of oil tankers. In the situation under research the result was obtained in the form of a matrix of assignments presented in Table 1.

**Table 1.** The Matrix of Ship Assignments for Cargo Lines of Volga LLC for the year 2020

Type of vessel; Cargo line	Samara-Caucasus	Saratov-Caucasus	Yaroslavl – St. Petersburg
Vessel № 1	1	0	0
Vessel № 2	1	0	0
Vessel № 3	0	1	0
Vessel № 4	0	0	1

Source: author.

In the Table 1 the value “0” means inefficiency of use on this cargo line, and the value “1” indicates the possibility of using the vessel on a particular cargo line to obtain a positive economic result. To determine the optimal scheme for transportation of goods based on the matrix of assignments, it is necessary to calculate the need for ships with the use of formula 2 (Industry instruction on the composition of costs and calculation of the cost of work and services of enterprises with the main activity of river transport (approved by the Ministry of Transport of the Russian Federation 08.03.1993 № BA-6/152)).

$$N_i = \frac{Q_i \times t_i}{q_i \times T_i} \quad (2)$$

where  $Q_i$  – total cargo turnover on the line  $i$ , tons;

$t_i$  – the duration of the round trip on the line  $i$ , 24 hours;

$q_i$  – carrying capacity of the vessel  $i$ , tons;

$T_i$  – duration of navigation on the line  $i$ , 24 hours;

The calculations showed that the company under the research will need 10 vessels of different carrying capacity which will make it possible to fulfill its obligations to the customer, and the other 6 vessels can be leased during the navigation period and provide additional income and profit.

To substantiate the effectiveness of the proposed solution, a comparative assessment of the financial results of the existing transportation plan and the new ship distribution scheme was carried out, taking into account the profitability goals. The calculations took into account the available resources, both financial and material in the form of the available fleet of ships. As alternatives, the possibilities of full loading of the existing fleet with customer orders or leasing of vessels with an increase in the level of loading with orders of the part of the fleet were considered. The results of the calculations demonstrated economic feasibility of the second option. According to the calculations, the gross profit of the enterprise will increase by 4%, and the average level of profitability will rise from 12.8% to 14.6% if the transportation company uses four vessels out of 10 to fulfill customer orders. Thus, the target indicator of profitability increase is achieved due to more rational loading of vessels' capacities and choice of routes. The use of this methodology for analyzing activities of a transportation company is focused on achieving the best overall result on the account of rational allocation of resources; complies with the principles of logistics management and provides a solution to existing economic problems in organizations.

## 7. Conclusion

Transport logistics is a reliable tool for optimizing the total costs of transportation process organization. The development of transport is a prerequisite for effective economic growth, and the use of many alternative modes of transportation makes it possible to choose the most optimal option in terms of costs and quality of transportation services (Kirillova et al., 2019; Makhmudova et al., 2019). The use of logistics methods in the field of water transport is an important resource for optimizing cargo flows with minimal costs; makes it possible to develop an appropriate infrastructure and to meet customer needs to the maximum. Transportation of goods by water transport is especially important for heavy and oversized cargo transported over long distances. The universal character of water transport in terms of cargo transported, high capacity and low cost make it attractive to satisfy the needs of customers in the delivery of goods. The methods for finding optimal solutions to reduce costs of goods transportation by water transport presented

in the work can be used as practical recommendations for transportation companies that own water vessels. Logistics methods of reducing the total costs of goods transportation make it possible to get a higher financial result and ensure a high profitability of activities.

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