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Some Methods of Increasing the Efficiency of River Transport System

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Abstract

The paper discusses two new methods to increase the efficiency of river transport system. The former method is based on treating the river system as a multiphase queuing system. The basic principles of arrangement and optimization parameters are determined. Mathematical tools for optimization were produced, the solution converting the stochastic input flow into the systematic output one was derived. The latter method includes at its core the need to make the stowage of goods optimized by constructing the corresponding mathematical and information tools. Experimental results of the software performance were on one of the vessels under operation.

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Keywords: waterways, cargo, vessel, optimization, transport corridors, river transport

1. Introduction

The market relations impose to river transport the strict requirements on acceleration of cargo and passengers delivery at the smallest costs of transportation, on decrease of the transport component in prime cost of production, on improvement of quality and reliability of transportations (Podevins, 2007).

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The current trends of transport services development compel the various types of transport to pass from direct fierce competition among themselves to more mutually beneficial cooperation within intermodal transportations. Development of such transportations in Russia is closely connected with situation on the all-European market of goods and transport services (Grigoriev *et al*., 2011).

A significant role in the integration processes belongs to the creation of conditions for free rendering of services on international transportations river-sea. The river transport provides the realization of transit potential of Russia within the international transport corridors (Sapko, 2015). The integration world processes directly affect the interests of the Russian Federation which according to the Partnership and Cooperation Agreement with the EU assumed certain obligations for opening of inland waterways for the international navigation (Konvisarova and Litvin, 2015).

The transport corridors are elements of the international logistic structure (Löhndorf, 2016). They are intended for achievement of bigger efficiency of transport process that is provided by application of the latest developments in technic, technology of the organization of transport and reloading process, and also by creating of favorable conditions for the transportations implementation.

The transport corridors are the powerful trunk lines corresponding to the requirements of the international standards with uniform technological organizational legal norms and conditions. They allow to achieve considerable decrease in terms and cost of transportations, increase of their quality and reliability.

The active integration into the system of the international transport corridors creates the additional opportunities for development of the Russian transport system and further improvement of its industrial, information and technological infrastructure.

The uniform technology of cargoes transportation in the transport corridors assumes a continuity of the transport process with minimization (elimination) of faulty situations, first of all, in the reloading points (distribution centres) and, including, in river ports. Such system demands the optimization of distribution centres, definition of the optimum transportations plan, detailed calculations of types and number of vehicles, cargo handling equipment and other resources, as well as coordination of different work technologies of each type of transport, work coordination of the trunk line transport and cargo owners in the transfer points.

All these issues are solved by using the methods of "physical" distribution of cargoes (Alehin, 1989), logistics and economic-mathematical simulation (Volkov *et al.*, 2000). However, besides the traditional economic-mathematical methods for efficiency calculation of similar systems it is possible to use the mathematical apparatus of the mass service theory and also the algorithms of discrete mathematics (Dzhejsuol, 1973).

In this context, the purpose of this paper is to improve the functioning of river infrastructure.

Achieving this goal within the framework of the paper presents a solution to two problems:

1. Optimization of river infrastructure by presenting it as a single multiphase queuing system with the identification and description of key optimization parameters.
2. Development of a common mathematical and information support to increase the efficiency of the use of port infrastructure and vehicles by optimizing the placement of cargo both on the open and in the closed areas.

2. Inland waterways as multiphase mass service systems (MSS)

We will consider the river system including initial, final and the intermediate transit points connected by river arteries, channels and locks. From the point of view of the mass service theory, the similar system (or less difficult) can be considered as set of the mass service systems (MSS) with expectation which are consistently connected with each other so that the flow of the served requests (vessels) coming out from one system is the flow coming in the following system. Such systems connection is multiphase MSS with expectation. Each component of system is called as a phase. The incoming flow of requests for multiphase MSS is the stream coming in the first phase; the outcoming flow is the stream coming out from the last phase (Fig. 1).