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O. Gryshchuk[1]
A. Petryk[1]
A. Kozlov[1]
M. Holovatiuk[1]

IMPLEMENTATION OF ORGANIZATIONAL PRINCIPLES OF MANAGEMENT OF THE PROCESS OF EXPORT TRANSPORTATION OF GRAIN CARGO

[1]National Transport University

Abstract

The peculiarities of creation of consolidated consignments are considered, scientific perspectives on development of technological and structural bases for improvement of infrastructural maintenance of international transportations are outlined, and transport service of grain cargo flows is modelled with use of the basic theoretical positions of systems of queuing. random demand for transport services. The functioning of transport systems under the condition of batch receipt of service requirements is analyzed, the possibility of introduction of the developed mathematical methods for coordination of the coordinated administrative decisions concerning service of export grain cargo flows is substantiated.

Key words: optimization of structural indicators, grain cargo flows, transport services, operational characteristics, consolidated consignment, international traffic.

One of the urgent tasks of research of production systems of export direction is not only to determine the optimal level of reliability of transport services, but also to assess the efficiency of transportation [1]. Using the diagram of the intensity of transitions in the theory of queuing, it became possible to determine the operational characteristics of production systems of flow technology of unloading [2]. And using known mathematical dependences, the results are obtained in the form of a matrix of solutions for the variable p over time [t_1, t_2], which contains s solutions implemented in the *MathCAD* environment and has the form *Z: = rkfixed (p, t_1, t_2, s, D)*. Possible variants of the structure of production systems may be the situation in the case of batch receipt of requirements or the case when to meet one requirement requires the presence of several service channels [3]. The total number of requirements coming to the system for time t is equal to

$$X_t = \sum_{k=1}^{K_t} N_j, \qquad provided \quad K_t > 0, \tag{1}$$

where K_t – the number of groups of applications coming into the system during the period *t*;

N_j – the number of transport service requirements in each *j*-th group.

The random variable K_t characterizes the number of additional vehicles involved in the system for the period *t*, defined as *y*, and *n* is the required number of own vehicles required by the transport system. The random variable X_t is called the process of accumulation of applications for transport services and is the sum of random terms. In the conditions of centralized supply for transportation of grain crops, the value of X_t characterizes the demand for vehicles in the transport system, that is determines the intensity of the incoming flow. Denote the mathematical expectation and variance of the random variable K_t by $m_t = M(K_t)$ and $D_t = D(K_t)$, and the parameter N_j by $m_x = M(N_j)$ and $D_x = D(N_j)$ and find the mathematical expectation and variance of *X*, which will be calculated through the corresponding characteristics of the values of K_t, N_t.

$$m_x(t) = M(X_t) = \sum_{n=1}^{\infty} M(X_t / K_t = n)\, p_n(t) = \sum_{n=1}^{\infty} \left[\sum_{i=1}^{n} M(N_i) \right] p_i(t) = m_x \sum_{n=1}^{\infty} n\, p_n(t) = m_x\, m_t. \tag{2}$$

Using $m_x(t)$ and $M(N_t^2)$, we obtain a mathematical expression to determine the variance of X_t

$$D_x(t) = m_x^{\,2} M\left(X_t^{\,2}\right) + D_x m_t - \left(m_x m_t\right)^2 = m_x^{\,2}\left[\left(M\left(K_t^{\,2}\right) - m_t^{\,2}\right)\right] + D_x m_x = m_x^{\,2} D_t + D_x m_t, \qquad (3)$$

The use of mathematical dependencies (1 – 3) makes it possible to determine the average value of the required number of operating vehicles, provided the batch receipt of service requirements. The practical application of the obtained mathematical dependences is considered on the example of the use of road transport to create a consolidated consignment of grain cargo of international orientation. In the functionality of the task of obtaining the maximum profit of such a transport system, the following values are characterized as income and expenses associated with the operation of vehicles: *A* – income from the performance of transport services by one car; *B* – operating costs for the operation of one car for the specified period; *C* – costs associated with downtime of vehicles due to lack of work; *D* – operating costs of the additionally involved car; *E* – possible loss of profit due to non-fulfilment of the order per one car. Numerical values of values *A, B, C, D* are calculated according to known mathematical dependences taking into account the impact of changes in tariffs and costs. The distribution of the function of the ratio of the number of available and borrowed vehicles, taking into account the corresponding costs is described by a mathematical dependence

$$f(n, X_t, y) = \begin{cases} (A-B)X_t - C(n - X_t), & X_t \le n; \\ (A-B)X_t - D(X_t - n), & n+1 \le X_t \le n+y; \\ (A-B)(X_t + y) - Dy - E(X_t - n - y), & X_t \ge n+y+1. \end{cases} \qquad (4)$$

The average profit per unit of time on the example of a transport company was defined as the difference between the profit from the sale of services and costs, taking into account the possible loss of profit from the lack of cars. The process of accumulation of the combined consignment of grain was modelled on the example of its deliveries from fifteen λ = 15 senders, when from each of them the specified cargoes are transported by five (v = 5) cars. In this case, the trucking company, taking into account the random nature of the demand for transport services, uses the opportunity to rent up to thirty (μ = 30) cars with a capacity of q = 20 tons (Fig. 1).

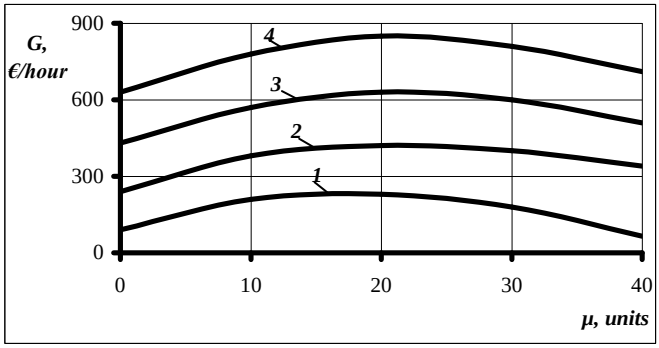

Fig. 1. Dependence of the company's profit on the number of reserve cars under the condition of the intensity of receipts, units/hour: 1 - λ = 2; 2 - λ = 3; 3 - λ = 4; 4 - λ = 5

According to the calculations, when accumulating a grain consignment in terms of the intensity of the requirements λ = 2 ... 5 units/hour, υ = 5 units/hour, the optimal value of the reserve rolling stock μ, which could potentially be involved in transport services, is in the range from 15 to 22 cars. That is, with the increase in the volume of potential transport services, the share of reserve cars decreases. The obtained results testify to the expediency of organizing the transport process of transportation with the constant activity of a single centre of operational management. The use of the proposed methodology provides an opportunity to optimize material and financial resources under the condition of batch receipt of service requirements. Based on the results of the calculations, the main directions of scientific research are determined in order to develop methods for organizing and managing the system of centralized transportation of grain crops. The use of various forms of profitable cooperation with partners in the organization of transport services defined taking into account the forms of ownership, market relations, tariff policy and marketing of export supplies, should create conditions for attracting additional exports and transit of grain.

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Gryshchuk Oleksandr, PhD, professor, Professor of Departments Tourism, National Transport University, Kiev, tarandushkal@ukr.net

Petryk Anatoliy, PhD, docent, Docent of Department of International Transportation and Customs Control, Kiev, anv.petruk@gmail.com

Kozlov Arkadiy, Docent of Department of International Transportation and Customs Control, Kiev, hoome3969@gmail.com

Holovatiuk Mykhailo, Assistant of Department of International Transportation and Customs Control, Kiev, golovatiukmichailo@gmail.com

ВПРОВАДЖЕННЯ ОРГАНІЗАЦІЙНИХ ПРИНЦИПІВ УПРАВЛІННЯ ПРОЦЕСОМ ЕКСПОРТНИХ ПЕРЕВЕЗЕНЬ ЗЕРНОВИХ ВАНТАЖІВ

Анотація

В роботі розглянуті особливості створення консолідованих партій вантажів, змодельовано транспортне обслуговування зернових вантажопотоків з використанням основних теоретичних положень систем масового обслуговування, запропоновані математичні моделі для оптимізації структурних показників транспортних систем при наявності випадкового попиту на транспортні послуги. Проаналізовано функціонування транспортних систем за умови пакетного надходження вимог на обслуговування, обґрунтована можливість впровадження розроблених математичних методів для координації узгоджених управлінських рішень щодо обслуговування експортних зернових вантажопотоків.

Ключові слова: оптимізація структурних показників, зернові вантажопотоки, транспортне обслуговування, операційні характеристики, консолідованої партії вантажів, міжнародне сполучення.

Грищук Олександр Казимірович, к.т.н., професор, професор кафедри туризму, Національний транспортний університет, м. Київ, gryshchuk@ntu.edu.ua

Петрик Анатолій Васильович, к.т.н., доцент, доцент кафедри міжнародних перевезень та митного контролю, Національний транспортний університет, м. Київ, anv.petruk@gmail.com

Козлов Аркадій Костянтинович, доцент кафедри міжнародних перевезень та митного контролю, Національний транспортний університет, м. Київ, hoome3969@gmail.com

Головатюк Михайло Вікторович, асистент кафедри міжнародних перевезень та митного контролю, Національний транспортний університет, м. Київ, golovatiukmichailo@gmail.com