Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 187 (2017) 167 – 172

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Scientific Conference Transbaltica 2017:
Transportation Science and Technology

Model of the Delivery Routes Forming Process as a Service Provided by Forwarding Companies

Vitalii Naumov[a,]*, Tatiana Omelchenko[b]

[a]*Cracow University of Technology, Poland*
[b]*Kharkiv National and Highway University, Ukraine*

Abstract

In this paper, we propose an approach to model the processes freight forwarding servicing under stochastic demand through forming rational delivery routes. This study aims to develop a mathematical model of forwarding servicing by defining the incoming impact and environmental factors, characterizing elements of the technological process and providing an analytical description of the relationship between the input parameters and efficiency criteria in a form of functional dependencies. The proposed model could serve as theoretical basis for development of decision support software for transport and freight forwarding companies.

Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017

Keywords: forwarding services, transportation problem, requests flow, criterion of efficiency, routing, cargo delivery

1. Introduction

Highlighting the ways of improving customers' forwarding service (FS), we have to underline that this process should be viewed from several points, such as the interests of freight owners, carriers, and a freight forwarding company (FFC). Despite the fact that one of the main tasks of contemporary freight forwarders is an orientation to

* Corresponding author.
E-mail address: vnaumov@pk.edu.pl

Peer-review under responsibility of the organizing committee of the 10th International Scientific Conference Transbaltica 2017
doi:10.1016/j.proeng.2017.04.362

customers' needs (an immediate response to a request, increasing service level, reducing costs of a customer, etc.), the purpose of an FFC, as a business entity, is to maximize its profits. These tasks could be achieved by improving the FS technology of customers using the information technologies and science-based approaches.

2. Analysis of publication

The majority of freight transport in Europe is carried out by trucks using the road network [1] and it is expected that this dominance will continue in the future. Thereby, the design of the intelligent systems could also improve the efficiency and productivity of fleets of carriers, decrease transportation costs and improve forwarding service.

Problems of planning the forwarding service processes are complicated due to the need of consideration of customer preferences, customer costs of waiting and human resource costs. Recent general models for servicing processes and scheduling system design could be found in the articles [2–5].

Using the modern software in combination with mathematical optimization techniques gives good results in solving the transportation vehicle problem while providing forwarding services. In the work [6] formation of the efficient freight delivery routes is provided using the GPS and the Google Maps with complex optimization tools of graph theory. The aim of the article [7] is to propose a solution for finding the shortest route for transportation by using the heuristic prim algorithm of searching the minimum spanning tree, which shows the shortest route for transportation.

One of the ways of improving the provision of FS to customers is the development of rational transportation routes. The current trend is the use of multi-criteria models [8, 9]. The goal of the freight forwarder is to maximize the difference between the transaction volume and its costs. Global cost oriented objective functions that minimize the sum of the costs are presented in the article [10].

The model of transportation routing, which provides the possibility to account the impact of multiple random factors is introduced by the article [11]. In the method of solving the open transportation problem when the demand is presented by fuzzy variables, the search for solutions could be based on genetic algorithms.

The disadvantages of the described approaches are the complexity of practical realization, the low degree of considering the influence of random factors, and also carrying out the optimization for the benefit of one of the clients.

3. Model of forwarding service while forming the delivery routes

The routing process as a part of FS includes three main stages: forming of rational routes, selection of the rational vehicle and implementation of transportation. As incoming unregulated factors of the model of freight forwarding, we consider parameters of the FS demand, costs per unit for technical operations during the delivery process and factors of environmental influence accounted with random variables of operational parameters of the delivery process. The input parameters of the model are the number of service areas and the minimum time for finding a rational variant of FS. The result of the servicing process we suggest to estimate on the basis of total costs of all the participants of freight forwarding process.

3.1. Restrictions and assumptions of the proposed model

The proposed model has the following set of restrictions.

1. The sum of time intervals between the shippers' requests equals the sum of the time intervals between the carriers' requests:

$$\sum_{i=1}^{n} I_{FOi} = \sum_{j=1}^{m} I_{car\ j}\ , \tag{1}$$

where I_{FOi} and $I_{car\ j}$ – time interval between i-th and $(i-1)$-th requests from shippers and carriers, h; n and m – number of requests from cargo owners and carriers respectively, received by FFC.