




## **Modern Trends and Research in Intermodal Transportation** pp 51–124

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# Current Issues of Multimodal and Intermodal Cargo Transportation

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## Abstract

Freight transport is constantly growing and the forecast is that this trend will continue in the future. The sustainable development of transport requires the development of activities, which yield higher economic and social results while at the same time reduce the negative impact on the environment. In the long term, the sustainable development of transport activities is complex and tied to enormous challenges, difficulties and barriers, related to the development of the technological environment, the social and economic development, the influence of

political factors and regulations. One of the central perspectives for the development of the freight transport in Europe is the development of multimodal and intermodal transport. The present chapter reviews some essential issues about the conditions for interaction between the modes of freight transport and the main challenges this kind of transport faces. An overview has been made of the main characteristics of organization and technology in multimodal and intermodal transport, and the related to them commodal and synchro modal transport that have appeared in recent years, as well as the physical internet concept. The application and barriers for modern use of information and communication technologies in multimodal and intermodal transport has been reviewed. An overview of the development of multimodal and intermodal transport in Bulgaria in accordance with the development of international transport corridors that pass through the country is carried out. A mathematical model has been developed on the basis of multicriteria optimization with three criteria: direct costs, time and external costs. The transport scheme is presented as an oriented graph line with each point corresponding to a node and each road, connecting nodes  $i$  and  $j$ , to an oriented weighted rib  $(i, j)$  in the graph. Weight  $c_{ij}$  is directly connected to the three criteria set. We assume that on each rib transport can be carried out by three modes: waterway, road and rail. If there is no physical connection, the respective weight is assumed to be an infinitely large number.

Pareto optimal solutions have been determined under conditions for integer variables and application of a weighting method. To verify the model, a specific task for providing multimodal transport has been solved with the help of Matlab R2017b software and the optimization functions built into the product have been found to be optimal under Pareto solutions, using heuristic approaches for solving a partially integer linear optimization problem.

Keywords

**Multimodal transport**

**Three-criteria optimization      Internal cost**

**Route and time optimization**

**Freight and passenger transportation**

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