A Decision Method for Disruption Management Problems in Intermodal Freight Transport

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Abstract. In this paper, we propose a new decision method for dealing with disruption events in intermodal freight transport. First of all, the forecasting decision for the duration of disruption events is presented, which decides whether a rearrangement is needed. Secondly, a network-based optimization model for intermodal freight transport disruption management is built. Then an improved depth-first search strategy is developed, which is beneficial to automatically generating the routes and achieving the recovery strategies quickly. Finally, a numerical example is applied to verify the decision method. The new decision method supports the real-time decision making for disruption management problems.

Keywords: Decision method, Disruption management, Intermodal freight transport.

1 Introduction

Many power facilities are delivered by multiple modes of transport. Uncertainties and randomness always exist in freight transportation systems, especially in intermodal freight transportation. Intermodal freight transportation is the term used to describe the movement of goods in one and the same loading unit or vehicle which uses successive, various modes of transport (road, rail, air and water) without any handling of the goods themselves during transfers between modes (European Conference of Ministers of Transport, 1993) [14]. It is a multimodal chain of transportation services. This chain usually links the initial shipper to the final consignee of the container and takes place over long distances. The whole
transportation is often provided and finished by several carriers. Almost all types of freight carriers and terminal operator may, thus, be involved in intermodal transportation, either by providing service for part of the transportation chain or by operating an intermodal transportation system (network) [5]. Therefore, the satisfied flow continuity and transit nodes compatibility of the multimodal chain of transportation services is significant while making modal choice decision once multiple transport modes, multiple decision makers and multiple types of load units are included.

Unexpected events (e.g. Hurricane, the snow disaster, traffic accidents) happening in one link of the multimodal chain could result in the disturbance of pre-decided transportation activities. A new strategy used to handle disruptions is disruption management. Its objective is the smallest disturbances the entire transportation system encounters with the new adjustment scheme, rather than the lowest cost. How to real-timely deal with the disruption events and achieve the coping strategies quickly and automatically is an important problem. It is necessary to present a new solution approach to improve the rationality and efficiency of disruption management in intermodal freight transportation.

The remainder of this paper is organized as follows: Section 2 briefly reviews the related solution approaches and applications. In Section 3, the forecasting decision method for the duration of disruption events is presented, and an optimization algorithm for intermodal freight transport disruption management is constructed. A numerical example is given in Section 4. Finally, concluding remarks and future research directions are summarized in Section 5.

2 A Brief Review of Related Literature

The research on the planning issues in intermodal freight transport has begun since the 1990s. Macharis and Bontekoning [15] conducted a comprehensive review on OR problems and applications of drayage operator, terminal operators, network operators and intermodal operators. Related decision problems for intermodal freight concern some combinations of rail, road, air and water transport. Following this approach, Caris et al. [3] provide an update on the review in Macharis and Bontekoning, with a stronger orientation towards the planning decisions in intermodal freight transport and solution methods.

In the current results on intermodal transportation system, we find most of them are related with planning transportation activities. We divide them into 4 categories from the perspectives of intermodal carrier selection, transportation mode selection, transportation routes, and terminal location. For the aspect of intermodal carrier selection, Liu et al. [12] establish an improved intermodal network and formulate a multiobjective model with the consideration of 5 important characteristics, multiple objective, in-time transportation, combined cost, transportation risks and collaboration efficiency. Ma [16] proposes a method for the optimization of the carrier selection in network environment by inviting and submitting a tender based on multi-agent. With respect to transportation mode selection, Liu and Yu [11] use the