Optimisation model for empty container repositioning.

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Asbtract

Empty container management is a transportation issue relating to the imbalance of container demand and supply in various parts of the world. Hence the necessity for shippers to move empty containers to supply areas. The purpose of this research is to develop a decision support tool applying to intermodal freight transport. This project aims at minimizing the overall cost of empty container management in the hinterlands of the ports of Antwerp and Rotterdam. The proposed model is a two-stage stochastic network model which takes account of transit time between ports and terminals, shipping cost, the carrying capacity of the various modes of transport, the stochastic demand and supply of each terminal and port as well as other parameters such as substitution or holding costs. In addition, the proposed model considers the possibility of intermodality with road transportation. Along with the optimal solution, our experimental data should yield an understanding of the impact of costs on the repartition of flows and inventories.

Empty container management is currently in the hands of international shipping companies which own containers and move them according to their needs. While these shippers focus on imbalance at intercontinental level such as between Asia and America or between Asia and Europe, little attention is given to imbalance relating to hinterlands surrounding Benelux, whose waterway accounts for over 85% of European river transport (Konings, 2009). In Antwerp and Rotterdam's hinterlands the issue is to keep enough empty containers close to suppliers while storing a sufficient number in the ports from where they are repositioned worldwide.

There exist few studies yet on empty container management relating to hinterland networks. Crainic et al. (1993) initiated their research from a deterministic and dynamic model where parameters vary from period to period in a rolling horizon framework; they then added the opportunity to substitute containers (multi-commodity), and eventually developed a stochastic single commodity model where they made the distinction between deterministic and stochastic demands and supplies.

Later, Cheung and Chen (1998) improved the model considering the residual capacity for containers on ships as a stochastic parameter. They also took into account the possibility of leasing containers, the cost of loading and unloading, and the revenue of satisfying demand. Their model did not directly include customer demands but rather the global demand for empty containers at a given terminal. In addition to their stochastic model they explained some ways to solve it with different algorithms. They expressed a multistage model as a natural extension for their mode.

More recently, in 2002 Choong et al. developed a two-stage model about empty container management for intermodal transportation networks for the Mississippi River while di Francesco in 2007 developed models similar to those of Crainic et al. (1993) but adding to these the possibility of intermodality.

This project is an allocation model with multimodal networks. It is relevant to empty container management as containers are carried by both road and water. It has been identified as an opportunity for research by Braekers et al. (2011). It combines characteristics from the two aforementioned models. To the former, it adds the possibility of intermodality with lorry, which, given its substantial financial benefits for both short- and long-haul, should be part of an overall model for empty containers. The model proposed here also differs from the second one as regards demands and supplies, which here as in Cheung and Chen's model (1998), are stochastics. It also takes into account additional parameters such as loading and unloading costs, which appear to have an important impact on empty container management costs.

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