A Robust Optimization Model for Dynamic Empty Container Allocation Problems in an Uncertain Environment

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Sea transportation is a competitive service industry. All shipping companies compete via freight rates, transit time and service quality. Since a shipping line pays substantial operational expenses to maintain its container fleet, it is important that shippers plan and schedule efficiently the movement and inventory of containers. Owing to a trade imbalance, shipping lines accumulate a large number of unnecessary empty containers in the Middle East, whilst some export ports such as Hong Kong and Japan often face a shortage of empty containers. In this paper, a well-known container shipping line that provides scheduled sea transportation services covering the Far East, the Middle East and Europe is studied. We develop a robust optimization model to dispatch empty containers from the Middle East to various export ports in the Far East region and reposition surplus empty containers from any port to shortage ports in anticipation of stochastic demand in subsequent periods. A set of real data from one of the largest shipping companies in Hong Kong is used to test the efficacy and robustness of the model. To enhance the practical implications of the proposed model, different logistics plans are evaluated according to changes of future policy and situation, which are demonstrated by numerical results.

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