Special issue on ‘Logistics and maritime systems for global trade’

Global trade nowadays faces significant challenges due to the pandemic, geopolitical conflicts, supply chain disruptions, technology innovations, and so on. In response to these challenges, the development of logistics systems continues to drive the recovery and growth of international trade. This leads to even more complex global supply chain networks, typically involving maritime transportation, inland waterways, road, air and rail transportation systems. This special issue aims to bring together recent theoretical and practical research on the development of logistics and maritime systems for global trade.

The first article by Sun et al. studies two new shipping routes in response to the retreat of Artic Sea ice caused by global warming. The two new shipping routes, including the Northwest Passage and the Northern Sea Route can significantly shorten the global transportation distance, stimulate trade among countries in the northern hemisphere, and change the hub ports. In order to evaluate the change of hub ports, this study applies a Spatial Computable General Equilibrium (SCGE) by modeling both global seaborne trade behavior and global container flow distributions. The SCGE is calibrated by actual trade and port throughput data, and the results indicate that some southern hub ports will show a declining trend,

as some potential hub locations will appear in the northern areas.

The second article by Zhang et al. studies the design of a multimodal and multilayer inbound logistics system for the delivery of iron ore from suppliers to steel plants. With demand uncertainty taken into account the study proposes a two-stage nonlinear stochastic programming model to optimize the design of the logistics system. The model is then linearized and reformulated. A scenario-based decomposition algorithm is then developed to solve the model. The proposed model and solution algorithm are applied to a case study of a steel company in China, and numerical experiments are conducted to demonstrate their effectiveness.

The third article by Kim et al. studies how to make efficient stowage plans for shipping liners with foldable containers and shift cost-sharing taken into account. Foldable containers have recently been used more and more in maritime transportation systems. On the one hand it brings opportunities for shipping liners to save vessel spaces, but on the other hand it complicates vessel stowage plans. To address such complications, this study proposes a mixed-integer programming model that incorporates foldable containers in stowage plans as well as shift cost-

sharing in the redistribution of containers on vessels. Through computational experiments, it has been shown that by applying the newly proposed model, shipping liners can eliminate most unnecessary redistributions of containers on vessels, and that inevitable container redistribution costs can be shared fairly.

The next four articles study terminal operations management for logistics and maritime systems, in response to the increasing pressure faced by seaports due to the significant growth of global trade. The study by Mahmoodjanloo investigates how to optimize the routing and scheduling of multiple ships for pickups and deliveries of cargoes at various terminals. Different terminals have different draft limits and time windows, making the optimization problem very challenging to solve. To tackle the challenge, a two-stage solution method is developed which is novelly based on dynamic programming and a branch-and-bound algorithm. The efficiency and effectiveness of the newly proposed method are then demonstrated by extensive numerical experiments.

The study by Song et al. investigates how to optimize the routing and scheduling of shuttle vessels that are usually run by large seaports between different terminals. Such shuttle seaports can fulfill inter-terminal transshipment demands

and alleviate congestion at seaports. To generate optimal or near-optimal routing and scheduling, two mixed-integer programming formulations are developed, and a two-phase heuristic algorithm is designed. Their efficiency and effectiveness are then demonstrated by numerical experimental results. Further computational analysis indicates that when routing and scheduling shuttle vessels, terminal operators should focus on the time and no-load rate, respectively, when the waiting penalty costs of shuttle vessels shift from low to high.

The study by Zhou and Kim proposes an optimal concession contract between a port authority and two container terminal operators under various revenue sharing schemes. Such a contract can be used to boost the traffic volume of a port, as well as to facilitate revenue sharing among the port authority and the two terminal operators. The study defines a Stackelberg two-stage game theoretical model to formulate the optimal contract design problem. It then conducts numerical experiments based on the game theoretical model to show the performance of the proposed contract design.

The study by Cao et al. investigates how to measure and enhance the performance of an Offshore Platform for Container Cargo Redistribution (OPCCR), which is

an open-water platform for ship-to-ship cargo transfer. The OPCCR has been attracting increased international attention due to the increasing difficulties in constructing special terminals to handle dangerous cargoes. In this study, a series of discrete event simulation models are developed to estimate the performance of two alternative OPCCR designs and, based on numerical experiments, the design with the better performance is suggested.

Overall, this collection of articles presents the latest research on the development of logistics and maritime systems for global trades. The newly proposed models and solution methods, as well as the research findings, will provide helpful guidelines for future research and assist industrial practitioners to tackle emerging challenges.