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Stochastic Optimization for Procurement of International Shipping Services

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Abstract

The traditional ways of procurement in the international shipping industry include spot market purchase and long-term (typically annual) contract with carriers. However, due to trade imbalances and uncertain economic environment, shippers and freight forwarders have suffered from difficulties in maintaining proper mix of capacities from multiple carriers and contracts. In this paper, we propose a stochastic combinatorial auction mechanism to manage a freight forwarder's procurement of maritime container capacities. Combinatorial auction has been successfully applied to truckload transportation and it can reduce overall procurement cost based on the economies of scope from the combination of bids. Unlike the traditional models, we devise a stochastic optimization model for the combinatorial auction to handle demand uncertainty, while adding constraints specific to maritime shipping services. To further hedge against demand uncertainty, we incorporate multiple contract types into the mechanism, which include spot purchase, short-term contract, option contract, and long-term fixed price contract. The computational experiments show that the proposed model has potential to reduce overall procurement cost and can improve responsiveness over sudden demand changes.

Keywords
Combinatorial Auction, Procurement, Stochastic Optimization, Contract Portfolio

Biography

Sang Hwa Song is an Associate Professor at Graduate School of Logistics, Incheon National University and Director of e-Logistics Research Institute, Korea. Prior to joining the school, he has worked for IBM as Advisory Software Engineer and Senior Consultant. He has published over 20 papers in domestic and international journals including Journal of the Operational Research Society, European Journal of Operational Research, International Journal of Production Research, IBM Journal on R&D, etc. His research interests include supply chain and logistics optimization, supply chain coordination and energy management.

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