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Liquefied Natural Gas Annual Delivery Plan Problem: A New Optimization Model and Analysis

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Abstract

The Annual Delivery Program (ADP) for Liquefied Natural Gas (LNG) represents a complex maritime inventory-routing problem requiring precise synchronization of production and distribution. This study introduces a novel Mixed-Integer Linear Programming (MILP) formulation designed to optimize vessel routing and scheduling over a one-year horizon under a direct-shipment assumption. The model minimizes total logistics costs, encompassing both fixed annual fleet costs and variable operational expenses. To ensure stability and prevent delivery clustering, customer demand is managed through discrete delivery frequency options that partition the year into specific windows. A key contribution of this work lies in the computational enhancement of the model, achieved by integrating multiple classes of valid inequalities and linearizing several sets of binary variables to improve solution efficiency.

Keywords
LNG Supply Chain, Annual Delivery Plan, Maritime Inventory Routing.

Biographies
Cansu Cav received a B.S. degree in Computer Engineering from Bilkent University, Ankara, Turkey, in 2015, and an M.S. degree in Industrial Engineering from the TOBB University of Economics and Technology, Ankara, in 2020. She is currently pursuing her Ph.D. degree in the Department of Industrial Engineering, TOBB University of Economics and Technology, Ankara. Her research interests include the applications of optimization techniques for modeling and analyzing research problems in supply chain management, and logistics.

Kadir Ertogral holds a BS from Gazi University in Ankara, Turkey, and completed his MS and PhD at Lehigh University in Bethlehem, PA, with all three degrees specializing in Industrial Engineering. Currently serving as an Associate Professor at Qatar University, his scholarly work focuses on optimizing complex systems through supply chain management, fleet operations, and the integration of inventory and transportation logistics. His expertise also extends to sustainability and specialized mathematical modeling, such as multi-item ordering and joint economic lot sizing. His research output has been widely recognized and published in top-tier academic journals, including *IIE Transactions*, the *European Journal of Operational Research*, and *Computers and Industrial Engineering*.