Decision Support Systems for Planning Contemporary Intermodal Freight Operations

Abstract

The container traffic has increased in the last decade worldwide, burdening the terminals with high container volumes. Container trains are crucial to handle the growing container traffic, however, the rail network and terminal infrastructure remain limited due to the lack of space and large investments required to build additional capacities. To increase train utilization and reduce transportation costs, double-stack container trains are introduced. However, double-stacking containers on wagons introduces additional operational and safety constraints, which makes the planning problem of assigning containers to wagon positions difficult to solve. Hence, train operators plan only one train at a time, negatively affecting the utilization of future trains. The first research objective proposes a model for planning trains simultaneously and practical solution approaches that account for the utilization of future trains while planning the present train. Computational experiments on real-life container train loading data show an improvement of up to ten containers in train utilization.

With the growing container traffic, container terminals face the challenge to improve their productivity and at the same time reduce operating costs. The second research objective aims to improve the terminal's operational efficiency for double-stack train loading operations by minimizing cranes' handling time while considering multifarious terminal and train loading constraints. It presents heuristic algorithms that provide an efficient retrieval and loading plan. Numerical experiments based on the real-life loading of container trains show that the proposed retrieval and loading policy can decrease the cranes' handling time by an average of 11.79% compared to the commonly used policy.

RORO trains, another intermodal freight transport mode, carry freight trucks and are used to transport time-sensitive cargo. The third research objective analyses RORO train operations and formulates a new integer program for the RORO service design problem. This problem determines an optimal train formation, routing, and block assignment jointly. Numerical experiments to solve the model provide an optimal total cost of service design within 32 minutes of computation time for practical problem size instances.

Keywords: Intermodal Transport, Terminal Operations Planning, Decision Support System, Heuristics, Train Service Design, Indian Railways, Lexicographic Optimization.

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