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OR Spectrum

Editorial

Today, container transportation is a predominant mode of inter-continental cargo traffic. Huge container ships transport containers between ports in all continents. Frequently, a large container ship requires thousands of container lifts in a port terminal during one call. Since a container ship involves a major capital investment and significant daily operating costs, customer service has become an important issue for container port terminals and competition among terminals has increased considerably.

Nowadays, automated container handling technology is used in many terminals. This in turn requires a highly sophisticated control strategy in order to meet the desired performance measures. As a result, OR methodology has received considerable attention to analyze and support the design, operations, and control issues arising in automated container terminals. Clearly, container terminal logistics is a challenging field for OR inhibiting real problems which are extremely complex in nature. Yet, given the recent developments in information technology, automated handling and transportation equipment, optimization algorithms and modelling tools, the overall productivity of container terminals can be significantly increased.

The primary objective of this special issue is to reflect these recent developments and to examine research issues concerned with quantitative analysis and decision support for container terminal logistics. Nine papers have been selected for publication. All papers have been peer-reviewed according to the standard of the journal. Because of the large number of submissions, papers are published in two physical issues.

The first paper by *Dirk Steenken, Stefan Voss* and *Robert Stahlbock* provides an overview and classification of container terminal operations and a comprehensive review of the related literature. The authors not only describe the configuration of modern container port terminals and the different types of handling equipment employed, but analyze the corresponding logistics processes and present a survey of methods for their optimization. This is complemented by a considerable list of references.

In the subsequent paper, *Sönke Hartmann* proposes a general model for various scheduling problems that occur in container terminals, e.g. scheduling cranes and vehicles. This model considers the assignment of jobs to resources and the temporal arrangement of the jobs subject to precedence constraints and sequence-dependent setup times. To support real-world scheduling problems, priority rule based heuristics and a genetic algorithm are discussed.

The problem of allocating berth space for vessels in container terminals is examined by *Yongpei Guan* and *Raymond K. Cheung*. Motivated by such a problem arising in the port of Hong Kong, they develop models and solution methods which aim at minimizing the waiting and operating time of a vessel. Computational experiments are reported which demonstrate the efficiency of the suggested methods.

In their paper, *Kap Hwan Kim, Jin Soo Kang,* and *Kwang Ryel Ryu* address the load sequencing of outbound containers. The solution to this complex decision problem requires the determination of the travel routes of transfer cranes and the number of containers to be picked up at each yard-bay as well as the determination of the load sequence for individual containers. A beam search based solution approach is presented which considers many practical constraints.

A detailed comparison and sensitivity analysis of different types of automated transport vehicles is presented by *Iris. F.A. Vis* and *Ismael Harika*. They examine the effects of using automated guided vehicles (AGVs) and automated lifting vehicles (ALVs) on unloading times of a vessel by means of a simulation study. In contrast to AGVs, ALVs are capable of lifting a container from the ground by itself. The study supports the choice for a certain type of equipment and the determination of the number of vehicles required.

Another simulation study of container terminal operations is provided by *Chang Ho Yang*, *Yong Seok Choi*, and *Tae Young Ha*. They also evaluate AGVs and ALVs as two competitive types of automated transport systems in automated container terminals. From the results of a detailed simulation analysis, they determine the comparative effect by cycle time and the required number of vehicles. The study demonstrates that the ALV is superior to the AGV in terms of productivity and efficiency.

The contribution of the second paper by *Sönke Hartmann* is the development of a practical tool for generating scenarios of sea port container terminals. The scenarios can be used as input data for simulation models as well as for testing the efficiency of optimization algorithms for different problems of container terminal operations. The scenario generator has been successfully used in a major simulation project for the design of a new container terminal.

In their paper, *Pyung Hoi Koo*, *Woon Seek Lee*, and *Dong Won Jang* investigate the problem of fleet sizing and vehicle routing for containers to be moved by trucks between container terminals and off-the-dock container yards. Their study is motivated by the situation in Busan where several small container yards are scattered in the city and relocating containers causes tremendous traffic problems. The approach suggested employs an optimization model to produce a lower bound on the required fleet size and a tabu search based heuristic to generate vehicle routes.

The final paper by *Martin Grunow*, *Hans-Otto Günther*, and *Matthias Lehmann* presents an efficient priority rule based dispatching algorithm for multi-load AGVs in highly automated seaport container terminals. This approach is well suited for practical application within an online logistics control system. The performance of the proposed heuristic is evaluated against an MILP model formulation with respect to total lateness of the AGVs. Numerical results also reveal the superiority of multi-load compared to single-load carriers.

This special issue has greatly benefited from the cooperation among the authors, reviewers, and editors. We would like to express our sincere thanks to the reviewers for their excellent and timely refereeing. Last, but not least, we thank all the authors for their contributions which made this special issue possible.

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Editors