

CONTAINER TERMINALS AND OPERATIONS RESEARCH - A SURVEY WITH SPECIAL EMPHASIS ON PLANNING AND SCHEDULING OF DOUBLE RAIL MOUNTED GANTRY CRANES

Stefan Voß

*Institute of Information Systems, University of Hamburg, 20146 Hamburg, Germany
stefan.voss@uni-hamburg.de*

ABSTRACT

In the last four decades the container as an essential part of a unit-load-concept has achieved undoubted importance in international sea freight transportation. With ever increasing containerization, the number of seaport container terminals and the competition among them has become quite remarkable. Operations are nowadays unthinkable without effective and efficient use of information technology as well as appropriate optimization (operations research) methods. In this paper we first describe and classify the main logistics processes and operations in container terminals.

Containers came into the market for international conveyance of sea freight almost five decades ago. The breakthrough was achieved with large investments in specially designed ships, adapted seaport terminals with suitable equipment, and availability of containers. Today over 60% of the world's deep-sea general cargo is transported in containers, whereas some routes are even containerized up to 100%. International containerization market analysis still shows high increasing rates for container freight transportation in the future. This leads to higher demands on seaport container terminals, container logistics and management as well as on technical equipment, resulting in an increased competition between seaports. The seaports mainly compete for ocean carrier patronage and short sea operators as well as for the land-based truck and railroad services. The competitiveness of a container seaport is marked by different success factors, particularly the time in port for ships, combined with low rates for loading and discharging. Therefore, a crucial competitive advantage is the rapid turnover of the containers, which corresponds to a reduction of a ship's time in port and of the costs of the transshipment process itself.

In recent years the number of publications and the methodological advances regarding container terminal operations has considerably increased. For a detailed description and a comprehensive list of references see Steenken et al. (2004). While we have conducted a comprehensive survey on operations research approaches related to container terminal operations, one aspect came to mind that had not fully been exploited in the literature. While there are many obvious differences between a container terminal and related problems, there are also some more or less obvious commonalities that allow for some interrelated observation. This holds for problems, e.g., in large so-called mega-hubs as they can be found for airports and major train stations. The first objective of this paper is to provide a comprehensive survey for container terminal logistics and to show possible correspondences that may be used as a means for looking over the fence with respect to related problems and solution approaches in not always different areas.

Moreover, we present some new research field within specific container terminals. That is, often restricted space is forcing incumbent operators of seaport container terminals to think in new directions. Automation is playing a major role for increasing efficiency. For instance, automated double rail mounted gantry cranes (DRMGs) represent the latest design of storage

equipment in modern container terminals and are able to work more efficiently than RMG-systems with a handshake area.

To the very challenging problems arising out of the operational scheduling of DRMGs belong the sequencing and the assignment of jobs as well as the prevention or handling of blocking situations, since these cranes are able to concurrently serve the whole storage block and transfer lanes. The main objective is to prevent delays in the horizontal transport of water-side import and export containers. We report on intensive simulation studies performed to determine well-suited, efficient scheduling strategies for the DRMGs. Among the tested methods are priority-rule based constructive heuristics and meta-heuristics. Preliminary results show the potential of this technology in practice.

REFERENCES

Steenken, D., Stahlbock, R. and Voß, S. (2004), Container terminal operation and operations research – A classification and literature review, *OR Spectrum* **26**, 3 - 49.

Key Words: *Container Terminal Operation, Scheduling, Gantry Crane.*