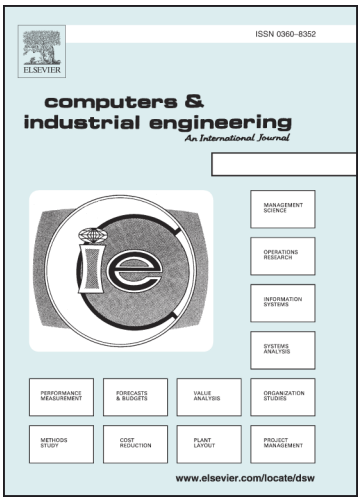

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Mathematical programming formulations for the strategic berth template problem

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Abstract

The strategic berth template problem (SBTP) is an important strategic problem arising at the seaside of container terminals. It aims at supporting terminal managers in deciding which calling ships should be accepted, and it covers determining the most appropriate berth template for the accepted incoming traffic. In this work, we propose and evaluate two formulations. One is based on a conceptual but yet unexplored mathematical model and another is based on a generalized set-packing problem (GSP). Both formulations are assessed on a well-defined set of problem instances. The results indicate that the GSP-based optimization model exhibits a relevant performance, providing optimal solutions within reasonable time for most of the instances considered.

Keywords: Maritime Transportation, Berth Allocation Problem, Strategic Planning, Set-packing Formulation

1. Introduction

The transportation of freight using containers is one of the main engines of the global economy because containerization allows to reduce transport costs while enabling rapid transfer between transportation modes. For countries and regions, the use of containers has an outstanding importance since it integrates different economies and establishes relations among them by means of global multi-modal supply chains. In this context, the United Nations Conference on Trade And Development (UNCTAD) publishes the Review of Maritime Transport (see [34]) which indicates that the international seaborne trade has increased to 160 million twenty-foot equivalent units (TEUs) in 2014. Such a volume gives rise to congested scenarios where terminal managers have to provide efficient solutions to capture the majority of the incoming ship traffic. In this sense, a poor utilization of the main seaside resources, such as berths, badly affects other operations taking place at the yardside (e.g., container storage allocation, handling equipment management, container transshipment management) and landside (e.g., truck appointments).

The previous discussion leads to the definition of the berth allocation problem (BAP) which aims at determining the berthing position and berthing time for each ship arriving at the terminal within a given planning horizon. According to the planning level considered, three different variants of the BAP may arise:

- *Strategic.* The decisions covered at this level consider a time frame ranging from one year to several years. This longer time horizon includes decisions such as establishing shared and dedicated berths, arrangement of

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