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CONTSIM – Container Terminal Management with Simulation

Uwe Clausen, Jan Kaffka*, Fabian Meier

Institute of Transport Logistics,TU Dortmund University, Leonhard-Euler-Str. 2, 44227 Dortmund, Germany

Abstract

A container terminal is a complex system with many subsystems, e.g. stacking area, cranes and vehicles, and a large number of decisions for each subsystem. Due to the interactions of these subsystems, there is a lot of stochastic influence and interdependencies within the decisions which make an optimized operation of a whole container terminal very complex and without technical and methodical support hard to handle. One optimal operated subsystem influences all other subsystems and therefore does not result in an optimality for the whole system. To optimize the operations in an overall system with all its stochastic influence and interactions the method of simulation is used in this paper, which provides the opportunity to create an experimental model and identify the best recommended course of action. The Institute of Transport Logistics developed the simulation suite ContSim in close collaboration with the Mindener Hafen GmbH which permits the modelling and simulation of material and information flows in an container terminal. ContSim provides the possibility to model a terminal on a microscopical layer. All handling and controlling processes of the terminal can be modeled and parameterized. Thus, it enables to optimize the operating strategies of a terminal with simulation. The aim is to optimize the terminal by determining the best mix of operating strategies for crane control, stacking area, handling area and resource management for every system load that can be handled by the terminal. Failures in the material flow can be identified and new strategies can be tested in a virtual model, without cost-intensive real time tests. ContSim can also be used as a daily control panel to plan the deployment and the operating strategy mix for the upcoming day.

Keywords: Intermodality, Hub Management, Logistics, Containerterminal, Simulation

* Corresponding author. Tel.: +49 231 755 7816; fax: +49 231 755 6338.
E-mail address: kaffka@itl.tu-dortmund.de.

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1. Introduction

The maritime transport of goods is an important factor in globalized markets. Nearly 95% of goods worldwide are transported with ships on sea routes. One key factor to the success of maritime transport in the past 20 years is the standardized container which became more important and allowed a time- and cost efficient transport of general goods. According to UNC [1] the shipping volume in the past 20 years grew by the factor of 5. Based on this increase the throughput of container terminals was also enhanced. For example the container terminals located at the North Sea increased their throughput in the past years between 10% and 20%. Figure 1 shows exemplarily the development of the throughput of the port of Hamburg as the second largest container port in Europe from 2004 to 2011 with a container throughput of 9 million TEU in 2011. From 2010 to 2011 the throughput was increased by 14.2%.

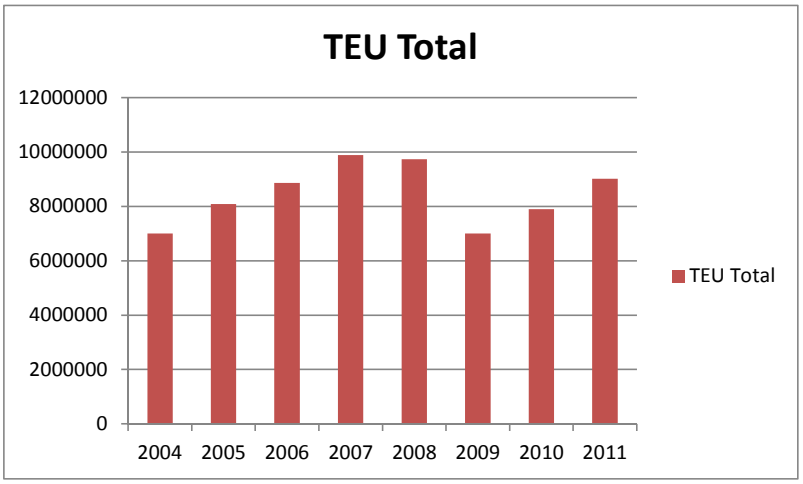

Figure 1: Throughput of the Port of Hamburg (Port of Hamburg [2])

This rate of increase in throughput causes terminal operators to expand their handling area. However container terminals are often located deep inside the port area. Due to this, free space to expand the handling area is often not available. Hereby terminal operators have to optimize the operating strategies to increase the capacity of the terminal.

Container terminals can be described as a complex material flow system with many subsystems, for example loading points, container stacks or handling equipment. These subsystems interact with each other, hence there is a lot of stochastic influence and interdependencies within the decisions. This makes an optimization of a whole container terminal very complex and without technical and methodical support hard to handle. Optimization in one subsystem influences all other subsystems and therefore does not result in optimality for the whole system. Stahlbock and Voss [3] and Steenken et al.[4] provide state-of-the-art summaries regarding operations and methods for optimization in these single subsystems.

Terminals can be differed into deep see container terminals and inland port container terminals. A deep sea container terminal serves the large container ships within the contract time. According to Lee et al. [5] this is the main issue of deep sea container terminal handling. Large container ships have to be handled as fast as possible so that the lay days remain as short as possible. Inland port container terminals serve as a hinterland hub for deep sea container terminals. Containers from the collecting area are stored in the terminal and delivered just-in-time to the sea port. Furthermore, incoming containers are dispatched in the hinterland to the consignee of the shipment. To ensure the just-in-time delivery of the container to deep sea terminals it is very important that these terminals