Chapter 13
Innovative Port Logistics Through Coupled Optimization/Simulation Approaches

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ABSTRACT

This chapter addresses different optimization/simulation approaches for the innovative logistics in Le Havre port in France. These approaches are applied to various decisional problems raised in the maritime terminals (MT) and in the multimodal terminal (MMT). The first problem concerns container transfer by rail between the maritime terminals and the multimodal terminal. The second aims to optimize trains/shuttles parking in the rail yard of the multimodal terminal. The third and the fourth are about rail-rail transshipment of containers. The goal is to elaborate a dashboard for decision makers to analyze and evaluate performance indicators of port logistics chain (costs, resource occupancy rate, service rate) and to test several management strategies.

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INTRODUCTION

The maritime mode is now the main mode for freight transportation. Thereby, the seaports must be more powerful than before (Henesey, 2006). Given Le Havre seaport, the overall containers transfer between the port and its hinterland (mainly the Paris area) is principally done by using the road. This transfer directly between the maritime terminals and delivery areas causes congestion for handlers and saturation of storage areas of maritime terminals. The future multimodal terminal of Le Havre seaport is an intermediate platform which ensures the transport of containers (collection and delivery) using a new container management transfers by trains, river barges and road. With the construction of the multimodal terminal, the containers will be evacuated to the multimodal terminal (Mega-hub) to be delivered later to their final destination by trucks, barges or trains.

This new configuration of Le Havre seaport requires organizing tours of rail shuttles to transfer containers between the maritime terminals and the multimodal terminal (internal transfer of containers), to manage rail-rail transshipment and rail-river transshipment. Many problems such as Berth Allocation, Quay Cranes Scheduling and Security Risk Management, arise from this new organization. Furthermore, improving performance indicators of a port is often a very important issue, especially because of the associated costs and the impact on container handling capacity (Armando and Stefano, 2012; Kefi, 2008). To this end, several studies concerning the optimization of port operations based on simulation and operational research methods have increased (Sammarra et al., 2007; Lim et al., 2005; Benghalia et al., 2014a; Henesey., 2006; Bielli et al., 2006; Rosa et al., 2012). According to Ung and Masanobu, (2009), simulation is the best tool used to represent any real-world system. It is often used for the analysis of complex systems and is recommended to analyze container terminal systems (Won & Yong, 1999). Contrary to the optimization, simulation alone cannot optimize a process (Almeder et al., 2009); it can only answer the question: what happens if we describe this scenario? However, the simplifications introduced in the mathematical formulation do not allow finding a directly exploitable solution (Belmokhtar et al., 2010). It is at this level that the simulation is supposed to provide a realistic assessment of the system while testing the robustness of the solutions generated by the optimization.

In this work, we summaries optimization/simulation approaches successfully applied for the innovative port logistics in Le Havre port. The remainder of this paper is organized as follows: Section 2 addresses the most related works in literature. Section 3 is about modal shift motivations in Le Havre port. The containers transfer is detailed in the Section 4. Section 5 highlights the trains parking problem in the

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