Chapter 4
Mapping the Process to Improve the Operative and Environmental Performance of Feeder Ports

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ABSTRACT

Container terminals play an important role in linking regional and continental areas for the exchange of goods. Port authorities have to provide their services under competitive prices and service levels to customers. This increasing competition pushes feeder ports to improve their processes. The goal is to increase the port capacity to deal with the increasing demand for containers and, at the same time, to reduce the environmental impact and operative costs. The authors address the gap in the literature regarding alternatives for feeder ports. They analyse best practices adopted in international terminals and evaluate the implementation in feeder ports. They apply a quantitative approach using the simulation software AnyLogic. The model uses market data to analyse the vessel unloading process at the berth. Moreover, an alternative to reduce the CO2 emissions for diesel equipment is presented. A flowchart for the vessel unloading and loading operations is proposed that includes the strategies to increase capacity and efficiency of operations and the utilisation of equipment.

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INTRODUCTION

The increasing number of competitors in the different sectors of the economy are pushing organizations to find ways to become more productive in order to offer products and services at competitive prices, superior quality and lower impact to the environment. As distribution and transportation play an important role, accounting up to 30% of the product price (Hasani Goodarzi and Zegordi 2016, Kaliszewski et al. 2020), ports have a significant position to implement innovative solutions for a positive (regional) impact on the economy and, therewith, the competitive advantage. In addition, it is crucial for ports to reduce their environmental impact as transportation and freight is a major source for global carbon dioxide (CO_2) emissions (Dekker, Bloemhof and Mallidis 2012, Pazirandeh and Jafari 2013). As a key component of transportation activities, feeder ports, smaller ports where large vessels generally cannot berth, serve as a link between regional and intercontinental areas, with the possibility of combining different modes of transportation through the use of standardized containers at the container terminal (specialised area of the port for container handling). The need for innovative and less environmental impacting port operations is emphasized by the large growth of container trade over the past decades World Shipping Council (2021).

Technological advances in the design of containers are one of the factors that contribute to their increasing demand and flow through seaports. According to Dekker, Bloemhof, and Mallidis (2012) the new generation of containers, including cooled (reefers) and temperature data loggers, allows the transportation of time sensitive products via ship, truck and rail to farther locations, including intercontinental areas. These new alternatives reduce significantly the transportation costs compared to the air mode (Dekker, Bloemhof and Mallidis 2012), making viable the demand of these types of products to even thousands of kilometres away, where container terminals work as transhipment points along the way.

Containerization allows the intermodal transportation through multiple modes such as barges, ships, trains and trucks and the changes between them in a single trip, without any manipulation of the freight (Gharehgozli, Roy and De Koster 2016). Loading a container provides security, with lower possibility of losses and damages and reduces the manipulation in intermodal trips, resulting in a faster and more efficient operation. Different sized containers can be handled by straddle carriers (SC), yard trucks (YC), yard cranes (YC) and quay cranes (QC) (Petering et al. 2009).

The key factors that give a competitive advantage to container terminals are their capacity and competitive rates (Gharehgozli et al. 2016). In previous decades it was common to design ports with machinery to handle ships with Panamax capacity (5000 TEU); however, the increasing annual demand is pushing port authorities to provide services at a competitive turn-around time and quality for mega-vessels (Stahlbock and Voß 2008) such as the new Panamax (18000 TEU) (Gharehgozli et al. 2016). However, the investment in machinery should be carefully studied. According to Low (2010) the careful investment in intelligent facilities results in competitiveness for the port, as it is not only the investment in already over-capacitated ports, such as some in Japan, UK and US, will contribute to a greater traffic control for port operators. This decision is more viable for newer container terminals that still need to implement more effective operative strategies and are located in areas that allow an infrastructure expansion. Therefore, solutions such as a new layout, automated vehicles, handling processes and investment in infrastructure (Stahlbock and Voß 2008), can have a greater impact on lower capacity ports. In the following, we investigate some measurements to increase their productivity and reduce the environmental impact of container terminals.