Chapter 5

Order Picking Optimization Based on a Picker Routing Heuristic: Minimizing Total Traveled Distance in Warehouses

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ABSTRACT

This chapter details the performance evaluation of routing policies and proposes a routing heuristic to determine the minimum traveled distance for different warehouse configurations and pick-list sizes. Numerical experiments are performed considering warehouse configurations used in literature and list sizes are chosen proportional to the number of storage positions of each layout. The proposed heuristic method was shown to reduce the distance traveled by 7% for the evaluated instances. Furthermore, travel distance reductions of up to 30% were found in cases involving large warehouse and pick-list sizes. The proposed heuristic therefore is concluded to provide a more efficient solution than individual routing policies for the picker routing problem.

INTRODUCTION

Warehouses are responsible for efficiently retrieving customers’ orders and managing inventory in a supply chain (Albareda-Sambola, Alonso-Ayuso, Molina, & De Blas, 2009). Likewise, warehouse management has a great influence on logistical costs, both in investment and direct operational costs (Chen, Cheng, Chen, & Chan, 2015). As such, warehouse optimization is of vital importance. In modern warehouses and distribution centers, it is common to receive a large variety of orders daily with a wide range of items to be delivered in quantities as small as one or two units per item (Bozer & Kile, 2008).

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Furthermore, the rapid development of business-to-consumer (B2C) e-commerce has focused attention on warehouse operation efficiency and requires increased availability of a wide range of products and a processing capacity of large quantities of daily orders (Li, Huang, & Dai, 2017). Overall, a company’s success is determined by their ability to respond to competitive markets with the right products at the right time (Roodbergen, Vis, & Taylor, 2015).

Additionally, warehouses and distribution centers often adjust or equalize sales offers in line with demand, thus soothing demand, consolidating and packaging products, and planning distribution activities (Manzini, Bozer, & Heragu, 2015). Business competitiveness requires continuous improvement in the design and operation of distribution networks, thus implying improved warehouse performance (Gu, Goetschalckx, & McGinnis, 2007), since efficiency and effectiveness within any distribution network is determined to a large extent by the operation of warehouses that must process diverse products and items, using limited picking vehicles (Cheng, Chen, Chen, & Yoo, 2015).

For this reason, this chapter aims to reduce the total traveled distance in warehouses for the order picking process through an easy-to-implement method that provide efficient solutions in very short computing time, so that programming and integration with information systems in companies such as warehouse management systems (WMS) and enterprise resource planning (ERP) can be feasible. Planning and controlling warehouse operations are crucial to the efficiency of supply chains, as poor performance results in unsatisfactory service and high logistics costs (Koch & Wäscher, 2016). To address these challenges, it is required to improve key factors affecting warehouse’s efficiency, such as warehouse design, storage location, and warehouse operation (Li et al., 2017). Warehouse design involves many important strategic decisions, such as the general structure of the warehouse, the size of the warehouse and its departments, the distribution of spaces within each department (layout), the selection of storage equipment, and the selection of operational strategies, as summarized in Figure 1 (Gu, Goetschalckx, & McGinnis, 2010). Decisions on warehouse design are considered strategic and have been widely addressed by researchers aiming to minimize costs and operating time and increase the overall performance of the supply chain (Manzini et al., 2015).

**Figure 1. Warehouse design process**