Regulation PAPER

Scheduling inbound and outbound trucks at cross docking terminals

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Abstract At cross docking terminals, shipments from inbound trucks are unloaded, sorted and moved to dispatch points where they are directly loaded onto outbound trucks for an immediate delivery elsewhere in the distribution system. This warehouse management concept aims at realizing economies in transportation cost by consolidating divergent shipments to full truckloads without requiring excessive inventory at the cross dock. The efficient operation of such a system requires an appropriate coordination of inbound and outbound trucks, e.g., by computerized scheduling procedures. This work introduces a base model for scheduling trucks at cross docking terminals, which relies on a set of simplifying assumptions in order to derive fundamental insights into the underlying problem’s structure, i.e., its complexity, and to develop a building block solution procedure, which might be employed to solve more complex real-world truck scheduling problems.

Keywords Logistics · Cross docking · Truck scheduling · (Bounded) Dynamic programming

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1 Introduction

In contrast to traditional warehouses, a cross docking terminal is a distribution center carrying no (or at least a considerably reduced amount of) stock. Incoming shipments delivered by inbound trucks are unloaded, sorted and loaded onto outbound trucks waiting at the dock, which forward the shipments to the respective locations within the distribution system. Compared to traditional warehousing, a cost intensive storage and retrieval of goods is eliminated by a synchronization of inbound and outbound flows. An additional major advantage of cross docking is that economies in transportation cost can be realized by consolidating divergent shipments to full truckloads without depending on (enlarged) inventories at the cross dock (Apte and Viswanathan 2000).

These advantages make cross docking an important logistic strategy receiving increased attention in today’s globalized competition with its ever increasing volume of transported goods. Success stories about considerable competitive advantages realized due to the use of cross docking terminals are reported for many industries with high proportions of distribution cost like retail chains (Wal Mart; Stalk et al. 1992), mailing companies (UPS; Forger 1995), automobile producers (Toyota; Witt 1998) and less-than-truckload logistics providers (Gue 1999).

A schematic representation of the material handling operations carried out at a cross docking terminal is depicted in Fig. 1. Incoming trucks are either directly assigned to a receiving door upon arrival, or have to wait in a queue on the yard until they are assigned. Once docked, the products, i.e. pallets, packages or boxes, of an inbound trailer are unloaded and scanned to identify their respective destinations. Then, products are taken over by some means of conveyance. This might be a worker running a fork lift, e.g. in retail industries (Gue 1999), or some kind of automated conveyor belt system, e.g. in mail distribution centers (McWilliams et al. 2005). The goods are forwarded to the designated shipping door, discharged in front of the outbound trailer and then loaded onto it. Once an outbound (inbound) trailer has been completely loaded.