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Cost-stable truck scheduling at a cross-dock facility with unknown truck arrivals: A meta-heuristic approach

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ABSTRACT

We study a cross-dock operator's truck scheduling problem at inbound doors in case of unknown truck arrival times. Due to uncertainty of truck arrivals, a scheduling strategy is subject to variations in costs of serving the trucks. A cost-stable scheduling strategy is defined as a schedule with low variation levels. In this paper, we analyze the cross-dock operator's problem of determining a cost-stable scheduling strategy while minimizing the average of total service costs. A bi-objective bi-level optimization problem is formulated and we discuss a genetic algorithm based heuristic to find Pareto efficient schedules. The proposed approach is compared to first-come-first-served policies.

1. Introduction and literature review

It is well known that cross-docking may achieve substantial savings for a supply chain (see, e.g., Kinnear, 1997; Gümüş and Bookbinder, 2004; Waller et al., 2006; Kreng and Chen, 2008; Galbreth et al., 2008), hence, it is practiced by many companies. The benefits of cross-docking are due to decreased warehousing costs, utilized transportation capacity as consolidated shipments result in fewer but full truckload deliveries, which decreases transportation costs, and increased service levels. The common processes included within a cross-dock facility are unloading incoming trucks at the inbound doors, sorting, storing and staging, and loading outgoing trucks at the outbound doors.[1]

A successful cross-docking implementation requires efficiently locating cross-dock facilities within supply chain networks (see, e.g., Syarif et al., 2002; Jayaraman and Ross, 2003; Sung and Song, 2003; Gümüş and Bookbinder, 2004; Campbell, 2005; Chen et al., 2006; Ross and Jayaraman, 2008; Bachlaus et al., 2008; Sung and Yang, 2008; Kreng and Chen, 2008), designing the layout of the cross-dock facilities (see, e.g., Bartholdi and Gue, 2004; Heragu et al., 2005; Hauser and Chung, 2006; Vis and Roodbergen, 2008; Yanchang and Min, 2009), and planning cross-dock operations. The studies on cross-dock operations constitute the major part of the literature on cross-docking. In a recent study, Agustina et al. (2010) review the studies on cross-dock operations. It is noted that allocating products to cross-dock facilities (Li et al., 2008, 2009), assignment of docks based on delivery origins and destinations (Tsui and Chang, 1990, 1992; Gue, 1999; Bartholdi and Gue, 2000; Bermudez and Cole, 2001; Oh et al., 2006; Lim et al., 2006; Bozer and Carlo, 2008; Ko et al., 2008; Miao et al., 2009; Marjani et al., 2011; Shuib et al., 2012), vehicle routing in networks with cross-docks (Lee et al., 2006; Wen et al., 2009), transfer of

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[1] Storage times at cross-dock facilities are generally less than a day (see, e.g., Yu and Egbelu, 2008; Alpan et al., 2011).

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