Optimizing Omni-Channel Fulfillment with Store Transfers

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Abstract

The presence of different distribution channels in omni-channel retail makes the fulfillment process challenging. When consumers can buy online and pick up their purchased goods at a store, the stores are often visited by a vehicle that supplies the pick-up points (PUPs) and by a vehicle that replenishes the store's inventory. We study the benefit of exploiting any spare capacity in the vehicles replenishing store inventories to reduce online order fulfillment cost by transferring online orders to these vehicles at one or more of the stores visited. This involves choosing transfer locations and the set of stores whose online orders are transferred at these locations so as to minimize the online order fulfillment cost. To enable feasible transfers at a transfer location, a vehicle from the online channel must visit the transfer location before the store replenishment vehicle. At a given transfer location, we can only transfer online orders of stores which are visited by the store replenishment vehicle after the transfer location in its route. We introduce the Shared Capacity Routing Problem with Transfers to minimize the transport cost of online order fulfillment in an omni-channel retail environment. We present a mixed integer linear programming model as well as an effective and efficient heuristic for solving this problem. An extensive computational study shows that a significant reduction in transport cost and store-visits can be achieved by sharing capacity across the two channels.

Keywords: Transportation, Routing, Capacity sharing, Store transfers, Omni, channel retail, Heuristics

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