
Using tricycles for express deliveries of urgent grocery needs

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Abstract

Stemming from a real-world problem, we consider the distribution of food kits in an urban environment. Customers order food kits online in one of the following two variants. Either, regular orders are placed on the eve and time windows for the delivery are specified for the next day, or so called "express"-orders are placed during the day, which are delivered within 60 minutes. Note that for express-orders, some of the goods might be out of stock, since they are directly taken from an operated customer store. Aiming for an environmentally friendly delivery system, the food kits are delivered with electric tricycles. Therefore, goods are picked up in pre-defined stores and delivered to the customers respecting temporal constraints and optimizing a combination of criteria: minimal travel time, minimal time from order to delivery, maximal fulfillment of ordered goods, minimal total tour length. We model the distribution system as a dynamic pickup and delivery problem with time windows (PDPTW). The regular orders result in initial tours for the tricycles and can be optimized using state-of-the-art PDPTW algorithms. For the dynamic part, express-orders during the day are inserted into these initial tours and choosing the store where the ordered items are packed is also part of the optimization. This process is modeled as generalized PDPTW where pickup locations are represented by clusters consisting of eligible stores. Aspects such as packing time, fulfillment and distances are considered to choose the best store for the pickup.

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