



Research School for Operations
Management and Logistics

Learning Dynamic Selection and Pricing of Out-of-Home Deliveries

Fabian Akkerman

Home delivery failures, traffic congestion, and relatively large handling times have a negative impact on the profitability of last-mile logistics. These external factors contribute to up to 28% of the overall costs and 25% of emissions for the home delivery supply chain. A potential solution, showing annual growth rates up to 36%, is the delivery to parcel lockers or parcel shops, denoted by out-of-home (OOH) delivery. In the academic literature, models of customer behavior with respect to OOH delivery were so far limited to deterministic settings, contrasting with the stochastic nature of actual customer choices. We model the sequential decision-making problem of which OOH location to offer against what incentive for each incoming customer, taking into account future customer arrivals and choices. We propose Dynamic Selection and Pricing of OOH (DSPO), an algorithmic pipeline that uses a novel spatial-temporal state encoding as input to a convolutional neural network. We demonstrate the performance of our method by benchmarking it against three state-of-the-art approaches. Our extensive numerical study, guided by real-world data, reveals that DSPO can save 20.8% in costs compared to a situation without OOH locations, 8.1% compared to a static selection and pricing policy, and 4.6% compared to a state-of-the-art demand management benchmark. We provide comprehensive insights into the complex interplay between OOH delivery dynamics and customer behavior influenced by pricing strategies. The implications of our findings suggest practitioners to adopt dynamic selection and pricing policies as OOH delivery gains a larger market share.