# Collaborative vehicle routing with excess vehicle capacity in urban last-mile deliveries

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**Abstract**

Consolidation of transport flows in logistics is one of the key ways for sustainability in urban transportation. The load factor for trucks in Europe is around 50% and a similar trend is seen in other parts of the world as well. In this paper, we introduce a novel collaborative vehicle routing strategy between logistics carriers where one (external carrier) offers the other (focal carrier) the possibility to piggyback on its routes by using its unused capacity. The number of nodes whose demand can be redirected from the focal carrier to the external carrier is constrained by the excess capacity in the vehicles of the external carrier. It is observed that the excess capacity in the external carrier routes varies from day to day, hence it is not always cost-feasible to consolidate demands of customer locations. There is a fixed cost per trip to move items from focal warehouse to external warehouse, which offsets the savings obtained by collaboration and also adds another dimension of complexity to the problem. The decision to collaborate is very ad-hoc and depends on the instance characteristics. We developed a heuristic inspired from the Knapsack problem to generate good quality initial solutions very fast. We also implemented a local search to improve the initial solution by defining some problem specific neighborhoods. For the benchmark instances, the local search heuristic provides solutions with a very small optimality gap ($< 0.1\%$). Our experiments show potential savings in total distance traveled using this collaborative strategy under different scenarios.

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