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# Formulation and value of an integrated order picking-vehicle routing problem

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## Abstract

Order picking and distribution are interrelated as goods can only be delivered when the order picking process is completed. Historically, these problems are solved sequentially which often lead to suboptimal solutions. Integrating these subproblems into a single problem can add value. In an integrated problem both subproblems are solved simultaneously in order to obtain an overall optimal solution. Existing studies focus on integrated production scheduling-vehicle routing problems (PS-VRP).

In this presentation, an integrated order picking-vehicle routing problem (OP-VRP) will be formulated. Different orders need to be picked by order pickers in a warehouse. Thereafter, these orders need to be delivered using a fleet of vehicles. Due to the increase in the number of e-commerce transactions, customers order more frequently in smaller quantities. Customers expect a fast delivery within tight time windows. Therefore, the objective of the mathematical formulation is to minimize the total earliness and tardiness of order delivery. The formulated mathematical problem is solved exactly using CPLEX for a small number of customer orders, order pickers and vehicles. Furthermore, a sequential approach is compared with the formulated OP-VRP to measure the value of integration. In the sequential approach, first an order picking problem is solved. Thereafter, the output of this problem is used as input for a VRP. In the integrated approach both problems are solved simultaneously. Preliminary results of the comparison between the two approaches will be provided.

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