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Joint order batching and picker routing in single and multiple-cross-aisle warehouses using cluster-based tabu search algorithms

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**Abstract** The organization of order picking operations is one of the most critical issues in warehouse management. In this paper, novel tabu search (TS) algorithms integrated with a novel clustering algorithm are proposed to solve the order batching and picker routing problems jointly for multiple-cross-aisle warehouse systems. A clustering algorithm that generates an initial solution for the TS algorithms is developed to provide fast and effective solutions to the order-batching problem. Unlike most common picker routing heuristics, we model the routing problem of pickers as a classical TSP and propose efficient Nearest Neighbor+Or-opt and Savings+2-Opt heuristics to meet the specific features for the problem. Various problem instances including the number of orders, weight of items, and picking coordinates are generated randomly, and detailed numerical experiments are carried out to evaluate the performances of the proposed methods. In conclusion, the TS algorithms come out to be the most efficient methods in terms of solution quality and computational efficiency.

**Keywords** Order batching · Picker routing · Warehouse management · Tabu search · Speed-based cluster algorithm

## 1 Introduction

Companies aim to handle the complete material flow from the manufacturing location to the final destination in the most economical way. From this point of view, warehouse design and operations planning influence the performance of inventory management in supply chain systems and thus impact the competitiveness of the company. There are numerous decisions involved in designing and operating

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