

# A study on the benefits of integrating inventory and routing decisions in a city logistics context

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**Keywords:** Inventory, Routing, City-logistics

This study investigates the potential of utilizing an Urban Consolidation Center (UCC) or a city hub as an intermediate storage facility within a B2B two-echelon urban distribution system. The main objective is to assess the advantages of integrating inventory and routing decisions in contrast to a traditional approach where the city hub functions only as a consolidation point. Two scenarios are explored in this study: a traditional one involving sequential inventory and routing decisions, and an integrated one where these decisions are made simultaneously.

A traditional problem in which inventory and routing decisions are taken sequentially is solved using the same model and method as in [1]. In the sequential scenario, various replenishment methods are employed for the inventory aspect, and a Large Neighbourhood Search (LNS) metaheuristic is utilized to optimize routing decisions from the UCC to the retailers. The integrated scenario is addressed using a matheuristic algorithm that combines mathematical optimization techniques with heuristics. A matheuristic algorithm based on the one presented in [2] is proposed to solve the integrated problem. We adapt the method to our specific problem context by extending it to a multi-product, heterogeneous, multi-trip context with a more complex objective function that also includes holding costs, order costs, and duration-based routing costs.

Computational results consistently demonstrate the superiority of the integrated approach across multiple performance metrics, including costs, logistics ratio, number of urban trips, loading degree, and distance traveled. A sensitivity analysis highlights critical factors, including retailer storage capacity, order cost, and retailer participation, that influence the implementation of the integrated scenario. Retailers can benefit from the implementation of the integrated scenario to reduce their storage capacity requirements and allocate the available space for other purposes. Additionally, a higher order cost reduces the savings obtained from implementing the integrated scenario. Furthermore, higher levels

of retailer participation result in more substantial cost reductions in both the second and first echelons.

Further analysis is conducted to investigate the impact of different transshipment costs on the cost difference between the sequential and integrated scenarios. As transshipment costs increase, the cost difference between the integrated and sequential scenarios becomes even larger.

## References

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