



Research School for Operations  
Management and Logistics

### **Multi-Echelon Distribution Networks in City Logistics**

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Increasing population growth in urban areas, increasing congestion and stricter emission rules raise the need to find new solutions for the management of freight distribution inside the cities. City logistics considers the whole freight distribution system as an integrated logistic system with multiple stakeholders and aims to improve the quality of life and reduce the total cost. Instead of direct shipping from supply points to customers, goods are consolidated in consolidation facilities. Multi-echelon distribution systems suit best with goods consolidation where the distribution system includes multiple stages. Each stage can be considered as a different area within the urban area, where the last stage consists of deliveries to final customers. Different vehicle fleets are used for each stage, which are compatible with characteristics and possible restrictions of urban areas. City freighters are used at the last level and trucks are kept away from city centres.

We focus on different level planning problems that arise in multi-echelon distribution systems. We introduce a new family of two echelon vehicle routing problems with hard time windows for customers. Moreover, a new version of the two-echelon vehicle routing problem with pickup and delivery is studied. Mathematical formulations will be provided and exact and heuristic methods will be designed to address these problems. In addition, we study a new version of a two-echelon vehicle routing problem with stochastic demands where a subset of demand requests occurs stochastically during the planning period.