



At the Chair of Logistics and Supply Chain Management of TUM School of Management, we are looking for an interested and qualified student to conduct his/her

Master thesis

on the topic

Integrating Cargo Value and Crime Risk into Vehicle Routing

The classical Capacitated Vehicle Routing Problem (CVRP) seeks to minimize travel cost under vehicle capacity constraints (Toth and Vigo, 2014). In contrast, the secure and safe VRP literature emphasizes minimizing exposure to external threats when transporting sensitive goods (Bozkaya et al., 2017). While these streams address different priorities operational (efficiency versus security), real-world logistics often requires balancing both, especially when values of cargo differ.

The goal of this thesis is to bridge the two perspectives by introducing the *Value-Aware VRP with Risk Constraints* (VAVRP-RC), where each delivery unit has both weight and economic value. Road segments are assigned crime-based risk scores, weighted by the value of cargo carried. The objective is to produce highly secure routes for higher-value loads and more cost-efficient routes for lower-value loads. Optionally, a *risk equilibrium* criterion (Fontaine et al., 2020) can be incorporated to balance value-weighted risk exposure across all routes, ensuring no individual vehicle or delivery bears a disproportionate share of the overall transport risk.

Key project tasks

- Review literature on relevant research streams
- Develop a MILP formulation for the VAVRP-RC with value-dependent risk costs
- Implement and test exact and heuristic algorithms
- Apply the model to an urban case study and compare with baseline VRP results

Requirements

The thesis is suitable for Master in Management and Technology students with a major in operations and supply chain management. The ability to work independently as well as analytical skills are required. Knowledge of one general-purpose programming language (e.g., Python) is required. Knowledge of mathematical programming and optimization is preferred.

Earliest begin: January 2026

Supervisor: Nicolas Kuttruff

Application: Email with curriculum vitae and transcript of records to logtheses.log@mgt.tum.de.

References

- Bozkaya, B., Salman, F.S., Telciler, K., 2017. An adaptive and diversified vehicle routing approach to reducing the security risk of cash-in-transit operations. *Networks* 69, 256–269.
- Fontaine, P., Crainic, T.G., Gendreau, M., Minner, S., 2020. Population-based risk equilibration for the multimode hazmat transport network design problem. *European journal of operational research* 284, 188–200.
- Toth, P., Vigo, D., 2014. *Vehicle routing: problems, methods, and applications*. SIAM.