



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

Modeling Hyperloop Network Design under Uncertainty

The *Hyperloop* is a high-speed transportation concept first introduced by Elon Musk in 2013, in which magnetically levitated pods travel through low-pressure tubes to achieve airline-like speeds with reduced energy consumption. Combining magnetic levitation and vacuum-tube technology, it represents a promising and sustainable alternative for future intercity travel (Santangelo, 2023). Among the institutions engaging in Hyperloop research, TUM Hyperloop is developing Europe's first certified Hyperloop segment for passenger mobility.

However, planning a reliable Hyperloop network is challenging due to uncertainties in passenger demand, construction costs, and energy efficiency. This thesis develops a stochastic programming model to support network design decisions, including route selection and hub location, under different uncertainty scenarios. Building on the methods from transport network design under uncertainty (Chen et al., 2011), the thesis applies scenario-based and robust optimization approaches to evaluate how uncertainty affects total cost and network performance. The proposed framework aims to improve decision reliability while keeping the model computationally feasible for practical use.

Key project tasks

- Reviewing literature on Hyperloop design and stochastic network optimization.
- Developing a stochastic programming model for Hyperloop network planning under uncertainty.
- Implementing a decomposition or scenario-based solution approach for route and hub design.
- Testing and evaluating the model and interpreting the 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 mathematical programming and optimization is required. Knowledge of one general-purpose programming language (e.g., Python, Julia) is a plus.

Earliest begin: December 2025

Supervisor: Nicolas Kuttruff

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

References

- Chen, A., Zhou, Z., Chootinan, P., Ryu, S., Yang, C., Wong, S., 2011. Transport network design problem under uncertainty: a review and new developments. *Transport Reviews* 31, 743–768.
- Santangelo, A., 2023. The infrastructure challenges of hyperloop. *Procedia Structural Integrity* 44, 626–632.