



Developing an Assessment Framework for Rail Entities' Resilience

Description

Railway entities, including Infrastructure Managers (IMs) and Railway Undertakings (RUs), play a crucial role in ensuring continuous and reliable transport services. However, they face increasing challenges from extreme weather events, cyber threats, capacity bottlenecks, and supply chain disruptions, all of which can severely impact operations. The European Commission's Critical Entities Resilience (CER) Directive (EU, 2022) underscores the need for enhanced resilience strategies for critical entities, including railways. Despite this, there is no standardized framework for systematically assessing and improving the resilience of these entities.

Existing research mostly identifies infrastructure vulnerabilities and operational inefficiencies (Bešinović, 2020). Many current methodologies focus on individual disruptions rather than offering a comprehensive approach to resilience assessment. However, organisational aspects, such as the intricate interactions within dispatching centers, the complexities of coordination across multiple departments, and the adaptability of workforce management during crises, are often overlooked in resilience assessments.

This thesis aims to develop a conceptual framework that allows railway entities to systematically evaluate their resilience, identify vulnerabilities, and implement effective improvement strategies, e.g. considering Rehak et al. (2024). By bridging existing gaps in resilience assessment, the proposed framework will support railway entities in adapting to emerging threats and ensuring long-term operational stability.

Assignment

- Literature review of resilience definitions, methodologies, indicators, and previous studies on railway resilience as well as critical entities resilience.
- Identification of resilience indicators, threat and entities characteristics.
- Formulation of an assessment methodology for resilience of rail entities.
- Conduct interviews with rail entities, i.e. IMs, RUs, and industry experts to refine the framework
- Write a report/thesis

Expected Knowledge and Skills

The topic is suitable for diploma/MSc thesis.

Background

The student should have a solid understanding of railway operations, infrastructure, and safety standards, as well as understanding of qualitative and quantitative approaches. Effective communication skills are necessary for presenting findings clearly in reports and presentations, and experience or willingness to engage with railway professionals through interviews.

References

- U (2022). Directive (EU) 2022/2557 of the European Parliament and of the Council of 14 December 2022 on the resilience of critical entities and repealing Council Directive 2008/114/EC.
- Bešinović, N. (2020). Resilience in railway transport systems: a literature review and research agenda. *Transport Reviews*, 40.
- Rehak, D., Splichalova, A., Hromada, M., Walker, N., Janeckova, H., & Ristvej, J. (2024). Critical entities resilience failure indication. *Safety science*, 170, 106371.

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