TU Wien
Institute for Management Sciences
Research Unit of Industrial Engineering
Research Group of Production and Maintenance Management

WIENER LINIEN
WIENER STADTWERKE GRUPPE

Call for Master Thesis

Preliminary title:

A Dynamic Bayesian Network Approach to Predictive Maintenance in Urban Rail Pneumatic Systems

Motivation:

The maintenance of rail vehicles in public transport is crucial for safe mobility. Traditional time-based approaches are reaching their limits due to rising demands for safety and reliability. Research on Vienna's V-type subway trains focuses on sensor-based monitoring of the compressed air system (see Project [1]). By applying advanced data analytics, a knowledge-based maintenance strategy is being developed. This aims to reduce operational disruptions to enhance the remaining useful life (RUL) and reliability of the Wiener Linien's V-train fleet. [2] (see Figure 1).

Figure 1: Roadmap to reduce malfunctions of the compressed air system.[2]

Goal:

This work focuses on the development and visualization of an interface between knowledge-based networks, specifically Failure Potential Analysis, and data-driven pattern recognition methods. To achieve this, the following tasks are proposed:

- Develop a domain-specific ontology with a focus on component functionality as a core attribute.

- Identify and define which maintenance data types are relevant for dynamic bayesian network modeling (e.g., work orders, overhaul logs, component histories). Include maintenance-specific attributes such as "overhaul component?" to differentiate between disposable and repairable parts.

- Extend the ontology to represent maintenance regimes, specifying: (1) Which components are affected, (2) the maintenance frequency and timing (time-based) and (3) The processing method during maintenance (e.g., replacement, inspection, overhaul).

- Map sensor data to specific components and their functional roles within the pneumatic system.
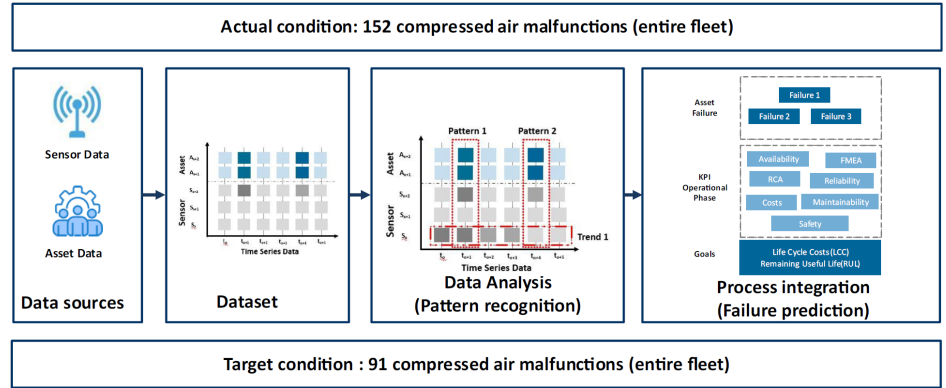
Thesis advisor:	Topic supervisor:	Topic supervisor:
Univ.-Prof. Dr.-Ing. Fazel Ansari	Dipl.-Ing. Andreas Steiner	Omar Abdelkader, MSc
fazel.ansari@tuwien.ac.at	andreas.steiner@tuwien.ac.at	omar.abdelkader@wienerlinien.at

[1] https://www.tuwien.at/en/mwbw/im/pim/projects/win
[2] Steiner, A., Abdelkader, O., Ansari, F., & Kollegger, A. (2024). Datengetriebene Instandhaltung von Schienenfahrzeugen im öffentlichen Personennahverkehr: Wissensbasierter Ansatz zur Auswahl und Analyse operativer Sensordaten. In Digital Excellence in der Instandhaltung: Strategien für Ihren Unternehmenserfolg (pp. 95–111). Köln: TÜV-Verlag.