Project Summary

Problem Statement

In predictive maintenance (PdM), a persistent gap exists between Remaining Useful Life (RUL) prediction models and their effective integration into maintenance strategy support. While many studies emphasize prediction accuracy, fewer approaches address how predictions can be contextualized, interpreted, and transformed into actionable decisions that align with industrial objectives.

Research Question

How can RUL predictions be fully integrated into real industrial maintenance strategies to enhance both technical reliability and business value?

Sub-Research Questions

1. How can we improve the communication phase and integration of heterogeneous data sources?

2. How can model complexity, interpretability, and adaptability be tailored to real-world industrial variability?

3. How can dashboards, digital twins, and explainable AI be combined into a closed-loop decision framework?

4. How can technical strategies be aligned with broader business and operational objectives?

Datasets

The framework will be validated using diverse benchmark datasets: NASA C-MAPSS, Pronostia, IMS bearing dataset, NASA milling machine dataset, and NASA battery dataset. These datasets cover different degradation mechanisms and operational contexts, ensuring robustness and generalizability.

Methodology

- **AW1**: Develop a robust data acquisition and preprocessing pipeline.

- **AW2**: Design a hybrid RUL prediction model leveraging deep learning and domain knowledge.

- **AW3**: Implement a generative recommendation system supported by SHAP-based explanations for interpretability.

- **AW4**: Build a business intelligence dashboard integrating predictive insights, digital twin representations, and decision support tools.