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Linear infrastructure efficiency improvement by automated learning and optimized predictive maintenance techniques

INFRALERT Deliverable D3.2 **Summary Sheet**

DELIVERABLE TITLE:

D3.2 Application of physical, data-driven and symbolic models from component to system level

WORK PACKAGE:	**Deliverable Leader:**
WP3. Asset Condition ○ **T3.2.** Integration of physical models in asset condition for component level ○ **T3.3**. Symbolic and data-driven methods for nowcasting and forecasting	Lulea Tekniska Universitet **Contributing Partners:** Infraestruturas de Portugal, Universidad de Sevilla, CEMOSA, Fraunhofer IVI, DMA

EXECUTIVE SUMMARY:

This deliverable presents the methodology necessary for implementing linear asset condition nowcasting and forecasting models. For the assessment of the condition of a linear asset, different types of inputs and limits are required. This involves the geometric dimensions, material properties, operational or usage profile, external and human factors as well. The output variables or features are asset identification, asset historical maintenance interventions and asset condition assessment and prediction (WP3). These features are the input for Alert Management (WP4), RAMS analysis (WP5) and decision support for maintenance planning (WP6).

To predict the future behavior of linear assets, there are four types of prognostic modeling techniques, mainly; knowledge based models (symbolic), life expectancy models, machine learning (data driven) and physical models as categorized in Figure 1. For physical modeling, it is important to investigate the physical mechanisms that have significant influence on the degradation process and failure events of linear infrastructure. This also includes the geometric dimensions and material properties of the asset, the operational or usage profile, external factors, and human factors. For railway and road deterioration, there are several physics-based models that have been proposed in the literature. A physics-based approach is based on the identification of potential failure mechanism for an asset. Hence, the main function and failure mode of major components of railway and road are identified and collected in this report.

The models can be divided into 'microscopic' and 'macroscopic'. Microscopic models deal with the stresses on specific components, e.g. rolling contact fatigue and wear. These models, based on physical laws, empirical evidence or engineering judgments are mainly applicable for design purposes. Macroscopic models (system or multi-segment level) are used for network analysis and maintenance planning, e.g. on the basis of road and railway track geometry deterioration models. The data-driven models are, considered as black box modeling, predicts the future behavior by analysing the data obtained from the linear assets. There are several models provided in this report and also comparison is also studied for the best suitable scenario. The symbolic modeling depends on maintenance work orders, external factors and other factors of interest. In this report, a fuzzy based symbolic model is proposed to

predict the behavior. The nowcasting and forecasting of the assets can be obtained from either of the above-mentioned models.

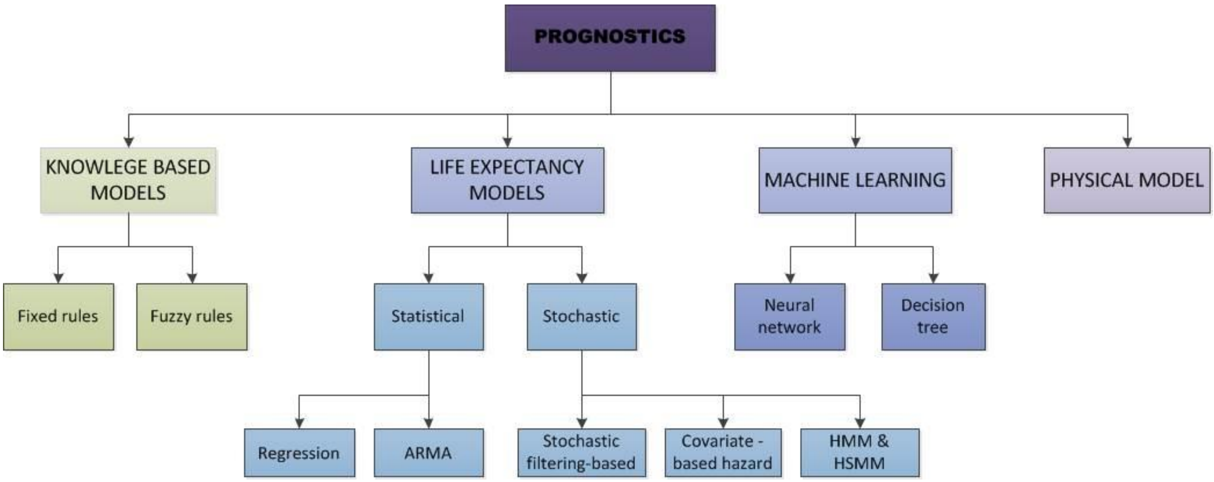

Figure 1: Different Methods of Prognostics

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