"Holistic Asset Management and Decision Support System: Development of the Intelligent Asset Management System for Predictive and Efficient Maintenance within the work package 8 of the European Rail Joint Undertaking FP3-IAM4RAIL Project"

Railway asset management is a complex discipline involving diverse systems, multiple stakeholders and various types of assets. Traditional maintenance planning often overlooks key factors such as weather conditions, asset interdependencies and historical records, which can lead to inefficient resource use and suboptimal outcomes, either excessive maintenance or an increased risk of failures.

To address these challenges, within the European Rail Joint Undertaking (ERJU) Flagship Project (FP) 3 IAM4RAIL Intelligent and Integrated Asset Management project, SNCF and Hitachi are exploring new ways to develop Decision Support Systems to support dynamic railway maintenance. Contributing to overall Work Package 8 (WP8) Long term asset management and Life Cycle Cost (LCC) with task 8.1 "Holistic Asset Management and Decision Support System (DSS): Development of the Intelligent Asset Management System (IAMS) for Predictive and Efficient Maintenance".

SNCF and Hitachi tackle this challenge with complementary tasks, wayside and on-board, with a shared goal: to provide a Holistic Asset Management that enables anticipating failures and optimising resources.

Aligned with the IEC 60300-3-14 standard, the development of a Holistic Asset Management approach complements existing maintenance frameworks and represents a significant step forward toward in railway long-term maintenance and LCC management. By integrating diverse data sources and enabling intelligent decision-making, the IAMS system supports a more resilient, efficient and cost-effective railway infrastructure.

Focusing on Hitachi subtask scope, the objective is the creation of Decision Support Systems within the Integrated Asset Management System aiming to enhance long-term asset management through integrated diagnostics, predictive analytics and dynamic maintenance planning.

The project is supported by the Europe's Rail Joint Undertaking and its members.

The IAMS processes data from sensors, technical reports, maintenance records and external sources such as weather conditions, particularly from point machines. These data are analysed to generate maintenance proposals, optimise inspection schedules and enable proactive interventions.

Hitachi is also participating within IAM4RAIL WP3/4, where the data from sensors and real installation is acquired, then incorporated within WP8 data income.

The demonstrator developed contributes to:

- Reduce the downtime through targeted, condition-based interventions.
- Improve the resource efficiency by aligning staff deployment with actual asset needs.
- Enhance the reliability by preventing failures before they occur.
- Produce data-driven planning that evolves with asset behaviour and environmental conditions.

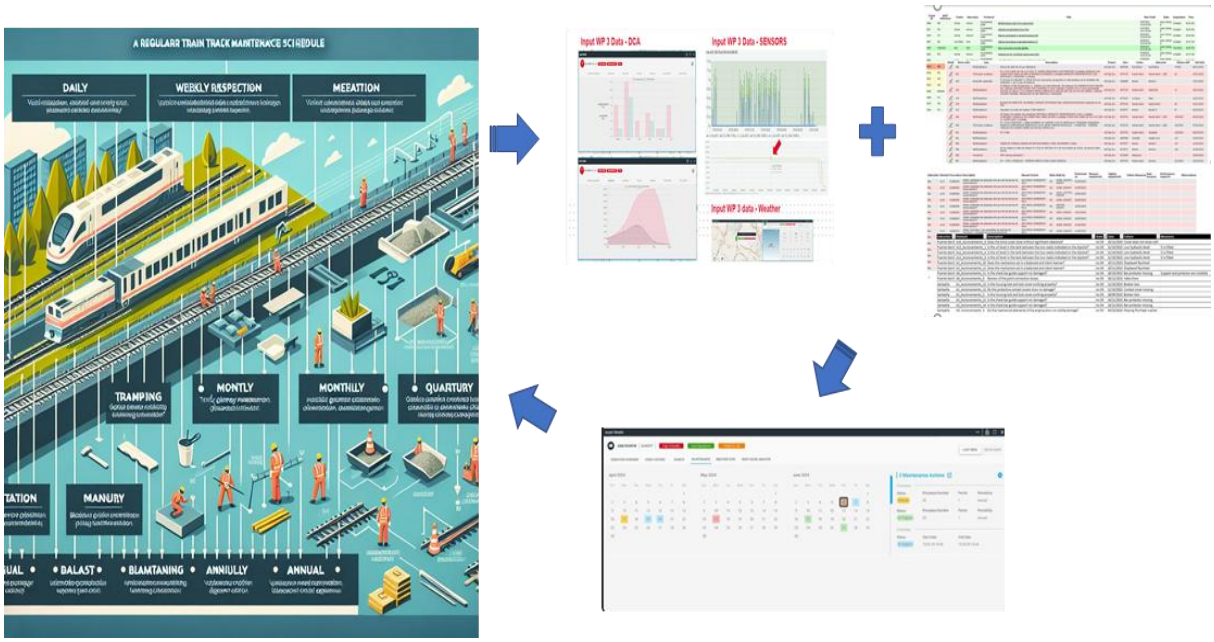

Figure 1: GTSD Holistic Asset Management and Decision Support System (DSS)

SNCF development uses Global Navigation Satellite System (GNSS) data to reconstruct train trajectories and detect infrastructure anomalies.

Spatio-temporal algorithms use GNSS data to reconstruct train trajectories and associate them with infrastructure segments, creating 'train path' objects. The key lies in having a continuous line instead of sparse GNSS plots. This also enables associating data from multiple sources to improve the density of available information

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An application of this system enables fault detection in Contrôle de Vitesse par Balises (KVB) beacons or track circuits by analysing train behaviour when passing through specific zones.

Accurate fault localisation reduces detection time, avoids unnecessary interventions and improves infrastructure availability.

The results of the work carried out within task 8.1 "Holistic Asset Management and DSS: Development of the IAMS System for Predictive and Efficient Maintenance" are promising. Two complementary paths, one shared goal: smarter, safer and more efficient railway maintenance.

The Holistic Asset Management for Dynamic Maintenance Management have shown that it is possible to improve maintenance management with limited data and intelligent tools.

While Hitachi focuses on integrating wayside asset condition with maintenance operation, SNCF analyses train behaviour in spatio-temporal correlation with the wayside. Together, they offer a holistic view of the railway system.

These developments lay the foundation for smarter, safer and more efficient long-term asset management, aligned with the sustainability and reliability goals of European rail transport.

Figure 2: UC8.1 Holistic Asset Management and Decision Support System (DSS)

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