Multi-Source/Multi-purpose IAMS application: scope refinement & quick wins – WP10

Successful Installation of Intelligent Turnout Demonstrators

Under FP3-IAM4Rail Work Package 10, ADIF, CEIT Technology Center and voestalpine Railway Systems, the founding members, have installed two intelligent turnout demonstrators. These demonstrators aim to implement a multi-source, multi-purpose intelligent asset management solution for railway infrastructure monitoring. A standard mixed traffic and a high-speed turnout have been equipped with novel monitoring technologies from voestalpine Railway Systems. The monitoring systems focus on tracking the health status of the turnouts, detecting and preventing faults, and assisting ADIF in maintaining the asset performance, availability, efficiency and safety of their infrastructure.

Mixed Traffic Prototype

From March 6th to 8th, a mixed traffic turnout demonstrator was installed on the Barcelona - Valencia line in Riffa, Tarragona, Catalonia. The prototype, a 60E1-500-1:15 intelligent turnout with a fixed cast manganese crossing from voestalpine Railway Systems JEZ and several integrated sensors, focuses on monitoring track (ballast) degradation and switch rail and crossing degradation. Four multi-sensors have been installed to monitor vibrations in the switch and crossing areas, providing essential data for asset management and maintenance.

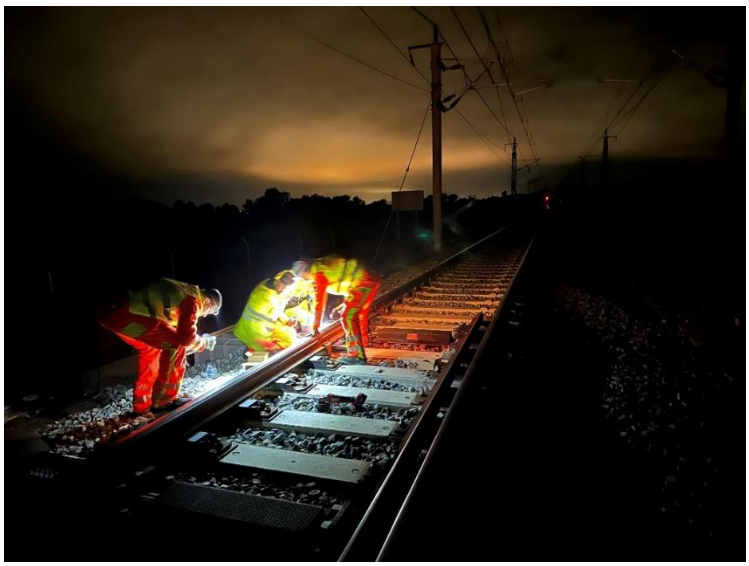

Figure 1: Installation of monitoring demonstrator in mixed traffic line Barcelona - Valencia

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

The installation was completed in two-night shifts alongside CEIT, who carried out a series of geometric and dynamic measurements and performed laser scans of the demonstrator turnout.

First, a 3D scanner was used to measure the geometry. The scanner projects and captures reflected light to achieve accurate geometry acquisition. For this purpose, these geometric measurements were conducted at night when ambient light is minimal. After scanning the panel, a complete point cloud is built. The actual state of the crossing is obtained using this technology, allowing work with degraded geometries to validate computational models in multibody and FEM environments.

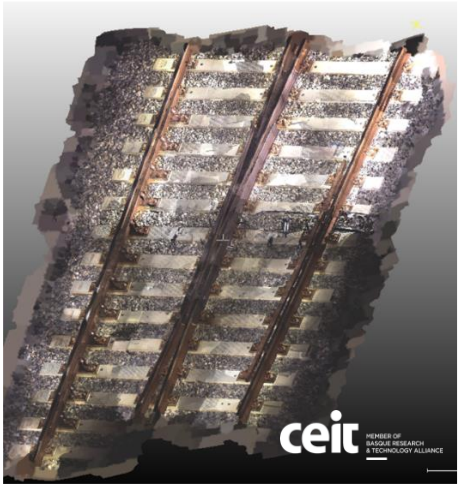

Figure 2: Scan model of the crossing

Second, a maintenance break was utilised at night to position all the sensors required for the dynamic measurements. In total, 15 sensors were installed: 13 accelerometers and 2 displacement sensors.

Figure 3: Passenger train passing over the turnout.

After installation, the monitoring system went online, recording each train passage and uploading pre-processed data to a cloud system. Several acquisitions were performed over the next two days for future post-processing. Due to mixed traffic on the track, up to 5 different types of vehicles passed through the crossing at various speeds during these days.

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Advanced data analysis algorithms evaluate this data, which are then integrated into the zentrak intelligent asset management and monitoring platform.

The figure below shows the track displacements and component accelerations in the switch and the crossing panel.

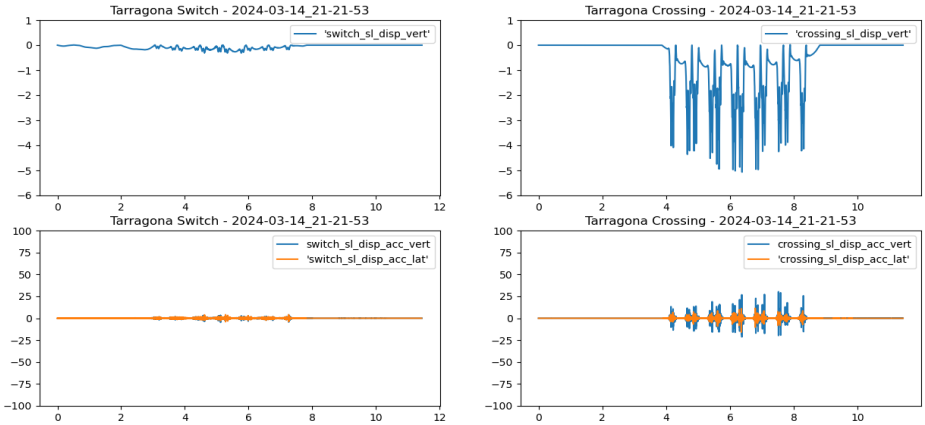

Figure 4: Signals recorded from the passage of a commuter train. Track displacements in crossing areas yield critical limits.

High-Speed Prototype

Following the mixed traffic installation, ADIF and voestalpine Railway Systems equipped a high-speed turnout in Santa Cruz de la Zarza, Toledo, on the Valencia-Madrid high-speed line with an advanced monitoring system. The 60E1-17000/7000-1:50 turnout supplied by voestalpine Railway Systems JEZ has a length of 180 m and 14 setting levels. From March 18th to 22nd, the team installed more than 30 sensors to monitor various usage cases and damage patterns, including swing nose, switch device, detector rod, track degradation and crack detection.

All relevant settings and parts of the turnout were covered to investigate the most promising approaches.

Figure 5: Installation of monitoring demonstrator in the high-speed line Valencia Madrid

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Once the power supply was in place, the data collection process was under way. The next steps include in-depth data analysis and the development of approaches to fuse multiple data sources, such as rolling stock data, wayside monitoring data, operational and traffic data, and inspection and maintenance data. This will lead to a holistic smart asset management demonstrator, targeting TRL 7, showing a prototype in an operational environment.

Next Steps and Future Developments

ADIF and voestalpine Railway Systems will implement the zentrak infrastructure monitoring, as well as the zentrak asset management and maintenance software for the two demonstrators. This will enable a centralised database that combines all relevant data sources and provides a comprehensive view of the assets.

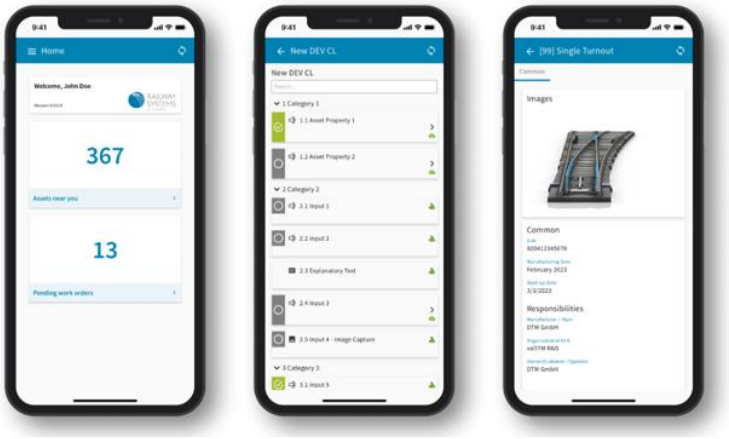

Figure 6: Zentrak infrastructure monitoring, asset management and maintenance management platform.

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