SUCCESS STORY

Project: Improved vehicle track interaction in the field of meter gauge railways (FFI Opt)

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET

Type of project:
FFI Opt Meterspur
duration: 01.10.2022 - 31.03.2026,
multi-firm

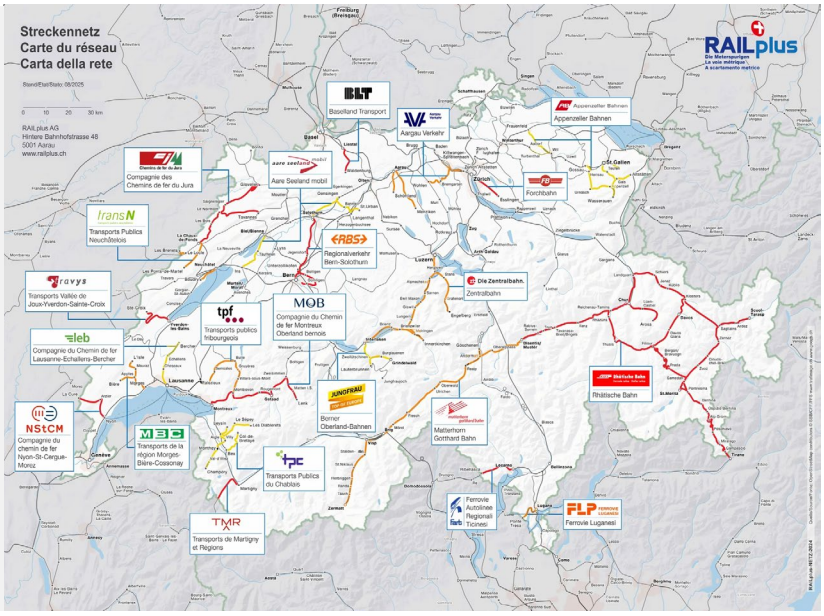

Figure 1: RAILplus network

FROM SIMULATION TO SYSTEM UNDERSTANDING IN METER GAUGE RAILWAYS

THIS COMET K2 PROJECT DEVELOPED A SIMULATION-BASED METHODOLOGY TO ANALYSE VEHICLE-TRACK INTERACTION IN METER-GAUGE RAIL SYSTEMS. BY COUPLING VEHICLE DYNAMICS, STRUCTURAL MECHANICS, AND TRIBOLOGICAL MODELS. WEAR AND NOISE PHENOMENA CAN BE ASSESSED UNDER REALISTIC OPERATING CONDITIONS. THIS ENABLES A TARGETED OPTIMIZATION OF MAINTENANCE AND OPERATIONAL STRATEGIES.

Meter-gauge railways are characterised by tight curves, steep gradients, and specific wheel-rail contact conditions. These characteristics lead to increased wear, higher noise emissions (particularly curve squeal) and higher maintenance demand. Solutions developed for standard-gauge systems are only partially transferable due to these distinct boundary conditions.

Project Approach

The work was carried out in close cooperation between Virtual Vehicle Research GmbH, RAILplus AG, Stadler Bussnang AG, voestalpine Railway Systems GmbH and Lucchini RS S.p.A. The objective was to consistently capture the coupled interaction between friction, wear, and noise behavior in a coherent modelling environment.

The modelling framework includes:

- Multi-body simulation for vehicle dynamics
- Finite element models for structural dynamics
- Tribological models for wheel-rail contact and friction behavior
- Acoustic models for noise emission prediction and laboratory measurements, including acoustic measurements, structural dynamic testing, and wear analyses.

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This ensured that relevant operating conditions are represented with a high degree of physical accuracy.

Figure 2: Impact hammer measurement to analyse the dynamic response of the track

Results and Applications

The validated simulation framework enables:

- Optimization of friction management strategies
- Assessment of vehicle and infrastructure design parameters
- Prediction of wear development and maintenance needs
- Analysis and mitigation of curve squeal phenomena

These capabilities provide a solid basis for decision-making in operation, planning and engineering. Measures can be evaluated virtually before implementation, reducing both technical risks and lifecycle costs.

Impacts

Environmental and social impacts:

- Reduction of noise emissions, especially in tight curves
- Decreased material wear and resource consumption

Scientific and structural impacts:

- Advancement of multi-physics railway simulation methods
- Strengthened system understanding in meter-gauge railways
- Reduced costs and maintenance efforts
- Enhanced collaboration between research and industry partners

Conclusion

The project demonstrates how integrated simulation methods can make complex interactions in meter-gauge rail systems quantifiable and manageable. This provides a robust basis for more efficient, cost-effective, and sustainable railway operation and decision-making.

Project coordination (Story)
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Project partners

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- Stadler Bussnang AG, Schweiz
- voestalpine Railway Systems GmbH, Österreich
- Lucchini RS S.p.A, Italien

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This success story was provided by the consortium leader and by the mentioned project partners for the purpose of being published. FFI Opt Meterspur is a COMET Project within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMIMI, BMWET, das Land Steiermark and Steirische Wirtschaftsförderung (SFG). The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet

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