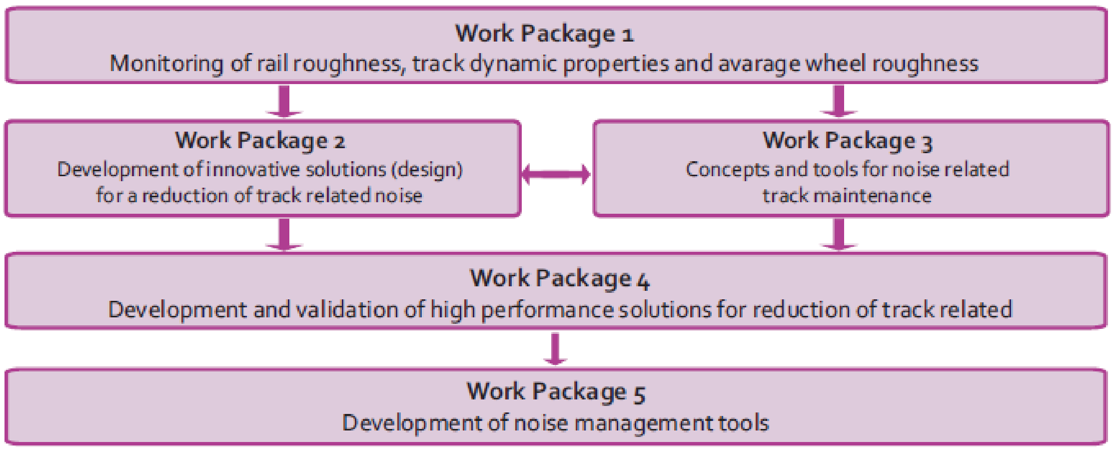
2 Summary description of project context and objectives

The aim of the project is to develop and validate novel tools and solutions for railway rolling noise mitigation, noise mapping and action planning and for condition based maintenance planning and track design.

Background to the project

- The European Noise Directive (END) requires noise maps in the cities, including the noise coming from all surface rail transport and action plans with solutions to reduce the noise hot spots.
- The rolling noise or wheel-rail noise is the most dominant railway noise source for vehicle speeds from 20 to 200 km/h. Below 20 km/h, the vehicle engine and ventilation noise is dominant, above 200 km/h the aerodynamic noise is dominant (high speed trains).
- For normally maintained surface rail transport vehicles (tram, regional trains, conventional trains), the track noise is dominant over the vehicle noise.
- For most freight trains wheel noise dominates, the rolling noise will not be reduced by track related measures (e.g. rail grinding has no effect on the rolling noise).
- Acoustic rail grinding is by far the most effective track based method to reduce rolling noise for non-freight surface rail transport, noise reduction of 10 dB(A) are feasible.
- Efficient noise mitigating solutions exist along railway lines but many of these solutions (e.g. noise barriers) cannot be applied in city (street) environment.
- Most existing noise mitigating track solutions used today (such as rail dampers) have only a small noise reduction performance (average 2 dB(A) reduction).

Concept



Project Structure

In terms of rolling noise modelling and simulation, a procedure has been developed based upon the use of multi body analysis to identify the wheel rail contact conditions in curves and in conditions with worn rails and wheels. A procedure for calculating the emitted rolling noise with multiple contact points between wheel and rail has been developed. This procedure has been validated by comparison simulation results with on-site measurement results at track sections in curve. Furthermore, a procedure has been developed based upon the use of finite elements and boundary elements to calculate the rolling noise in the low frequency domain between 40 Hz and 250 Hz. This procedure has been validated by comparison simulation results with on-site measurement results at a track section with floating slab track.

The rail roughness growth has been monitored in function of time and tonnage at locations in the networks of Infrabel (conventional rail and freight) and of De Lijn (urban transport) to tune a rail roughness growth model that has been developed for further use in condition based maintenance schemes (acoustic rail grinding) and for use in developing rail fixation systems that exhibit no corrugation growth.

The relationship between rail wear and noise emission has been studied in the laboratory and validated with an instrumented vehicle at a depot section with small track curve radius. This work was continued with on-site tests to identify track locations with high rail wear using on board noise monitoring at SSL (Stockholm). A descriptor for wear related noise has been developed and has been validated by measurements on site.

A noise related track maintenance tool has been created which allows the infra manager to oversee the evolution of rail roughness changes in the network and to calculate the noise exposure and hence to detect hot spot; this allows the optimization of the rail grinding maintenance actions.

The concept of combining existing solutions (track absorption panels, low noise barriers and rail dampers) has been validated on site at Athens with a gain of more than 10 B(A) noise reduction. Using the developed rail roughness growth model, innovative rail fixations systems have been selected, installed and monitored in the network of Infrabel (Belgium) with the aim of avoiding the appearance of corrugation. Two rail fixation systems are validated fit for that purpose. This is a major breakthrough in the area of corrugation prevention.

Low noise embedded track systems have been developed and validated within the network of De Lijn, combining stability, low maintenance and low noise.

Extensive monitoring of rail wear in the network of De Lijn (Belgium) and the development of a wear simulation tool have resulted in the optimization of the rail type and rail hardness for minimal wear and associated noise. The tool for carrying out reliable wear calculations is a major output of the project. At any moment, noise emission simulations can be carried out with the computed worn rail profiles using the simulation tools developed in the project.

Noise management tools have been developed for track maintenance activities and for noise mitigation solutions at the track level. The noise management tools calculate the monetary benefit of maintenance actions and noise mitigation solutions with cost factors coming from the HEATCO study and compare it with the global cost of the proposed actions and solutions in order to come to economically viable decisions by the infra managers in terms of noise management.