The present PhD Thesis addresses the analysis of the vibration generation phenomenon in the wheel-rail contact, transmission across the track elements and propagation through the adjacent ground. Additionally, particular attention has been paid to the treatment of different types of loads (quasi-static load and load due to imperfections), different track configurations (ballasted track and tram slab track) and mechanisms of attenuation of vibration propagation (wave barriers) as well.

The research has been developed implementing an analytical model and a numerical model. The first one is based on the Timoshenko theory for the rail modeling, and on the wave equation to model the transmission of vibrations through the track. The second model is based on finite element method and has been implemented in a commercial software.

Models performed with both methodologies have been calibrated and validated with real data obtained from experimental campaigns. This fact provides great robustness to the models and configures them as helpful tools for different types of additional simulations.