Optimizing the capacity of railroad yards within noise limits

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The problem

On railroad yards, passenger trains are parked overnight and prepared for the next day. They are also used to shunt freight wagons. Typical noise sources on these yards are stationary running diesel engines, compressors, ventilation, squeal noise from switches or curves, impact noise from joints etc.

Environmental noise originating from railroad yards is regulated in permits in the Netherlands. Each yard has its own permit with local noise limits. These limits differ for the three evaluation periods: day, evening and night. A permit is usually updated every 5 to 10 years.

ProRail is the rail infrastructure manager and responsible for complying with the legal environmental noise limits for the railroad yards. ProRail is also responsible for the yearly capacity allocation on these yards. So ProRail has to plan the activities of the different operators in way that the total noise stays below the limits laid down in the permits.

There are about 100 yards in total in the Netherlands. So there is a need for accurate and efficient procedures and tools to test whether all activities stay within the legal noise limits on each of these yards. This can not be done using 'traditional' full-scale noise models. These models are big, need an acoustician to operate and it is time-consuming to update the model for a new activity planning. So another solution was needed for ProRail to check the compliance to the permits

The solution: DNM

To make it possible manage the capacity within the noise limits, M+P developed a software program "Dynamic Noise Model" (DNM).

DNM combines four parts that were traditionally separated: an activity planning tool, a very efficient computational model of the acoustics of the railroad yard, the noise emission characteristics of all the activities that take place on the yard, and a database of noise reduction measures that can be taken on the yard.

The benefits

With DNM, many possible yard activity plannings can be evaluated with just a push of a button. This makes it easier to find the optimum activity planning which produces the least noise.

Acoustical knowledge is not required to work with DNM. Therefore, ProRail's capacity planners can evaluate the noise impact themselves.

Because planning alternatives can be evaluated quickly, ProRail can respond better to operators on the yard about the effect of their (always changing) activities and the impact on the permitted sound levels. ProRail and the operaters can work together to find the best planning for all activities. This makes it possible for ProRail to be compliant with the environmental laws and optimize the use of the yard during the capacity allocation process.

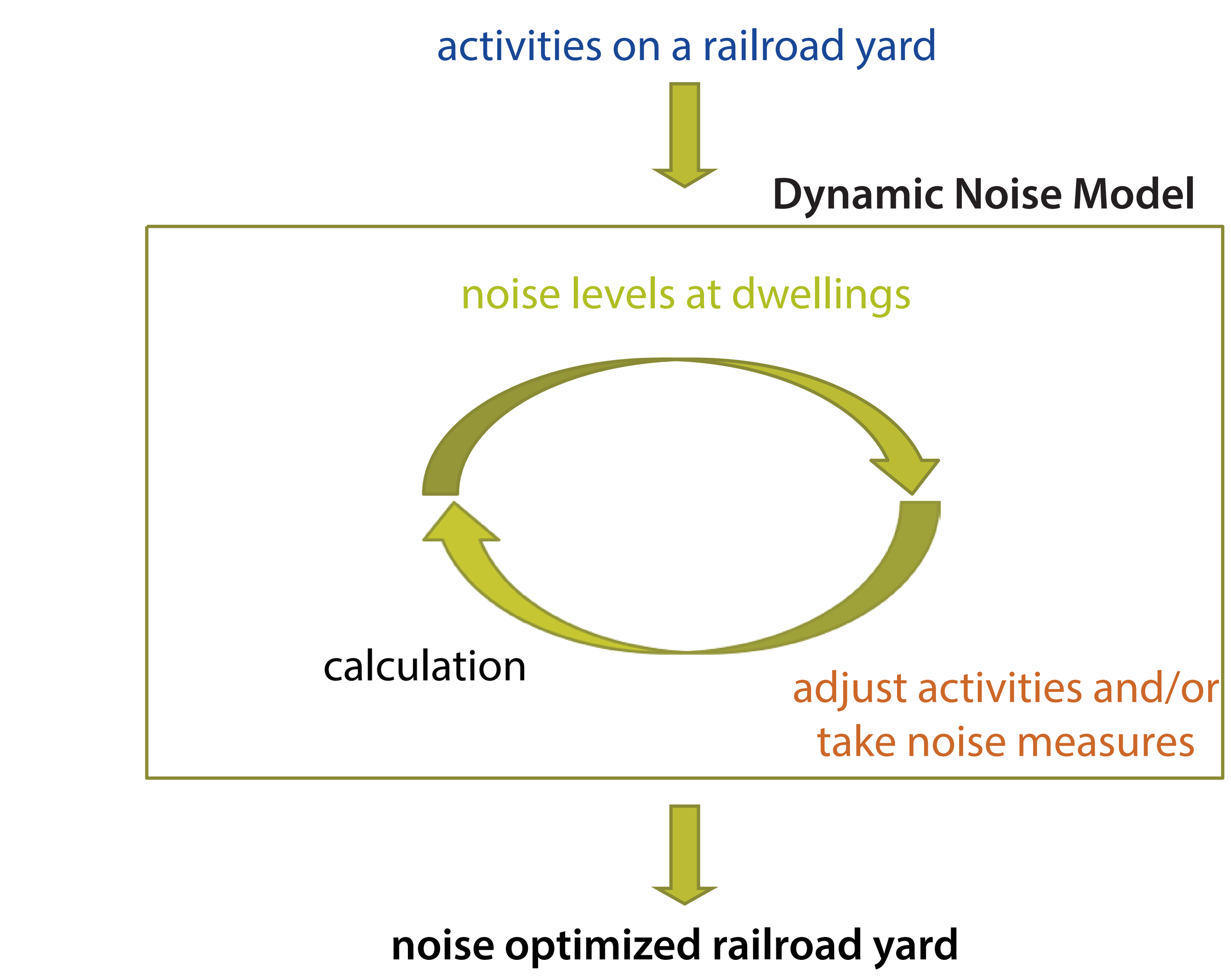
A DNM also can be used to make informed decisions between taking noise measures or applying changes in the activities on the yard, which are needed for a capacity enhancement plan.

How it works

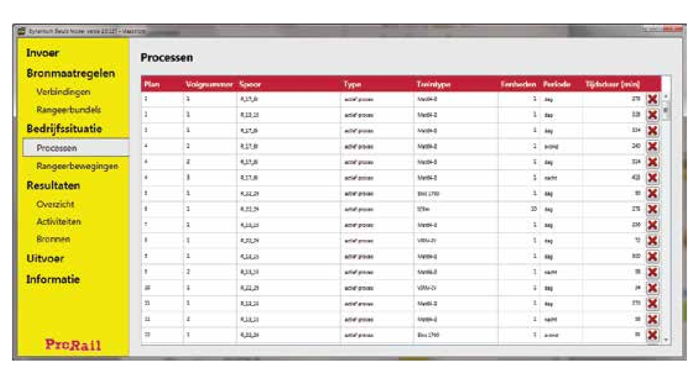
The DNM uses a database with two datasets. The first set are the attenuations between standardized activities and the receivers (i.e. the noise limit enforcement points at nearby dwellings). The attenuations are calculated in advance with a propagation model. The second dataset contains all sound power levels (SPL) per train type. This is combined with a list of all activities taking place on the railroad yard, resulting in the total SPL for all receiver positions.

ProRail is going to use the DNM for a large number of railroad yards for testing for compliance with environmental laws during the capacity allocation process.

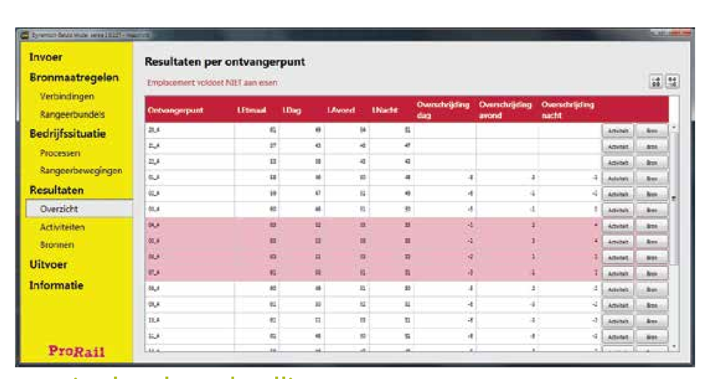
The workflow



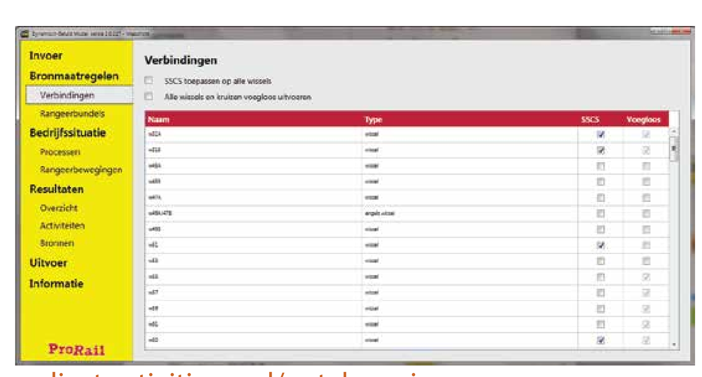
The software



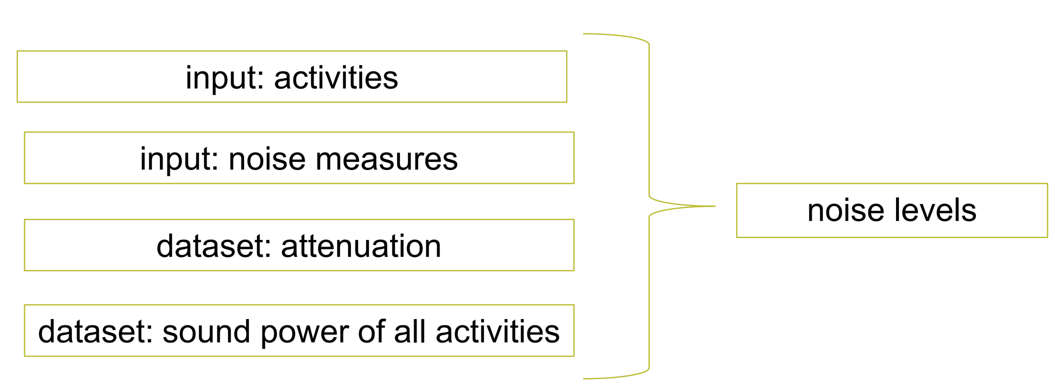
activities on railroad yard



noise levels at dwellings



adjust activities and/or take noise measures



Noise transfer models for calculating attenuation in advance