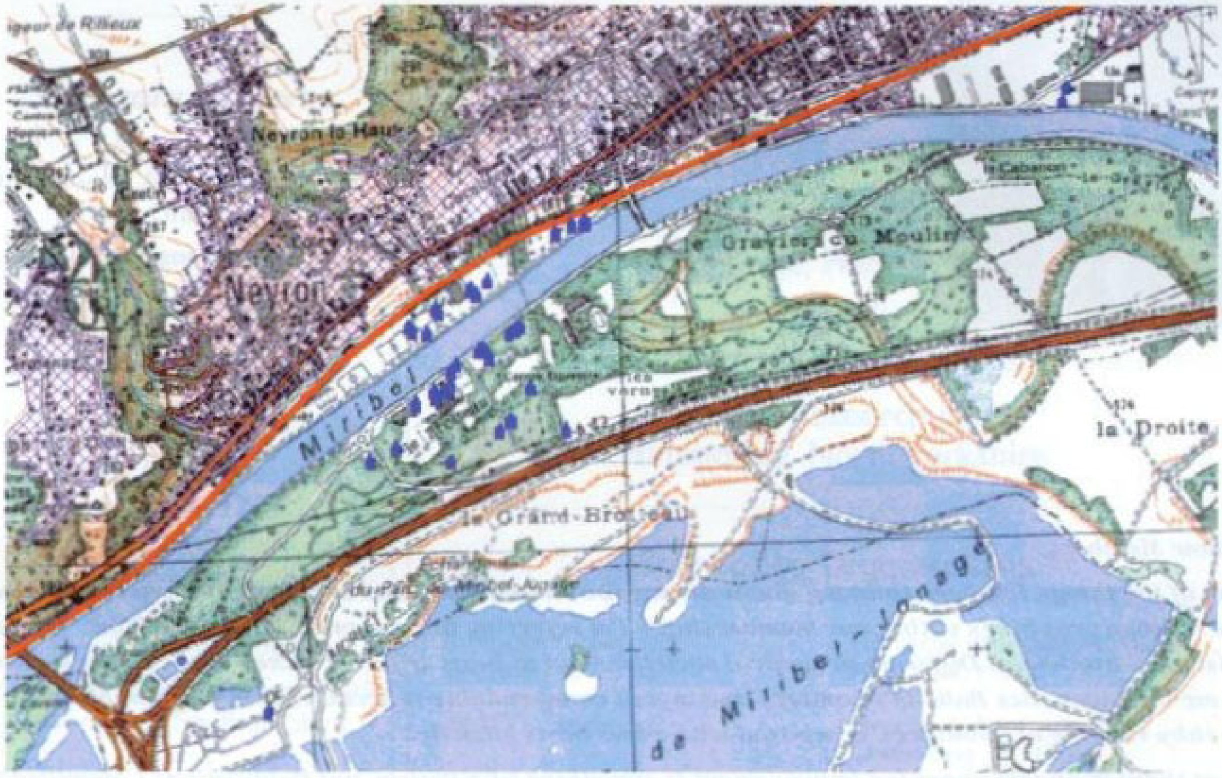

Fig. 2. Detail from the French Noise Model

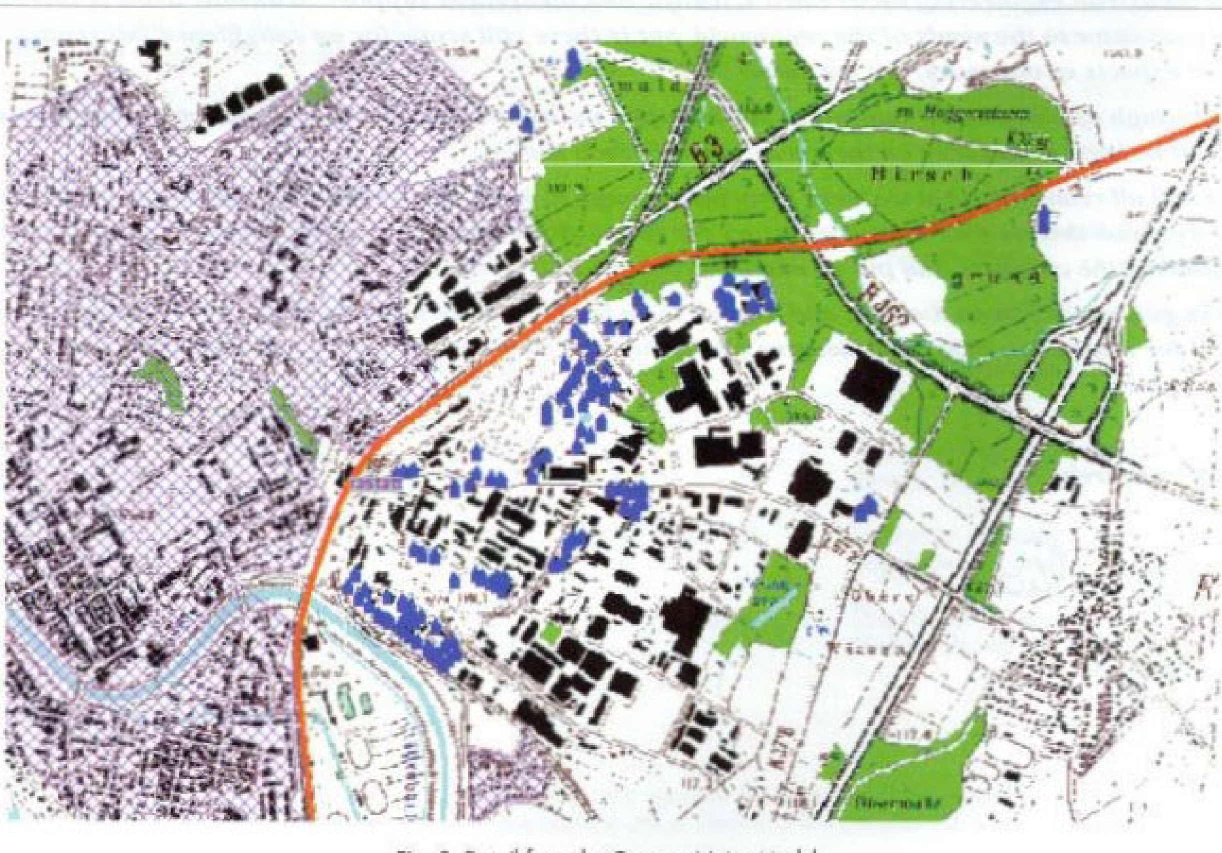

Fig. 3. Detail from the German Noise Model

EUROPEAN RAIL NOISE ABATEMENT: A COST-BENEFIT ANALYSIS

Frank Elbers

Introduction

Noise control is a major economic factor for the railways as national and EU-wide environmental legislation is being enacted.

It is therefore important for the railways to determine an optimal noise control strategy, allowing for the highest benefit in terms of noise reduction per lineside inhabitant for given cost levels. This article presents the main features of the work done for the UIC-sponsored Cost Benefit Project.

The project focused on two major European freight transit lines: Rotterdam – Basel – Milano and Bettembourg – Lyon with a total line length of 1667 km. A general overview is given in Figure 1.

Strategic Noise Policy Tool

The project started with data collection and the development of a common software tool Eurano99.

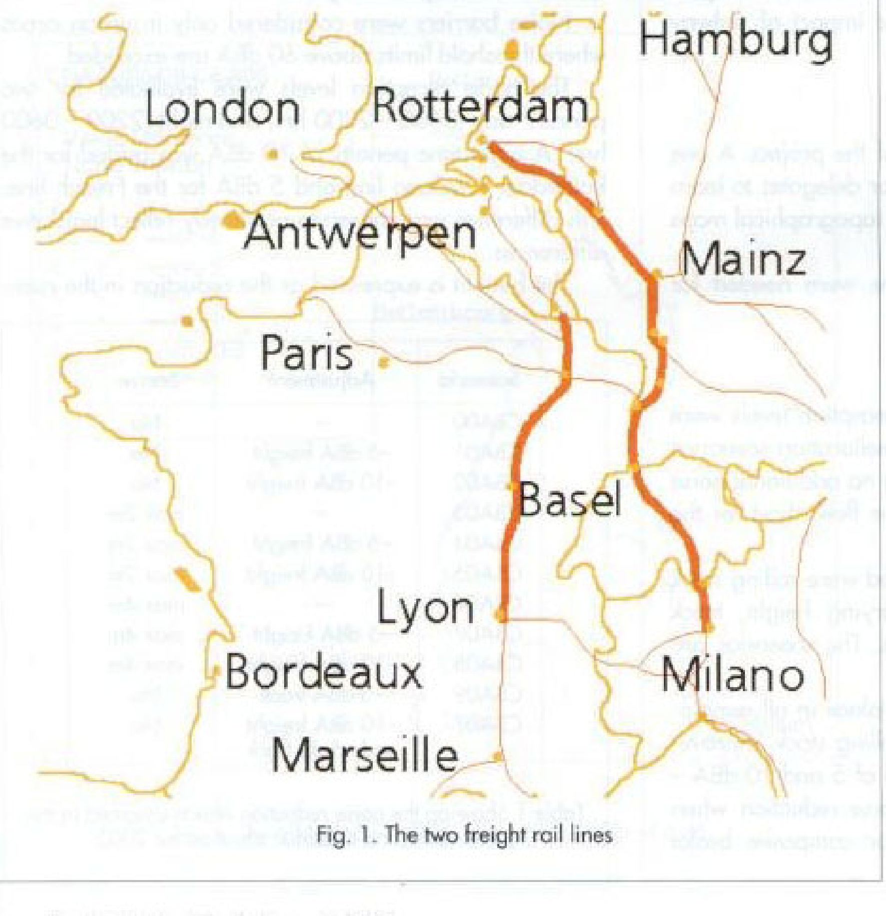

Fig. 1. The two freight rail lines

Eurano99 is based on the Dutch software concept Gerano. This special purpose GIS tool is easy to use and can handle large amounts of data. Main features are the capabilities to:

- Handle thousands of km of railway lines.
- Include up to 30 different train types.
- Include up to 30 different track constructions.
- Manipulate source strength.
- Calculate noise creation.
- Calculate noise reception.
- Calculate noise annoyance.
- Test different noise abatement possibilities.
- Calculate forced measures (barriers and/or track).

Therefore Eurano99 is an excellent tool for large scale studies of the environmental impact of railway noise.

Data Collection

The data collection was undertaken by the individual railways: SNCF was responsible for France, DB AG for Germany, NSTO for the Netherlands and SBB for Switzerland and Italy.

Figures 2 and 3 show a detail of the data on a part of the line. The urban areas are marked purple and the individual houses are marked blue. Geographic data collection was mainly based on 1:25,000 topographical maps.

For easy and rapid data input on-site of the local railways, Eurano99 Data Manager was developed. The main features of this are:

- a graphic user interface
- possibilities for data input and management on a national level
- integration of up to four coordinate systems

The national datasets are combined to one European dataset. This European dataset is stored on a central computer.

On this computer large scale cost benefit calculations were undertaken.

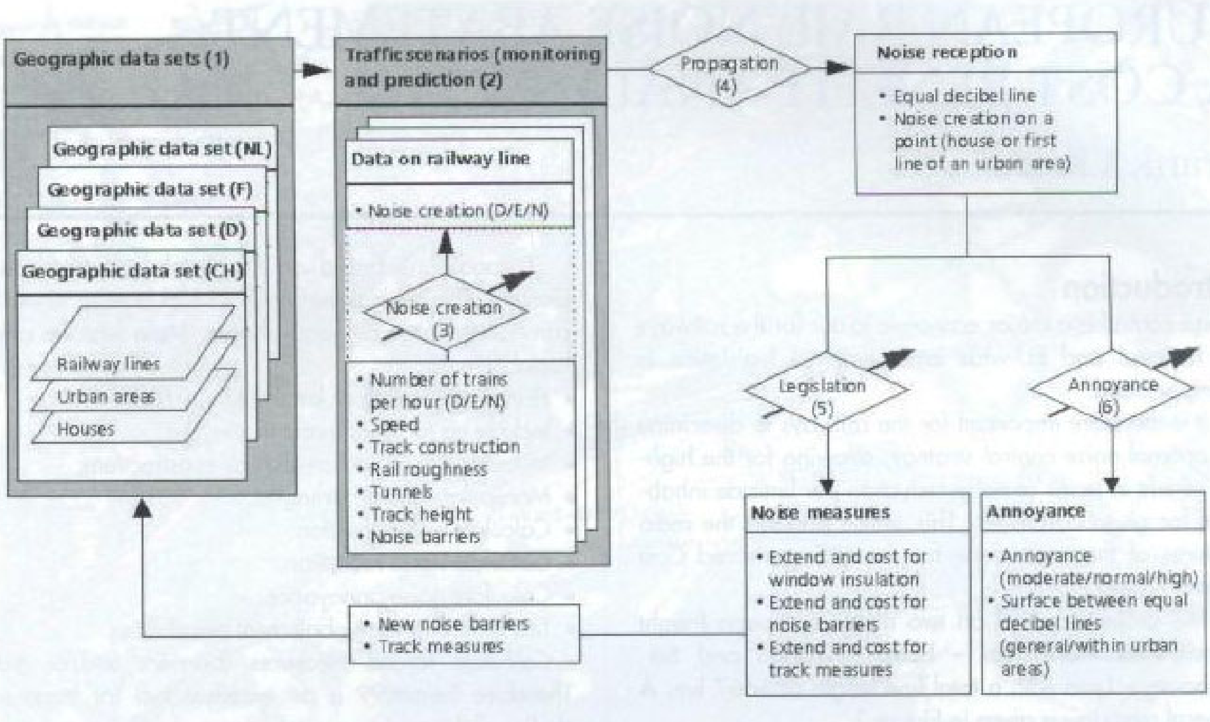

Fig. 4. Computation Flow Chart

A result of this project is an international network for construction and management of noise data for the purpose of research on the large scale impact of railway noise.

Education

An educational program was part of the project. A one day software course was sufficient for delegates to learn to handle the software and to collect topographical maps and traffic data.

No additional on-site instructions were needed for installation or software handling.

Calculation of Scenarios

On both lines, noise creation and reception levels were calculated for a total of 10 noise amelioration scenarios in addition to a default situation with no additional noise control measures. Figure 4 shows the flow chart for the computation process.

Noise control measures considered were rolling stock improvement, noise barriers of varying height, track improvement and insulated windows. The scenarios are given in Table 1.

Insulated windows were put into place in all remaining situations above 60 dBA. For rolling stock improvement the two scenarios – a reduction of 5 and 10 dBA – represent the range of expected noise reduction when cast iron brakes are exchanged for composite brake blocks and BA004 wheel sets.

A track improvement of 5 dBA corresponds to tuned absorbers and optimised pads.

Noise barriers were considered only in urban areas where threshold limits above 60 dBA are exceeded.

The noise reception levels were evaluated for two periods: day (0600 – 2200 hrs) and night (2200 – 0600 hrs). A night time penalty of 10 dBA was added for the Rotterdam – Milano line and 5 dBA for the French line. This difference was chosen to accurately reflect legislative differences.

The benefit is expressed as the reduction in the num-

Scenario	Adjustment	Barrier
CBA00	–	No
CBA01	–5 dBA freight	No
CBA02	–10 dBA freight	No
CBA03	–	max 2m
CBA04	–5 dBA freight	max 2m
CBA05	–10 dBA freight	max 2m
CBA06	–	max 4m
CBA07	–5 dBA freight	max 4m
CBA08	–10 dBA freight	max 4m
CBA09	–5 dBA track	No
CBA07	–10 dBA freight and –5 dB track	No

Table 1 Showing the noise reduction effects assumed in the calculations and a default situation for 2005

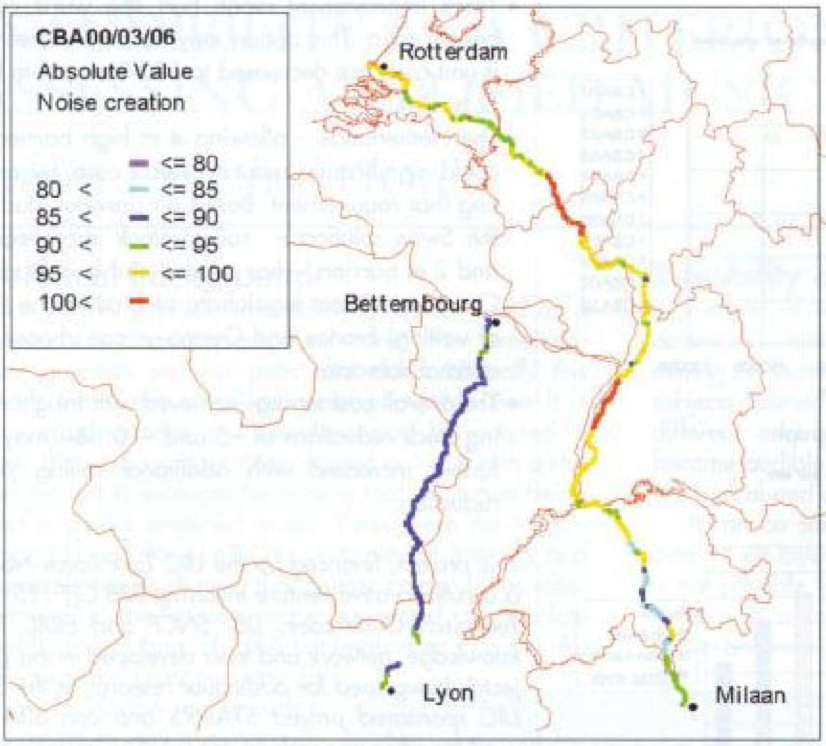

Fig. 5. Overall noise levels with no rolling stock improvement

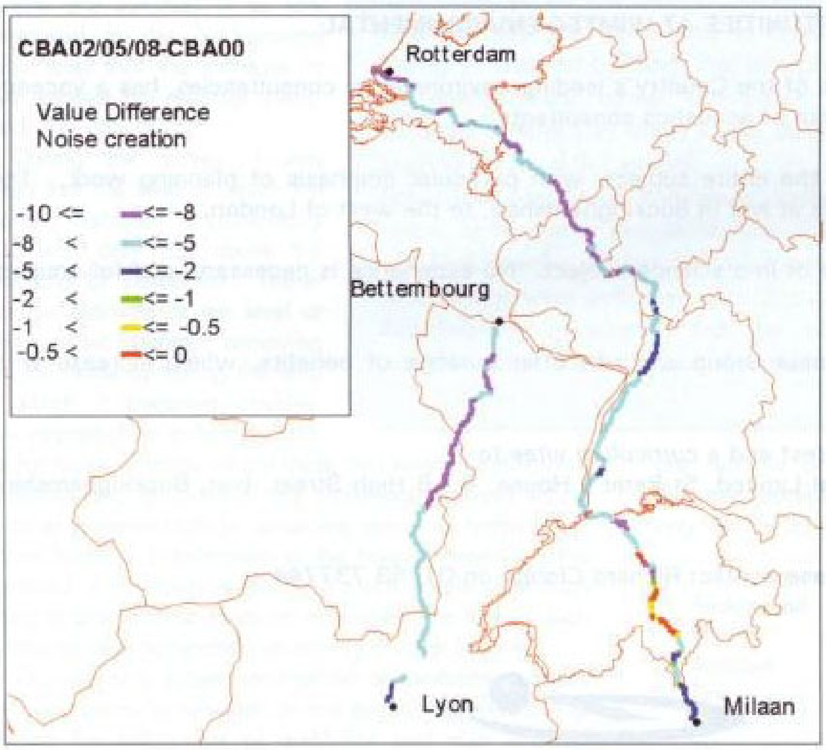

Fig. 6. The effects of a rolling stock improvement of 5 dB

ber of people above 60 dBA. This value is representative of the noise annoyance. The number of measures for each scenario is capitalised in yearly cost per km.

Results

Overall noise creation figures without any rolling stock improvement are given in Figure 5. High noise creation values can be seen throughout the project. Note that night-time penalty in France is only 5 and not 10 dB, therefore values are generally lower there.

The effect of a rolling stock reduction by −10 dBA is given in Figure 6. These values are achieved by subtracting noise creation values in CBA 02/05/08 by the default scenario (CBA 00). In most instances a rolling stock reduction by −10 dB reduces overall noise creation between −5 to −10 dB. Exceptions are areas where freight traffic does not contribute significantly to overall traffic.

The main cost/benefit graph and the capitalised cost per measure over a 40 year time period are shown in Figures 7 and 8.

Major Conclusions

- Without noise control about 250 persons/km will experience noise levels above 60 dBA in 2005.
- Depending on the scenario chosen, the costs for noise control vary between 20,000 and 100,000 Euro/km/y.
- Above this value there is no additional benefit in scenarios with higher costs. Conversely, it is impossible to protect all people at a reasonable cost; about 10 persons per km retain values above 60 dB in every situation.
- Rolling stock improvement is an interesting option, alone and in combination with other measures. In all cases, it reduces the costs of the measures it is combined with.
- Scenarios containing 4 m high noise barriers did not have an additional benefit when compared to 2 m high solutions.

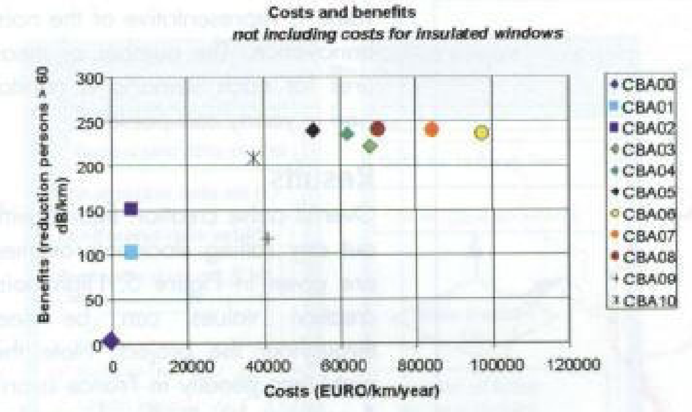

Fig. 7. Cost benefit graph

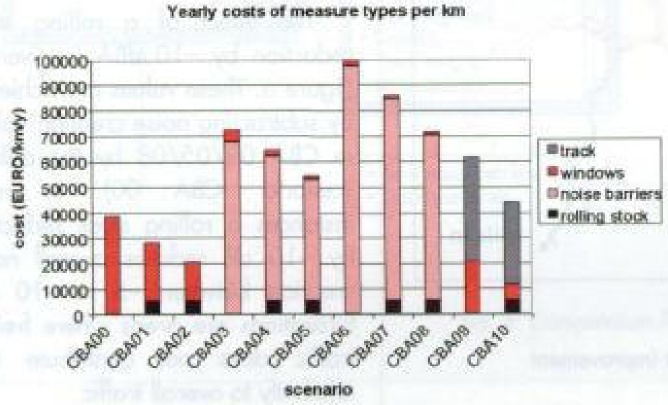

Fig. 8. Capitalised costs

- Track improvement alone had tthe worst cost/ benefit ratio. This option may become interesting if unit costs are decreased to 150 Euro per m line (2 tracks).
- The Netherlands – allowing 4 m high barriers – could significantly reduce overall costs by omitting that requirement. Based on previous studies, the Swiss solution – rolling stock improvement and 2 m barriers – has a good cost-benefit ratio. Countries without legislation, such as (at the time of writing) France and Germany, can choose an optimal scenario.
- The overall cost savings achieved with freight rolling stock reductions of –5 and –10 dBA may be further increased with additional rolling stock reduction.

This project, financed by the UIC Task Force Noise, is a collaborative venture involving SBB CFF FFS, NS Technisch Onderzoek, DB, SNCF and ERRI. The knowledge, network and tools developed in this project is being used for additional research in the EU/ UIC sponsored project STAIRRS and can also be used for other research on optimisation of noise control strategies. UIC is the European Railway Union.

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