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EUROPEAN RAIL NOISE ABATEMENT: COST-BENEFIT ANALYSIS

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ABSTRACT
In a UIC sponsored project, costs and benefits of different noise control strategies were calculated for the Rotterdam − Milano and for the Bettembourg − Lyon railway lines including a total length of 1667 km. Noise control measures considered were rolling stock improvement, noise barriers of varying height, track improvement and insulated windows. Benefits were defined as the reduction of the number of persons above 60 dBA. Major conclusions include: With an average of 250 persons per km above 60 dBA a large number of persons are affected by noise. The cost for noise control varies between EURO 20'000 to 100'000/km/year depending on the scenario chosen. A maximum benefit is achieved at about EURO 60'000/km/year. Rolling stock improvement proved to be the most interesting option both alone and in combination with other measures

1 - INTRODUCTION

Awareness of railway noise is increasing in most countries as the adverse affects on health and quality of life are being recognized. Several countries such as Italy, Switzerland and the Netherlands have enacted severe noise control legislation, both for existing and for new lines. Other countries are expected to follow suite and E.U.-wide legislation is being considered as well.
Those countries with existing noise control ordinances report tremendous costs to attain legislated thresholds. These costs threaten the economic viability of the railroads, all of which must operate on very restricted budgets and with intense competition from other modes of transportation. Although the overall environmental benefits of railway transportation are generally acknowledged, the railways are at risk of losing this advantage, if satisfactory noise control cannot be achieved. The railways must therefore react quickly in an effort to negotiate economically feasible legislation.
Railway and E.U. funds are currently sponsoring a number of research studies and demonstration projects including Eurosabot, Silent Track, Silent Freight and Low Noise Freight Train. These projects supplement or improve traditional noise control methods such as noise control barriers, rolling stock and infrastructure improvement.
Lacking, however, to date was a system to calculate the network-wide costs of implementing different possibilities and their benefits in terms of noise reduction for lineside inhabitants. This information is necessary to determine the optimal noise control strategy, so that the greatest benefit can be achieved for the money invested. This type of study is of paramount importance, since the expected investments are high.

2 - METHODOLOGY

Costs and benefits of different noise control strategies were calculated for a total of 1667 km of line length along two major European freight transit lines: Rotterdam − Basel − Milano and Bettembourg − Lyon. On both lines, noise creation and reception levels were calculated for a total of 10 noise abatement scenarios in addition to a default situation without any noise control. Noise control measures considered were rolling stock improvement, noise barriers of varying height, track improvement and insulated windows. All calculations were undertaken with the software program Eurano, an upgraded version of the Dutch software Gerano. The scenarios are given in Table 1.

Scenario	Measure	Barrier
CBA00	–	None
CBA01	- 5 dBA freight	None
CBA02	- 10 dBA freight	None
CBA03	–	Max. 2 m
CBA04	-5 dBA freight	Max. 2m
CBA05	-10 dBA freight	Max. 2 m
CBA06	–	Max 4 m
CBA07	-5 dBA freight	Max. 4 m
CBA08	-10 dBA freight	Max. 4 m
CBA09	- 5 dBA track	None
CBA10	- 10 dBA freight and − 5 dBA track	None

Table 1: Scenarios with 10 measures combinations in addition to default situation for the year 2005; 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 bakes are exchanged for composite brake blocks and BA004 wheel sets. For track improvement a − 5 dBA reduction represents tuned absorbers and optimized pads. Noise barriers were considered only in urban areas where threshold limits above 60 dBA are exceeded. The noise reception levels were calculated for two periods: day (06 − 22 h) and night (22 − 06 h). A night time penalty of 10 dBA was added for the line Rotterdam − Milano and 5 dBA for the French line. This difference was chosen to accurately simulate legislative differences. Benefits were expressed in the reduction of the number of persons above 60 dBA.

3 - RESULTS AND CONCLUSIONS

A summary of the results is given in Figure 1.
Other results and the major conclusions derived thereof are:
Large number of persons affected: Without noise control about 250 persons/km will have values above 60 dBA either during the night or during the day in 2005.
High cost for noise control: Depending on the scenario chosen, the costs for noise control vary between EURO 20'000 and 100'000/km/year. If these costs are capitalized for a duration of 40 years, the costs vary between EURO 0.4 and 4 million per km.
Maximum benefit achieved at about EURO 60'000/km/year: Above this value there is no additional benefit in scenarios with higher costs. Conversely, it is not possible to protect all people if costs are not increased dramatically; about 10 persons per km retain values above 60 dBA in every situation.
Solutions containing rolling stock improvement prove to be optimal: 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.
No additional benefit from 4 m barriers: Scenarios containing 4 m noise barriers did not have an additional benefit when compared to 2 m solutions.
Track improvement only interesting in combination with rolling stock improvement: Track improvement alone had the worst cost-benefit ratio. This option may become interesting, if unit costs are decreased to about EURO 150/m for two tracks.
Significance of results depend on national legislation: 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 currently not requiring noise control on existing lines, such as (at the time of this writing) France and Germany can choose an optimal scenario.
Additional cost reduction may be achieved by a further improvement in rolling stock: The overall cost savings achieved with freight rolling stock reductions of −5 and −10 dB may be further increased with additional rolling stock noise reduction.
In a EU and UIC supported expansion of the project called STAIRRS (Strategies and Tools to Assess and Implement Noise Reducing Measures for Railway Systems) further lines will be studied totalling about 12'000 km to provide a comprehensive decision support system for all of Europe.

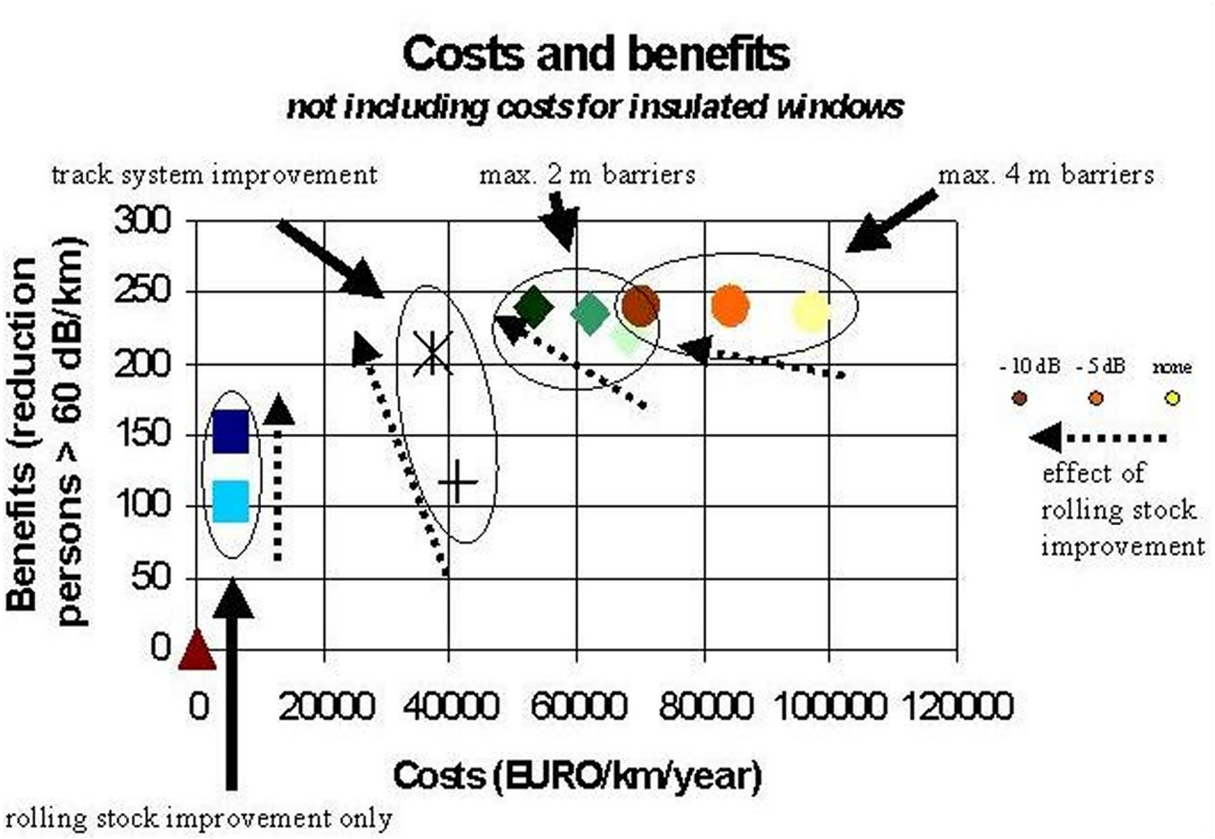

Figure 1: Main cost benefit results: diagram showing the yearly costs and the reduction of the number of persons above 60 dBA.

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