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How the money machine may help to reduce railway noise in Europe

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Abstract

The need to reduce railway noise, particularly from freight transport in international traffic, is recognized by all stakeholders in the field. Solutions are currently available to provide a significant reduction, and research is underway to investigate further options. Several recent studies clearly show that noise abatement at the source (i.e., vehicles *and* track) are to be preferred over solutions that affect noise propagation (e.g., barriers) or noise reception (façade insulation) when it comes to overall life cycle cost. In spite of these three important conclusions, the necessary noise reduction at source is not yet taking place, with some small-scale exceptions. The parties involved agree that financial and economical constraints prevent the process of noise reduction from starting. The present paper presents the results of the second consensus building workshop in the STAIRRS project. It explores the possible financial and economic instruments that may help to launch the necessary developments.

1. Introduction

Freight trains with cast iron tread brakes basically show the same technology and noise performance as 50–100 years ago. Containerization has been the single important development in vehicle design. Rail freight transport in Europe consumes most of the environmental capacity of existing lines. The reason for that is two-fold: the noise creation of freight vehicles is up to 10 dB(A) higher than that of passenger trains, and also freight trains often run during night time, when noise reception limits are up to 10 dB(A) more stringent (the expressions ''noise creation'' and ''noise reception'' are used here to distinguish between the sound power output of the source and the free-field sound intensity arriving at the receiver position).

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Both the European Commission's transport policy and the joint European railways' ambitions envisage a dramatic increase of rail transport in the coming decades. This development leads to a scarcity of infrastructure capacity, which is not likely to be solved in the short term, due to high cost and lengthy planning and construction procedures for any new infrastructure. The solution of this problem is to reduce the noise from freight traffic in order to create the environmental capacity for future growth. Once this need for noise reduction is recognized, the remaining questions are [3]:

- What is the required reduction and how should it be achieved (at the source, in the propagation path or at the receiver)?
- Who (which party) is responsible for taking the first step and how does that interfere with other interest groups?
- What should this first step be?

2. Consensus building in the STAIRRS project

The STAIRRS project began in January 2000 as an EU Fifth Framework project under the Growth programme, with the objective to develop Strategies and Tools to Assess and Implement noise Reducing measures for Railway Systems (STAIRRS). One of its three work packages consists of a contribution to 'consensus building', which is carried out, among other topics, through the organization of special workshops. In these workshops, representatives from four different stakeholder groups have been invited, including

- railway operators,
- rail infrastructure managers and capacity regulators,
- governmental bodies,
- railway product suppliers and manufacturers.

In the second consensus building workshop, held in March 2001 in Paris, the discussion was focused around one particular question, i.e., What needs to be done to generate quieter railways? Approximately 70 participants agreed that it could not be expected that noise reduction would begin as an autonomous process, the reason being that the parties who influence this process (i.e., operators and possibly suppliers) do not yet have any incentive to do so. The four interest groups therefore agreed that legislative bodies should take the first step and introduce strict but realistic and common European legislation for new vehicles and track. For existing freight rolling stock the feeling was that operators themselves should take the first step, possibly under the regime of voluntary agreements. It was also agreed that funding would be required in the first stage to compensate for the additional cost necessitated by both legislation and voluntary agreement. A straightforward subvention of the railway operation is impossible due to equal treatment of rail and road transport. The funding will thus need to be integrated into new or existing legislative regulations.

The above suggestions have already been taken further in different initiatives:

- for new rolling stock (and track) Interoperability Directives have been set up by the AEIF (European Association for Railway Interoperability), which will propose noise

creation limit values and compliance testing methods for vehicles (and track) in international traffic;

- a voluntary agreement has been proposed by UIC/CER/UIP to replace cast-iron brake blocks of freight vehicles by composite blocks, a lengthy process for all freight vehicles on the European network, which could however be speeded up if additional funding were provided.

A clear consensus view on the financial and economical consequences of the above initiatives is still due. This is particularly important since the initiatives would address a low profit enterprise such as rail freight transport, not only in relatively rich member states with a well-established national noise legislation, but also in "poor" member states with no background in noise control at all.

3. Balanced cost for noise control

In several recent studies it has been shown that the overall life cycle costs of noise control at source are lower than the cost of noise control by barriers and façade insulation only [1,2]. Nevertheless, the latter, more costly, combination is common practice in most European countries. The reason is that different parties are responsible for the different mitigation measures and corresponding cost categories. Usually the infrastructure manager is responsible for barriers and façade insulation. There is currently no advantage whatsoever for the operator to pay for the increased cost of low noise rolling stock, and the operator is therefore reluctant to take the initiative, even more so when it would create more infrastructure capacity for his competitors on the network. As a consequence the suppliers would not be compensated for their efforts to develop quieter trains and tracks, which would prevent them from offering innovative solutions.

On the basis of available studies it can be assumed, that on a national scale and certainly on a European scale, the total net cost of noise control could be much lower if noise abatement at the source were to be given a higher priority. One of the work packages in the STAIRRS project was intended to provide a full European scale extrapolation of cost and benefits for different scenarios of noise control, and the validity of this assumption has been confirmed.

4. Large-scale financial space

On the basis of conservative but qualified estimates the order of magnitude of the funding budgets has been established. These estimates have been based on the assumption that 60 dB(A) L_{den} would be the target value anywhere in Europe.

4.1. Barrier cost

As a working hypothesis, it is assumed that noise control is established everywhere by means of noise barriers with a maximum height of 2 m above rail head. With a total length of 280,000 km of European network and an annual cost of 70,000€ per km for noise barriers, the total annual cost for Europe amounts to 20×10^9€. This amount is indicated as the 'equivalent barrier cost'.

These 'equivalent barrier costs' are compared to the total cost for track maintenance and renewal, extrapolated from the Dutch situation (NS Annual Report 1998). These costs amount to 70×10^9€, so the 'equivalent barrier costs' are equal to approximately 30% of the total annual cost for rail infrastructure.

4.2. Option 1: Freight vehicle renewal

Clearly the most innovative and attractive option is to replace all tread braked freight rolling stock by modern, disc-braked vehicles. Assuming an investment cost of 500,000€ for a new vehicle and a 50-year life span, this amounts to an annual cost of 36,000€ (including 5% interest and maintenance cost). The 'equivalent barrier cost' would allow for the replacement of 56,000 wagons per year, so that the total European fleet of 500,000–1,000,000 wagons would be replaced after 9–18 years. The potential limited capacity of the supply and maintenance industry is ignored in this example. The full investment of replacing a wagon is considered as an environmental cost and neither the cost nor income from scrapping the existing fleet has been taken into account.

4.3. Option 2: Brake block replacement

The UIC/CER/UIP initiative includes replacement of cast-iron brake blocks by composite K-blocks. Additionally, new low-residual-stress wheels will have to be installed in some cases. The initial cost per wagon may amount to between 6000 and 10,000€. On this basis, the 'equivalent barrier costs' mentioned above would allow for at least 200,000 wagons to be treated annually, so that the total European fleet would be treated after 2.5–5 years, again ignoring the limited capacity of the supply and maintenance industry. Changes in maintenance cost resulting from the replacement of the brake blocks have also been ignored.

4.4. Savings for society

When it is further assumed that no additional noise abatement is required, the savings for society, on the basis of a 40-year time window, would amount to at least 440×10^9€ for option 1 and up to at least 700×10^9€ for option 2.

Even when the above figures are only estimates, the example clearly indicates the enormous gain that can be achieved if the present strategy of 'barriers only' is avoided. It should be emphasized here that the noise abatement at source, particularly when large reductions are required, would involve some track related measures, e.g., rail dampers, acoustic grinding, etc. Some of the funding therefore would not need to be re-directed from infrastructure managers to the operators, but should merely be re-directed within the infrastructure management organizations.

5. How to transfer budgets

In the examples of options 1 and 2, the financial gain for society can only be achieved if railway operators can be persuaded to spend their share of the costs of the replacement of vehicles or

replacement of brake blocks and wheels. Different models are conceivable that may achieve the required shift of costs from infrastructure management to railway operators, and from operators to suppliers.

5.1. Association subvention

In most member states the rail infrastructure is still owned by the state and governmental organizations are responsible for its maintenance. In those cases the state could reduce its contribution to the infrastructure cost and direct the funding to the operators. This method has some drawbacks:

- it would not work in countries where the infrastructure is owned and maintained by private enterprises (e.g., the UK);
- it would not work in countries where budgets for infrastructure maintenance are low; for example, because noise barriers have never/not yet been considered;
- it would not work in countries which have insufficient means to make available the necessary funding; after all, in order to be effective the measure would need to cover every vehicle in international traffic on the European network.

These disadvantages could be overcome if the European Commission were to grant the subvention directly to the operators, e.g., through UIC/UIP as associations, without interference of the infrastructure management organizations. The subvention could take the form of stimulating investment for environmental improvement, or by buying up existing rolling stock using old technology so that it could be scrapped. However, other disadvantages would remain or even become more evident:

- it could be considered as unacceptable state aid by the automotive world;
- it is not clear how the savings in barrier cost could match the cost for noise abatement, because there is no flow of money from infrastructure to the state.

5.2. Association loan

It has been suggested that turning the funding into a loan, possibly provided by the EC to the operators, with UIC/UIP acting as an intermediary, could overrule the latter objections. This assumes that the operators would be able to increase their profit rate after the measures have been carried out, in order to be able to pay back the loan. In fact, as shown above, the main financial profit from the measures would benefit the infrastructure management. In the two options presented above, it is conceivable that the large-scale introduction of modern, disc-braked freight rolling stock contributes to the profitability of the branche sufficiently, to enable operators to pay back the loan in due time. For the K-block option a significant effect on profitability is not to be expected.

5.3. Track access charges

In many countries, where railway infrastructure management and railway operation have been separated into different organizations, some form of track access charging mechanism has been

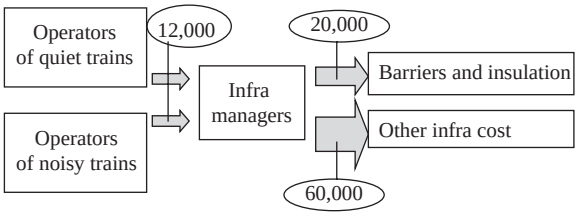

Fig. 1. Annual cost flow for the current situation (European scale; numbers are million euros).

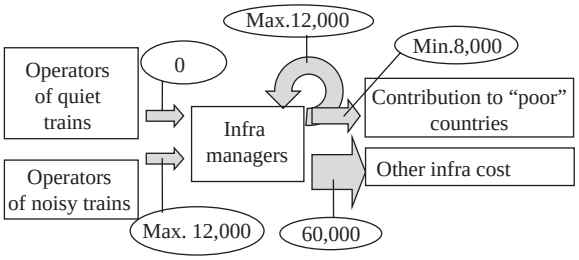

Fig. 2. Annual cost flow for predicted (fictitious) future situation (European scale; numbers are million euros).

established or will be established in due course [4]. Eventually, the public contribution to rail infrastructure may be suppressed completely, assuming that the full infrastructure cost will be charged to the operators. In the Netherlands in 1998, the infrastructure cost represented approximately 53% of the total turnover of rail passenger and freight passenger transport together. However, the track access charges to be paid by NS Passenger Transport in 2000 amounted to slightly over 11 million euros, covering only 1.6% of the total infrastructure cost in 1998, and will gradually increase to a level of 16% in 2005.

Since this amount is so small, the 'equivalent barrier cost' may have significant impact if they were re-directed to the operators. As indicated above, the total annual rail infrastructure cost in Europe is estimated at 70×10^9€. Around 30% of that amount is barrier cost and only 16% of the total cost is covered by the income from track access charges. This means that it should be feasible to remit completely the track access charges to operators running quiet trains, without having to increase the charge for others. Even in that situation, the infrastructure business would gain sufficiently so as to be able to shift funding from ''rich'' countries with established noise legislation to ''poor'' countries. A comparison on the basis of track lengths shows that approximately 50% of the European track is in ''rich'' countries with established noise legislation (Austria, France, Germany, Italy, The Netherlands, Scandinavia, Switzerland). This fits well with the 16–30% ratio of annual cost flow that was shown above. The resulting flows in million Euro (current and predicted situations) are presented in Figs. 1 and 2.

6. Conclusions

Obviously there are other solutions that could achieve railway noise abatement at the source other than the financial mechanisms introduced in the previous section. Strict legislation with

clear noise creation limits for new rolling stock will help the supplier to start adopting the technologies that have been developed in numerous demonstration projects. The Action Plan of UIC/UIP/CER will lead to the replacement of cast-iron brake blocks on existing freight vehicles. However, the question about who will pay for these developments is still unsolved. Clearly the profitability of the recently privatized operating companies should not be endangered. In order to be effective, the measures should cover most of the networks operating internationally in continental European. When noise control at source is effective an enormous amount of money can be saved, as it is no longer required for noise barriers. When this cash flow is properly controlled, it will not only protect the railway operators from high cost burdens for noise control, but will also help them to modernize their fleet. Moreover it can stimulate the noise abatement to take place in the whole of Europe, even in countries which currently have no noise legislation in place. Further study and more detailed economic calculations are required to provide more insight into the costs and benefits, as well as the impetus that can be expected from funding injections into the railway operating companies.

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