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COST–BENEFIT ANALYSIS IN RAILWAY NOISE CONTROL

J. OERTLI

Swiss Federal Railways, Mittelstrasse 43, *CH*-3030 *Bern, Switzerland*

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A method to calculate the network-wide costs of realizing different noise control possibilities and their benefits in terms of noise reduction for lineside inhabitants has been implemented in Switzerland. These studies have shown that an optimal cost distribution consists of spending 65% of the available finances on rolling stock improvement, 30% on noise control barriers and 5% on insulated windows. This mix protects 70% of the lineside population for 30% of the cost necessary to attain threshold levels for all inhabitants. This noise control strategy has been accepted by the federal traffic and environment agencies involved and will save billions of Swiss francs. The success of the calculation methodology has prompted development of a Europe-wide decision support system to the same effect. Along two freight freeways the relationship between rolling stock improvement, noise barriers, insulated windows, operational measures and track characteristics is being studied. The decision support system will allow determination of those combinations with the best cost–benefit ratios. The study is currently being undertaken as a joint venture by the railways of Switzerland, France, Germany and the Netherlands as well as the European Rail Research Institute. The results constitute part of the negotiating strategy of the railways with European and national legislators.

1. INTRODUCTION

Awareness of rail noise is increasing in most countries as the adverse effects on health and quality of life are being recognized. Several countries such as Italy, Switzerland and the Netherlands have enacted severe noise control legislation. Other countries are expected to follow suit and EU-wide legislation is being considered as well.

Those countries with existing noise control ordinances report tremendous costs to attain the regulatory threshold levels. Costs for railway noise control are threatening the economic viability of the railways, all of which must operate on very restricted budgets. The railways must therefore react quickly in an effort to negotiate feasible legislation. A method to calculate the network-wide costs of implementing different noise control possibilities is therefore of great importance.

This article reports on the results of an extensive cost–benefit study undertaken by the Swiss Federal Railways and on similar work being initiated on a European level.

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2. DEFINITION OF COST–BENEFIT RELATIONSHIP

First, three parameters must be defined:

Benefit of a noise control measure:

$$\text{benefit} = \text{attained noise reduction} \times \text{number of profiting persons}$$

In Switzerland the noise reduction is weighted, i.e., reductions at higher levels count more than at lower ones.

Cost–benefit relationship:

$$\text{Cost–benefit} = \frac{\text{yearly costs of noise measure}}{\text{benefit of measure}}$$

Yearly, rather than absolute costs, take differing amortization times into account. This relationship can be described with a number: the cost–benefit index. The lower the value, the better the cost–benefit ratio.

Goal-attainment level:
The goal-attainment level takes legislated threshold levels into account:

$$\text{goal-attainment level} = \frac{\text{number of persons with noise reception levels above threshold } \textbf{with} \text{ measure}}{\text{number of persons with noise reception levels above threshold } \textbf{without} \text{ measure}}$$

3. THE SWISS STUDY

3.1. NOISE CONTROL LEGISLATION IN SWITZERLAND

Swiss noise legislation, enacted in 1987, calls for noise control measures on existing railway lines by the year 2002, although a postponement until 2015, and on new lines as they are built. Different threshold levels are defined for existing and new lines. In addition, these levels vary with the noise sensitivity of the neighbouring areas and the time of day; i.e., threshold levels are higher for existing lines, in areas with low sensitivity, and during the daytime. The legislation allows the consideration of economic criteria when evaluating noise control measures; however, the federal agencies require a goal-attainment level of at least 66%.

3.2. RESEARCH CONCEPT

The aim of the research was to quantify the economic considerations allowed by the Swiss noise legislation and to determine the most economic combinations of measures. Rolling stock improvement, noise barriers and insulated windows were considered to be the most interesting noise possibilities to be examined. Using a computer simulation of a large part of the network, the overall costs and benefits of many different measure combinations were calculated.