A SUSTAINABLE SAFETY PERFORMANCE FOR RAILWAYS

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1. The European Railway Agency (ERA)

ERA is an Agency of the European Union (EU) which was established in 2005 to facilitate the harmonisation of safety management and the development of interoperability across Member States. ERA delivers recommendations to the European Commission, which result in EU legislation.

The reference text for ERA in the domain of safety is Directive 2004/49/EC (Ref. /1/), which has been put in place to support the creation of an integrated European railway area and facilitate the market opening. Directive 2004/49/EC will also contribute to improve safety by a cultural shift from a deterministic to a risk based approach, the introduction of common and transparent methods to monitor safety performance and set targets, the establishment of safety management systems, the introduction of a system for independent accident investigation, as well as by moving from self-regulation to regulation by independent authorities (National Safety Authorities).

2. How ERA sees railway safety

Railway safety is one aspect of the transport service quality delivered to passengers, employees and third parties; the latter at level crossings and because of railway lines' integration in urban contexts.

Customers of the railway system consider safety as one of the elements (together with price, travel time, punctuality, comfort, etc.) to be taken into account when choosing a transport mode for their travels.

3. "Current safety performance" and "sustainable safety performance"

ERA is developing a set of Common Safety Indicators (CSIs) and common methods to:

- measure the "current safety performance" of the Member States of the European Union,
- calculate the "economic impact of accidents".

There is a safety performance that society is willing to pay for and which we can call "economically sustainable safety performance"; this represents a sort of economic optimum for society. The CSIs to calculate the "economic impact of accidents" facilitate Member States in estimating their "sustainable safety performance".

Member States who are not aware of their "sustainable safety performance" will most probably:

- either provide "more" safety than is economically sustainable or
- provide "less" safety than is economically sustainable

In the first scenario, railways are providing more safety than passengers are willing to pay for. This "excess of safety" is likely to have an impact on train tickets' prices (if not on taxes) and passengers might move to a cheaper, less safe but more sustainable transport mode, if the choice is available.

If the railway system is tax-financed the behavioural response might be weaker, nevertheless customers will have less money to spend, they may travel less and pay more attention to tickets' prices.

In the second scenario, passengers perceive that safety performance of the railways is lower than they are willing to pay for; as a result of this consideration, they might move to a safer and sustainable transport mode, if the choice is available.

4. Measuring the "current safety performance"

ERA has developed a recommendation (Ref. /2/) including methods to calculate the "current safety performance" (called national reference values) of Member States. This recommendation is addressed to the European Commission and was delivered in April 2008; the main purpose of the document is to provide a harmonised method to set common safety targets (CSTs) for the European Union.

The "current safety performance" is expressed in individual risks (relating to passengers, staff, level crossing users, unauthorised persons on railway premises, others) and societal risk (expressed in terms of collective risk).

The aforementioned recommendation sets one or two indicators for each category of individuals, which are expressed in Fatalities and Weighted Serious Injures (FWSI[1]) divided by a scaling factor.

$$\text{Current Safety Performance} = \text{FWSI} / (\text{Scaling Factor})$$

The "current safety performance" is calculated applying weighting average processes and taking into account data related to the last six years.

The scaling factors used are Train – Km, Passenger – Km (the latter for the category "passengers"), number of level crossings and Track – Km (for "level crossing users", together with Train - Km).

Other sets of indicators, CSIs, are collected and are to be used to understand better the "current safety performance"; these are related to precursors to accidents (hazards) and technical safety of infrastructure and its implementation (automatic train protection systems in place and level crossings classified by type.)

[1] FWSI = 1 Fatality + Serious injuries/10; NB: common definitions have been developed for both.

5. Estimating a "sustainable safety performance"

ERA is developing a recommendation to provide common definitions of all CSIs and methods to calculate the economic impact of accidents; this recommendation is due to be delivered in September 2008, it will be addressed to the European Commission and will result in a Directive of the European Commission in 2009.

The economic impact of accidents

This recommendation will set out a common methodology to calculate the "economic impact of accidents" for society using four indicators expressed in €:

- number of deaths and serious injuries multiplied by the Value of Preventing a Casualty (VPC),
- cost of delays as a consequence of accidents,
- cost of material damages to rolling stock or infrastructure,
- cost of damages to environment.

It has been assessed through questionnaires based on case studies and available statistics that these four indicators, which will be collected annually, cover all relevant aspects; the questionnaires were filled in by the National Safety Authorities of Member States. Nevertheless, it may be relevant to analyse other aspects at country level when specific safety measures are selected.

Methods to calculate the economic impact of accidents

The VPC is a common concept in economic analysis and it is the aggregate willingness to pay for typically very small reductions in individual risk of death and serious injury. This reflects people's normal approach to risks which they face in everyday life, where they trade off cost or convenience against real, but very small, risks (Ref. /3/).

The cost of delays is calculated through a formula which mainly requires as inputs the time of delay and the value of time. The value of time is to be calculated using the methodologies "Cost saving" and "Willingness to pay".

Cost of material damages to rolling stock or infrastructure and cost of damages to environment are to be calculated on the basis of real costs borne by railways.

For both VPC and value of time, the current research provides fall back values (Ref. /4/) which will be part of "guidance for CSIs" that ERA will develop by the end of 2008, together with explanations to apply the proposed methodologies.

A sustainable safety performance

The "economic impact of accidents" can be reduced by implementing safety measures for the prevention of such events. The costs of safety measures can be estimated relying on the information currently available at European and national level, completed by information to be collected through questionnaires and case studies.

A "sustainable safety performance" is achieved when the reduction of the "economic impact of accidents" equals the costs of the measures to implement to obtain this reduction.

Any further improvement of safety performance would result in costs for society higher than benefits.

The possible scenarios are depicted in chart 1, country A's performance is sustainable for society; if country B improves its safety performance, society will bear costs smaller than the benefits. For country C, an improvement of safety performance would result in costs greater than the benefits.

Country B's safety improvements are sustainable, the more B improves the less B's society will be willing to pay for safety measures; if there is a continuous improvement, at a certain moment in time costs for further improvements will exceed benefits.

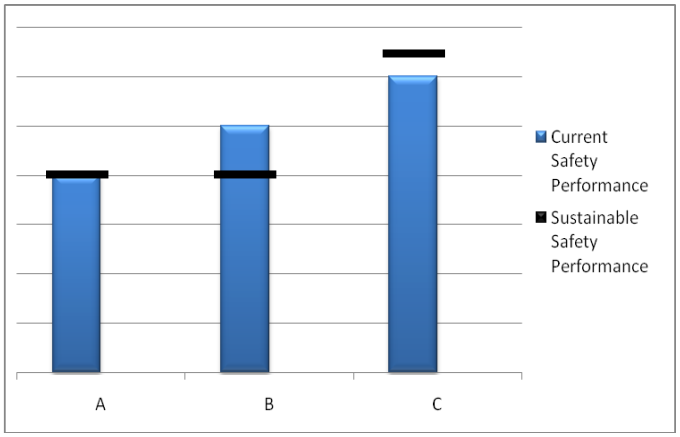

Chart 1

A possible method to calculate a reduction of the "economic impact of accidents" is reported in Appendix 1 .

6. Conclusions

When managing safety, railways have to live with the fact that economic resources are limited. In order to maximise the effectiveness of actions, it is therefore essential to be aware of the "economic impact of accidents" on society, as well as of costs and benefits to reduce this impact.

The paper has depicted the tools the European Railway Agency is developing to measure the "current safety performance" and to estimate a "sustainable safety performance" for the Member States of the European Union.

Railways who are not aware of their "sustainable performance" might deliver either an excess of safety or a lack of safety; in either scenario customers may shift to another transport mode.

The European Railway Agency is releasing in the coming years recommendations for the achievement of common safety targets leading to sustainable rail safety performance for Member States.

Both pieces of information, "current safety performance" and "sustainable safety performance", are intended to support good management of safety at national level and form an important reference for decision makers.

Decision makers would have useful information to plan an efficient allocation of economic resources to safety transport, if the industry of all transport modes measured their "current safety performance" and estimated their "sustainable safety performance".

7. Abbreviations

CSIs Common Safety Indicators

CSTs Common Safety Targets

ERA European Railway Agency

EU European Union

FWSI Fatality and Weighted Serious Injuries

VPC Value of Preventing a Casualty

VPF Value of Preventing a Fatality

VPSI Value of Preventing a Serious Injury

8. References

Ref. /1/: DIRECTIVE 2004/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 on safety on the Community's railways (Railway Safety Directive)

Ref. /2/: European Railway Agency, Recommendation on the Common Safety Methods for calculation, assessment and enforcement to be used in the framework of the 1st set of Common Safety Targets (ERA/REC/01-2008/SAF)

Ref. /3/: Rail Safety and Standards Board, Research Programme Management Assessment of the Value for Preventing a Fatality (VPF), The Definition of VPF and the Impact of Societal Concerns, Oxford Risk Research and Analysis

Ref. /4/: Developing Harmonised European Approaches for Transport Costing and Project Assessment (for details, see: Proposal for Harmonised Guidelines: http://heatco.ier.uni-stuttgart.de/)

Appendix 1 : Possible method to calculate a reduction of the economic impact of accidents

Formula 1

Current Safety Performance = FWSI/ (Scaling Factor)

Formulas 2

Economic impact of accidents, total in €:

- Number of fatalities and serious injuries multiplied by the Value of Preventing a Casualty (VPC): N_F*VPF + N_{SI}*VPSI

  VPF = Value of Preventing a Fatality, VPSI = Value of Preventing a Serious Injury,

  N_F = Number of Fatalities, N_{SI} = Number of Serious Injuries
- C_D= cost of delays as a consequence of accidents
- C_M= cost of material damages to rolling stock or infrastructure
- C_E = cost of damages to environment.

The economic impact of all accidents can be calculated applying the same weighting average processes as for the current safety performance (see section 4).

Formulas 3

On average a number N of FWSI resulted in:

Costs of delays = C_D /N

Material damage = C_M /N

Damage to environment = C_E /N

Formula 4

By estimating the trend of the scaling factor for the future years, it is possible to derive the FWSI to prevent to achieve a target (CSTs for the European Union), that we can call $FWSI_{CST}$.

F_{CST} and SI_{CST} are the fatalities and serious injuries to prevent to achieve a target.

Reduction of the economic impact of accidents = (F_{CST})* VPF + (SI_{CST})* (VPSI) + $(FWSI_{CST})$* [(C_D + C_M + C_E)/N]