ROAD SAFETY INSPECTION AND ROAD SAFETY AUDIT AS THE MAIN TOOLS FOR INFRASTRUCTURE SAFETY IMPROVEMENT IN RAPIDLY MOTORIZING COUNTRIES

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Abstract

Even the road safety in Baltic republics have been improved faster than in other European regions, we still face a number of safety problems, especially regarding the lack of the infrastructure safety issues. Safe transportation is important, especially considering that the increasing road traffic in the Baltic Sea Region comes at the price of accidents during which lives are lost and injuries caused. The road safety must be further improved to help to reduce the number of accidents, fatalities and injuries. Road infrastructure is one of the key pillars for road safety. In the BALTRIS project authorities and academic institutions in Estonia, Latvia, Lithuania and Sweden work together for improved road safety focusing on infrastructure safety issues, including road safety audit and inspection knowledge.

Key words: *Road safety, road safety inspection and audit, infrastructure safety, BALTRIS project*

1. INTRODUCTION

Traffic accidents pose a serious social problem — more than 3,200 people get killed and over 130 000 injured in traffic every day. More than 90% of fatalities occur in low- and middle-income countries. Though road fatality rate in high-income countries (10,3 per 100 000 population) has been decreasing over the last decades, even in these countries road accidents remain one the main causes of death, injury and disability. Almost half of all fatal accidents involve pedestrians, cyclists and power two wheelers, collectively called vulnerable road users. Road traffic injuries are the third death cause for people aged between 5 and 44 years. (WHO, 2009)

While in many high-income countries road fatality rate have stabilized or decreased, in the majority regions of the world the number of people killed in road traffic is constantly increasing. If the current trends continue, traffic accident related deaths may take the fifth place in the list of death-causing health disorders and injuries by the year 2030 and results in an estimated 2,4 million fatalities per year (WHO, 2009).

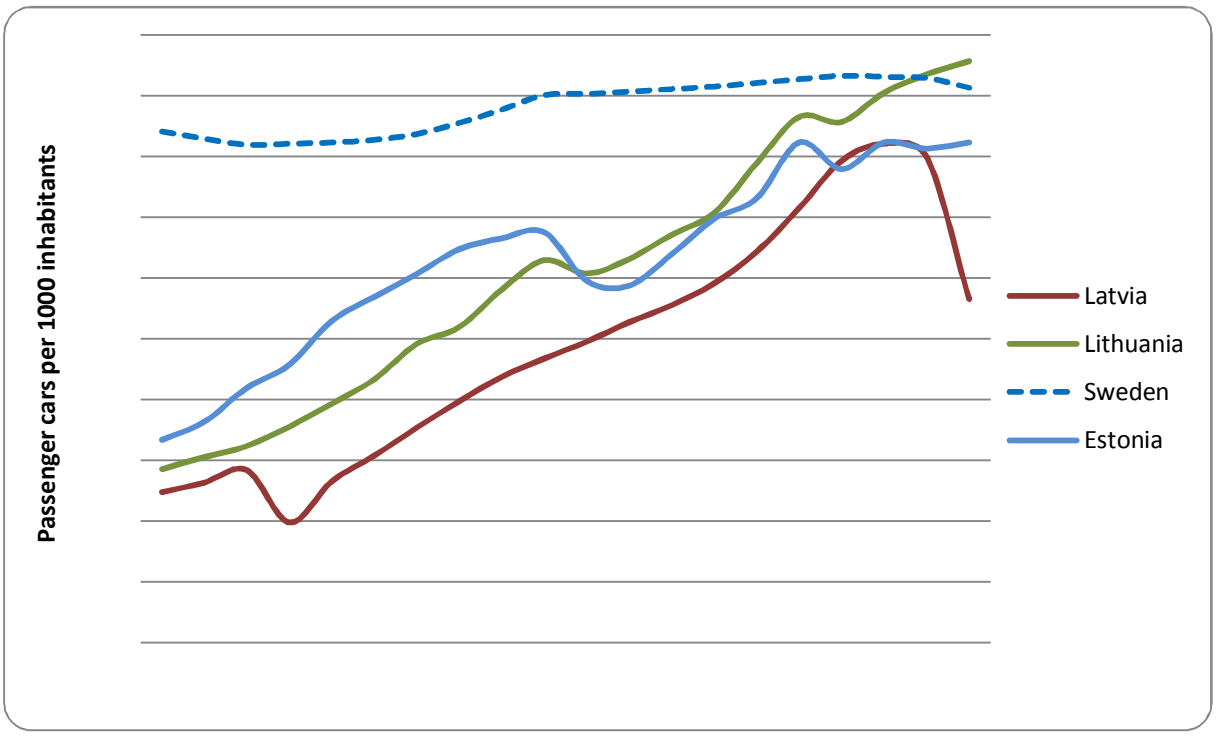
Several studies have tried to estimate the social damage caused by traffic accidents. The conclusion drawn shows that this sum reaches 180 billion euros per year just in the EU, which comprises almost 2% of the GDP of EU countries (Elvik, 2002). And the global losses caused by injuries in road traffic are estimated to be 518 billion US$ (WHO, 2009).

One of the main tasks in developing transport systems is to decrease human losses caused by traffic accidents. The social consequences of accidents and the relating human losses were the main reasons why the ministers of transport of the ECMT countries decided in 2002 to take measures in order to decrease the number of traffic accident related deaths in Member States 50% by the year 2012. Approaching road safety issues systematically The European Commission has set a similar task for the EU Member States, recommending to decrease the number of accident related deaths 50% by the year 2020 (European Road Safety Action Programme 2011 – 2020).

2. ROAD TRAFFIC SAFETY IN THE BALTIC STATES

The development of the transport system in the Baltic states follows the principal tendencies of other European countries to a great deal. The increase of car ownership (usually measured by the number of passenger cars per 1,000 inhabitants) has been rapid in Baltic states. This figure has tripled in the last twenty years.

Fig. 1. Motorisation rate in Baltics, 1991–2010

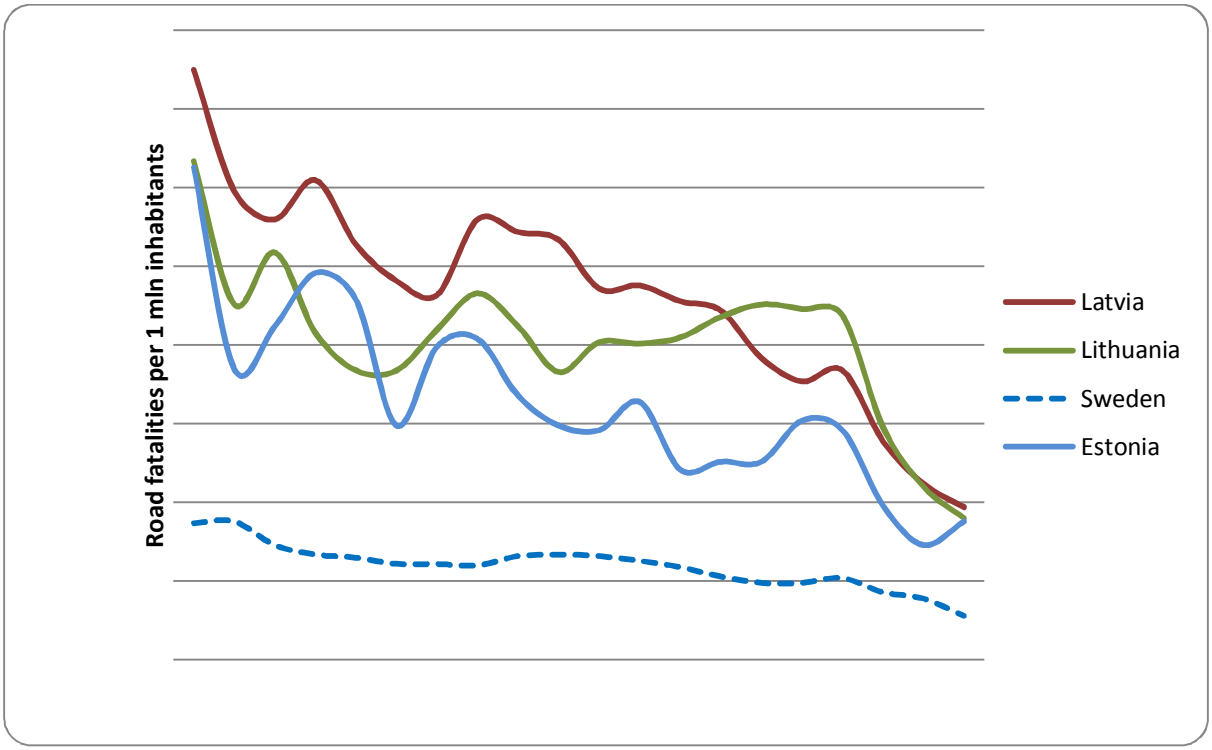


Sources: EUROSTAT database, national statistical agencies

The growth in car ownership together with a more active car usage and higher mobility resulted in many negative consequences also in Baltic. The most serious of them is the increase of people killed and injured in traffic accidents.

The year 1991, when all together 2 661 people were killed in three Baltic States (491 in Estonia, 997 in Latvia and 1173 in Lithuania), was the worst year ever for Baltic in terms of traffic safety. The number of traffic related deaths has dropped since then and less than 600 people were killed on Latvian, Estonian, Lithuanian roads in 2010. Having shown the fastest change of road fatalities (-60% versus -43% EU average), Baltic states still have to struggle for road safety in the context of constantly growing motorisation.

Fig. 2. Road fatality rate in Baltics, 1991–2010



Source: CARE database

3. BALTIC STATES IN COMPARISON WITH OTHER EUROPEAN COUNTRIES

Despite a decrease in the number of people killed in traffic accidents, Baltic states are still among the countries with a low road safety level. The lack of officially available and reliable statistical data on transport makes the comparison between European countries inadequate and superficial.

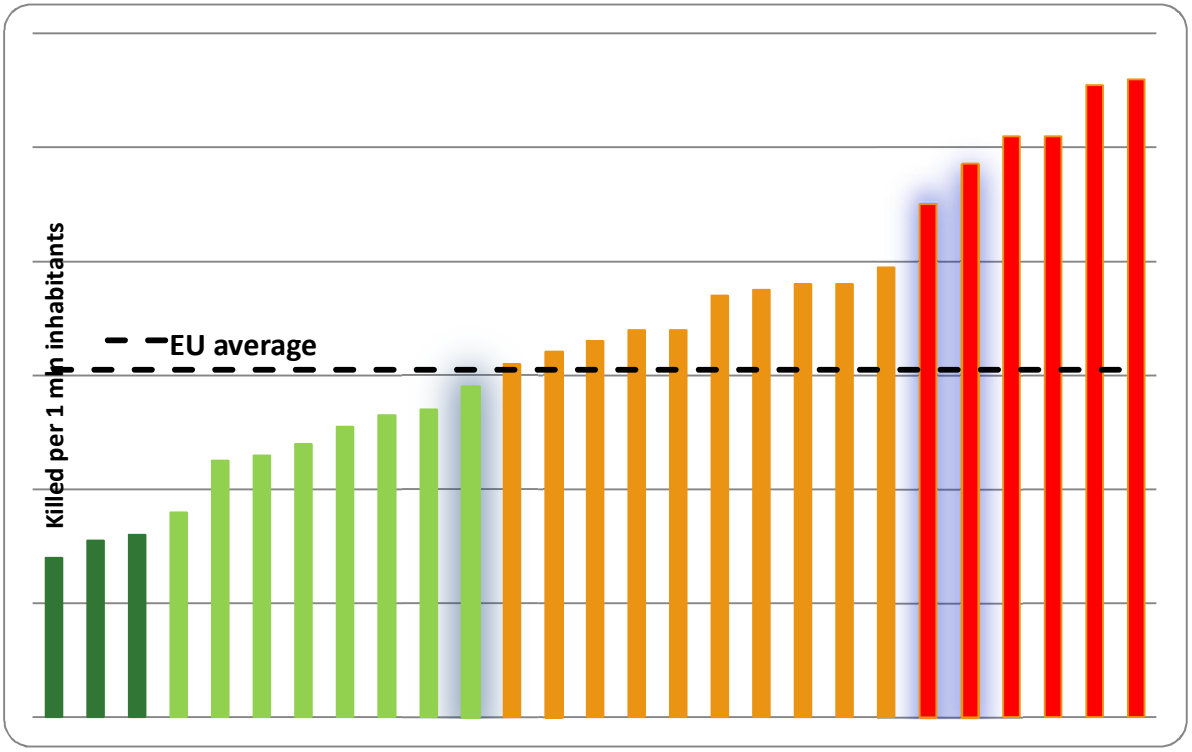
Reliable road traffic safety comparison can only be carried out only with respect to the countries that have a similar motorisation level. This means that countries with a similar number of motor vehicles per 1,000 inhabitants can be statistically comparable. More indicative parameter for road safety assessment is traffic exposure (e.g. vehicle-km driven), however these data are often missing in official european databases or aren't considered to be reliable. The most commonly used and generally available criterion for assessing road traffic safety is the number of traffic accident related deaths per one million inhabitants. At the same time this indicator doesn't reflect to the full extent the

effectiveness of a country's road safety policy. Differences may also be caused by a wide range of geographical and socio-economic factors influencing traffic conditions:

- climate and geographical conditions,
- division of vehicles by type,
- traffic management,
- importance of international traffic,
- density and quality of road network,
- land usage and planning,
- population density,
- traffic behaviour,
- standard of living, etc.

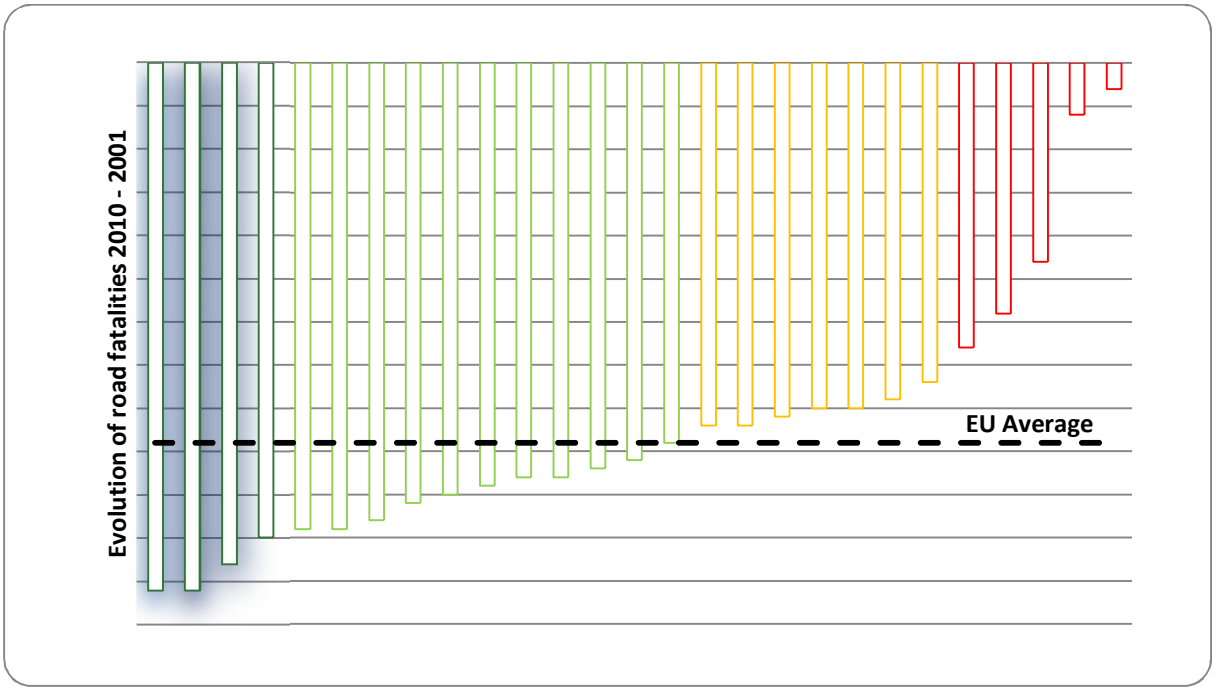
Fig. 3 and 4 show the number of people killed in traffic accidents per one million inhabitants in European countries in 2010 and the progress made by EU countries in the period 2001 – 2010. It has been a great challenge for the Baltic states to improve their safety level and to get to the average of EU. During the last decade (2001-2010) Latvia, Estonia and Lithuania succeeded to perform the best improvement among EU, although the average risk is still much higher than EU average. The probability of getting killed in a traffic accident in Baltics is almost three times higher than in Sweden.

Fig. 3. Road fatalities per 1 mln inhabitants in EU, 2010



Source: http://ec.europa.eu/transport/road_safety/pdf/scoreboard_2011.pdf

Fig. 4. Change in road fatalities in EU, 2001 – 2010



Source: http://ec.europa.eu/transport/road_safety/pdf/scoreboard_2011.pdf

4. INFRASTRUCTURE SAFETY PROBLEMS

Road crashes tend not to be evenly distributed throughout the road network. They occur in clusters at single sites, along particular sectors of roads or scatter across the whole neighbourhoods (WHO & WHO, 2004). Effective road engineering can help in reducing road accidents, while poor engineering can contribute the crashes. Road network effects accidents' occurrence risk, because it determines road users' perception of the environment and provides instructions on road users' behaviour. The most of road engineering measures thus work through their influence on human behaviour (Ogden, 1996).

The four particular elements affecting road safety have been identified in the road network planning, design and maintenance stage (Ross, 1991):

- safety-awareness in the planning of new road networks;
- incorporation of safety features in the design of new roads;
- safety improvements on existing roads;
- remedial actions at high-risk crash sites.

It is often supposed that good design standards can or even must prevent accident occurrence. Despite the use of modern design standards, accidents do occur even on newly constructed roads. There are numerous reasons for this. On some roads, often in urban areas as an example, it is not always possible to keep the highest safety design standard due to land use problems and limited budget. Combination of several features designed individually according to the standards can cause further problems e.g. with visual deception. Existing standards are often rather flexible, giving to the designer an

opportunity to choose the best design solution, but the best does not sometimes mean the safest. Safe infrastructure can be defined as the relation between how engineers design a road and how road users behave on it. If road users perceive the road to allow drive faster, they will hardly comply with the speed limits, despite the increasing risk to be involved into a crash.

Rather than improving safety of existing facilities it's better to use the proactive engineering approach, which focuses on predicting and improving safety on planning and design stage (de Leur, 2003). The same is relevant in case of existing roads, when proactive intervention through the lower cost road safety improvements may be more fruitful than reactive approach. Thus the two developing procedures – road safety audit (RSA) for planning and design stages and road safety inspection (RSI) for existing road schemes have a lot of opportunities to contribute to the infrastructure safety improvement. RSA and RSI can become a source of valuable information on potential safety improvements to be used to develop new technical standards, specifications and guidelines.

In relation to the road infrastructure safety the Vision Zero approach could be introduced. Vision Zero is a philosophy of road safety, foreseeing that no one eventually will be killed or seriously injured within the road transport system (Tingvall, 1999).

The Vision Zero is an expression of the ethical imperative that:

it can never be ethically acceptable that people are killed or seriously injured

while moving within the road transport system.

Vision Zero is a theory of a safe road transport system, which can become a platform for road safety strategies, quantitative goals and targets. Zero is not a target to be achieved by a certain date. It is a shift of emphasis from existing problems and their possible solutions to the effective road transport system in general.

Vision Zero also draws attention to the responsibility aspect in road safety. In all current road transport systems the road user has to bear responsibility for safety alone. In majority countries there are general traffic rules that prescribe the road user to behave in a way to avoid accidents. If road accident occurs, this means that at least one road user has violated the general safety rule and the legal system can therefore punish him.

On the contrary Vision Zero explicitly states that the responsibility is shared by the system designers and a road user:

"1. The designers of the system are always ultimately responsible for the design, operation and use of the road transport system and thereby responsible for the level of safety within the entire system.

2. Road users are responsible for following the rules for using the road transport system set by the system designers.

3. If road users fail to obey these rules due to lack of knowledge, acceptance or ability, or if injuries occur, the system designers are required to take necessary further steps to counteract people being killed or seriously injured." 'Ethical rules have been proposed to guide the system designers. Two of these are:

- "Life and health can never be exchanged for other benefits within the society";
- "Whenever someone is killed or seriously injured, necessary steps must be taken to avoid a similar event".

These rules are also the most important for the RSA and RSI.

The present best practices show that the following aspects are of essential importance (Elvik R., 2006) (SETRA, 2008):

- Speeds are often most adapted to the situation and excessive speed differentials may cause high risks;
- Keeping the right driving direction;
- Decreasing conflicts between motorized vehicles and other road users;
- Avoiding any unpredictable situations.

It should be kept in mind, that there is always a possibility to improve road infrastructure using a number of different countermeasures but only some of them can be implemented in a short term, while long term measures could have a different perspective.

Of course, it is often difficult to introduce large-scale and expensive countermeasures on a road constructed long time ago. Often an overall improvement leads to a decision of a completely new road (re)construction with high costs, time consumption for preparation etc. As this way is sometimes totally impossible, improvement of the existing traffic facilities using short-term and low-cost countermeasures should be arranged.

5. HISTORY OF ROAD SAFETY AUDITS

British traffic engineers first developed the idea of road safety audit as a safety check for new and improved road schemes in the early 80s. However, the concept of a safety checking procedure within transportation had existed for over 180 years.

A study of the British railway network development from the 1830s shows how railway engineers and their regulators grasped the concept of safety audits as the key to a safe transportation system (Proctor, 2001). The road safety audit process started when safety engineers realized that it is necessary to adopt the principle of 'prevention is better than cure'. They decided to use some of the safety experience from the remedial work and incorporate safety principles into new and existing road schemes' designs.

During the early 1990s road safety audit procedures were adopted and the guidelines were worked out in Australia, Scandinavian countries, New Zealand, followed further by the most highly motorized countries as well as the developing countries.

RSA and RSI is a systematic work method contributing to safer roads and safer road traffic. In some older references the term of audit could cover also the present road safety inspection procedures. Road safety inspection is a today's notion that has been adopted to deal with existing roads. Despite RSA and RSI have several similarities, there are some essential differences, especially regarding the procedures.

The road safety audit concept came into use in Great Britain, where the method had been developed and implemented by the end of the 1980s. Today, the method is used in most European and also other countries.

RSI is defined in a different way, while the main purpose and procedures remain similar between different countries. The EU Directive [11] defines RSI as **an ordinary periodical verification of the characteristics and defects that require maintenance work for reasons of safety**. RSI allows to evaluate existing road traffic facilities and to improve road safety performance.

In spite of minor differences in definitions it is important to note that the majority of present practices underline the similar characteristics of RSI:

- A RSI is systematic – this means it will be carried out in a methodical way following a formal procedure.
- A RSI is pro-active – try to prevent accidents through the identification of safety deficiencies for remedial actions rather than react only when accidents happened.
- A RSI relates to an existing road not roads being constructed (these constitute subject of RSA).
- A RSI describes the potential hazards from the road user point of view;
- A RSI should be carried out by an independent team (or person) with experience in road safety work, accident analysis, traffic engineering and road user behaviour and/or road design.

The basic concept is to provide a method that will help the road operators to improve their knowledge of the network by inspection visits made by an independent expert with a fresh look at an issue. Such visits have to be made by appropriately prepared personnel after having been trained both in the methodology and principles of road safety.

The objective of this approach is to provide the road operator with necessary knowledge to improve road safety of an existing network and to develop "safety vigilance" on the road. In addition RSI provides an independent and a fresh view of potentially risky safety issues.

To attain this objective, the approach aims to be:

- preventive;
- simple, effective and practical;
- recurrent and systematic;
- at the initiative of and for the benefit of the road operator.

In addition to the above mentioned we should highlight the following issues:

- The roads designed and constructed years or even decades ago were often planned for different amount of traffic, motor vehicle fleet or even different types of road users (bicyclists or pedestrians).
- It is often a case that local road administrations (state, private or municipal) do not have enough safety related knowledge to analyse the road risks in a same way and efficiency that an independent expert can do.
- Even in some reconstructed or rehabilitated road sections the number of accidents recorded is still high in spite of undertaken improvements because road safety in most cases wasn't the matter priority.
- It is a wide-spread misconception that the faults or incorrect behaviour of a driver are considered to be the main cause of road accidents. But from a number of research findings we know already that road infrastructure has a great influence on safety outcomes, as contributing or even the main factor of the crash occurrence.

The purpose of a RSI is to manage safety proactively by identifying and addressing risks associated with road safety deficiencies. Thus, the benefits of RSI can be summarised as follows:

- It identifies potential road safety concerns for all road users;
- It minimizes the risk and severity of road accidents that may result from the existing situation of a road section;
- It minimizes unsustainable losses to health and economy,

Still it is obvious, that some deficiencies and following RSI treatments will have bigger impacts than others. As an example a research by Elvik (Elvik R. , 2006) shows expected accidents' significant reduction as a result of RSI and associated treatments:

- Correcting signs: 5 – 10% reduction of injury accidents;
- Adding guardrails along embankments: 40 – 50% reduction of running-of-the-road injury accidents;
- Guardrail end treatments: 0 – 10% of striking on injury accidents reduction;
- Providing clear recovery zones: 10 – 40% reduction of running-of-the-road injury accidents;
- Removing sight obstacles: 0 – 5% reduction of all injury accidents;
- Yielding lighting poles: 25 – 75% of striking poles injury accidents reduction;
- Flattering side slopes: 5 – 25% reduction of running-of-the-road injury accidents;
- Signing on hazardous curves: 0 – 35% running-of-the-roads-on-curves injury accident reduction.

The above constitute measures are typically included in a RSI report for short and medium-term implementation.

6. COSTS AND BENEFITS OF RSI AND RSA

Although it is not always easy to quantify precisely the economic benefits of RSI, there is strong evidence that such inspections are highly cost-effective. With the introduction of some typical measures like the ones mentioned above, it is possible to save lives. Obviously, even saving of only one human life per year on an inspected road section, the resulting benefit of the RSI would be much higher than the caused costs. When audit or inspection is carried out, the recommendations given in the report are not compulsory for the implementation.

Still some research works were carried out to assess the benefits of RSA and RSI implementation. In Denmark (Directorate, 1997) the first year rate of return for safety audits was estimated to be over 149%. This figure was based on estimates for accidents' savings that might be obtained by introducing audit recommendations. TRL study (Laboratory, 1999) of 22 audit schemes resulted in 11,000 GBP savings per audit.

BALTRIS is a project within the European Union's Baltic Sea Region Programme 2007-2013, a programme that promotes regional development through transnational cooperation. The aim is to make the Baltic Sea region an attractive place to invest, work and live in. The BALTRIS project is expected

to lead to improved safety of road infrastructure as well as possibilities to choose cost-effective engineering solutions. Safer road infrastructure will result in improved overall road safety.

The specific objective of BALTRIS is to develop tools and build capacity to better manage safety of road infrastructure in the Baltic Sea Region. This by exchange of experience and joint development of road infrastructure safety management procedures, i.e.:

- road safety impact assessment;
- road safety inspections and road safety audits;
- evaluation of high accident concentration sections.

BALTRIS is led by Lithuanian Road Administration. Project partners are Estonian Road Administration, The Swedish Transport Administration, Vilnius Gediminas Technical University, Tallinn University of Technology, Lund University and Riga Technical University. By combining expertise of road authorities and academic institutions the BALTRIS project is aimed to bring out ready-to-apply road infrastructure management tools for the Baltic Sea Region.

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