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POLICY INSTRUMENTS FOR MANAGING ROAD SAFETY ON EU-ROADS

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Abstract. Directive 2008/96/EC on road infrastructure safety management requires the establishment and implementation of procedures relating to road safety impact assessments (RSIA), road safety audits (RSA), ranking of high accident concentration sections and network safety ranking (NSR) and road safety inspections (RSI). The aim of this article is to present the outputs of BALTRIS project. The goal of the international project BALTRIS is to elaborate the road and street infrastructure safety management procedures and teaching material consistently explaining the above mentioned infrastructure management procedures. Four Baltic Sea region countries (Sweden, Estonia, Latvia, and Lithuania), represented by universities and national road administrations participate in the elaboration of these procedures and teaching material. This article describes the scope of NSR, RSA and RSI procedures prepared in the frame of BALTRIS project, also article provides detailed implementation and execution of procedures for the EU Member States. NSR means a method for identifying, analysing and classifying parts of the existing road network according to their potential for safety development and accident cost savings. *Ranking of high accident concentration sections* means a method to identify, analyse and rank sections of the road network which have been in operation for 3÷5 years and upon which a large number of fatal/injury accidents in proportion to the traffic flow or compared to respective conditions have occurred. RSI is a strategic comparative analysis of the impact of the new road or a substantial modification to the existing network on the safety performance of the road network. RSA is a formal safety performance examination of the existing or future road or intersection by an independent audit team.

Keywords: network safety ranking, concentration sections, hazardous section, homogenous sections, accident rate, accident data, safety audit, safety inspection, auditor, road.

1. Introduction

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 European Conference of Ministers of Transport countries decided in 2002 to take measures in order to decrease the number of traffic accident related deaths in Member States by 50% by the year 2012. 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 2010 (EC 2009).

Directive 2008/96/EC on road infrastructure safety management (EC 2008) requires the establishment and implementation of procedures relating to road safety impact assessments (RSIA), road safety audits (RSA), ranking of high accident concentration sections and network safety ranking (NSR) and road safety inspections (RSI). This Directive shall apply to roads which are part of the trans-European road network, whether they are at the design stage, under construction or in operation. Member States may also apply the provisions of this Directive, as a set of good practices, to national road transport infrastructure, not included in the trans-European road network.

The growth in car ownership together with a more active car usage and bigger mobility has also brought along many negative consequences in the Baltic region, the most serious among them being the people killed and injured in traffic accidents.

We can carry out a reliable road traffic safety comparison only with respect to countries that have a similar level of car ownership, which means that we can compare countries in which the number of motor vehicles per 1000 inhabitants is similar. An important input for assessing road traffic safety is traffic volume; however, this data are missing for many countries or they are unreliable (WHO 2004). The best and most 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 may not necessarily show if the respective country's road traffic safety policy is better or worse. Differences may also be caused by very different traffic conditions caused by various geographical and socio-economic factors:

- 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.

Rather than working to improve safety of existing facilities the proactive engineering approach to road safety improvement focuses on predicting and improving safety of planned facilities (De Leur, Sayed 2003). The same is relevant to existing roads where the lower cost road safety improvement activities through proactive intervention may be more active than reactive approach. Here the three developing procedures – evaluation of high accident concentration sections, road safety auditing (for planned road schemes) and road safety inspection (for existing road schemes) have big chances to contribute the infrastructure safety improvement.

Research results of the last decade might work as basis for improved road design standards and guidelines to improve safety of roads. The RSA and RSI can work as a source of information on potential safety improvements, to be used to develop technical standards and specifications.

BALTRIS (2011) 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 (Laurinavičius *et al.* 2012).

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 would be 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.

2. The Process of Road Network Safety Ranking

Network safety ranking and ranking of high accident concentration sections is performed on the basis of injury accident records (accidents with material damage only are excluded) and inspections of the road sections with a large number of fatal and severe accidents. Its organisational costs can be therefore assumed comparable to costs of routine road safety inspections. Road safety inspections shall be carried out pursuant to 'Procedures for Road Safety Inspection' (Antov 2011). As results of the inspections, remedial measures for realisation shall be ranked based on their benefit/cost ratios for prioritisation for implementation. Therefore, only safety measures showing the highest benefit-cost ratios shall then be implemented. This guarantees that costs increases due to the measures selected for implementation will be offset within a short while due to reduced number and cost of accidents.

Determination of safety levels of road network is organized by the institution implementing the road network owner's rights and duties of the state road maintenance enterprises. Road network safety and high accident concentration sections ranking procedures can be divided into 5 stages: Data collection, Definition, Dividing, Indication and Analysis.

2.1. Data Collection

Data collection is a very important part of the implementation of the guidelines. The necessary data is as follows:

- ***Injury accidents*** (location of the accident, date and hour of accident, accident type, accident severity, including number of fatalities and injured persons, characteristics of the persons involved such as age, sex, nationality, alcohol level, use of safety equipment or not, data on the vehicles involved (type, age, country, safety equipment if any, date of last periodical technical check according to applicable legislation), accident data such as collision type, vehicle and driver manoeuvre, road surface and weather conditions, whenever possible, information on the time elapsed between the time of the accident and the recording of the accident, or the arrival of the emergency services, pictures and/or diagrams of the accident site).
- ***Traffic volume*** (Annual average daily traffic (AADT), proportion of light and heavy vehicle).

- ***Road parameters*** (road status or function, road significance (type), road category, cross section including number of lanes, lane width, shoulder and the presence of bicycle lanes and side strips, possibility for oncoming traffic, speed limit, lighting, markings, alignment, roadside obstacles, number and design of intersections and access roads, junction type including signalling).
- ***The surrounding environment*** (rural or urban area).

Those data have to be relatively easily located and be immediately interoperable with each other.

2.2. Definition of Road Groups and Junction Groups

The road network should be divided into homogeneous sections with regard to selected traffic and road design parameters. The groups of road sections and the groups of junctions are formed separately (EC 2009). The groups of road sections are formed according to the following parameters:

- road type and category;
- surrounding environment (rural or urban area);
- cross section;
- speed limit;
- traffic volume.

Fig. 1 illustrates a scheme for dividing roads into groups and subgroups based on 4 criteria:

- by the first criterion ***'road type, category, surrounding environment (rural or urban area)'*** four large road groups are distinguished, i.e. motorways, main roads, national and regional roads, urban roads.
- by the second criterion ***'cross-section'*** the subgroups are distinguished: roads with median and roads of different width of carriageway without median.
- by the third criteria ***'speed limit'*** the subgroups are divided into smaller subgroups: roads with a speed limit of 50 km/h, 70 km/h, 80 km/h, 90 km/h, 100 km/h, 110 km/h and 130 km/h;

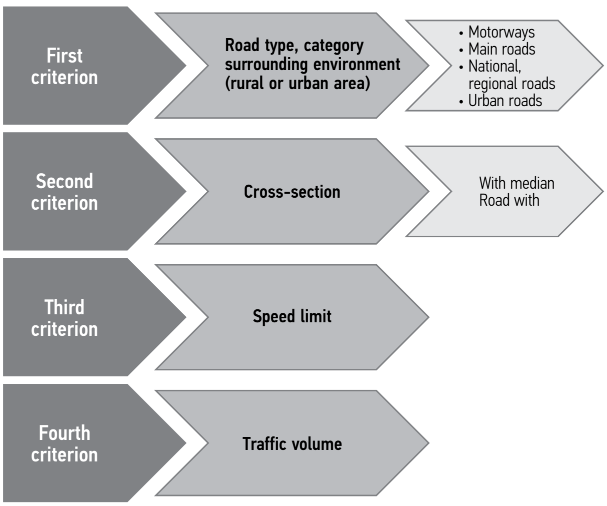

Fig. 1. The process of dividing the road network into road groups and subgroups

- by the fourth criteria ***'traffic volume'*** the subgroups are divided into smaller subgroups: roads with different traffic volume.

Junction groups and subgroups are formed taking into account two criteria (see Fig. 2):

- junction type (level crossing T, level crossing X, roundabouts and grade separated crossing);
- traffic volume for level crossings (according to the proportion of the incoming traffic from the minor road).

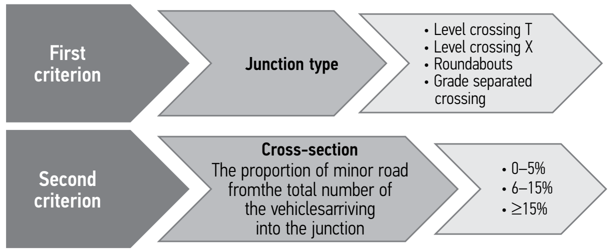

Fig. 2. The process of dividing the junctions into junction groups and subgroups

Junction zone is called an area (address) of the junction and its approaches, i.e. 200 m on both sides of a crossing point of road axes on major road and 150 m on both sides of a crossing point of road axes on minor road (Lietuvos automobilių kelių... 2011).

2.3. Dividing the Road Network into Homogeneous Road Sections and Junctions

The road network, based on the above formed road and junction groups is divided into homogeneous road sections and homogeneous road junctions. For dividing the road network into homogeneous sections, data of the surrounding environment, road parameters and traffic volume of at least 3 ***last*** calendar years is used, described in sub-chapter '*2.1. Data Collection*'.

2.4. Road Network Safety Ranking and Identification of Hazardous Road Sections

After having divided the road network into homogeneous road sections and junctions, the road network safety levels are identified. Road sections and junctions with their own accident data get into the groups of road sections and junctions respectively.

First stage. Network safety ranking in the road and junction groups

To distinguish the road network safety levels, it is necessary to determine the total accident level in each road group or junction group, i.e. to calculate accident rate in each road or junction group. When calculating accident rate the accident severity shall be taken into consideration. For road links accident rate AR shows the number of weighted injury accidents per vehicle mileage (Lietuvos Respublikos susisiekimo… 2011):

$$AR = \frac{A \cdot 10^6}{365 \cdot N \cdot L \cdot m}; \quad (1)$$

$$A = \left(A_k \cdot x_k\right) + \left(A_{si} \cdot x_{si}\right) + \left(A_{li} \cdot x_{li}\right), \quad (2)$$

where: A – number of road accidents in the studied road group in m years, calculated by the formula (2); N – annual average daily traffic in the studied road group, veh./day; L – total length of homogeneous road sections in the studied road group, km; m – number of years, i.e. of how many years data is used ($m \geq 3$). A_k – number of road accidents where at least one person was killed; A_{si} – number of road accidents where at least one person injured undergoes in-patient treatment; A_{li} – number of road accidents where people injured undergo out-patient treatment; x_k, x_{si}, x_{li} – weight coefficients of accident severity.

For junctions accident rate is calculated similarly, however the rate is calculated per millions of vehicles arriving into the junction. So instead of $N \cdot L$, the number of vehicles arriving into the junction is used (calculated by AADT's of the approaches in the studied junction, veh./day).

Weighted evaluation of accident severity is of two options (Sørensen 2007):

- based on injury cost: weighted value is calculated on the basis of socio-economical evaluation of injuries;
- agreed strategy: weighted value is assigned in a way of agreement, e.g. taking into account political objectives.

It is recommended (Sørensen 2007) that the weighted value is calculated based on the first option, i.e. to use monetary expression in different severity levels of the average number of people injured, this is a more objective and reliable method than agreed/political determination of values.

Having calculated AR for each road group or junction group the safety levels of the road network are obtained, i.e. from the total road network the group of roads or junctions having the largest accident level is distinguished.

After implementation of this stage, ***the current network safety level*** is obtained in each road group or junction group.

Hazardous road sections should be identified in terms of the expected number of accidents. For this purpose it is necessary to determine general expected number of accidents in each road group or junction group using accident prediction models (Elvik 2008a; EC 2009).

Second stage. Safety ranking in the homogenous road sections and junctions

Hazardous road sections or junctions are any sections on the road network that have a higher expected number and severity of accidents than other similar road sections or junctions as a result of local and section based accident and injury factors. Hazardous road sections are also referred to as dangerous roads, problem roads and accident prone locations. The expected number of accidents is estimated by using the empirical Bayes method (Elvik 2007).

An accident prediction model gives an estimate of the expected number of accidents for a roadway element that has a certain combination of traits. In most models, these include traffic volume, characteristics of highway geometry and type of traffic control. Most accident prediction models will not include all factors that produce systematic variation in accident counts. Hence, estimates of the expected number of accidents derived from accident prediction models are mean values for units that have a given combination of traits. The expected number of accidents for a specific unit will normally differ from the mean value for units that have similar general traits.

According to the empirical Bayes method, the best estimate of safety is obtained by combining two sources of information:

- the accident record for a given site;
- an accident prediction model, showing how various factors affect accident occurrence.

In the empirical Bayes method (Elvik 2008b), the expected number of accidents of a road section is estimated by weighting the registered number of accidents on the road section or junction and the general expected number of accidents for a road group or junctions group (similar sites) estimated by accident prediction models. This method is illustrated in the following formula (Sørensen 2007):

$$E\left(\lambda / A\right) = \alpha \cdot \lambda + \left(1 - \alpha\right) \cdot A; \quad (3)$$

$$\alpha = \frac{1}{1 + \lambda / k}, \quad (4)$$

where: $E(\lambda/A)$ – the local expected number of accidents on a road section/junction; λ – the general expected number of accidents estimated by accident models; A – the registered number of accidents on the road section/junction; k – the inverse value of the over dispersion parameter.

The parameter α determines the weight given to the estimated normal number of accidents for road group or junctions group (similar sites) when combining it with the recorded number of accidents in order to estimate the expected number of accidents for a particular site.

Having calculated the local expected number of accidents for each homogeneous road section or junction, they are listed in a decreasing order of the local expected number of accidents value. ***The higher position of the road section or junction in the list the more hazardous it is compared to the other sections of the same group.*** For further evaluation, those homogeneous road sections or junctions ***which in their group are characterized by a higher than the average accident probability*** are selected.

All the identified most hazardous road sections or junctions must be analyzed and subjected to special-purpose inspections.

2.5. In-Office Analysis of Hazardous Road Sections and Junctions

In office analysis

In office analyses are carried out pursuant to 'Procedures for Road Safety Inspection' (Antov 2011), however, the below information shall be evaluated:

- A description of the road section or junction:
  - which group,
  - groups safety level;
- A reference to possible previous reports on the same road section (if there was any report made before);
- The analysis of available accident reports (data of at least ***3 last*** calendar years is used):
  - precise as possible location of the accident;
  - pictures and/or diagrams of the accident site;
  - date and hour of accident;
  - accident data such as accident type, collision type, vehicle and driver maneuver;
  - accident severity, including number of fatalities and injured persons;
  - characteristics of the persons involved such as age, sex, nationality, alcohol level, use of safety equipment or not;
  - data on the vehicles involved (type, age, country, safety equipment (if any), date of last periodical technical check according to applicable legislation);
  - information on the road such as area type, road type, junction type including signalling, number of lanes, markings, road surface, lighting and weather conditions, speed limit, roadside obstacles;
  - whenever possible, information on the time elapsed between the time of the accident and the recording of the accident, or the arrival of the emergency services.

On-site observations of road-user behaviour

On-site observations of hazardous road sections or junctions are carried out pursuant to 'Procedures for Road Safety Inspection' (Antov 2011) (see below).

3. Road Safety Audit and Road Safety Inspection

The road safety audit process started when safety engineers realized that it is necessary to adopt the principle of 'prevention is better than cure', and they decided to use some of the safety experience from the remedial work and design safety into new and existing road schemes.

Road safety audit (RSA) (Belcher *et al.* 2008) and road safety inspection (RSI) is a systematic work method contributing to safer roads and safer road traffic. In some older references the term of audit could also cover the present road safety inspection procedures. *Road safety inspection of existing roads* is a today's concept that has been adopted because this term appears to be more appropriate when associated with existing roads. In spite of this, road safety audit and road safety inspection have several similarities, but also essential differences, especially regarding the procedures.

The EU Directive (EC 2008) defines road safety inspection as ***an ordinary periodical verification of the characteristics and defects that require maintenance work for reasons of safety***.

Following the principle 'Prevention is better than cure' the RSI makes it possible 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 most of present practices underline the similar characteristics of RSI and RSA:

- the RSI and RSA are systematic – this means it will be carried out in a methodical way following a formal procedure;
- the RSI and RSA are pro-active, trying to prevent accidents through the identification of safety deficiencies for remedial action rather than react only after accidents occurred;
- the RSI relates to an existing road, not roads being constructed (those are subject of Road Safety Audit);
- the RSI and RSA identifies and describes the potential hazards from the road user point of view;
- the RSI and RSA check the road and its environment against safety principles and not against norms;
- the RSI and RSA 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 someone from outside who has a fresh look. These visits will be made by appropriately qualified personnel after being trained both in the method to be used and in the principal road safety stakes.

The objective of this approach is to provide the road operator with a tool to improve safety of the road network by prevention and to develop 'safety vigilance' of the road; in addition, it will help the operator in the management by providing *an independent and fresh view on 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 we should highlight the following issues:

- often, the roads were designed and constructed some years or even decades ago 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 the same way and efficiency that an independent expert can do;

- even in some reconstructed or rehabilitated road sections the number of accidents is still recorded high in spite of improvements taken because in most cases the road safety issues were not the priority of the project;
- it is a popular misconception that the faults or bad behaviour of a driver are often considered to be the main cause of road accidents; but we already know, from a number of research findings, that road infrastructure has a great influence on safety outcomes, as contributing or even a main factor of the crash occurrence.

The purpose of a RSI is to pro-actively manage safety 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.

4. Costs and Benefits of RSI and RSA

RSI is an approved tool to improve road safety. With the inspection expert knowledge and with systematic RSI, it is possible to reduce the number and the severity of traffic accidents by improving the road safety performance of existing roads.

It is obvious that some RSI treatments will have bigger impacts than others. As an example a research by Elvik (SÉTRA 2008) shows significant expected accident reductions as a result of a road safety inspection and associated treatments:

- correcting incorrect signs: 5÷10% reduction of injury accidents;
- adding guardrails along embankments: 40÷50% reduction of run-off-the-road injury accidents;
- guardrail end treatments: 0÷10% reduction of striking on injury accidents reduction;
- providing clear recovery zones: 10÷40% reduction of run-of-the-road injury accidents;
- removing sight obstacles: 0÷5% reduction of all injury accidents;
- yielding lighting poles: 25÷75% reduction of injury accidents due to striking poles;
- flattering side slopes: 5÷25% reduction of run-of-the-road injury accidents;
- signing on hazardous curves: 0÷35% run-of-the-roads-on-curves injury accident reduction.

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

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 in an inspected road section, the resulting benefit of the RSI would be much higher than the involved costs.

The cost of a road safety audit is around 4% of the road design costs (Toth-Szabo, Várhelyi 2011). As design costs can be in the order of 5% to 6% of total implementation costs for larger projects, the increase in total project cost is usually quite small. The earlier inadequacies are identified in the design process, the lower the cost and redundant design time will be for rectifying these inadequacies. The earlier the better – it is easier to make changes in the schemes in early phase of the road design process when the deficits only exist on paper. Deficits which are not rectified in the first phases are less likely to be rectified later.

The cost of RSAs may vary greatly based upon project size, scope and complexity; the composition of the RSA team; and the level of detail of the audit. The cost of human resources to conduct RSAs may range from a one-day field review by in-house audit team members to maintaining full-time auditors working on a state-wide basis. Costs may also be higher if consultants are retained to conduct the audit or to supplement staff expertise on audit teams. Overall, the costs of RSA programs are dependent on the agency's creativity in integrating audit activities within existing project tasks, practices and resources, and on the decision-making methodology used to evaluate and implement audit suggestions.

It is often difficult to identify benefits of carrying out RSA or RSI in a quantitative way. When audit or inspection is carried out, the recommendations written in the report may or may not be implemented. Still some research carried out could give a number of good examples here. In Denmark (Gaardbo, Schelling 1997) the first year rate of return for safety audits was estimated to be over 149%, which figure was based on estimates for accident savings that might be made by introducing safety audit recommendations. A TRL study (Road Safety Audit Guidelines 1999) of 22 audited schemes showed 11000 GBP savings per audit.

5. Conclusions

The purpose of the BALTRIS project is to develop tools to better manage safety of road infrastructure in the Baltic Sea Region. This is by exchange of experience and joint development of road infrastructure safety management procedures, road safety impact assessment, road safety inspections and road safety audits and evaluation of high accident concentration sections.

According to the NSR procedure, traffic accidents with injury have to be registered continuously, but it is also important that information about traffic volume, road design and surrounding environment are maintained and updated all the time because both traffic and roads change over time for example as a result of traffic safety engineering. It is important that this information is updated, because it is used as input to the road classification, the division of the road system into road sections, in the making of accident prediction models and in the comparison of hazardous locations and safe locations or the normal accident pattern. When a location is changed, it is also important to record when the reconstruction is made, because this information should be used in the comparison of different locations, calculation of the normal accident pattern and possibly in a before-after evaluation.

The general safety level changes over time. The accident prediction models should also be reestimated continuously. This does not need to be done every year, but it is recommended that it be done in a 3÷5 year cycle.

The updating is especially needed if the police recorded accidents in the accident database are supplemented with hospital recorded traffic accidents as recommended.

The aim of the itinerary RSI is to report on the particularities of a road, it's surrounding area and it's general environment (hereinafter referred to as 'events' in this guide) that can influence user behaviour or affect his passive safety and thus have repercussions on road safety. In the core part of the RSI the deficiencies on the road should be detected that *may cause accidents* or could *have an influence on the severity of accidents*.

The essential principles of the RSI are: interdisciplinary detailed analysis of the road and the road environment; identification of possible accidental risks; analyses of the condition of road users' perception and quality of guidance; formal check of the performance of road equipment.

The benefits of the road safety audit process should be considered as the combination of the direct reductions in road trauma from design and site specific treatments and the qualitative improvements to the road safety performance of a road agency and associated organisations. Benefits of RSA are of the following kind: throwaway costs and reconstruction cost to correct safety deficiencies identified once roads in-service are either avoided or substantially reduced; lifecycle costs are reduced since safer designs often carry lower maintenance costs (e.g., flattened slope versus guardrail); societal costs collisions are reduced by safer roads and fewer, less-severe crashes; liability claims, a component of both agency and societal costs, are reduced; safer road network; a better understanding and documentation of road safety engineering; eventual safety improvements to standards and procedures; more explicit consideration of the safety needs of vulnerable road users, and the encouragement of other personnel in road safety.

It should be noted, that in some countries the linking of the local condition with guidelines and norms are considered to be an essential part of RSI, while in other countries this issue is performed separately unless there is no clear effect on safety issues. As it is evident that RSI and RSA are getting more international where single auditors or inspection teams can and will perform RSI and RSA in foreign countries, it is necessary to harmonize the main principles, procedures and rules among countries that are some of the most important issues of the BALTRIS project, (covering Latvia, Lithuania and Estonia and also Sweden) as minimum, but this information could also be of some value for other countries.

Country's legal base must be adopted by implementing procedures relating to road safety impact assessments, road safety audits, the management of road network safety and safety inspections. Member countries should adopt own political, legislative, governmental, administrative segments/sectors in such way that procedures would be fully functional.

References

Antov, D. 2011. *Road Safety Inspection Guidelines and Checklists*. BALTRIS WP 4. 43 p. Available from Internet: http://www.baltris.org/files/Road_Safety_Inspection_Guidelines-kopia.pdf

BALTRIS. 2011. *Improving Road Infrastructure Safety in the Baltic Region*. 2011. Available from Internet: http://www.baltris.org

Belcher, M.; Proctor, S.; Cook, P. 2008. *Practical Road Safety Auditing*. 2nd edition. Thomas Telford Publishing. 160 p. http://dx.doi.org/10.1680/prsa.35157

De Leur, P.; Sayed, T. 2003. A framework to proactively consider road safety within the road planning process, *Canadian Journal of Civil Engineering* 30(4): 711–719. http://dx.doi.org/10.1139/l03-034

EC. 2008. *Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on Road Infrastructure Safety Management*. European Commission. Available from Internet: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0096:EN:NOT

EC. 2009. *Safety Ratings: Project Co-financed by the European Commission, Directorate-General Transport and Energy*. European Commission. Available from Internet: http://ec.europa.eu/transport/road_safety/specialist/knowledge/pdf/safety_ratings.pdf

Elvik, R. 2007. *State-of-the-Art Approaches to Road Accident Black Spot Management and Safety Analysis of Road Networks*. TØI Report 883/2007. 109 p. Available from Internet: https://www.toi.no/article19461-29.html

Elvik, R. 2008a. A survey of operational definitions of hazardous road locations in some European countries, *Accident Analysis and Prevention* 40(6): 1830–1835. http://dx.doi.org/10.1016/j.aap.2008.08.001

Elvik, R. 2008b. The predictive validity of empirical Bayes estimates of road safety, *Accident Analysis and Prevention* 40(6): 1964–1969. http://dx.doi.org/10.1016/j.aap.2008.07.007

Gaardbo, A.; Schelling, A. 1997. *Håndbog i Trafiksikkerhedsrevision*. Danmark. Vejdirektoratet. 56 p. (in Danish).

Laurinavičius, A.; Grigonis, V.; Ušpalytė-Vitkūnienė, R.; Ratkevičiūtė, K.; Čygaitė, L.; Skrodenis, E.; Antov, D.; Smirnovs, J.; Bobrovaitė-Jurkonė, B. 2012. Policy instruments for managing EU road safety targets: road safety impact assessment, *The Baltic Journal of Road and Bridge Engineering* 7(1): 60–67. http://dx.doi.org/10.3846/bjrbe.2012.09

Lietuvos automobilių kelių direkcijos prie susisiekimo ministerijos direktoriaus įsakymas dėl kelių tinklo saugumo lygių nustatymo tvarkos aprašo patvirtinimo Nr. V-61. 2011 m. vasario 25 d. Available from Internet: http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=395036 (in Lithuanian).

Lietuvos Respublikos susisiekimo ministro įsakymas dėl avaringų ruožų nustatymo valstybinės reikšmės keliuose metodikos patvirtinimo Nr. 3-342. 2011 m. birželio 7 d. Available from Internet: http://www3.lrs.lt/pls/inter3/dokpaieska.

showdoc_l?p_id=401193&p_query=&p_tr2=2 (in Lithuanian).

Road Safety Audit Guidelines. 1999. University of New Brunswick Transportation Group. New Brunswick, Canada. Available from Internet: http://www.unb.ca/research/transportation-group/_resources/pdf/rsa-guidelines.pdf

SÉTRA. 2008. *Methodological Guide: Road Safety Inspections*. Service d'études sur les transports, les routes et leurs aménagements (SÉTRA). 70 p. Available from Internet: http://www.setra.equipement.gouv.fr/IMG/pdf/US_0928A_RSI_-_Road_Safety_Inspections.pdf

Sørensen, M. 2007. *Best Practice Guidelines on Black Spot Management and Safety Analysis of Road Networks*. TØI Report 898/2007. 67 p. Available from Internet: https://www.toi.no/article19503-29.html

Toth-Szabo, Z.; Várhelyi, A. 2011. *Road Safety Audit – Good Practice Review for Implementation*: *Recommendations for Road Safety Impact Assessment*. BALTRIS Project report WP 3.2.2. 51 p. Available from Internet: http://www.baltris.org/files/Good-Practice-Review-1-kopia.pdf

WHO. 2004. *World Report on Road Traffic Injury Prevention*. World Health Organization, Geneva. 244 p. Available from Internet: http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/index.html.