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# THE ROAD SAFETY AUDIT AND ITS INFLUENCE ON ROAD DESIGN PROCESS: IMPLEMENTATION OF EU DIRECTIVE 96/2008

**Lutz Stefan Pfeiffer[1], Krsto Lipovac[2], Dejan Jovanov[3]**
*1 VIALE Consult, Germany*
*2 Academy of Criminalistic and Police Studies, Serbia*
*3 TSM – Association for Road Traffic Safety Management, Serbia*

## Abstract

The paper introduces the Road Safety Audits (RSA) and Road Safety Inspections (RSI) as one of high potential road safety tools. Also, the role of RSA/RSI is presented under the lights of new EU Directive 96/2008 on road infrastructure safety management [3]. Focus of paper is given to the presentation of main common findings and results of a few available RSA/RSI officially done in Region (by authors of paper or collected as existing reports) and to the establishment of the connection between the findings and direct potential for design improvements. A deep analysis was carried out in the way to identify most common design deficits, and the findings are presented. It is shown how RSA/RSI could be used for improving the road design process.

*Keywords: Road Infrastructure Management, Road Safety Audits (RSA)*

## 1 Introduction

The goal of recently finished EU project "Support for Implementing Measures for South East Europe Core Regional Transport Network Multi Annual Plan (MAP) 2008-2012" - Europe Aid/125783/C/SER/MULTI [8], was "to continue to pursue joint efforts for fostering a harmonized reform and integration process in the transport sector across the South East Europe Region and to support the improvement in the efficiency of the SEE Core Regional Transport Network". The project was made up of two components, relating to South East European Transport Observatory (SEETO) Multi Annual Plan 2007-2011. One of them was dedicated to the Road Safety Auditing as a tool for improving the road safety of infrastructure.
This Paper presents the main common findings and results of a 14 available Road Safety Audit (RSA) and Road Safety Inspection (RSI) Reports, officially done in Region (in Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Former Yugoslav Republic of Macedonia, Kosovo under UNHSCR 1244 and Albania). Basic goal of Paper is to summarize the most common road safety deficiencies (observed by RSA) in the design phases, as well as, to show the major road safety weakness of the existing roads (record by RSI) in Region. These findings should be used for future improving the road design process and standards which will lead to the safer roads.

## 2 Road Safety Management (EU Directive 96/2008)

It is a popular misconception that the faults or bad behavior of a driver are alone in almost all cases the cause of road traffic accidents. As result of a basic research project it is evident, that in every third accident the road environment has at least some influence (road environment factors 34 %) [10].

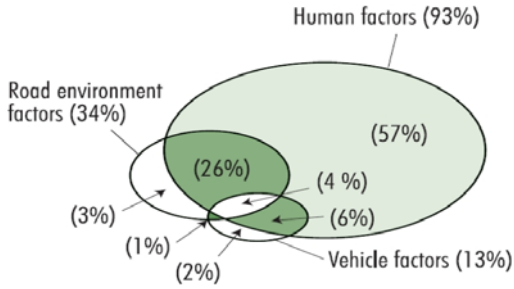


**Figure 1** The contribution of accident factors (Source: PIARC Road Safety Manual, 2003)

Therefore, the idea for a Road Safety Management came out because of dangerous road sections and intersection also along new constructed roads in many countries.
After almost two decades of experience with the RSA all over the world [1], this procedure is recognized as one of the most important engineering tool in our hands. With its Directive of the European Parliament and of the Council no. 2008/96 on road infrastructure safety management, published in October 2008, the European Union made a clear decision that the Road Safety Audit will be mandatory for the trans-European Road Network in the next years. In the mentioned directive [3] the RSA is part of a package of the following road safety measures like:

- Road safety impact assessment (RIA),
- Road safety audit for the design stages of roads (RSA),
- Safety ranking and management of the road network in operation, including management of high risks road sections (BSM),
- Road safety inspections for existing roads (RSI) and
- In-depth accident analysis (IDS).

The introduced RSA and RSI are an integrated part of the road safety management (shown in Figure 1) [8].

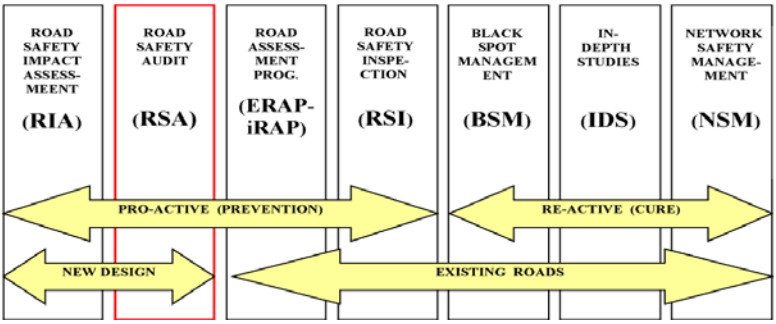


**Figure 2** Figure 1. The Road Safety Audit as part of the Road Safety Management

The RSA is pro active formal examination of a road project.
The RSA procedure is [9]:

- A formal process,
- An independent process,
- Carried out by someone with appropriate experience and training and
- Restricted to road safety issues.

The outcome of a RSA is a formal Report, which identifies any road safety deficiency and if appropriate, makes recommendations aimed at removing or reducing the deficiencies.
The RSA is an approved tool to improve the road environment factors. With the audit expert knowledge it is possible to reduce the number and severity of traffic accidents by improving

the road safety performance of an infrastructure project. The RSA as a part of a quality assurance system will ensure that every investment will be as effective as possible because a safe road is a sustainable investment.
According to the experience in Western Europe and mentioned latest EU directive, there are four different stages during which Road Safety Audits are conducted:

- Stage 1: draft (or preliminary) design,
- Stage 2: detailed-design,
- Stage 3: pre-opening of the road and
- Stage 4: early operation – when the road is some time in operation.
  RSI use the similar procedure, but it is used for existing roads (roads in use). The output of RSI is formal Report, which is slightly different from RSA Report.

# 3 Results of the RSA and RSI Reports in Region

## 3.1 Overview about the Road Safety Audit findings

All RSA and RSI Pilots in Region were conducted upon written RSA and RSI Manuals and accompanying check-lists and together with local engineers [8]. The basis for the RSA was the design documents of a preliminary or detailed design phase and existing roads for RSI. The projects for audit and the content of the documentation were quite different. This was on one hand very good to get an overview about the problems in different fields of road design tasks (rehabilitation projects, new motorways, interurban link sections, intersection projects). On the other hand in few cases not all necessary design documents were available according to the demands of the RSA procedure. The different character and the different content of the documentation have been taken into consideration when preparing the overview of findings. Typical problems, sorted by the categories given in the RSA Manual, are identified as follows [2], [4]:

### 3.1.1 Function

In the audited project documentation only few problems were found regarding the function of road were identified. A typical situation is for example the choice of the legal speed in intersection (legal speed was too high). That means, regarding the audited projects that obviously the road administration and the designers made right decisions regarding the function and operation of the road.

### 3.1.2 Cross section

According to the findings in the Pilots, it is obvious that problems regarding the cross section can be found quite often. In some case the designed dimensions of the road can lead to safety deficiencies. For example the cross section is too narrow for the expected traffic. In another case the 2-lane cross section should have asphalted hard shoulders in addition.
Another quite common problem is the lack of sufficient drainage conditions for the case of the transition of the cross fall of the carriageway in front of curves.
Finally it is recommended to have in future projects generally with gravel stabilized shoulders along the carriageway in order to reduce the risks of runoff incidents.

### 3.1.3 Alignment

Only few RSA problems occur due to alignment. A lack of alignment consistency regarding the curve design was identified, that was quite surprising because the rules for a consistent curve design are well known since decades. Of course, sometimes it is unavoidable to have an alignment designed not in accordance with the consistency principles because of some space restriction. But in that case at least some assistance to the driver like chevron sign etc. should be foreseen. In one case of audit, in a mountainous road section with steep gradients climbing lanes were missing.

### 3.1.4 Intersections, traffic lights, railway crossings

In the pilot audits, most findings were regarding this topic. With the exception of one audit, project intersections were always included in the audited project. Obviously, road safety issues are not well catered for the intersection design and the difference in the design philosophy as well in detail solution of intersections and interchanges is in Region quite different from the best practices used in Western Europe. That could be because of the fast advances of the intersection design principles in developed countries in the last 20 years, especially for improving road safety at intersections, which constitute the most critical points in a road network. In one RSA, traffic signals were included. The typical findings regarding intersections were:

- lack of left turning lane in high speed section,
- inconsistency of the design principles with adjacent intersections,
- the design of the intersection does not support hierarchy of road and right of way. There are missing islands at canalized junctions,
- insufficient sight conditions and
- difficult multilane roundabout solutions.

### 3.1.5 Public and private services, service and rest areas

Facilities for rest areas were not included in any of the audited projects.

### 3.1.6 Vulnerable road user needs

Since the emphasis of project is in intercity roads, only few pilots included evaluation of the needs of pedestrian traffic. In some projects it was not quite clear if pedestrians have to walk along or cross the road or not. It is obvious but not unusual that the needs of pedestrians from settlements nearby or along the road are not in the main focus of Road Administrations (designers). As conclusion, in future road design should provide more attention to the needs of the vulnerable road users. Especially in the case of rehabilitation and reconstruction projects with a higher traffic speed level then before, the risks for pedestrians is usually higher than in the previous time and can cause more fatal accidents then before intervention.

### 3.1.7 Traffic signing, marking and lighting

In the ranking of the most common deficiencies, signing and marking issues are on the top. Although the number of findings was high, the identified problems were in every case almost the same. The typical, but not unusual findings were:

- missing regulating signs for speed limit, overtaking forbidden etc.,
- contradictions between signing and marking and
- missing warning signs like curve warning signs and chevrons.

### 3.1.8 Roadside features and passive safety installations

There is without any doubts a big potential to increase the road safety by a sufficient usage of passive safety installations. But in the audited projects, a remarkable number of problems regarding road safety were identified. Typical mistakes in the design of passive installations are:

- missing guardrails in the case of high embankments,
- missing guardrails in bridge sections and
- lamp poles as fixed obstacles.

In general there is an urgent need to introduce the European Norms (EN 1317) with all its 5 parts to ensure the necessary performance of the safety barriers. This would also help to avoid mistakes in the design process.

### 3.2 Overview about the Road Safety Inspection findings

In detail, the findings and examples (not shown because of paper length limitation), with proposals for improvements [4], [5], [6] according to the RSI Manual categories are summarized below:

#### 3.2.1 Function

In the pilots it was evident, that a lack of sufficient and sustainable functional performance is one of the main problems. There are big contradictions between mobility and access. As a most typical problem, the lack of the access control is identified.
The main arterials, as road sections of the core network nearby big cities are very attractive for business and trading activities. In addition there is often no backup sufficient secondary network for access. That leads to a situation that in addition to their original function to guarantee the mobility for the through traffic the road shall ensure access. There are challenging problems resulting not only for the road safety but also for the level of service and average travel speed.
Furthermore in the concept of the legal speed this special situation (high number of turning maneuvers and pedestrians) is often not respected. For the driver it is partly not understandable if he is driving inside or outside the built up area. The existing speed limits in subsections with pedestrian traffic are sometimes dangerous (60 – 70km/h) and can lead to serious consequence of accidents with pedestrians.
To improve that situation, a strict policy to avoid access on interurban roads and a reorganizing of existing facilities (separation with service road etc.) is necessary.

#### 3.2.2 Cross section

In some RSI pilots, problems regarding the cross section were found out. The main findings were lack of super elevation in curves, low long fall in section with turning direction of the cross fall, road surface in bad conditions (ruttings, lack of skid resistance) and in one situation too narrow lanes in an interchange subsection.

#### 3.2.3 Alignment

In few RSI pilots, problems regarding the alignment were identified. The identified issues are very common for similar existing network. The typical deficiencies were identified as a lack of alignment consistency regarding the curve design and insufficient sight distances.

#### 3.2.4 Intersections, traffic lights, railway crossings

In some cases intersections were also included in the RSI pilot sections. The most common problems are quite unorganized intersections with unsafe length of acceleration and deceleration lanes as well as lack of turning lanes, missing signs and missing sight conditions.
In one RSI Pilots a roundabout solution was included. The roundabout was quite new, unfortunately in some details the solution was insufficient (number of lanes, too low deflection leads to speeding, missing signs etc.).
In one pilot, traffic signals were included (traffic signals under construction). The RSI team made some suggestions to improve the visibility of the traffic signals.

#### 3.2.5 Public and private services, service and rest areas

Regarding this issue, the typical problem in the Region is at one hand the lack of sufficient rest place (esp. for trucks) and on the other, the unsafe solution of access to petrol stations along interurban road sections.

### 3.2.6 Vulnerable road user needs

Only in few pilots the inspected road section was in an area with pedestrian traffic. If there was pedestrian traffic common problems were identified like a lack of footpath connection or crossing facilities.

### 3.2.7 Traffic signing, marking and lighting

In almost all pilots problem regarding the signing and marking were identified like:

- missing regulating signs,
- missing directional signing or misguiding signing and
- marking with bad performance especially at night.

This is quite surprising because in the existing standards the instructions are usually precise.

### 3.2.8 Roadside features and passive safety installations

Considering the challenging situation regarding the road function the passive safety installation are together with the signing and marking the most common problem. The following typical deficiencies were identified:

- lack of passive safety installations at dangerous spots,
- insufficient technical solutions (like usage of wrong connection bolts and welded connection of beams, dangerous end construction etc.) and lack of maintenance after crashes,
- lack of coordination between sufficient safety barrier solution along road sections and adjacent bridges and
- hard obstacles along the road.

## 4 Conclusion

With its EC Directive 96/2008 on Road Infrastructure Safety Management, published in October 2008, the European Union made a clear decision about the Road Safety Audit and the Road Safety Inspection.

Between other road safety tools, RSA/RSI present a highly effective tool for road infrastructure safety management [7].

Detailed analysis of first Pilots and RSA/RSI Reports shows some common findings (design and maintenance deficits). According to the format of this paper, only major deficiencies collected in 14 RSA/RSI Reports were shown.

The results of the RSA and RSI are evidence that there is a urgent need for a modern RSA and RSI System all over the Region. With the results of the RSA it is possible to reach the target of more road safety for all road users and a good efficiency of the future investments. The RSI will help to identify the weakness in the existing road network and to create conceptions for improvements.

Furthermore the knowledge collected from RSA/RSI procedures can be used at two different levels.

First way is improving of road safety inside RSA/RSI process (build a triangle client-designer-auditor/inspector).

Second way of improving the road safety is more systematically oriented and assumes that all noticed common road safety deficiencies will be implemented in new road design standards. This directly shows how RSA/RSI could be used for improving the road design process.

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