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STANDARDIZED SET OF COMMON ROAD SAFETY AUDIT PROCEDURES, ACCORDING TO EU STANDARDS, PREPARED FOR SEETO PARTICIPANT AND TESTED THROUGH PILOT PROJECTS

Final

Specific Project Result no. 13

October, 2009

creative minds safe hands

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Abbreviations

AADT	Annual Average Daily Traffic
ADB	Accident Data Base
ALB	Albania
AMM	Annual Meeting of Ministers
BiH	Bosnia and Herzegovina
CA	Contracting Authority (EC DG ELARG)
CARDS	Community Assistance for Reconstruction, Development and Stabilisation
Consultant	WYG Engineering, TRADEMCO, Vienna Consult, TRL
DG ELARG	Directorate General for Enlargement
DG TREN	Directorate General for Transport and Energy
EBRD	European Bank of Reconstruction and Development
EU	European Union
EC	European Commission
HR	Croatia
IFI	International Financing Institution
IT	Information Technology
KOS	Kosovo (under UNSCR 1244/1999) – as mentioned in the TOR
MK	former Yugoslav Republic of Macedonia
MAP	Multi–Annual Plan
MNE	Montenegro
MoT/C	Ministry of Transport/and Communications
MoU	Memorandum of Understanding
NGO	Non Governmental Organisation
PE	Public Enterprise
PEC	Pan European Corridors
PM	Project Management
PMU	Project Monitoring Unit
PPR	Project Progress Report
RS	Road Safety
RSA	Road Safety Audit
RSI	Road Safety Inspection
RRSS	Regional Road Safety Strategy
RS TF	Road Safety Task Force
RS WG	Road Safety Working Group
SEE	South East Europe
SEETO	South East Europe Transport Observatory
SC	Steering Committee
SPR	Specific Project Result
SRB	Serbia
TA	Technical Assistance
TEN-T	Trans European Networks (Transport)
TF	Task Force
ToR	Terms of Reference
WB	World Bank
WG	Working Group
WS	Workshop

1. Introduction

Specific Project Result 13 is defined in ToR as "**Standardized set of common Road Safety Audit procedures, according to EU standards, prepared for each Participant and tested through Pilot projects**".

This Report is dealing with the updating of Road Safety Audit (RSA) and Road Safety Inspection (RSI) Manuals and common road safety procedures which are made upon the results of the Pilot projects in each SEETO Participants. It means that both Manuals and particularly their checklists have been revised and improved on the basis of local conditions of infrastructure and other local conditions related to road safety.

The report consist of 5 Chapters, which other than this "Introduction" Chapter concern the following topics:

- Chapter 2 "Revision of Draft Road safety Audits and Inspection Manuals" explains why and how were the changes to the first drafts of the RSA and RSI Manuals made and by whom have the changes been suggested,
- Chapters 3 and 4 "Results of the Road Safety Audit and Inspection Pilots", present a comprehensive and comparative analysis of RSA and RSI Pilots, that the Project carried out in all seven SEETO Participants.
- Chapter 5 "Comments regarding education and certification of Road Safety Auditors and Inspectors", is provided over and above the requirements of the TOR. It contains information concerning the training procedures in EU for the certification of experts as road safety Auditors and/or road safety Inspectors. It also attempts a first estimate of the number of RSA/RSI Auditors and Inspectors that will be initially necesssary in SEETO Participants, when according to EU Directive 2008/96 RSA and RSI will become mandatory.

The Report is accompanied by two Annexes in which the revised final versions of the RSA and RSI Manuals are provided as follows:

- Road Safety Audit Manual, with its own Annexes consisting of the relevant checklists,
- Road Safety Inspection Guideline, with its own Annexes consisting of the relevant checklists.

The specific results of the Audit and Inspection pilots are not submitted in this report since they are confidential, due to a potential conflict between results found and safety risks that may be actually observed on the roads. These so called "audit/inspection reports" have been submitted only to the RS Working Group member of the respective SEETO Participant as well as to SEETO Secretariat and in particular to the General Manager of SEETO and to the Transport Planning Manager and they are intended for internal use ONLY, in each case.

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2. Revision of draft Road Safety Audit and Road Safety Inspection Manuals

The draft of the Road Safety Audit and Road Safety Inspection Manuals were firstly delivered in March 2009 to the representatives of SEETO Participants in the RS WG, as Specific Project Result 12 A and 12B..

These Manual were also submitted as Annex 4 to the 2nd Project Progress Report that was submitted in May 2009 to EC and to all the members of the RS WG..

In the period April till July 2009 the RSA and RSI pilots were conducted, in all seven SEETO Participants.

The procedure for the revision of the Manuals is explained in the following graph.

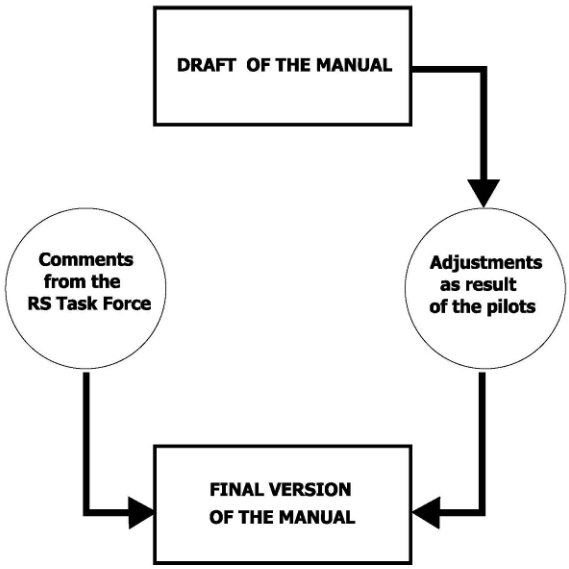


Figure 2.1. Process of RSA/RSI Manual Revision

The comments from the RS Tasks Force were received orally during the TF meeting in Skopje on July 1. One SEETO Participant gave comments in a written way (Albania). Other comments were given by the SEETO Secretariat (SEETO Transport Planning Manager). Furthermore one suggestion was received from the World Bank.

Very helpful for the revision of the Manuals were the discussions with local experts during the practical RSA and RSI pilot work. It was possible to clarify several questions of the main part of the Manuals regarding the process of the RSA/RSI and the corresponding responsibilities. In the pilots, the relevant checklists were used.

With this feedback it was possible to revise also the checklists. According to the local situation of the infrastructure or of other safety related conditions, some questions of the checklist were not not considered feasible anymore, while for some other questions more clarification and explanation was needed. The following changes were done to the Manuals:

- Revision of the main body inter alia about the role of the partners in the RSA/RSI process (Revision Commission etc.), cross reference to EU documents, information about typical deficiencies and the training of auditors/inspectors,

- Revision of the checklist with addition of some new relevant questions for the regional situation and some re-structuring to make the work with the checklists easier,

- Revised annexes with example for reports and overview about the findings of the pilots

The changes are minor.

The revised RSA and RSI Manuals are now appended to this Specific Project Result as Annex 1 and 2.

3. Results of the Road Safety Audit Pilots

3.1. Overview about the findings

The RSA experts of the project team have conducted in every SEETO Participant an RSA of the audit stage 1 or 2. The pilots were conducted together with local engineers. The basis for the RSA was the design documents of a preliminary or detailed design phase, according to the RSA Manual which were provided to the project team by the members of the RS WG of SEETO Participants.

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 design documents were available according to the demands of the RSA Manual. For conducting the pilot, the project tasks were successfully carried out, but for future RSA the necessary design documentation should be complete. The different character and the different content of the documentation has to be taken into consideration when comparing the number and character of findings.

The table below shows in chronological order the RSA pilots and their findings.

Table 3.1.1: RSA pilots and findings

SEETO-Participant	Project data, characteristics	Findings
Montenegro	National road M2, between km 1034+613 - km 1035+490 Length: about 0,8 km, Interurban character, 2-lane, one carriageway, Rehabilitation project, Part of the European network (E 65/80) Rehabilitation project, Date: 03/04/2009	• Number of problems: 16 • Number of remarks: 4 • Main deficiencies: passive safety installation and marking and signing
Serbia	Motorway M 1 (E 75) Section from Grabovnica – Grdelica Subsection Interchange Grdelica km 872+080 – 872+930 (“red variant”), Length: about 0,85 km, New Motorway with 2-lane, 2 carriageways, Preliminary design, Date: 21/04/2009	• Number of problems: 10 • Number of remarks: 6 • Main deficiencies: drainage problems on the motorway, design of the interchange and the adjacent inter-sections in the secondary network with critical solu-tions in detail
Albania	National Road E 852 (SH 3) (part of European Corridor 8) Section 1: Korca – Ploca (from km 21+250 to km 29+143) Length: about 7,9 km,	• Number of problems: 26 • Number of remarks: 3 • Main deficiencies: unsafe cross section, deficiencies in the alignment, intersection

	Interurban character, some short through road section, 2-lane, one carriageway, Detailed design, Rehabilitation project, Date: 15/05/2009	solutions and pedestrian facilities, partly lack of necessary passive safety installations
former Yugoslav Republic of Macedonia	Regional road R-409, between km 34+666,53 to km 37+699,22, Length: about 3,0 km, Interurban character, Detailed design, Reconstruction project, 2-lane, one carriageways, +Date: 21/05/2009	• Number of problems: 14 • Number of remarks: 3 • Main deficiencies: unsafe narrow cross section, intersection solution and pedestrian facilities, partly lack of necessary passive safety installations
Croatia	Motorway A11, Zagreb-Sisak Subsection - Interchange Buševec from km 8+000 to km 9+000, Length: about 1,0 km, New Motorway with 2-lane, one carriageways, Detailed design, Date: 28/05/2009	• Number of problems: 5 • Number of remarks: 2 • Main deficiencies: details of intersection design of the interchange with secondary network
Kosovo (under UNSCR 1244/1999)	Separate graded roundabout at entrance of Pristina, junction of roads M2 and M9, Length: - km, New intersection of two main arterials, incl. one roundabout, Detailed design, Date: 22/06/2009	• Number of problems: 7 • Number of remarks: - • Main deficiencies: solutions regarding the foreseen roundabout design
Bosnia and Herzegovina	Magistralni put M4 Kalesija bypass (design-km 0+000 to km 5+779), Length: 5,7 km, New bypass with two lanes, Detailed design, Date: 09/07/2009	• Number of problems: 12 • Number of remarks: 2 • Main deficiencies: problems regarding the consistency of the alignment, details of intersections design, signing, safety barriers

3.2. Conclusion from the RSA pilots

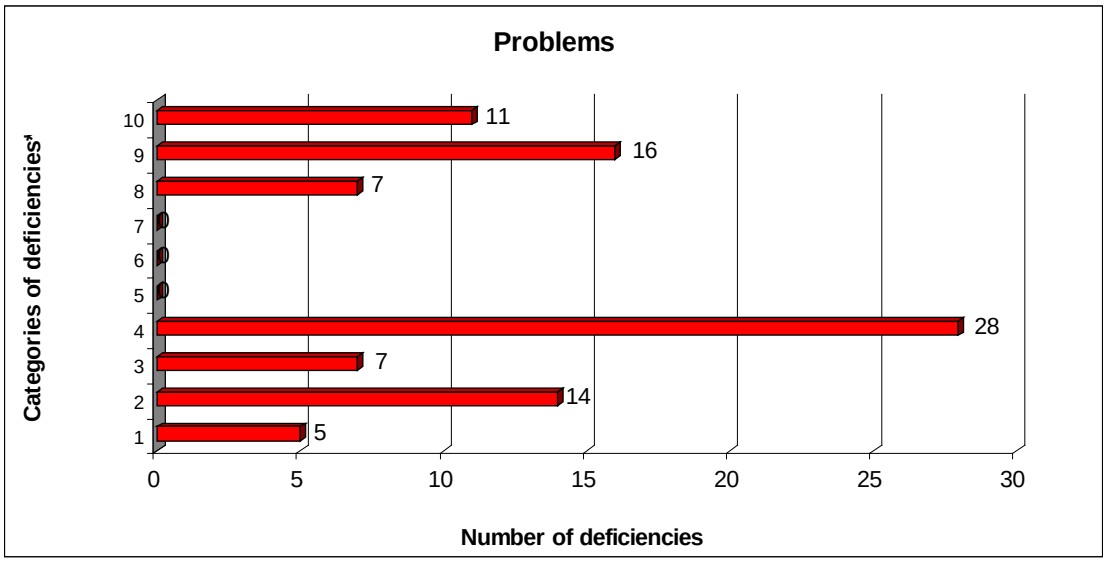
In the seven RSA reports of the pilots, in total 90 problems regarding the road safety were identified. The main deficiencies are typical design mistakes and with some minor differences in details, the problems were quite similar.

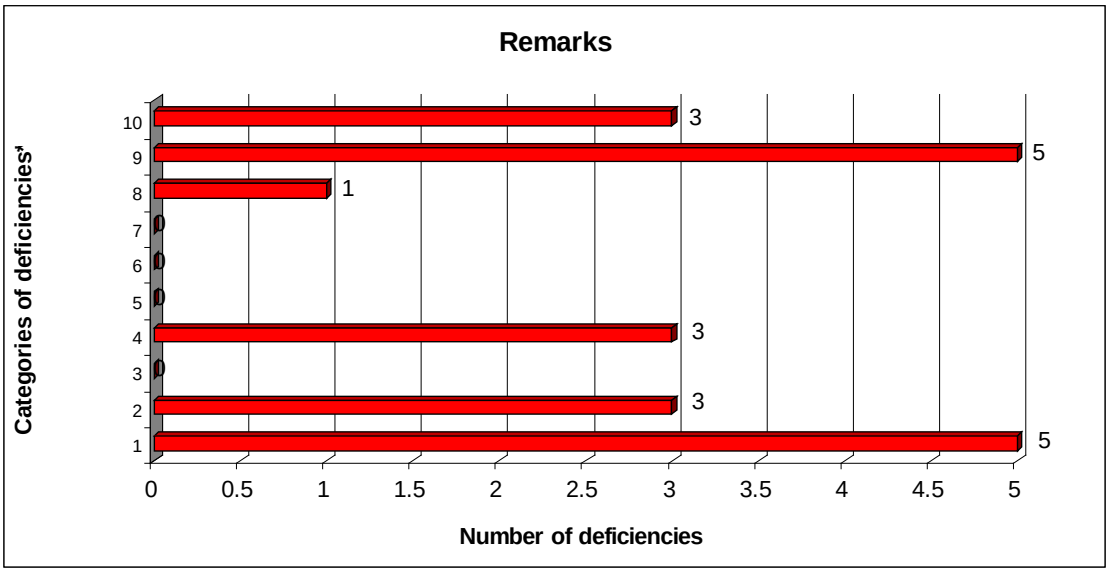
In the following table the findings are sorted by the RSA Manual categories:

Table 3.2.1.: RSA finding sorted by RSA Manual categories

	MNE	SRB	ALB	MK	HR	KOS	BiH	Total
Problems	13	9	25	14	5	7	15	88
1 Function, Operating elements	1	0	0	1	0	0	3	5
2 Cross section	2	2	4	3	1	0	2	14
3 Alignment	0	0	3	2	0	0	2	7
4 Intersections, Interchanges	0	5	7	2	3	6	5	28
5 Traffic signals, ITS	0	0	0	0	0	0	0	0
6 Railway crossings	0	0	0	0	0	0	0	0
7 Service and rest areas	0	0	0	0	0	0	0	0
8 Need of vulnerable road users, Public transport	0	0	4	2	0	1	0	7
9 Traffic signing, marking, lighting	4	2	5	3	0	0	2	16
10 Civil engineering structures Passive safety installations	6	0	2	1	1	0	1	11
Remarks	4	6	3	3	2	0	2	20
1 Function, Operating elements	1	2	1	1	0	0	0	5
2 Cross section	1	0	0	0	2	0	0	3
3 Alignment	0	0	0	0	0	0	0	0
4 Intersections, Interchanges	0	3	0	0	0	0	0	3
5 Traffic signals, ITS	0	0	0	0	0	0	0	0
6 Railway crossings	0	0	0	0	0	0	0	0
7 Service and rest areas	0	0	0	0	0	0	0	0
8 Need of vulnerable road users, Public transport	0	0	1	0	0	0		1
9 Traffic signing, marking, lighting	1	0	1	1	0	0	2	5
10 Civil engineering structures Passive safety installations	1	1	0	1	0	0	0	3

In the following graph the contribution of the problems and remarks is illustrated:





The need of a sufficient Road Safety Audit system is evident by the findings. Although there is in almost all SEETO Participants a quality assurance system like the official Revision Commissions installed in the level of the Ministry of Transport, there is a big potential to improve the safety performance of the projects.

In some cases there is a need of improvement of the design, although the design was done according to the existing but mostly obsolete design norms. In other cases the design was not following the demands of existing norms. If the norms will be renewed and further developed in the future on a basis of international best practice, some typical design deficiencies can be avoided.

The typical problems sorted by the categories of the RSA Manual are identified as follows:

3.2.1. Function

In the audited project documentation only few problems regarding the function of road were identified. A typical situation is for example the choice of the legal speed in intersection (legal speed 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.

3.2.2. 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 run off incidents.

3.2.3. Alignment

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[1] etc. should be foreseen. In one case of an audit, in a mountainous road section with steep gradients climbing lanes were missing.

3.2.4. 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 most SEETO Participants quite different from the best practises used in Western Europe. That could be because of the fast advances of the intersection design principles in Western Europe in the last 20 years for improving road safety at intersections, which constitute the most critical points in a road netowrk. In one RSA, traffic signals were included. No pilots was conducted at railway crossings.

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;
- difficult multilane roundabout solutions.

3.2.5. Public and private services, service and rest areas

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

3.2.6. 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 near by or along the road are not in the main focus of Road Administrations. 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.

3.2.7. 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:

1 

- Missing regulating signs for speed limit, overtaking forbidden etc.;
- Contradictions between signing and marking;
- Missing warning signs like curve warning signs and chevrons.

3.2.8. 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 was identified.

Typical mistakes in the design of passive installations are:

- Missing guardrails in the case of high embankments;
- Missing guardrails in bridge sections;
- Lamp poles as fixed obstacles.

In general there is an urgent need to introduce the European Norms (EN 1317) with all its 5 parts[2] to ensure the necessary performance of the safety barriers. This would also help to avoid mistakes in the design process.

[2] List of parts of the EN1317

EN 1317-1 : Terminology and general criteria for test methods
EN 1317-2 : Performance classes, impact test acceptance criteria and test methods for safety barriers
EN 1317-3 : Performance classes, impact test acceptance criteria and test methods for crash cushions
EN 1317-4 : Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers
EN 1317-5 : Product requirements, durability and evaluation of conformity

4. Results of the Road Safety Inspection Pilots

4.1. Overview about the findings

The RSA / RSI experts of the project team has conducted in the period from April to July 2009 seven Road Safety Inspections in the Region. The pilots were done together with local engineers in every SEETO Participant. The following table contains the findings with the assessment of deficits.

The table below shows in chronological order the RSI pilots and their findings.

Table 4.1.1: RSI pilots and findings

SEETO-Participant	Project data, characteristics	Assessment of deficits RSI pilots
Montenegro	Interurban road in a mountainous area, Road M2, Length: about 1 km, 2-lane, one carriageway, Part of the European network (E 65/80) Date: 31/03/2009	• Lack of super elevation with combination with problems regarding skid resistance, • Lack of safety guardrails, "windows" in the guardrail systems, no guardrails on bridges • Problems regarding road surface (rutting, potholes, drainage problems), • Problems with hard obstacles (fallen materials on the road, open manholes), • Bad sight conditions at intersections and missing signs, • Lack of sufficient rest areas, • Problems regarding marking and signing (some missing signs, marking in bad condition, missing delineators, missing edge lines, broken center lines suggestion, not sufficient coordination between horizontal and vertical signalization), • Bad sight conditions passing tunnels, driver can loose orientation
Serbia	Interurban road near Belgrade, Road M22, Length: about 2 km, 2-lane, 2 carriageways, part of the interchange "Orlovaca" Date: 07/04/2009	• Unclear and unsafe situation for the interim solution for the interchanges, especially markings and signing, • too short and narrow weaving lane at one intersection, • unrecognizable and surprising change of cross section in a curvy situation (left curve after one intersection), • unsafe exit at another intersection with a lane subtraction • Problems with directional signing causes confusion to the drivers • After the long straight section, curvy situation with lack of chevron signs and delineators, as well as guardrails • Unprotected lamp posts and direction signs- need of additional guardrail sections • Insufficient speed limit at the area of interchange.

Albania	Interurban road near Tirana, Road M22, Length: about 2,6 km, 2-lane, one carriageways, connection to the Tirana International Airport Date: 12/05/2009	• Number of small intersection and accesses to the private properties in contradiction with the foreseen function and operation principle as a express connection to the airport • Fixed hard obstacles near by road such as lamp post, billboards, etc. • Speed limit concept should be revised, • Unclear limit of urbanized area, • Some problems regarding signings (missing stop signs and missing chevron signs in curves) are recognized. Some correction of marking are necessary (phantom markings, correlation between marking and signing for forbidden overtaking) • No left turning lanes on small intersection with local roads. • Destroyed bridge joint can be dangerous especially powered two wheelers
former Yugoslav Republic of Macedonia	Interurban road near Skopje, Road M 3, Length: about 2,0 km, 2-lane, one carriageways, Part of the European network (E 65) Date: 20/05/2009	• Number of small and illegal intersections and accesses to the private properties is in contradiction with the foreseen function and operation of the road. • Bad sight conditions along the road and at access points (regular maintenance of the road), • Improving of the road signing and marking (including the intersection, for marking the usage of modern cold plastic materials with better retroreflection and better sustainability is recommended), • Problems regarding the pavement of the carriageway (rutting, pot holes) • Drainage system should be improved (re-profiling of ditches), • Few fixed hard obstacles near by road (directional signs and tree), • No left turning lanes on gasoline station (it should be checked). • Existing guardrail system is partly incomplete
Croatia	Interurban road, Road D1, Length: about 1,0 km, 2-lane, one carriageways, Diversion link for motorway, partly through road character with pedestrian traffic Date: 26/05/09	• Number of small accesses to the private properties is in the contradiction with the foreseen function and operation of the road (foreseen AADT is about 12000 pc/d), • Harmonization of speed limits, • Visibility at small intersections from secondary roads (to ensure give way), • Visibility and recognize ability of traffic signals, especially the repetition signal. • System of sidewalks incomplete, risks that pedestrian will use the carriageway for walking.
Kosovo (under UNSCR 1244/1999)	Interurban road section near by Pristina, Road M2, Length: 2,7 km,	• Unclear and unsafe situation for the roundabout especially with the unsafe and unusual connection with the service roads (too many conflict points, incomplete signing, wrong marking, high entrance speed, merge problems, dangerous manoeuvres by

	main arterial character, two divided carriageways, parallel service roads, incl. one roundabout, Part of the European network (E 65) Date: 22/06/2009	drivers with destination to the service roads), • Dangerous solution for the access to the fuel station from the main carriageway, • Operation principle for the parallel service roads as two way roads cause safety problems especially at the connecting points, • Concept and regulation for legal speed especially for the service road is not clear, • Solution for a safe pedestrian traffic is unclear, one pedestrian bridge is existing but no connection for guiding the pedestrians to the bridge, • Missing passive safety installation for the underpass near intersection Lapo Selo • Incomplete signing
Bosnia and Herzegovina	Interurban road section near by Banja Luka Road M16, Length: 0,7 km, main arterial character, two carriageways without median separation, some access to adjacent shopping centre etc., Part of the European network (E 661) Date: 07/07/2009	• Unsafe cross section: Lack of separation of the directions can cause head on collisions and illegal “U” turns. • Speeding: Drivers behave like on a motorway (existing cross section as well as the number of accesses and speed limits are not in accordance). • Access control: Too many unsafe (and/or illegal) solutions of access roads in short distance with too short acceleration and deceleration lane. • Lack of directional signing: Can cause confusion to the drivers. • Some signs are missing and there are some problems with night visibility of the marking. • High risk of severe run off accidents: Unprotected bridge piles, deep ditches, illegal access to road need additional safety barrier protection. • Bad conditions of the road surface. • Crossing pedestrians.

4.2. Conclusion from the RSI Pilots

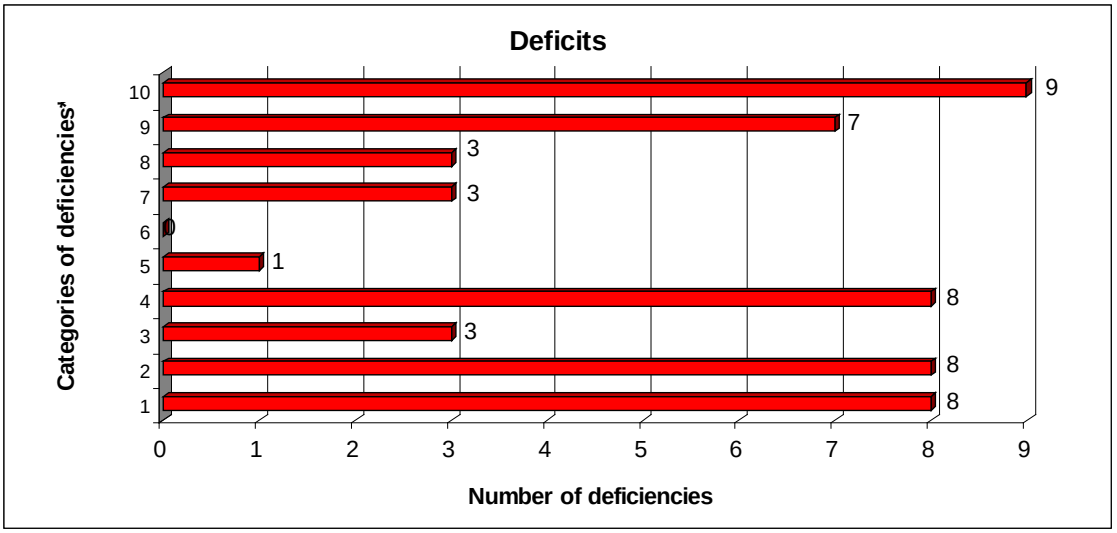
As a general conclusion, we can conclude, that the problems in the existing network are similar in the whole SEETO Region. When evaluated in more detail, we found out some differences which were obviously the result of the effort which was done during the last decade to improve the road safety by improving the infrastructure but the results were not always the anticipated ones.

In the following Table the findings are sorted by RSI manual categories:

Table 4.2.1.: RSI findings sorted by RSI Manual categories

	MNE	SRB	ALB	MK	HR	KOS	BiH	Total
Most critical deficit	8	8	7	8	5	7	7	50
1 Function, Operating elements	0	0	3	1	2	1	1	8
2 Cross section	2	1	0	2	0	1	2	8
3 Alignment	1	1	0	1	0	0	0	3
4 Intersections, Interchanges	1	3	1	0	1	1	1	8
5 Traffic signals, ITS	0	0	0	0	1	0	0	1
6 Railway crossings	0	0	0	0	0	0	0	0
7 Service and rest areas	1	0	0	1	0	1	0	3
8 Need of vulnerable road users, Public transport	0	0	0	0	1	1	1	3
9 Traffic signing, marking, lighting	1	2	1	1	0	1	1	7
10 Civil engineering structures Passive safety installations	2	1	2	2	0	1	1	9

The graph below shows clearly the weak points (x-axis= number of deficiencies and y-axis = RSI Manual categories):



We can summarise that most RSI challenges were identified in the RSI Manual categories “Road Function, Operation”, “Marking and Signing” as well as in “Passive Safety Installations, Road Side Features”.

Taking into consideration, that it is possible to improve the passive safety installation and the gaps regarding marking and signing with so called “low cost measures” a fast progress on the way to more road safety is realistic in the Region.

The identified problems regarding the contradictions between the foreseen road function and existing situation are worrying because of the difficulties to improve this situation. The main reasons for this situation are the lack of a consequent hierarchy of the road network, a lack of sufficient legal regulation or/and lack of enforcement of existing laws and regulations as well as contradictions between urban planning and traffic planning.

In detail, the findings and examples with proposals for improvements according to the RSI Manual categories are summarized in the Sections below, being also illustrated with some typical examples and pictures from the pilots.

4.2.1. 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 near by 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 manoeuvres 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 – 70 km/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.

The following pictures are examples to illustrate the findings regarding “function”:

Figure 2.1. Interurban road near by a city – unorganized access situation

Figure 2.2. Express road with parallel service road but direct access from a petrol station to the main carriageway

Comments to example in figure 2.1.:

Problem: Unorganized development of trading and business activities, the roadside is “occupied” as a big access area.

Proposal for improvements: Reorganizing access from secondary access road network, reduction - better closure of the access.

Comments to example in figure 2.2.:

Problem: The two carriageway express road have parallel service roads, but the costumers of a petrol station have direct access to the main carriageway

Proposal for improvements: Closing the direct connection, improvements regarding the directional sign can lead costumers to the petrol station by using the well developed service road with a small delay

4.2.2. Cross section

In some RSI pilots, problems regarding the cross section were found out. The main findings were lack of superelevation 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.

Figure 2.3. Ruttings and bleading of asphalt

Figure 2.4. Weaving lane too narrow for large vehicles

Comments to example in figure 2.3.:

Problem: The lack of evenness in combination with rain and snowfall can lead to serious problems for the driver like aquaplaning. In addition, very high risks for powered two wheelers.

Proposal for improvements: Resurfacing

Comments to example in figure 2.4.:

Problem: A two carriageway express road in a subsection of a splitlevel junction. In a first construction step an interim solution was design with an insufficient lane width for the weaving lane (approx. 2,5 m)

Proposal for improvements: Change of the marking would make it possible to have 3 x 3,0 m wide lanes

4.2.3. 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.

Figure 2.5. Curve sequence with small radii after a long stretched section is not visible

Figure 2.6. Lack of lateral clearance

Comments to example in figure 2.5.:

Problem: The curve sequence with small radii after a long stretched section is unexpected for a driver. There are not any measures foreseen to support the drivers perception like: chevron sign, delinators etc..

Proposal for improvements: Add sufficient warning signs, provide obstacle free zone in the outside of the curve (or guardrails) to reduce accident severity in the case of run offs.

Comments to example in figure 2.6.:

Problem: Lack of lateral clearance, problem with the stopping sight conditions

Proposal for improvements: Cutting the slope to ensure sight distance

4.2.4. 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, 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, 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.

Railway crossings with road were not inspected in any SEETO Participant.

Figure 2.7. "Canalized" junction without marking and signing

Figure 2.8. Regulation of the traffic with traffic signals – bad visibility regarding the signals

Comments to example in figure 2.7.:

Problem: In one road section we found a canalized junction which was obviously constructed some years ago. In the current situation there was not any marking to show the right and left turning lane and almost all signs were missing.

Proposal for improvements: It should be checked if this junction is still in use. If so, the situation should be improved with a proper marking and signing.

Comments to example in figure 2.8.:

Problem: From the secondary leg of a junction, the traffic signals (under construction) are hardly recognizable (esp. when the operation will start). One signal is hided by signs, the second is installed on the far and side of the road.

Proposal for improvements: It should be checked if it is possible to have overhead signals for better visibility.

4.2.5. 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 (pls. see section 2.2.1).

4.2.6. 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.

Figure 2.9. Bus-stop with lay-by, lack of crossing facility and connecting footpath

Figure 2.10. Modern pedestrian bridge crossing an express road with adjacent service roads, but lack of connection to guide the pedestrians

Comments to example in figure 2.9.:

Problem: Good designed bus lay-bys with shelter, but no regular pedestrian crossing, as well as no sufficient footpath connection to the adjacent built up area.

Proposal for improvements: Marked pedestrian crossing or traffic island as crossing help should be installed, improvements of footpath connection to avoid that pedestrians are forced to use the carriageway.

Comments to example in figure 2.10.:

Problem: Modern pedestrian bridge crossing an express road with adjacent service roads, but lack of connecting footpaths to guide the pedestrians to that facility.

Proposal for improvements: Parallel footpaths to connect the bridge with the adjacent built up area are necessary.

4.2.7. 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;
- Marking with bad performance especially at night.

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

Figure 2.13. Insufficient directional signing solution, misguiding marking

Figure 2.14. Marking in bad condition, old "phantom" marking

Comments to example in figure 2.13.:

Problem: The directional signing does not show the real situation of the three lanes and the complex situation (only 250 m after this interchange is the next one). Also the marking is mixed (broken line with solid line).

Proposal for improvements: Improvement of directional signing, clarify marking

Comments to example in figure 2.14.:

Problem: The marking is in the darkness not sufficient and the old" phantom" marking could misguide the driver.

Proposal for improvements: Renewing of the marking in sufficient quality for a European TEN road.

4.2.8. 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;
- Obstacles along the road.

Figure 2.15. Missing guardrail for an overpass bridge pile

Figure 2.16. Missing guardrail at the bridge section

Comments to example in figure 2.15.:

Problem: Missing guardrail for an overpass bridge pile along a express road. This is not only a problem of the result for the car which could hit this facility. It could be also a critical situation for the structure in the case of a hit by a big truck (is the structure stable enough).

Proposal for improvements: Installing of a sufficient safety barrier

Comments to example in figure 2.16.:

Problem: Missing guardrail at a viaduct and in the adjacent road section.

Proposal for improvements: Installing of a sufficient safety barrier.

5. Needs Assessment for Road Safety Auditors and Inspectors in SEETO Region

With its EC Directive 2008/096 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.

One core demand is that the Auditors should undergo an initial training resulting in the award of a certificate of competence and take part in periodic further training courses.

Also regarding the Road Safety Inspection there is no doubt that some education and training to ensure the quality of this task is necessary.

5.1. RSA/RSI Training procedures in the EU

5.1.1. Training and certification according to the EUROAUDIT project

To support the road safety work in the field of the infrastructure the European Union gave support to the EUROAUDIT project. The focus of this project was the preparation of a proposal for a European Road Safety Auditor Training Syllabus. The project was done by a Consortium of the European Union Road Federation (ERF), a nonprofit organisation, the TMS Consultancy (Great Britain) and the Asociación Española de la Carretera (AEC), a Spanish research institute. The project was finished in 2007. For sure we can identify some similarities to the British training concept, because TMS is one of the leading companies for RSA in United Kingdom (UK). It has to be mentioned, that in UK the RSA is in use since 1988 and that there is a good source of knowledge in the field of road safety engineering.

Proposal for training procedures

In the following graph of EUROAUDIT project, the proposed training procedures and the way of certification is explained.

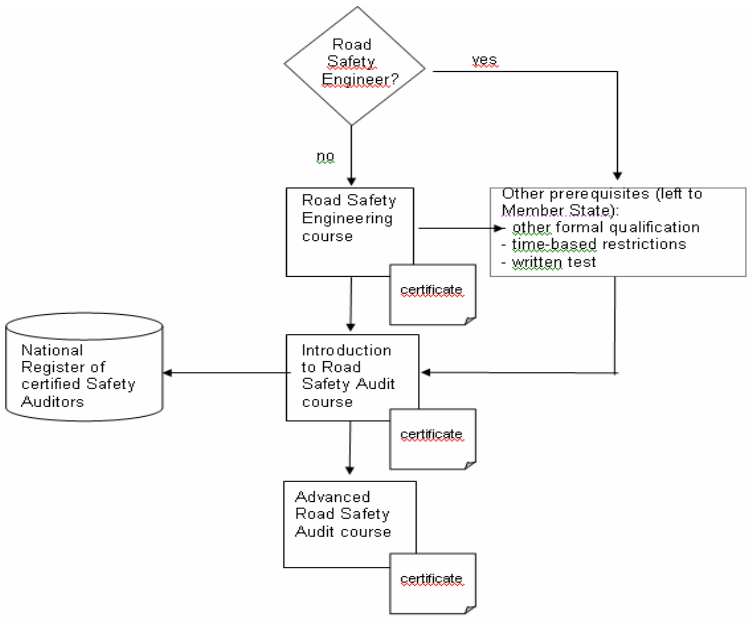


Figure 5.1 Training and certification according to EUROAUDIT (source EUROAUDIT report)

According to EUROAUDIT, the precondition to attend a training course is to be a Road Safety Engineer. That proposal is following especially the practise in the UK. Indeed, in UK it is possible to have special seminars at Universities regarding Road Safety Engineering. In that case a person who has already got these special seminars can attend the basic Road Safety Audit course and he can get a certificate.

In addition a so called Advanced Road Safety Audit course proposed as a measure of further education.

The training syllabus is proposed in the following way:

Table 5.1. Training syllabus according to EUROAUDIT

Modul	Duration	Core subjects
Road Safety Engineering	10 days (or two times 5 day training course)	scale of national accident problem, European and national legal requirements in road safety & road management, accident causation and risk assessment , accident data, use of statistical methods & monitoring, principles of road safety engineering, cost benefit analysis for remedial measures , cost effective solutions to identified problems, the role of road safety equipment, application to a site visit, introduction to road safety auditing
Basic Road Safety Audit course	3 days (or 1,2 day modules)	The European context – how Road Safety Audit relates to European policies, Overview of Road Safety Engineering and workshop, What is Road Safety Audit?, National Standards in Safety Audit (where applicable), How to carry out Road Safety Audits, Safety Audit qualifications, Common problems and solutions – case studies, Checklists and control data, Safety Audit Report writing, Response to Safety Audit, Early Operation Audit (on Site – Stage 3 Audit), Feedback from site visit , Design Stage Audit workshops, Delegate issues
Advanced Road Safety Audit course	3 days (or 1,2 day modules)	Optional modules to be more flexible like: European Standards and Guidelines, Accident data, Remedial measures, Safety Audit Procedures Option, European Projects / Risk Assessment, Safety Audit of Existing Road workshop etc.

The total number of training days will be 16. It is possible to cover the needs for the RSI with the Advanced Road Safety Audit course. Road Safety Audit competence should be assessed through an examination following the course and/or independent assessment of Audits carried out following the course.

Proposal for certification and registration

In the report is recommended that the certificates of competence should be awarded by appropriate academic or professional bodies within each EU Member State. That means the training course can be organised by universities or engineer associations etc.

In every EU Member State a central register of certified Road Safety Auditors should be organized.

5.1.2. Training and certification in Germany

The Road Safety Audit was introduced officially in 2002 with the publishing of the first German "Recommendation for the Road Safety Audit" (ESAS 2002). The first training courses were started in 2003 and were organized with a standardized curriculum of an association of German universities.

A new and detailed guideline for the training and certification was officially launched in this year (MAZS 2009) and the German Federal Highway Research Institute (Bundesanstalt für Straßenwesen) is now responsible for monitoring and registration of the training activities at University level. In the MASZ 2009, precise advises regarding the preconditions about basic qualification for future auditors, the training curricula, examination and certification as well as re-certification are included.

Because the proposed training model is already in use the following explanation is provided for MAZS.

Proposal for training procedures

The German training model is also modular as the EUROAUDIT one. The content of the modules is focused to the infrastructure and the structure is following the principles of basic modules and thematic modules.

Because the profession of a Road Safety Engineer is not in use in Germany, the preconditions to take part in a training course are:

- Knowledge in the design of roads and road safety (usually a University degree in civil engineering of road traffic facilities)
- Profound professional practice in design or in the field of accident analysis (e.g. as court expert for accident analysis etc.)

In the following graph the foreseen training modules are explained:

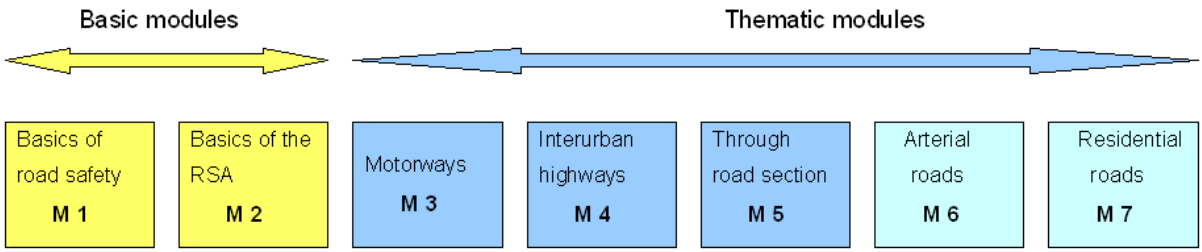


Figure 5.2. Modular training procedure in Germany

There are some variations of module combination possible. For all attendants, the Basic Modules M1 and M2 (yellow) are mandatory. Furthermore they can continue with the modules M 3, M 4 and M 5 (blue – focused to interurban road) **or** with M 6 and M 7 (cyan – focused to urban streets). The attendants can of course take part in all modules.

Since the RWR/RSA project is concerned with intercity roads only (core network etc.). A combination of Modules M1 till M 5 would be sufficient. Therefore the sections that follow are focused on these modules.

In every case the training measures with seminars and workshops is combined with some additional time with homework of the attendants which is in every case necessary to finish the training course with success. The attendants are obliged to present their own RSA reports, as part of the homework.

In the MASZ is the relevant training course for the modules is defined as follows:

Table 5.2. Training syllabus according to MASZ (Germany)

Modul	Duration	Core subjects
M1 Basics of road safety	1 day + 3 days homework	Basics about traffic accidents, influence of road design to accidents, road safety issues in design guidelines, accident records, accident databases, identification of high risk road sections, basics about in depth studies, accident costs and usage accident ratio parameters
M2 Basics of Road Safety Audit		What is Road Safety Audit, German Guidelines for RSA, Seminar about the usage of checklists, reporting etc.
M3 Motorways	2 days + 3 days homework (e.g. one RSA)	Training with lecture and workshop about safety issues of the motorway design, choice of the cross section, alignment principles, Interchange design, connection to the adjacent network, Rest areas, signing and marking, safety features
M4 Interurban highways	5 days + 6 days homework (e.g. two RSA)	Training with lecture and workshop about safety issues of the interurban highway design, choice of the cross section, alignment principles, Intersection design (intersections, roundabouts, traffic signals), pedestrians and bicyclist needs, safety features, signing and marking, practical training of an field study for RSA stage 1/2 in team work
M5 Through road sections of interurban highways	3 days + 6 days homework(e.g. two RSA)	Training with lecture and workshop about safety issues of the trough road section, transition zone, choice of the cross section, public transport stops, crossing help, Intersection design (intersections, roundabouts, traffic signals), parking along the through road, enforcement by design, specialties about typical accidents in built up areas, practical training of an RSA stage 3 in team work

The total number of training days for that profile including the homework will be 29. It is necessary to have the training with separate meetings in order to have enough time in between to carry out the self studies and homework. In Germany, typically the duration from start till the end of all necessary trainings is about 4 - 5 months.

The Germany RSA model includes 4 audit stages. The stages 1, 2, 3 are related to the design (feasibility study, preliminary design, detailed design) and the stage 4 (pre-opening). The stage “post opening” which is necessary according to the EU Directive 2008/96 is until now not in use.

Because of the intensive training content and the similarities between RSA stages pre-opening with the RSI the need of professional training for the RSI, are covered.

Certification and registration

All training courses in Germany are organized in the university level. The universities are obliged to inform the German Federal Highway Research Institute when they want to start a training and about the number of attendants.

The attendants are obliged to pass an exam to finish the training and to get the certificate.

The validity of the certificate is limited to 3 years. To receive an extension of the certificate for the next 3 years the auditor should present at least one RSA report for each of the relevant 3 years and should take part in special Seminar for RSA or similar scientific conference about road safety and accident prevention.

All auditors are registered in a central database of the German Federal Highway Research Institute (Bundesanstalt für Straßenwesen). In addition, in some Federal States an additional registration at the level of the Ministry of Transport of the Federal State is necessary.

5.1.3. Comparison of the training and certification procedures

Content

The content of the two training procedures models is different.

The demands for training and self studies in the German curriculum are quite higher. The content is strictly related to technical design issues in the audit stages of design documents, that means the attendant gets detailed information on how to evaluate a presented technical solution on the basis of the design documents. That constitutes a big advantage because the audit of the design documents is in the most cases more challenging than to audit an existing situation.

The auditor should have in total 29 days of training compared to 13 days in the EUROAUDIT model.

The advantage of the EUROAUDIT model is the shorter training period with a compact training procedure. That means obviously the financial effort to organize such a training could be significantly less than the German model.

Certification and registration

Regarding the bodies who have the right to organize a training course and about the way of certification both training models are similar.

5.2. RSA/RSI Training needs in SEETO Participants

Content

The content of the training course in the SEETO Participants has to be adapted to the local situation. But it is also recommended not to underestimate the need of an intensive training.

In most SEETO Participants, there is obviously a gap of knowledge comparing actual design procedures with the best practice in Western Europe Countries. The results of the RSI are showing also the needs for improvements in the existing network. That leads to the conclusion that the training content proposed by EUROAUDITS has to be extended.

As side effect, the RSA will help to improve and extend the knowledge of the engineers in the SEETO Participants because after a training of auditors and introduction of the RSA/RSI system and the resulting intensive discussion of the audit reports, the knowledge of all parties in this process will be increased.

It is recommended to develop in the future **one harmonized training curriculum for all SEETO Participants** as model to define the **minimum requirements** for the training. This is also necessary due to language requirements in the Region.

The target should be to combine the training of RSA auditors and RSI inspectors. Training should be offer according to SEETO standards in English. But due difficulties in English language comprehension at the level of experts to be trained, some local language peculiarities will have to be taken into consideration.

The possibility to organize a modular training could have some advantages like it is shown in the following pictures.
The first training concept is for RSA auditors and will cover all traffic facilities in the core network. After this training, the auditors are also well trained to act as RSI inspectors.

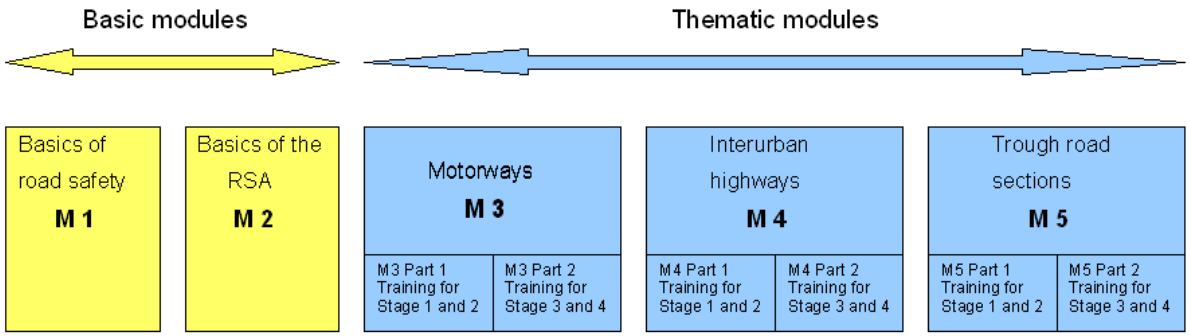


Figure 5.3.. Training modules for RSA auditors

An other possibility is to organize a separate training for RSI inspectors. In the picture the necessary training content is illustrated:

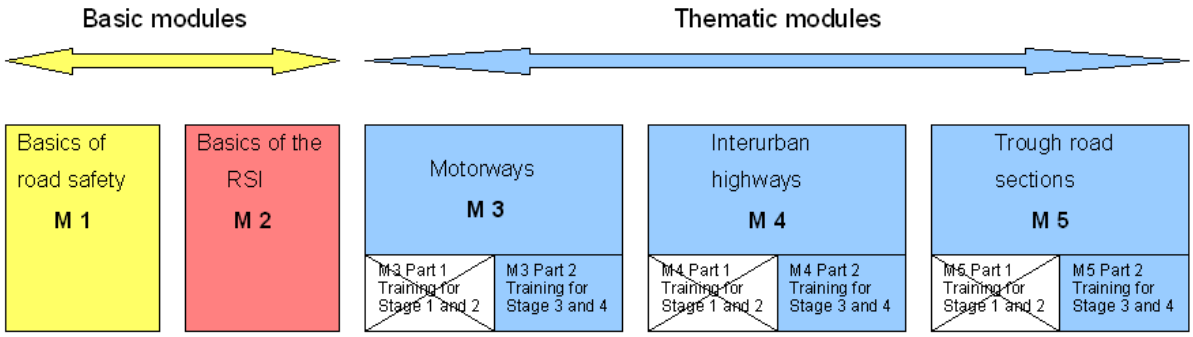


Figure 5.4. Training modules for RSI inspectors

Certification and registration

The training courses could be organized at the university level. But the universities should be obliged to follow the standardized training curriculum. Another possibility could be training course organized by the Ministry of Transport or Road Administration. Finally, it could be also possible to have joined training course for some or all SEETO Participants under the umbrella of the SEETO. Due to language requirements, training courses can be organized separately for experts from Bosnia and Herzegovina, Croatia, Montenegro, Serbia and the former Yugoslav Republic of Macedonia and separately for experts from Albania, and Kosovo (under UNSCR 1244/99).

All attendants are obliged to pass an exam to finish the training and to get the certificate. It is recommended to use a harmonized exam procedure to ensure the level of the training.

The certificates will be awarded from the body who has organized the training. In addition a registration in the SEETO Participants is recommended.

All auditors and inspectors should be **obliged** to have a sufficient further education. This could be organized by universities as periodical road safety workshops or congresses. It would make sense, to reach the target of a good exchange of knowledge in the Region, to invite auditors and inspectors from all SEETO Participants to such events.

According to the project tasks a good cooperation among the RSA and RSI auditors in the SEETO Region should be supported.

If the SEETO Participants follow a harmonized approach of training content, exam and certification, as the one suggested earlier, an exchange of audit teams could be possible.

For that reason it is recommended to organize a central register of auditors and inspectors in the SEETO Secretariat. Also information about the number of audits and inspectors, information about the content etc. could be collected in this register to follow up the progress in the RSA and RSI system.

5.3. Assessment of number of RSA/RSI auditors needed

Organizational issues – auditors position

For the practical RSI and RSA work, two principles are nowadays in use in Europe.

One way is to dispose the needed qualified staff as employees of the public administration, public road safety institute or similar (e.g. from a University). In the literature this solution is often called "internal auditor".

The other possibility is to have contracts with RSI experts from private consultants, so called "external auditor".

The administration in each SEETO Participant should decide if they will follow in the future only the first or only the second or both principles. There are practical and technical advantages to have a "mixture" of experts from the public and private sector in one team, because every team member can bring in the "picture" his special professional experience. On the other hand, the principle of "independency" of the auditor has to be obeyed and properly understood by all stakeholders.

Estimation of the necessary number of auditors and inspectors

To make some estimation about the needed numbers of **RSA auditors** it is possible to make some rough estimations by using of the likely costs for the RSA. In the following table the results of Europe-wide investigation published in the RIPCORD – project are shown:

Table 5.3. Indicators for the cost of RSA (Source: RIPCORD project)

Country	Audit costs (€ per stage)	Audit costs (% of construction costs)
Australia	600-6,000	
Austria	700-2,500 (per km road length)	0.1-0.15%
Czech Republic	1,000-3,000	
Denmark		<0.5%
Germany	800-5,000	<<1%
Norway		0.1-1%
Portugal		4%-7% (of planning costs)
UK	700-1,400	0.5%

These results are quite different but they provide a wider orientation.

Using the figures for Germany as example, an estimation of the number of needed RSA auditors can be done.
In Germany, is also in use the formula: average RSA effort: ~ 1200 - 2.000 Euro (net) per 10 km Motorway including interchanges etc. per design audit stage. The effort for the pre-opening and post-opening stages is usually less.

If we calculate one expert day with an average fee of 400 Euro in Germany, the average would be 3 - 5 expert-days for a team of two auditors. It is reminded that the EU Directive 2008/96 is demanding 4 Audit-phases.

The following model for the estimation of the numbers of certified **auditors** can be used:

- Data of the length in km of planned investments for the relevant SEETO Participant or for all SEETO (annual average) should be identified. The total length should be divided by 10 (length of an average section/loan) = Number of projects
- Number of projects x 4 (audit phases) = average number of audits per year
- Number of audits x 4 expert team-days = total number of expert days (for a team of two auditors, the half of the result the number of single auditors)
- Number of expert days divided by possible average working days per expert and year = number of auditors

Previous algorithm can be used to determine the necessary number of auditors in the case where investments in road infrastructure are well planned and known, and in the case of larger number of foreseen kilometres of constructed roads. If the low level of investment in SEETO Participants is taken into account, previous calculation will show unreasonably small number of needed auditors.

More realistic recommendation for minimal number of auditors should be based upon the fact that it is necessary to establish the system of road safety auditing in all SEETO Participants and to provide enough independent and well trained auditors. A likely minimum number of auditors, which can provide quality service for RSA in Region, is shown in following table.

Table 5.4: Minimum number of certified auditors in SEETO Participants

Participants	Suggested minimum number of certified auditors
Albania	6
Bosnia and Herzegovina	6
Croatia	8
the former Yugoslav Republic of Macedonia	4
Montenegro	4
Serbia	8
Kosovo (under UNSCR 1244/1999)	4
Total No. of auditors	**40**

To get an estimate about the number of **certified RSI Inspectors** is more difficult, because there is no comparison with other countries available. The principle of the RSI according to the formal and strict way which is introduced with the SEETO Manual for Road Safety Inspection and which is following the demands of EU Directive 2008/96 is quite new.

The task would be to ensure a **RSI** in the core network periodically at least once every 5 years.

One of the models for estimation of the necessary numbers of **inspectors** can be:

- Data of the length in km of routes and corridors for the relevant SEETO Participant or for all SEETO should be investigated,
- According to some experience, the RSI team needs for a 5 km of road an average of 2 working days (one day field study, second day reporting) and a half day for office work to prepare the RSI report.

- Total length of core network / 5 km = total number of “subsections” to inspect in total network
- Number of “subsection” divided by 5 = annual average of periodical inspection every 5 years,
- Number of “subsections” to inspect x 2,5 expert team-days = total number of expert days (for a team of two inspectors, the half of the result is the number of single inspectors)
- Number of expert days divided by possible average working days per expert and year = number of inspectors

In the case of SEETO Participants, having in mind the establishment of RSI system and the necessary quality and independence of inspectors, the previously shown model should be extended, as in case of number of auditors.

Table 5.5: Minimum number of certified inspectors in SEETO Participants

Participants	**Core Network**	**Arterial and regional roads**	**Suggested minimum number of certified inspectors**
Albania	779	na	18
Bosnia and Herzegovina	870	8467.2	18
Croatia	1346	17560	24
the former Yugoslav Republic of Macedonia	680	4495	12
Montenegro	545	1847	12
Serbia	1505	17065	24
Kosovo (under UNSCR 1244/1999)	250	1925	12
Total No. of inspectors	**5975**	**51359.2**	**120**

The proposed number of auditors and inspectors are indicative and enable the establishment of RSA and RSI system to be established in SEETO Participants. In this case, with similar training and certification curricula for auditors and inspectors, it will be possible to exchange the experts between different Participants whenever it is necessary. If time shows that it is necessary to increase the number of auditors or inspectors, it can be easily done upon the once established system of training and certification.