

DRAFT

Technical note 2

**REGIONAL ROAD SAFETY AUDIT
MANUAL**



**TRACECA Regional Road Safety Project
Safety Engineering Team**

March 2015

**EU funded road safety project
For
Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova,
Tajikistan, Turkmenistan, Ukraine, Uzbekistan**

PREFACE
TO THE DRAFT REGIONAL ROAD SAFETY AUDIT MANUAL
FOR TRACECA COUNTRIES

After almost two decades of experience with Road Safety Audit (RSA) all over the world, this procedure is now recognized as one of the most efficient engineering tools. With its EU Directive no. 2008/96 on road infrastructure safety management, published in October 2008, the European Union has made a clear decision that the RSA will be mandatory for the Trans-European Road Network in forthcoming years. RSA is highly effective and cost effective engineering tool for improvement of safety on roads. It is much cheaper to identify road safety deficiencies in the process of design than later after construction has been done. Therefore, RSAs are amongst the most cost-beneficial investments a Road Authority can undertake.

Unfortunately, in reality there is little application of RSA at present in TRACECA Region. RSAs that are implemented are mostly pushed by IFIs and implemented by foreign consulting companies. Even when RSAs are undertaken the RSA recommendations are not always implemented by the road authorities.

This is why the Project has tried to develop capacity in each country for RSA. The Project team in cooperation/consultation with concerned stakeholders have produced this Regional RSA Manual. This RSA Manual for TRACECA Countries is based on best international theory and practice and it offers a unified approach across the Region. As TRACECA Region contains important transport links (corridors) from China to Europe, the importance of harmonization and elimination of potential risks to the road users is of great importance. This is why the Regional RSA Manual is built on existing Manuals from the Region and tries to apply a common approach to RSA. This will ensure similar approaches are applied for RSA related improvement of road infrastructure in all TRACECA Countries.

Special attention has been given to try to make the Manual and accompanying Checklists user friendly. This RSA Manual has six chapters followed by three Appendices (Checklists).

Dr. Alan Ross

Team Leader

Email: alanross999@gmail.com

Dejan Jovanov

Senior Road Safety Engineer

Email: dejan.jovanov68@gmail.com

Contributing Safety Engineering Team Members:

1. Hans-Joachim Vollpracht
2. Saša Jasnić
3. Rajko Brankovic
4. Walter Viti

Table of Contents:

Abbreviations and acronyms	4
1. INTRODUCTION	7
2. BASICS ABOUT ROAD SAFETY AUDIT	7
2.1. What is Road Safety Audit? (Definition)	7
2.2. Why do we need Road Safety Audit?	8
2.3. Area of Application (Types of projects)	9
2.4. Value and Costs of Road Safety Audit	10
2.5. Structure of the Manual	12
3. STAGES OF ROAD SAFETY AUDIT	13
3.1. Draft (or Preliminary) Design	13
3.2. Detailed Design	13
3.3. Pre-Opening of the road	14
3.4. Early Operation - when the road has been in operation sometime	14
4. ROAD SAFETY AUDIT PROCESS (HOW TO PERFORM A RSA?)	15
4.1. Ordering a Road Safety Audit	15
4.2. Audit team	16
4.3. The practical RSA workflow (How to perform a RSA?)	17
4.3.1. Ordering a Road Safety Audit	19
4.3.2. Undertaking the Road Safety Audit	21
4.3.3. Completion of the Road Safety Audit	23
5. TRAINING OF THE AUDITORS AND LEGAL ASPECTS	25
5.1. Training of the auditors	25
5.2. Legal aspects	25
6. REFERENCES	27
Annex 1:	Checklists for the Draft (Preliminary) Design (stage 1)
Annex 2:	Checklists for the Detailed Design (stage 2)
Annex 3:	Checklists for the Pre-Traffic Opening of road and Road in Early Operation (stage 3 and 4)

Abbreviations and acronyms

BSM	Black Spot Management
EC	European Commission
EU	European Union
IBRD	International Bank for Reconstruction and Development (World Bank)
IFI	International Financing Institutions
MoIA	Ministry of Internal Affairs
Mol	Ministry of Interior
MoTC	Ministry of Transport and Communications
PIARC	World Road Association (PIARC actually means Permanent International Association of Road Congresses but this name is rarely used)
RSA	Road Safety Audit
RSI	Road Safety Inspection
SEETO	South-East Europe Transport Observatory
TL	Team Leader
ToR	Terms of Reference
TP	Traffic (Road) Police
TRACECA	Transport Corridor Europe-Caucasus-Asia
WE-WC	Western Europe – Western China International Transit Corridor
WHO	World Health Organization

1. INTRODUCTION

Today, all around the world it is well known that road crashes are a big social and economic problem. Different measures and programs have been developed to reduce the number of casualties on roads. On an international level, the United Nations, World Health Organization, International financial institutions (especially IBRD or ADB, EBRD, EIB, etc.) and some specialized NGOs (PIARC, ETSC, PRI, SEETO, etc.) represent high quality stakeholders of global road safety improvements. Recently, in the autumn of 2009, ministers and stakeholders from all over the world approved the Moscow Declaration on Road Safety (First Global UN Ministerial Conference on Road Safety). Within 2 years this matter was discussed at the UN and a Decade for Action on Road Safety was announced for the period 2011-2020 with a target to reduce the worldwide total of deaths by 50% by 2020.

In most countries, road design guidelines are applied which, in most cases include implementation of road safety issues. Despite this, crashes still occur on new roads. There are several reasons for this. Firstly, design standards often contain minimum requirements regarding road safety and a combination of these elements can sometimes lead to dangerous situations. Furthermore, it is not always possible to comply with the standards. Sometimes, especially in built-up-areas or in difficult terrain, there are reasons which make the application of the standards impossible.

One common misunderstanding is that drivers fault or bad behavior is the single and only cause of road traffic crashes¹. As a result of international understanding from various research it is clear that the whole system (driver, road with its environment and the vehicles) is strongly connected and usually at least two of these contributory factors are involved.

This is why “The Safe System Approach” is not focusing anymore on single elements of the transport system but on their interfaces, especially on the Human Factors and the interface between road users and the road which has to be adapted to road users abilities and limitations.

A number of techniques and processes have been developed in last two decades. One of them is Road Safety Audit which is now recognized as one of the most efficient engineering tools. With the Directive of the European Parliament and of the Council no. 2008/96 on road infrastructure safety management, published in October 2008, the European Union clear decision and direction that road safety is important. It is clear that RSA will be mandatory for the trans-European Road Network in the forthcoming years and European Investment Bank is already extending application of the Directive via its lessons to the neighborhood countries. In this directive, RSA is part of a package of road safety measures, including:

- 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 risk road sections (BSM),
- Road safety inspections of existing roads (RSI) and

¹ This occurs because in most countries Traffic Police tend to blame the driver for driving too fast, for illegal manoeuvres etc. without asking, “Why the driver may have made that error?” Because they generally do not have understanding of the road engineering and vehicle factors. They do not identify such defects and police statistics always show that “Driver error” is the main factor in 70-90% of road crashes.

- In-depth crash analysis (IDS).

These measures are an integrated part of the wider road safety management system, as shown at Figure 1.1.

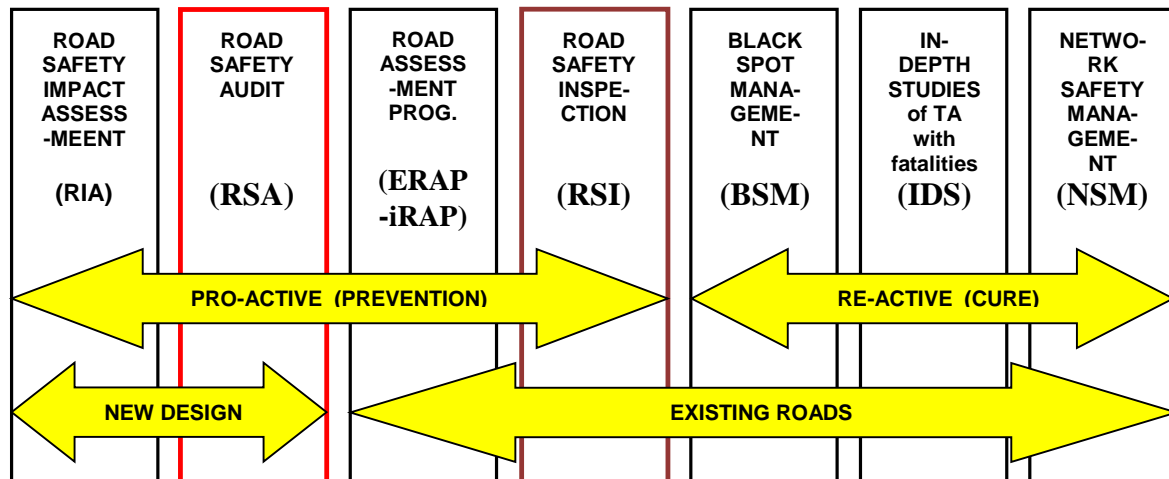


Figure 1.1. RSA as part of the Road Safety Management
(Source: SEETO Road Safety Audit Manual, 2009)

It can be seen from figure 1.13. that **RSA** represents a pro-active (preventive) element that should be included in the road design process.

Furthermore, the RSA procedure is:

- A formal process,
- An independent process,
- Carried out by someone with appropriate safety experience and training,
- Restricted to road safety issues of the road and making it safer for all road users.

The outcome of a RSA is a formal Report, which identifies existing and potential road safety deficiencies and, if appropriate, makes recommendations aimed at removing or reducing these deficiencies. With the audit process, it is possible to reduce the number and severity of traffic crashes by improving the road safety performances.

According to the best practice, as well as the previously mentioned EU directive, there are four different stages during which Road Safety Audits are most commonly² conducted:

Stage 1: **draft design,**

Stage 2: **detailed design,**

Stage 3: **pre-opening of the road and**

Stage 4: **early operation, when the road is in use.**

² In some countries a 5th stage “planning” is added at the beginning or “Feasibility” stage. Often safety critical decisions can be made even before draft design starts. For example, the route that is selected, junction strategy, future developments all affect safety of the road. If for example it is known that a new port or freight generating facility will be built, it may result in huge increase in trucks using certain parts of the road and junctions. This may affect the type of junction that should be selected

The RSA has a lot of similarity with another road safety management procedure and that is the **Road Safety Inspection (RSI)**. The output of RSI is also a formal report, and the form is slightly different from RSA report.

2. ROAD SAFETY AUDIT BASICS

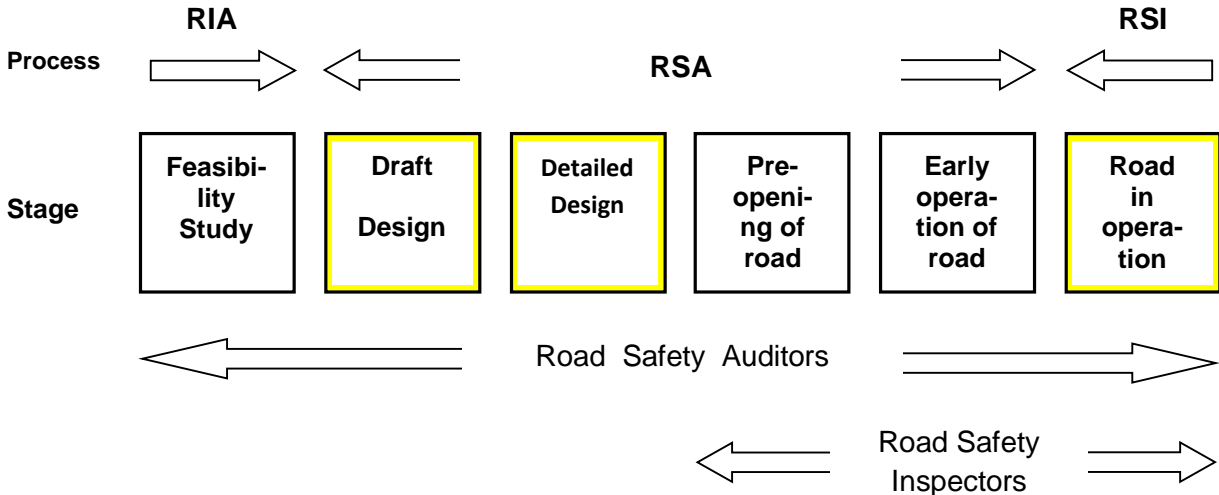
2.1. What is Road Safety Audit?

RSA is a well-known term used internationally to describe an independent review of a road project to identify road or traffic safety concerns. It can be regarded as part of a comprehensive quality management system. It is a formal examination of a road or a traffic project. The systematic application of RSA increases the safety of all road users. RSA is a pro-active approach with the primary aim of identifying potential safety problems as early as possible in the design process so that decisions can be made about eliminating or reducing the problems, preferably before a scheme is implemented or crashes occur.

The most common definition of RSA is: **“A formal road safety examination of the road or traffic project, or any other type of project which affects road users, carried out by an independent, qualified auditor or team of auditors who reports on the project crash potential and safety performance for all kinds of road users”.**

The latest EU Directive presents the following definition of RSA: **“RSA means an independent, detailed, systematic and technical safety check relating to the design characteristics of a road infrastructure project and covering all stages from planning to early operation”.**

As part of the road safety engineering process, the Road Safety Audit (RSA) has a strong relationship and a lot of similarities with the Road Safety Inspection (RSI). Therefore, processes and phases explained in the Figure 2.1.1.



Bearing in mind similarities between RSA (phases 3 and 4) and RSI, for the production of the Report, the same checklists can be used.

Figure 2.1.1 Processes and phases of RSI and RSA

Figure 2.1.2. explains the interaction between RSA and RSI procedures.

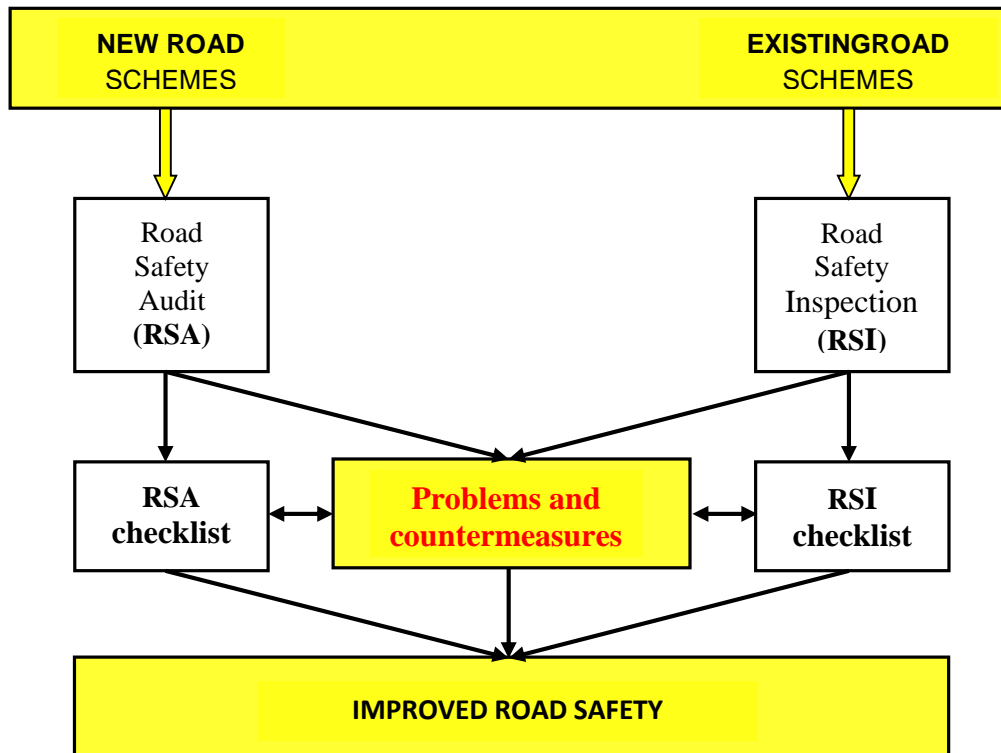


Figure 2.1.2. Interaction between the RSA and RSI procedures

The outcome of a RSA is a formal report and the time required to undertake a RSA is very short compared to the individual planning stages. It is better if RSA is implemented in the early stages of the design process, before expensive construction begins – after which changes can be costly.

For maximum effectiveness, it is very important that RSA is carried out by independent auditors from private companies, the road administration or some “audit centre”, not involved in the actual project design team. All auditors have to be trained and fully qualified.

2.2. Why do we need Road Safety Audit?

Over the last decades, road crashes casualties have specially increased in many countries and road safety has become a serious concern for many national level government stakeholders (usually Ministry of Transport and Communication, Ministry of Interior – Traffic Police, Road Administrations, Ministry of Health, Ministry of Education, etc.). The rapid growth of the road network, the increasing vehicle population, different types of vehicles on the roads, technological advances, etc. have contributed to an environment with significantly increased risks of crashes. Furthermore, the system of the three principal elements which contribute to road crashes: driver, vehicle and road, are also affected by the social and political environment under which they interact. Alongside these changes, road (traffic) experts have been looking at ways of decreasing the risks of road crashes.

In the first phase of the development of road safety, the concentration of most experts was focused on the drivers as this was a general tendency to think “driver error” was the only cause whereas (as earlier explanations indicate) this was simply because the need for “safe system”

was not understood. After decades of improvement work a lot was achieved. The same was achieved with cars. Car safety was dramatically increased, and it is still improving.

After these improvements, the remaining factor was the road and its improvement.

The first action was made in establishing the road design standards. While attempting to reduce costs of building roads, engineers take into account a number of different factors during the design process (capacity requirements, right-of-way availability, geotechnical conditions, archaeological considerations, environmental constraints, socio-economic impacts, budget constraints, etc). Designers therefore have a substantial responsibility and difficult task to balance the opposing interests (costs vs improved road safety) that are relevant to any modern road design project. This may lead to compromises sometimes at the expense of safety.

On the other hand, road safety requirements for planning, construction and maintenance of roads, as well as for operation and equipment are inadequately addressed in existing and outdated Standards and norms, such as GOST and SNIP standards which are still in use in ex-soviet countries. Therefore, it often happens that along newly constructed and rehabilitated road sections, a great number of traffic crashes still occur. Sometimes the number of crashes is increased along rehabilitated road comparing to the road before improvements since much higher speeds are now possible on such "improved" roads. This can have a negative impact on linear villages which the new rehabilitated road passes through.

It is not likely that all necessary road safety improvements will be achieved only by using design standards, having in mind how slowly standards are improved or changed. In some of TRACECA Countries old Soviet standards and norms are still in use. Added to this, new scientific findings take some time to find their way into the technical standards and specifications, because they need to be verified and accepted.

Because of previously mentioned reasons, RSA as an approved road safety tool can be used for improvement of the road environment. With the expert knowledge of the Road Safety Audit, it is possible to reduce the number and severity of traffic crashes by improving the road safety performance and safety elements of the road..

2.3. Area of Application (Type of projects)

An RSA should be undertaken on a wide range of projects varying in size, location, type, and classification. The types of projects that can be audited are categorized under the following headings:

- function in the network (International roads, Corridor roads, Regional and Local roads)
- traffic (motor vehicles only or mixed traffic with non-motorized and/or slow agricultural traffic)
- position - locality (outside or inside built up areas).

It is recommended that RSA is implemented for projects that have the value of technical

documentation more than 30.000 Euro. RSA is an integral part of the design process but independent from the actual design. The designer³ of a new road project (or other applicable project) remains responsible for the design. The designer should make regular checks of the implications for safety work as the design progresses.

This manual is applicable for:

- new roads, motorways, state roads of I and II order and other road traffic facilities,
- reconstruction and rehabilitation,
- inside and outside built-up areas.

The types of projects to be mandatorily audited will be defined according to the legal (law or by-law) regulations.

For example, RSA could be implemented for:

- Major projects, i.e. motorways, Highways and other road facilities.
- State roads of I and II order, bypass roads etc.
- Medium-sized projects, i.e. reconstruction and rehabilitation projects
- Minor improvements, i.e. bicycle pathways, footpaths', major maintenance works, etc.
- Traffic management schemes (both permanent and temporary)

RSA can be used for interurban roads as well as for urban arterials.

There is a great chance that in some of TRACECA Countries in the future RSA will be regulated by the Law on Road Traffic.

2.4. Value and Costs of Road Safety Audit

Benefits of RSA are based on pro-active management of road safety, by identifying and preventing the risks associated with road safety deficiencies.

Namely, values of RSA are:

- Safer roads through crash prevention and crash severity reduction.
Research in the United Kingdom has indicated that up to 1/3 of collisions may be prevented on a road that has been audited. The Austrian Road Safety Board (KfV) estimates that the financial benefit of the RSA in Austria is 50 times higher than the costs. A Danish study in 1995 came to the result of a benefit to cost ratio of 16,8. Scotland has estimated a benefit/cost ratio of 15:1. Germany Insurance Institute for Traffic Engineering (VTIV) has made some case studies about the benefit of the RSA, and benefit/cost ratio was in a range from 4 to 99. New Zealand has estimated the ratio to be closer to 20:1. Other research indicated a 1 to 3 percent reduction in injury collisions.
- Enhancement of road safety engineering.
- Reduced whole life costs of road construction.
- Reduced need to modify new roads after construction.
- A better understanding and documentation of road safety engineering.
- Safety improvements to standards and procedures in the future.

³ Is a considerable merit in introducing design engineers to concepts of safe design and how to avoid typical safety problems that can occur. The TRACECA regional road safety Project is training 6 design engineers in each country and exploring how the design engineer most actively involved in national regional and municipal road design, whether in government, design institutes or consultations can be given such awareness raising training.

- More explicit consideration of the safety needs of vulnerable road users.
- Encouragement of other institution/personnel's involvement in road safety.
- Foster a principle of safety conscious design among owners and designers.
- Cost savings, lower health care and societal costs due to reduced crashes.
- To improve the awareness of safe design practices of everyone involved in the design.
- Enhancement of the corporate safety culture.
- Cross-fertilization between specialists within a highway department (e.g. Design, Maintenance, Traffic, etc.).

The earlier the project is audited within the design and development processes, the more effects and benefits are achieved. Early auditing can lead to the early elimination of problems and, consequently, minimization of time and cost of redesign at later stages.

In addition it has to be mentioned, that the implementation of RSA leads to intensive discussion between the auditors, client and designer. This discussion is helpful to increase the knowledge of all involved parties and is also helpful to improve the daily work, design procedures and would also be helpful in the process of the renewing of the standards.

The cost of audits is divided into three categories:

- consultant fees,
- the client's time costs to manage the audit, and
- costs associated with implementing recommendations that are adopted.

Some experiences show that a safety audit of a new facility costs approximately the same as a geotechnical survey. Another experience places the average cost of a conventional audit for small to mid-sized projects between \$1,000 and \$5,000. In other research, fees range vary from \$700 to \$6,000, with most falling in the \$2,000 to \$3,600 range. The actual cost depends greatly on the size and complexity of the project and composition of the required audit team.

Some consultants find that audits add approximately 5 to 10 percent to design costs, or less than 0.5 percent to construction expenses. Another approximates that audits will add 4 to 10 percent to the road design costs. As design costs are roughly 5 to 6 percent of the total project sum, road safety benefits far outweigh these small costs.

On smaller projects (traffic calming or retrofits), the costs may be a higher percentage of the overall capital cost. Costs of redesign/rectification should be considered which will vary on a project-to-project basis. The cost of rectifying deficiencies depends on how early in the design process the problem is identified as well as the amount of time required to redesign the area.

2.5. Structure of the Manual

This manual is divided into five chapters as follows:

The first Chapter introduces the RSA and explains the rationale for existence of RSA procedures.

Chapter 2 presents basics about RSA. This Chapter contains answers to the following questions: What is Road Safety Audit? Which definitions exist? Why do we need RSA? Where can RSA be applied? and What are the values and costs of RSA?

Chapter 3 discusses the stages of RSA. Detailed explanations are provided for: Draft (or Preliminary) Design, Detailed Design, Pre-Opening and Early Operation. The chapter also discusses the methodology used when conducting audits at different project stages.

Chapter 4 presents the RSA process and explains how RSA should be performed. It describes the complete process from the selection of the audit team to the completion meeting and follow-up.

Chapter 5 provides a discussion about the training of the auditors and about legal issues associated with road safety audit.

Annexes 1-3 contain the checklists for road safety audits (for all stages).

3. STAGES OF ROAD SAFETY AUDIT

RSA can be effective for most projects, regardless of size, and at any or all key milestones in the development of a road project. According to the latest international experience, as well as EU Directive 2008/96, there are typically 4 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 in use.

The complexity and level of effort of the audit process changes with each stage. An overview of what each of the audit stages entails is provided below.

The audit of the very early design stage (feasibility study or planning) should be made by using the road safety impact assessment method, not by RSA procedure. But in cases of rehabilitations, widening or just major maintenance projects of existing roads Road Safety inspections should be performed to detect existing safety deficiencies and the elaboration of countermeasures in the following design and construction phases.

The RSA stage 1 and 2 will be conducted on the basis of the design documentation (drawings, technical reports, explanatory notes, etc.) of the project. Site visits may also be needed, especially for rehabilitation schemes on existing alignments. To ensure an adequate accuracy of the RSA, the design documentation must have sufficient quality and content.

Before opening the new road to traffic with the stage 3, the audit should be made to check if the scheme has been constructed as designed, with full respect to road safety and whether any other road safety deficiencies that were not previously discovered increase the road safety risks after construction. Daylight and darkness checks should also be done for Stage 3 and 4. The final stage 4 of the RSA process is checking the road during early operation. It is important that an evaluation /assessment of actual safety situation is made after some months.

A detailed overview of each of the audit stages is provided below.

3.1. Draft (or Preliminary) Design

During the draft (or preliminary) design stage, the audit team evaluates the general design principles. Primary objectives are to evaluate the relative safety of intersection or interchange types and layout, horizontal and vertical alignment, cross section, sight distance, lane and shoulder widths, super elevation, provisions for pedestrians and other vulnerable road users and other design elements. Audits conducted at this stage should be completed before the finalization of land acquisition to avoid complications if significant alignment changes are required.

3.2. Detailed Design

All elements of the final design should be in place during the detailed design stage. During this stage, the audit team reviews the final geometric design features proposed traffic signing and pavement marking plans, lighting plans, drainage, guardrails and other roadside objects, landscaping, intersections and interchange details (such as tapers, lengths of acceleration and

deceleration lanes, and turning radii). The team also reviews provisions for specific users such as motorcyclists, pedal cyclists, pedestrians (including the particular needs of children and the elderly) and the mobility-impaired.

3.3. Pre-Opening of the road

Immediately before opening a road or facility, the audit team should conduct a site inspection to ensure that the safety needs of all road users (*i.e.*, pedestrians, cyclists, motorists, and others) are adequately satisfied. The audit team should conduct day and night drive and walk through inspections and, if possible, perform the inspection in different weather conditions. This type of audit attempts to determine if hazardous conditions exist which were not evident in the previous audits.

3.4. Early operation – when the road is in use

RSA can be undertaken soon after opening a new or reconstructed/rehabilitated road or facility to the public traffic. When a road “attracts” traffic previously using other routes, some problems may be observed which may not have been detected as road safety deficiencies. Corrective measures, although much more expensive to carry out at this stage, may still be cost effective. RSA can also be conducted on any section of an existing road network to identify safety related deficiencies.

4. ROAD SAFETY AUDIT PROCESS (HOW TO PERFORM A RSA?)

4.1. The participants in the audit process and their roles

In most cases, three different parties are involved in the audit process: the client, the designer and the auditor. The roles and responsibilities of the different parties are similar in different countries.

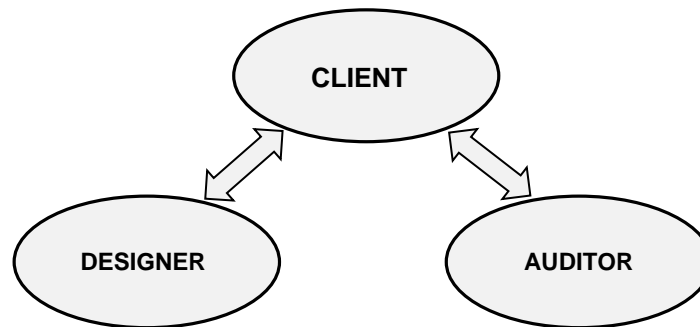


Figure 4.1.1: The participants in the audit process

The typical roles and responsibilities of all parties involved in the safety audit process are outlined in the following sections.

Client: The organization responsible for the project, sometimes also called the project manager, or project investor. This is often the road authority, or in some cases local stakeholders.

Road safety audit should be considered an integral component of the road design process. It is therefore essential that clients/road authorities allocate sufficient funding and resources to support the road safety audit process. Clients/road authorities should:

- require road safety audits as a part of quality management,
- allocate funds in budget to hire consultants for safety audit work
- commission audits at the proper project stages and
- review the formal audit report and act upon recommendations whenever appropriate and feasible.

Without the client's full commitment to the process, particularly by giving genuine consideration to recommendations, the audit process becomes ineffective. Furthermore, the client/road authority should provide training at all levels within the own organization to ensure that safety is an integral component of all phases of a road project (*i.e.*, planning, design, construction, and maintenance). Correct training of personnel increases the potential of safety issues being identified by the audit team.

It is the responsibility of the client/road authority to:

- select an audit team with the appropriate training and experience,
- provide project documentation;
- ensure that the auditors have satisfied the requirements described in the terms of reference,
- analyze the auditor's report and forward accepted suggestions to designers with request to incorporate them into design,
- attend the initial and completion meetings and
- follow up design work.

At the end of the RSA procedure, the client is supposed to provide the audit team with a written response addressing all safety issues. This includes either accepting the proposed measures and providing a design solution for them, or rejecting the measures and stating the reasons for this action.

Designer: A person or team commissioned by the client to develop the road schemes. The design team can be an independent or part of the client's organization. The designer is fully responsible for the design.

It is the responsibility of the design team/project manager to attend the initial and completion meetings. The responsibility of developing or adopting corrective solutions, suggested by the audit team and accepted by the client, lies with the design team/project manager. The design team/project manager is responsible for all design decisions; however, decisions may sometimes require the involvement of the client/road authority (if design changes increase the project budget significantly).

Auditor: A person or team commissioned (or approved) by the client to carry out the audit. The auditors should be independent from the design team.

The primary role of the audit team is to identify potential safety problems of a road project by reviewing project documentation and drawings and/or conducting site inspections. They typically do not redesign the project or implement changes. The audit team may use a developed set of checklists to assist them while conducting the audit (Annexes 1-3). Checklists identify issues and problems that can arise at the relevant stages of an audit. These checklists are more like guides and should not be used as a substitute for experience. They also provide continuity from audit to audit by ensuring core aspects are checked on every scheme.

The audit team is required to submit a report to the client, identifying critical issues based on safety engineering experience. A completion meeting is held between the audit team, the design team and the client to discuss the audit findings. The audit team is required to review the design team's response to the audit report, if any. It is not the role of the audit team to approve of or agree with the obtained response, this is the client's responsibility.

4.2. Audit team

The size of the audit team will vary depending upon the size and type of project. It is recommended that the team consists of two to five multi-disciplinary individuals. The use of at least two individuals provides cross-fertilization of ideas. It is much better if the audit team is bigger and contains experts with different specialties. There are a few requirements that an audit team must fulfill:

- **Independence**

Road safety auditors should be independent of the project design team to ensure impartiality and so that the proposals are reviewed solely from a road-user's perspective. Audit teams can be established within large organizations or by using consultant firms. It is essential that an environment exists which fosters good communication between the audit team and the client/design team to ensure that the audit is effective.

- **Qualifications**

Road safety audits should be conducted by an individual or team with adequate experience in road safety engineering principles and practices, crash investigation and prevention, traffic engineering and road design. Additionally, members with experience in enforcement,

maintenance and human factors can be added to the team on a project by project basis and at different audit stages. Human factor expertise may, in selected areas, contribute to a road safety audit by providing an understanding of the interactive nature of user behavior with the road environment.

- **Experience**

It is imperative that the audit team has substantial collective experience in the key areas noted in the previous section. While audit checklists serve to identify critical items/areas to be considered, they should only be considered memory reminders for individuals with experience and not an exhaustive listing of issues. In some countries, auditors should be accredited (certified) at national level. Accredited auditors must have undertaken a specified course in road safety audits and have participated in a defined number of audits per year. If it is necessary additional expertise may be added to the project team at different stages of the audit process (*i.e.*, police officers, maintenance personnel, human factor experts, and others).

4.3. The practical RSA workflow (How to perform a RSA?)

As a relatively new road safety tool, RSA has to be organized with an effective structure and with clear responsibilities.

The general RSA procedure will include three main phases:

- **ordering,**
- **undertaking** and
- **completion.**

The Figure 4.3.1. describes the typical audit process.

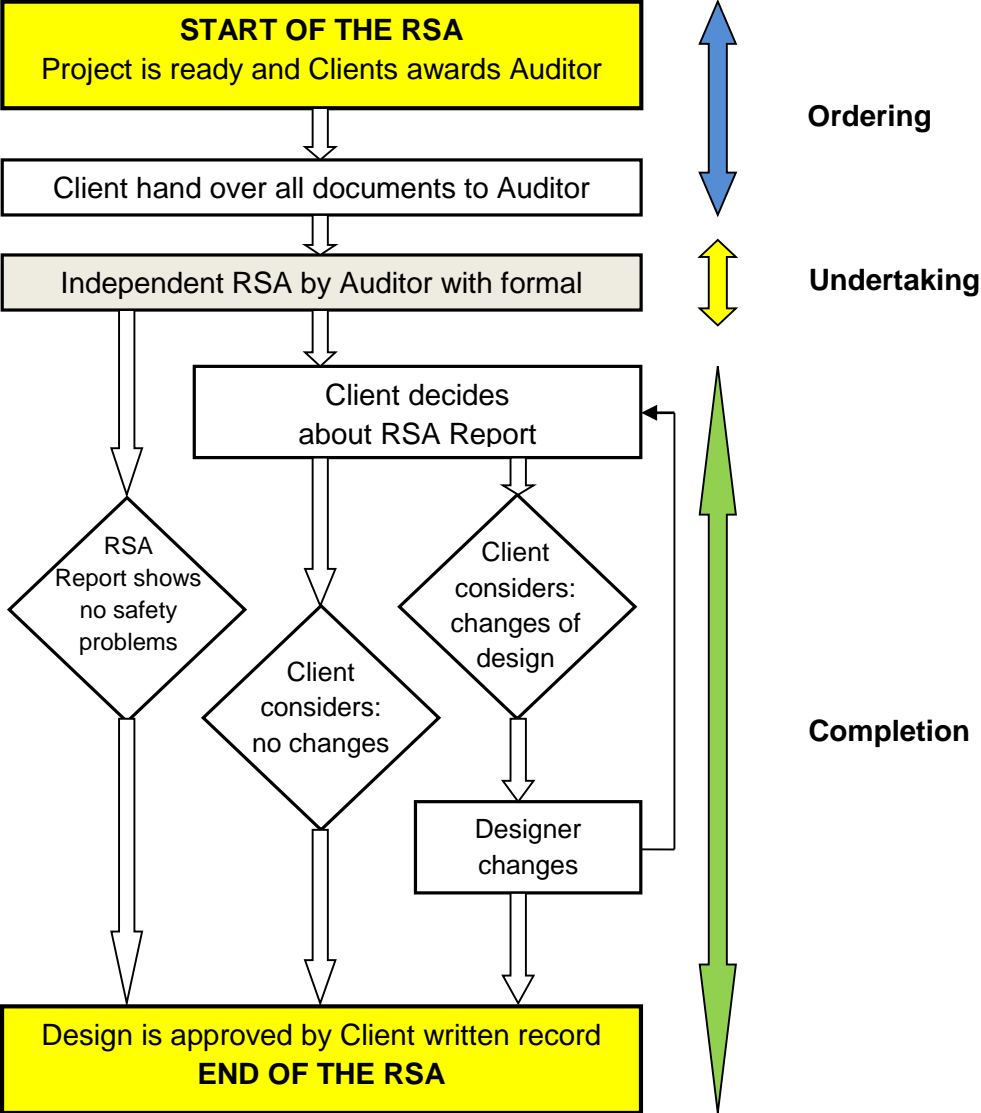


Figure 4.3.1: The RSA workflow (main steps)

Bearing in mind the scope and nature of a road infrastructure project, and regardless of audit stage, it is possible to conduct the RSA on the basis of this diagram.

It has to be mentioned, that in the RSA stage 3 and 4 in most cases no design work would be necessary. Often the changes can be organized directly by the construction company (contractor) for the stage 3 or the maintenance unit of the client for stage 4.

Depending on type of changes in design, sometimes it may be necessary to have a partial repetition of the RSA, to check the changed documentation. In case of doubt the client should send the auditor the relevant documents.

4.3.1. Ordering a Road Safety Audit

Ordering the audit

Usually, the decision to start the audit is taken by the client/road authority. But it may be regulated by Ministry decision or by law as well as by the financing institutions. In this phase the client hands over all necessary documentation to the Auditor.

Selecting the team

It is the responsibility of the client to select the audit team. As previously noted the audit team should be independent of the design team and should have appropriate experience and training in road safety engineering. A list of potential auditors, including qualifications, would be beneficial to the client when selecting the audit team. The audit team leader should be someone who has experience in road safety engineering and has participated in previous audits. The client should exercise caution when selecting the audit team. The team with the lowest bid is not always the most experienced. In road safety audits, experience is paramount, and cost is secondary.

The nature and composition of the team depends upon the complexity, size and type of the scheme being audited. It can also vary for each audit stage.

The first two design stages should be undertaken by experienced auditors including road safety specialists, crash investigation specialists and road design engineers.

At the detailed design stage, it is beneficial to have an audit team with members having expertise in road design, traffic signals, lighting and drainage, non-motorized users etc., depending on the type of scheme being audited. A person with knowledge of human behavioral aspects of road safety could also be very useful.

At the pre-opening and post-opening stages, it is important to have in the team members with experience in aspects of facility maintenance including signage, lighting, traffic controls, vegetation, snow removal etc. It may be useful to include a Police officer who is experienced in road safety and crash investigation.

Collection of background information and Audit Brief

The client is responsible for providing all relevant project documentation, including reports, data, drawings, contract documents and, where required, traffic volumes. This information will be used by the audit team to assess the project from a safety perspective.

It is important that the audit team is given all required documents at the beginning. Incomplete documents lead to questions and additional demands, resulting in more time and work being necessary for the audit.

The Audit Brief (or Initial meeting) is the meeting with all parties involved in the audit, where the audit team gets instructions describing the scheme to be undertaken. The meeting must provide sufficient background information to enable the audit to be successfully carried out.

As a minimum, the brief should include:

- a brief project description,
- an account of project conditions and design parameters (design speed, radii of curves, super elevation, sight criteria, traffic volume, vehicle types, crash data, etc.),
- set of drawings (hard copies are essential),
- details and reasons for any deviation from road standards,
- any previous RSA or RSI reports,
- for reconstruction or rehabilitation schemes on existing roads, crash statistics should be provided.

The number of documents required increases as the design phases proceed. A complete recommendation about the minimum requirements for contents of the documentation is shown in the Table 4.3.1.1.

Table 4.3.1.1. Recommended minimum of documentation for RSA

Preliminary Design	Detailed Design	Traffic Opening
<p>Explanatory report with: Traffic analysis with traffic volume estimates</p> <p>Crash diagrams and maps with dangerous locations and road sections highlighted</p> <p>Overview map: Site plans with types of junction</p> <p>Overview of vertical alignment</p> <p>Cross sections</p> <p>Horizontal alignments</p> <p>Vertical alignments</p> <p>Construction sketches</p> <p>Site plans of accompanying landscape measures</p> <p>Any existing signing and marking plans</p>	<p>Result of previous audit stage with Client's decision</p> <p>Explanatory report</p> <p>Overview map</p> <p>Cross sections</p> <p>Horizontal alignments</p> <p>Vertical alignments</p> <p>Construction plans</p> <p>Site plans of landscaping detail</p> <p>Signing and marking plans</p> <p>Site plans with road equipment</p> <p>Junction drawings with all signs, markings and traffic signal installations</p> <p>Documents for traffic signals</p>	<p>Result of previous audit stage with Client's decision</p> <p>Explanatory report</p> <p>Horizontal alignments</p> <p>Vertical alignments</p> <p>Site plans of landscaping detail</p> <p>Signing and marking plans</p> <p>Site plans with road equipment</p> <p>Signal installation plans</p> <p>Documents for traffic signals</p>

4.3.2. Undertaking the Road Safety Audit

After the Brief or initial meeting, it is the responsibility of the audit team to assess the project documentation and to conduct the RSA. If it is possible, it is useful to organize field studies to help determine the safety related issues of the project. The following sub-sections present the process used when conducting road safety audits.

Analysis of background information

Once all the background information is collected, the audit team needs to assess/evaluate and analyze all the available information.

For audits at the draft (preliminary) design or detailed design stage (stages 1 & 2), the audit team should examine the details about the proposed project, details of plans and background information on a section by section basis. This provides an opportunity to consider the road safety impact of the design on all road users. Auditors should be given sufficient time to carry out a RSA.

If the audit is being conducted at the pre-opening or early-operation stage (stages 3 & 4), the team should analyze all relevant and available information such as for example crash reports (this does not apply to pre-opening stage). The analysis of crash reports is not intended to be used as analysis at dangerous locations, but as an aid for the auditors in identifying potential areas with safety problems.

Field studies

Field studies (inspections) are required at all stages because they provide the team with a feeling for the existing conditions. A field inspection allows the auditor to see how the proposal interacts with surrounding and nearby roads.

Before going to the field, the audit team should become familiar with the drawings and checklists to ensure that the inspection is productive and relevant concerns are raised.

For audits at the stages 1 & 2, the team should conduct site inspection, including “green field” sites, upon completion of the preliminary assessment. The audit team should examine the correlation and transition between any new and existing roads to ensure consistency. This includes all types of road users.

Audits at stages 3&4 review the physical characteristics of the project by conducting site inspections. These inspections involve assessing the furniture, signs, lighting, markings, delineation, and geometric features from a multi-modal perspective. The team should identify issues that may affect the road users’ perception of the road or restrict sight lines.

The audit team should conduct the inspection by driving and walking (if feasible) through the project in all directions. In addition, site inspections should be conducted at night and in adverse weather conditions if possible.

Photographs, video and voice memos, with GPS co-ordinates where possible, can be useful for later discussions.

Reviewing documentation

The auditor carries out the Safety Audit on the basis of his personal experience and his knowledge of road safety. To ensure that safety aspects have not been overlooked during this experience-based procedure, checklists (Appendix 1-3) can be used to assist in this.

The auditors must have the following basic questions in mind:

- Who can be hurt and in what way?
- Is the proposed solution safe for all potential road users?
- Is the design that has been selected the best for traffic safety, within the framework of the regulations?
- Do new findings concerning traffic safety and road design make a different design seem advisable?

Checklists

Different checklists have been developed for different stages of a project's development process and they are attached as Appendix 1-3 to this Manual. The checklists present different questions regarding the safety of all users and they should help the auditor to identify issues and problems that can arise at the relevant stage of an audit.

Checklists are based on experience collected from earlier audits, findings from crash investigations, knowledge from experience with black spot management, road safety follow up, best practice, etc.

Audit findings and report

At the end of analysis process, the audit report is prepared. The report should clearly and concisely describe the project, the audit stage, the audit team members, the process of the audit, any safety deficiencies identified and proposed countermeasures. These countermeasures are conceptual in nature and should not provide the design team with design solutions. There is, for example, the possibility to give clear advices in the RSA report with cross references to guidelines and norms. On the other hand, some sketches with ideas about improvements in the audited design, as an annex to the main text of the report, can be helpful. It is not within the auditor's task to create a new design .That is the task and responsibility of the design engineer

The RSA report for phases 1 and 2 should contain the following information:

- **General or detailed project details:** Name of project, audit stage, date of audit and dates and times of any inspection, weather conditions during inspections, etc. A statement regarding which stage of the audit process the report relates to. Details of the team involved. An overview about the content of the audited documentation.
- **Audit results:** Details of the specific deficiencies identified, with reasons why these are regarded as deficiencies. Recommendations for actions to remove or reduce the impact of these deficiencies.

To give the client a better understanding of the audit results, the RSA report for phases 1 and 2 should be structured as follows:

- **Problems** are findings that clearly affect road safety. That means that a noticed deficiency will increase the crash risk or severity. With the proposed changes (measures), crashes and risks should be reduced. The auditor can illustrate his recommendations verbally or with sketches, but it is never the auditor's job to design the change.
- **Remarks** should be made regarding findings which will probably not lead to more crashes and severity, but could improve the overall road safety situation and sustainability of the project or can ease the demands on the road user. Contents of the remarks can also be related to the next project steps, so that it could help and lead the designer how to improve safety at that point.

It is very important to write down findings on the drawings or other working documents and this must be kept as evidence. In this way, the checklists can be helpful as working documents. In the last checklist row “comments” the auditor could make remarks which will help if the client later asks for some more explanation. Also, in the case of findings which are not deemed to be as relevant and therefore not part of the formal report, it may be useful to note them there.

During the audit procedure the auditor may find deficiencies in the project documentation which are not safety related. It is recommended not to include these findings in the audit report. Instead it is recommended to mention them in a cover letter or in a separate (informal) annex to the report.

The final report is sent to the Client.

A typical table of contents of RSA for phases 3 and 4:

1. **Introduction** including details about road sections of the road being inspected and the composition of the inspection team, date, times and conditions at the time of the inspection.
2. **Part A.** Project data (road function, traffic situation, road standards and surroundings). This part should outline the background data obtained during the preparatory work in the office and a description of the activities undertaken.
3. **Part B.** Investigation results with the deficiencies specified, the content should be sorted in a formal way, following the headings in the checklist. This part describes the shortcomings or deficiencies which were found and an assessment of these deficiencies. It should contain the completed investigation form and the documentation with pictures. The part B should be finished with a conclusion about the findings (“Assessment of deficits”)
4. **Part C.** Proposals and options for countermeasures – short term (e.g. low cost measures which could be as part of a maintenance program), medium term (e.g. small investments, e.g. adding guardrails) and long term (larger investments).

The RSA report for phases 3 and 4 needs to contain an introduction, three main parts and appendices with maps, pictures and illustrations as necessary.

To clarify the proposals and their locations, maps, illustrations, photos and sketches of countermeasures may be included as separate Annex, or could included in Part B.

4.3.3. Completion of the Road Safety Audit

Upon receipt of the RSA report, the client must consider the problems and proposals and make a decision how the project should proceed. The client refers the audit report to the designer, with his request what should be accepted and changed in design.

Completion meeting

Once the audit report has reached the stage where all findings are clearly documented, a completion meeting should be held to allow all interested parties a chance to interact and discuss the results. This meeting should precede the development of client responses to the audit team’s findings. The completion meeting should involve the audit team, the client, the design team, and any other employees who might be involved in formulating responses to the audit findings.

The meeting provides an opportunity to:

- informally present the audit findings and clarify or elaborate their meaning,
- suggest improvements to the report structure,
- discuss possible remedial measures for the problems identified, and
- set a timetable for completion of client responses.

It must be noted that it is crucial that a positive, constructive, and cooperative tone pervades on the meeting. The meeting should commence with a reminder that the intent of an audit is simply to enhance safety of the final project and that it is not a critique of individual or design team performances. It is essential for those involved to understand that the audit is a beneficial part of project development. Special effort therefore should be made to ensure that those involved have been informed about the audit process and positive experiences associated with it. Meeting facilitators should be careful to maintain an atmosphere for positive exchange of views and not permit animosity or unfounded disagreement.

Response to the Audit report

The client reviews the formal audit report and considers the indicated problems and proposals. The client can ask the designer to comment and give response to the report's recommendations, but the client has the final decision whether recommendations are to be adopted or not. He has to determine if, and to what extent, the remarks and proposals in the audit report will lead to design modifications. All recommendations must be given due consideration. Those that are accepted should be implemented without delay.

The client response should be given directly to the auditor. It is important that this formal response contains a clear and complete account of the reasons why any recommendations are not accepted. This response acts as an evidence trail through the decision making process.

Following the client's decision, the designer modifies the scheme in accordance with the accepted amendments. The client then decides whether if it is necessary to have a partial repetition of the RSA to check the changed documentation. This will depend on the nature and extent of the changes in design. In case of doubt, the client should send the relevant documents to the auditor.

The client's written response to the audit report will become part of the project documentation.

Follow up

The follow up process is led by the client. The client reviews the audit report and prepares a written response to each problem. Each measure proposed by the auditor in the audit report can be accepted or rejected by the client. Then, the designer makes the changes in the scheme to diminish the safety hazards. The client will check that the designer has made the agreed changes.

For each audit suggestion rejected, justification should be documented in the report by the client. Both the audit report and the client's response become part of the final audit record. All relevant documents should be kept as evidence.

5. TRAINING OF THE AUDITORS AND LEGAL ASPECTS

5.1. Training of the auditors

It is important that the auditor has extensive experience in road safety issues.

Proposal is that RSA team leader (TL) should have completed relevant university education preferably with Master degree and have significant experience in road safety engineering (design) and/or road traffic crash investigation. About three years of working with RSA and more than 3 RSA Reports produced would be minimal requirement for an RSA Team Leader.

RSA Team Members (TM) should have at least a bachelor education and about three years of experience in road safety engineering (design) and/or road traffic crash investigation.

Auditors should possess driving licenses and have good knowledge about Road Design Standard, the Traffic Safety Law and the Law for roads. The knowledge of other road standards is highly desirable.

To ensure the quality of the audit, auditors should undergo initial training, resulting in the award of a certificate of competence and should then take part in additional periodic training courses. Where audits are undertaken by teams, at least one member of the team shall hold a certificate of competence.

The content of training should include road safety related topics like crash investigation, road safety network management, road safety engineering and design. In several European countries like Germany, Denmark and Great Britain developed and well respected RSA training courses.

Two alternative approaches exist in Europe with regard to how road safety audit is done. The first is to have qualified staff as employees of the public administration, public road safety institute or similar. In the literature this solution is often called "internal auditor". The other possibility is to have contracts with RSA experts from private consultants - "external auditor".

In addition, the creation of a national Audit Centre (preferably inside some of existing organization) can be helpful for long-term sustainability. Such an institution could organize the training, certification and refresher courses for the authorized auditors. The association or Society of road engineers or similar body can be a suitable body to organise regular courses.

5.2. Legal aspects

Safety audits are a way to identify deficiencies or problems which have the capacity to impact on the safety of road infrastructure. They also identify remedial actions that could reduce or eliminate the potential safety problems. Sometimes audits can raise legal issues which the auditor should consider.

Experience in many countries indicates that claims related to the use of RSA have not been a problem. RSA provide a means to check that all reasonable safety initiatives have been taken in the design, construction and operation of schemes. The auditors are simply identifying safety issues or concerns that have the potential to reduce the safety level of a future road or existing road.

It should be stressed that the correct undertaking of RSA should not expose those authorities that adopt them to undertake a greater liability. With regard to legal liability, the following main principles can be expressed:

- If the road safety audit procedures are deemed to be an asset to the public, the fears of legal liability should not be used to prevent their use,
- Documentation is essential. The client's response to an audit report must provide reasons for not accepting the auditor's recommendation, where applicable. The response should be detailed and defensible,
- The audit report and formal response report must be placed in the project file. They could be used for any future legal investigation, and
- A follow up procedure of the actions or inactions taken by the client/road authority and identifying what was said and done at the time of responding to the audit is helpful.

A simple answer to the question: Will the undertaking of RSA expose road safety authorities to a greater responsibility than the one they already have?, would be: "No" .

Some legal experts have even more advanced opinions, that consideration should be given to the possibility that the non-use of road safety audits in an environment where they are being applied could raise another question: "*Will the absence of the use of a road safety audit which could have identified the safety problem under consideration be considered in a negative context by the courts?*". They believe that the answer to this question will eventually be: "yes".

Furthermore, it should be kept in mind that the EU has published the Directive 2008/96 on road infrastructure safety management, which made a clear decision that the RSA will be mandatory for the trans-European Road Network in the next few years. In addition, the eight multilateral development banks have now agreed a joint approach to emphasizing road safety in all their infrastructure activities and this will put more pressure to have road safety audit on all roads that they finance

6. REFERENCES

- [1]. *CATALOGUE OF DESIGN SAFETY PROBLEMS AND PRACTICAL COUNTERMEASURES*, World Road Association (PIARC), Paris, 2009
- [2]. *DIRECTIVE ON ROAD INFRASTRUCTURE SAFETY MANAGEMENT No 96/2008*, European Parliament and of the Council, Brussels, 2008
- [3]. *DRAFT MANUAL FOR ROAD SAFETY AUDIT*, Azerroadservice, Baku, 2009
- [4]. *DRAFT MANUAL FOR ROAD SAFETY AUDIT*, KazAvtoZhol, Astana, 2014
- [5]. *DRAFT ROAD SAFETY AUDIT MANUAL*, Kyrgyzstan, Bishkek, 2012
- [6]. Elvik, R. & Vaa, T.: *THE HANDBOOK OF ROAD SAFETY MEASURES*, Elsevier, Amsterdam, 2004
- [7]. *GOOD-PRACTICE GUIDELINES TO INFRASTRUCTURAL ROAD SAFETY*, European Union Road Federation, 2002
- [8]. *GUIDELINES FOR ROAD SAFETY AUDITS*, German Road and Transportation Research Association (FGSV), Edition 2002
- [9]. *GUIDELINES FOR URBAN SAFETY MANAGEMENT*, Institution of highways and transportation, London, 1990
- [10]. *IMPROVING GLOBAL ROAD SAFETY*, Resolution 60/5, United Nations, General Assembly, Geneva, 2005
- [11]. M. Belcher, S. Proctor & R. Cook: *PRACTICAL ROAD SAFETY AUDITING*, TMS, 2nd Edition, 2008
- [12]. *MANUAL OF ROAD SAFETY AUDIT*, Road Directorate, Denmark, 1997
- [13]. *ROAD SAFETY AUDIT – BEST PRACTICE GUIDELINES, QUALIFICATION FOR AUDITORS AND “PROGRAMMING”*, RiPCORD-ISEREST Project – WP4, EU Project, 2008
- [14]. *ROAD SAFETY AUDIT AND SAFETY IMPACT ASSESSMENT*, European Transport Safety Council, Brussels, 1997
- [15]. *ROAD SAFETY AUDIT GUIDE - FOR USE ON ALBANIAN ROADS*, Ministry of Transport, Albania 2008
- [16]. *ROAD SAFETY AUDIT GUIDELINE*, World Road Association (PIARC), Paris, 2007
- [17]. *ROAD SAFETY AUDIT GUIDELINES*, National Roads Authority, Dublin, 2004
- [18]. *ROAD SAFETY AUDIT GUIDELINES*, University of New Brunswick-Transportation Group, Canada, 1999
- [19]. *ROAD SAFETY AUDIT MANUAL*, South East Europe Transport Observatory (SEETO), EC/SEETO, 2009
- [20]. *ROAD SAFETY AUDIT*, Austroads, Australia, 1994
- [21]. *ROAD SAFETY AUDITS: A SYNTHESIS OF HIGHWAY PRACTICE*, Transport Research Board, USA, Washington D.C., 2004
- [22]. *ROAD SAFETY INSPECTION – BEST PRACTICE AND IMPLEMENTATION PLAN*, RiPCORD-ISEREST Project – WP5, EU Project, 2008
- [23]. *ROAD SAFETY INSPECTION GUIDELINE*, World Road Association (PIARC), Paris, 2007
- [24]. *ROAD SAFETY INSPECTION MANUAL*, South East Europe Transport Observatory (SEETO), EC/SEETO, 2009
- [25]. *ROAD SAFETY MANUAL*, World Road Association (PIARC), Paris, 2003
- [26]. *SAFETY AUDIT OF ROAD DESIGN. GUIDELINES FOR DESIGN AND IMPLEMENTATION*, Finnish Road Administration, Helsinki, 2002
- [27]. *SUSTAINABLE SAFE ROAD DESIGN: A PRACTICAL MANUAL*, World Bank, 2005
- [28]. *WORLD DISASTERS REPORT*, WHO, Geneva, 2002
- [29]. *WORLD REPORT ON ROAD TRAFFIC INJURY PREVENTION*, WHO, Geneva, 2004