ЈАВНО ПРЕДУЗЕЋЕ
ПУТЕВИ СРБИЈЕ

GUIDELINES FOR ROAD SAFETY AUDIT (RSA)

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CONTENTS

EXPLANATORY NOTE

The modern concept of improving road infrastructure safety requires explicite consideration of road safety, i.e. implementation of modern tools (procedures) aimed at improving road safety, in all life cycles of road infrastructure:

- Road Safety Impact Assessment (RSIA) is conducted at the road planning stage,
- Road Safety Audit (RSA) is conducted at all stages of road design, as well as immediately before road opening and six months at the latest after road opening,
- During road operation – for existing roads:
    - periodic and targeted Road Safety Inspection (RSI),
    - Black Spot Management (BSM),
    - An independent evaluation of the road's contribution on traffic crashes with the fatalities, or In-Depth Study (IDS), and
    - Risk Mapping (RM).

A detailed analysis of the abovementioned modern tools and effects of their implementation have been shown systematically for the first time in the European project RiPCORD-iSEREST, whose abstract (https://trimis.ec.europa.eu/sites/default/files/project/documents/20101007_170651_37168_RIPCORD%20ISEREST%20-%20Final%20Report.pdf, downloaded at 11.12.2018.) has singled out the procedures included into the EU Directive 2008/96/EC.

Thus the European Commission has prescribed, *inter alia*, that road safety audit and road safety inspection are mandatory for the core European road network, as well as for other roads that are partly or fully funded by EU sources.

Based on Directive 2008/96/EC of the European Parliament and of the Council, of November 19, 2008, on road safety infrastructure management, the National Assembly of the Republic of Serbia has prescribed by the 2009 Law on Road Safety, as well as by the 2018 Law on Public Roads (Official Gazette of the Republic of Serbia No 41/18) carrying out mandatory road safety audits of category I state road designs, i.e. independent detailed systematic and technical safety checks relating to road design characteristics, for all construction projects of new roads and for reconstruction projects of the existing roads, covering all design stages, immediately before road opening and six months at the latest after road opening.

According to the Law on Public Roads, the minister in charge of transport matters, has passed the Rulebook on Implementing Audit and Inspection and Establishing the Team of Experts for Audit and Inspection (Official Gazette of the RS, No. 52/19).

The above mentioned law and by-laws have provided conditions for applying regular official implementation of road safety inspections and road safety audits in Serbia.

A road safety audit (RSA) is a systematic, professional, multidisciplinary, independent, formal, comprehensive, detailed analysis of a road design or a newly built road, whose aim is to identify and eliminate possible failures that may lead to the occurrence of road crashes or make the consequences of road crashes severer. A road safety audit comprises offering recommendations in order to improve specific elements of a road design or a newly bilt road

and consequently reduce the risk of occurrence of road crashes, or reduce the severity of occurred road crashes. Road safety audits are carried out on all new road designs and on reconstruction projects of the existing roads, covering all design stages, immediately before road opening and six months at the latest after opening the road to traffic.

The present document represents the Guidelines for road safety audits in the Republic of Serbia. Having regard to Decision No 1692/96/EC of the European Parliament and of the Council, of July 23, 1996, on Community guidelines for the development of the trans-European transport network, and Decision No 1346/2001/EC of the European Parliament and Council of May 22, 2001, the guidelines have laid down procedures for carrying out the audits of road designs or newly built roads in the Republic of Serbia, in compliance with the Law on Public Roads of the Republic of Serbia.

The Guidelines are applicable to all other public roads in the Republic of Serbia, if such a decision has been made by the Government of the Republic of Serbia, a local self-government unit or other public and private project contracting authorities (investors).

These Guidelines are based on requirements prescribed by the Directive EU 2008/96, stipulations of the Law on Public Roads, experiences of foreign states that have been dealing with road safety audits for decades already, and on results of some European projects (for example, https://library.swov.nl/action/front/fulltext?id=327775).

The Guidelines are not a law, or a regulation. They are therefore not binding, nor intended to be prescriptive. The Guidelines only show the way to road safety auditors when carrying out an audit, referring them to procedures that must be undertaken during that audit, the way in which to carry out these procedures and expected results of an audit completed in that way.

1. DIRECTIVE 2008/96/EC ON ROAD INFRASTRUCTURE SAFETY MANAGEMENT

This chapter covers the articles and citations from the Directive 2008/96/EC on road infrastructure safety management relating to road safety audits.

Article 1

Subject matter and scope

1. This Directive requires the establishment and implementation of procedures relating to road safety impact assessments, **road safety audits**, the management of road network safety and safety inspections by the Member States.
2. This Directive shall apply to roads which are part of the trans-European road network, whether they are at the design stage, under construction or in operation.
3. Member States may also apply the provisions of this Directive, as a set of good practices, to national road transport infrastructure, not included in the trans-European road network, that was constructed using Community funding in whole or in part.
4. This Directive shall not apply to road tunnels covered by Directive 2004/54/EC.

Article 2

Definitions

For the purposes of this Directive, the following definitions shall apply:

1. 'trans-European road network' means the road network identified in Section 2 of Annex I to Decision No 1692/96/EC;
2. 'competent entity' means any public or private organisation set up at national, regional or local level, involved in the implementation of this Directive by reason of its competences, including bodies designated as competent entities which existed before the entry into force of this Directive, in so far as they meet the requirements of this Directive;
4. 'road safety audit' means an independent detailed systematicand technical safety check relating to the design characteristics of a road infrastructure project and covering all stages from planning to early operation;
8. 'guidelines' means measures adopted by Member States, which lay down the steps to be followed and the elementsto be considered in applying the safety procedures set out in this Directive;
9. 'infrastructure project' means a project for the construction of new road infrastructure or a substantial modification to the existing network which affects the traffic flow.

Article 4

Road safety audits for infrastructure projects

1. Member States shall ensure that road safety audits are carried out for all infrastructure projects.
2. When carrying out road safety audits, the Member States shall endeavour to meet the criteria set out in Annex II.

   Member States shall ensure that an auditor is appointed to carry out an audit of the design characteristics of an infrastructure project.

   The auditor shall be appointed in accordance with the provisions of Article 9 paragraph (4) and shall have the necessary competence and training provided for in Article 9. Where audits are undertaken by teams, at least one member of the team shall hold a certificate of competence as referred to in Article 9 paragraph (3).
3. Road safety audits shall form an integral part of the design process of the infrastructure project at the stage of draft design, detailed design, pre-opening and early operation.
4. Member States shall ensure that the auditor sets out safety critical design elements in an audit report for each stage of the infrastructure project. Where unsafe features are identified in the course of the audit, but the design is not rectified before the end of the appropriate stage as referred to in Annex II, the reasons shall be stated by the competent entity in an Annex to that report.
5. Member States shall ensure that the report referred to in paragraph 4 shall result in relevant recommendations from a safety point of view.

Article 8

Adoption and communication of guidelines

1. Member States shall communicate these guidelines to the Commission within three months of their adoption or amendment.
2. The Commission shall make them available on a public website.

2. BASIC PRINCIPLES OF AUDIT

2.1 Definition of an Audit

A road safety audit is a systematic, professional, multidisciplinary, independent, formal, comprehensive, detailed analysis of a road design or a newly built road, whose aim is to identify and eliminate possible failures that may lead to the occurrence of road crashes or make the consequences of road crashes severer.

Unlike inspection, an audit is intended for road safety improvement by reducing the risk of road crashes as early as at the stage of making the technical documentation of a project.

An audit offers recommendations with the aim to improve specific elements of a road design or a newly built road and consequently reduce the risk of occurrence of road crashes, or reduce the severity of occurred road crashes.

An audit is carried out on all new road designs and on reconstruction projects of the existing roads, covering all stages of road design, immediately before road opening and six months at the latest after opening the road to traffic.

An audit can't be only a simple check of application of regulations or norms applicable to roads for which an audit is carried out, or a check of a facility to see if it is designed in accordance with the project's terms of reference. A road safety audit is an »added value« serving for a higher-level analysis of technical documentation.

An audit must consider all road users equally. It means that a road safety auditor must take into account pedestrians, bicyclists, motorcyclists, disabled persons, children, elderly road users, as well as drivers of all motor vehicle types and passengers transported by those vehicles.

An audit should analyze road safety problems in various weather and other conditions: in the daytime, at night, in conditions of reduced visibility, during precipitations, on winter and summer days, etc.

An auditor must make use of his/her road safety related knowledge and experience in the way that he/she keeps asking the following question:

Will all road users be able to use the road safely, at any time, and in any circumstances?

An auditor must recognize road safety problems and suggest measures for minimizing possibilities of occurrence of road crashes and their consequences in the future.

2.2 Goals and objectives of an audit

The mail goal is to recognize and more precisely define the elements of a road design or the elements of a newly built road that may have adverse effects on road safety on the observed road or on the remaining road network.

The main goal is achieved through specific objectives, including the following ones:

- Reducing the risk of occurrence of road crashes to a minimum,
- Reducing the severity of consequences of road crashes that have eventually occurred,
- Reducing the possibility of a design solution to increase the risk of a road crash on some other portion of road network (prevent the »*migration of road crashes*«) that is affected by new construction works designed in the way that they modify the traffic flow, the volume or structure of road traffic.

2.3 Costs and benefits of an audit

Audit is a proactive procedure that eliminates or reduces the risk of road crashes even before they occur. On the other hand, an audit eliminates or reduces expensive interventions on the road after it had been opened to traffic. That is why an audit is a measure with a very good ratio of costs and benefits. In some cases, road safety audit suggests measures that help reduce significantly the costs of road construction, by improving road safety (for example, by reducing the width of roadways when they are unnecessarily wide, especially on bridges, etc.).

Audit:

- Enables highly efficient and financially acceptable measures for road safety improvement, especially if they are implemented at early stages of design,
- Reduces the number of road crashes,
- Reduces the severity of consequences of road crashes,
- Increases the harmonization of a design with road safety requirements,
- Improves the procedures of road design and construction,
- Accelerates the development of »*road safety culture*«,
- Enables an organized and purposeful exchange of knowledge and experience in the field of road safety,
- Offers long-term support to the optimum saving of financial means, by reducing road casualties.

There are several reasons why implementing audit is more effective than implementing an inspection:

- An audit is carried out at its first two stages, while the project is still »on paper«, and the costs of an audit are by far smaller than the savings from implementation of audit recommendations (modification is made on the drawing, and not in real conditions!). Implementing the audit at early stages (Stages 1, 2 and 3) eliminates or reduces

possible expensive interventions on the road after it has been put in operation (prevention is better than cure)!

- An audit is carried out at its Stage 4 while the road has not been opened to traffic yet, which means that neither road crash nor material damage have occurred yet,
- Caring out of audit at an early stage of road operation, when a larger number of road crashes could not have occurred yet.

The cost/benefit ratio, or the cost/effective (of recommended measures) ratio of implementing a road safety audit are higher than the ratios from a road safety inspection!

The cost of an audit includes the following:

1. administrative costs and costs of initiating audit procedures,
2. the cost of implementing an audit and writing an audit report, and
3. the cost of implementing recommended, or alternative measures aimed at improving road safety.

Administrative costs are the lowest, but time needed to initiate and conduct a public procurement procedure, or slowing down the design and road improvement process due to audit implementation, must be also taken into account.

The cost of implementation of recommended, or other measures intended for road safety improvement is the biggest item of the audit costs and depends on the stage at which the audit is carried out, as well as on recommended, or accepted improvement measures.

The first stage of the audit can have proposals for significant and expensive measures, given that the horizontal and vertical elements of road alignment, as well as types and locations of intersections, etc. can be still modified. That is the reason why the cost of implementation of suggested measures at the first stage of audit implementation is higher than the one at later stages.

The cost of recommended measures at the second stage of audit implementation is lower, since all road elements, installations, road signs, traffic lights, road equipment, methods of regulating traffic, etc. have been defined already. The audit at this design stage is the last possibility to modify the design before road construction begins. At this stage, the expropriation process may have already been completed. That is why road safety auditors should only exceptionally offer proposals that would contain, for example, significant modification of road alignment or cross-section elements.

The scope of suggested measures is smaller, and the cost of implementation of recommended measures at the third stage of audit implementation is far lower. In fact, as a rule, this case concerns only proposals for small add-ons or modifications (for example, extending safety barriers, changing location of a road sign, supplement a road marking, etc.).

The fourth stage of the audit (several months after the road has been opened to traffic), as a rule, there may be proposals for smaller improvements and »cosmetic« measures, whose price is far lower than the price of implementing measures at the previous stages of a road safety audit.

3. AUDIT PROCEDURE

3.1 Participants in audit procedure

Table 3.1 Participants in a road safety audit procedure, their competences and responsibilities

Roles	Competences and responsibilities
Contracting authority (road authority, investor of an infrastructure project)	Legal or natural entity responsible for initiating, funding, managing and implementing the project that is subject of an audit: • Prepares the terms of reference for carrying out the audit, • Initiates and executes public procurement procedure and makes a selection of a professional audit team, • Signs the agreement with the audit team or the audit team leader, • Submits to or provides the audit team with access to necessary documentation and all project work needed for audit implementation, • Together with the designer, or the contractor, analyzes the report on implemented audit or prepares the reply to proposals, listed in the auditor's report, • Together with the designer, or the contractor, eliminates deficiencies and irregularities of the project or already built facility, following the warning by auditor from the auditor's report, • Makes comments and explanations for each recommendation made by the auditor that has not been accepted, and • Makes a record of road safety audits and road safety inspections that have been carried out.
Designer	Legal or natural entity that provides technical documentation for the new construction or reconstruction of a facility, according to the Agreement made with contracting authority: • Makes a road construction or road reconstruction design and other related documentation, • When making that design, ensures that design solutions allow for a safe and efficient circulation of road traffic, are in line with the terms of reference, regulations and norms, or that there are no negative effects on road safety and traffic flows, • At the stage of road safety audit implementation, gives the auditor all necessary explanations and clarifications for specific design solutions and elements of technical design used (usually through contracting authority that manages and coordinates the whole process), • After having received the auditor's report, studies the remarks and recommendations from the report and forms a professional position on them, or makes the modifications of technical documentation (with which he/she agreed), in line with the auditor's recommendations, • Together with the contracting authority, prepares the replies to auditor's proposals and suggestions,

	• Provides harmonization of technical documentation with auditor's remarks and recommendations, as accepted and agreed on by the auditor and contracting authority.
Road Traffic Safety Agency	In line with the valid regulations of the Republic of Serbia, the Road Safety Agency conducts professional training programmes for persons intended for taking a professional examination for an auditor, or an inspector, and for professional improvement of auditors, or inspectors, and for taking a knowledge examination for auditors, or inspectors; keeps the record of licenced auditors and inspectors.
Professional audit team	Audit is carried out by an independent, professional team of auditors lead by the Team Leader – a licenced road safety auditor. A professional audit team is established on the basis of Article 92 of the Law on Public Roads and Article 18 of the rulebook on implementing audit and inspection and establishing the team of experts for audit and inspection. A road safety auditor is a professionally trained neutral entity holding a valid auditor's licence and carrying out a road safety audit, as part of the audit team, of which he/she makes a report. Team Leader: • Coordinates the work of team members and harmonizes the activities with the representative of contracting authority, • Reviews and analyzes technical documentation, or the newly built road section, • Prepares, or coordinates making of the audit report, • Manages harmonization with contracting authority, after receiving a reply to the audit report, and • Re-checks supplemented/amended technical documentation.
Member of a professional audit team	A member of a professional audit team: • Reviews specific parts of technical documentation as entrusted by the Team Leader, • Participates in the preparation of a report on a conducted road safety audit procedure, as determined by the Team Leader, • Participates in the analysis of replies of contracting authority and designers, and in the writing of auditor's replies to contracting authority and designer's positions, and • Participates in the review of technical documentation after the amendments – acceptance of recommendations.
Professional Panel of road safety auditors and road safety inspectors	Professional Panel of road safety auditors and road safety inspectors is a professional and advisory body of the ministry in charge of transport issues, providing professional assistance to the ministry in making a final decision, following the explanation of state road authorities on possible failures in acting according to auditor's recommendations.
External (outsourced) professional	In the case of specifically demanding designs and projects from the technical documentation, the Team Leader can, on the basis of a prior consent by the authority that contracted an audit, include in the

associate	procedure external (outsourced) professional associates, who are not licenced road safety auditors. Their task will be to: • Review and make a professional analysis of specific parts of technical documentation and examine if they are harmonized with the valid regulations, norms, professional positions and model solutions generally used in similar projects, • Together with the Team Leader, make a professional analysis of auditor's remarks relating to design solutions, and help with defining recommendations, and • Study the replies received from the contracting authority and designers for the remarks made and review the modifications and supplements of the technical documentation.

3.2 Stages of a road safety audit

A road safety audit is carried out at all stages of preparation of technical documentation.

In some states, an audit is carried out at five stages, and in other states – at four stages, preceded by the making of a Road Safety Impact Assessment (RSIA).

Pursuant to Article 89 of the Law on Public Roads, Serbia has opted for carrying out a four-stage road safety audit.

Road safety audits are undertaken at two levels, i.e. prior to construction (Stages 1, 2 and 3) and after construction (Stage 4). At the stages prior to construction, a road safety audit can have the largest impact on modifications of design solutions and can thereby improve road safety since auditors revise the design even before construction works have begun. It is necesary to make a before-construction audit for each design that may change mutual relationships among various road users and/or between road users, road and/or road environment.

Table 3.2 Four stages of a road safety audit and their specific features

RSA stage	Level of technical documentation	Activities
1	Preliminary Design	The central point at this stage is road alignment. The audit is focused on horizontal and vertical alignments/curves, as well as on elements and dimensions of a normal road cross-section elements and types of intersections, prior to land expropriation procedure.
2	Construction Permit Design	All detailed drawings are considered at this stage, prior to construction works. Detailed drawings contain information on all road elements, installations, position of road signs, traffic lights, method of regulating road traffic, carriageway markings, road equipment, road protection elements, etc.

		Auditors check safety features before the construction works begin.
3	Construction Design	Drawings incurred from a detailed examination of design solutions for the Construction permit design that are necessary for construction works, are considered at this stage. The subject of the audit at this stage is textual documentation containing technical description with additional data, in relation to those already defined by the Construction permit design that relate to technical specifications (technical conditions for construction works) of construction material and equipment intended for fitting. Design solutions relative to safe circulation of road traffic during construction works are given particular consideration at this stage.
4	As-built Design	At this stage, the audit is carried out after the completion of construction works, immediately before and after road opening. Following the completion of construction works, auditors make a field review of the as-built design during different time periods (day and night) in order to check if safety of all road users have been provided, in different conditions of visibility. The audit is carried out soon after the road has become operational. The auditors check if road users use the road as foreseen by the design. Since the objective of road safety audits are preventing road crashes, even before they occur, the audit should be carried out at the latest in the first six months after road opening.

3.2.1 Preliminary design (Stage 1)

Scope – The preliminary design already offers defined road alignment and intersections, the drawings show horizontal and vertical road elements, carriageway widths, types of intersections foreseen, locations of facilities, etc.

The purpose of the audit at Stage 1:

The following is the purpose of the audit at Stage 1:

- To avoid, or reduce the possibility of unnecessary loss of time and efforts due to redesigning work at later stages of making technical documentation,
- To ensure that road safety is not jeopardized by mutual influence of specific

design elements (design solutions),

- To assess if possible deviations from the regulations will have considerable effects on road safety,
- To asses if the needs of all road users have been met.

At stage 1, road safety audits are carried out using preliminary designs. At that level of processing, a design only shows general information, or horizontal and vertical alignments and characteristic cross-sections of a road, together with characteristic features of the cross-sections themselves. At-grade and grade-separated intersections must be so documented that they contain all necessary calculations, analyses and drawings, so that the RSA team could make a detailed analysis and assessment. The general drawing must be able to present the field recordings, watercourses and existing roads, facilities, boundaries of cadastre parcels, etc.

During the conducting of audit in stage 1 it is not possible to see the actual road alignment (as it is possible after completion of construction), but, nevertheless, it is necessary to carry out a review of the situation on the field.

The audit team of experts should recognize and devise the way in which the planned road will tie into the existing road network, or study the existing roads within a wider cover zone, in order to find out how the devised infrastructure fits into existing road network, from the point of view of road safety of various road users.

At that level of the project, basic decisions on route selection, overall design and arrangements have been already accepted. Regardless of that all, the audit at that stage still allows proposing significant modifications the horizontal or vertical alignments, arrangement of the median, etc. Intersecting roads (access roads, service roads, at-grade intersections, grade-separated intersections) have to be checked for possible negative impacts, if a change in intersection location occurred (due to a change in horizontal or vertical alignment), or a change in possible traffic conflicts, a change in sight-distance, etc. It is still possible at that stage to analyze the likelihood of modifications of locations for intersecting roads or intersections.

3.2.2 Construction permit design (Stage 2)

Scope – It is necessary to re-check the issues analyzed at Stage 1 of the audit, as well as to see if the corrections have been made in the design, according to recommendations from Stage 1 of the audit. At this stage, the following details have been added to the design: details on drainage, curbs, hard-shoulders, public lighting, arrangement of environment, road signs, road markings, road equipment, protective road elements, traffic lights and other equipment and facilities. It is necessary to check all the elements that may exercise influence over road safety of all road users (not only motor vehicles, but also bicyclists, pedestrians and motorcyclists).

The purpose of the audit at Stage 2

The following is the purpose of the audit at Stage 2:

- To check if and how the recommendations form Stage 1 of the audit have been implemented, following the consent of road authorities,

- To identify and analyze all critical spots connected with the completed design at this level,
- To assess if they will affect road safety considerably, if there occur deviations from regulations and standards,
- To assess the impact on road safety of those road elements that have not been presented yet at Stage 1,
- To assess if the needs of specific road user types have been taken into consideration to a sufficient extent and if the conditions for safe participation in road traffic of all road users have been met,
- To check possible mutual negative effects of various elements of road design, as well as the mutual relationship among those elements and the existing road network in the neighbourhood,
- To continue with the analysis of all irregularities identified at Stage 1.

At Stage 2, the audit is carried out upon the completion or a bit before the completion of the making of technical documentation for road construction. At this stage of the audit, road authority must give the audit team the elaborated construction permit designs.

The audit team should consider possible negative risk compensation due to changes in road features, especially with the road reconstruction. In fact, road characteristics are foreseen by road designs, such as new asphalt carriageway, carriageway widening, increasing curve radius, increasing sight-distance at critical locations, etc. These changes incite increase in real (operating) speeds on the road, regardless of posted speed limits, which may have negative effects on the risk and severity of road crashes. That is why the RSA team must, at all times, have in mind these expected changes in driver's behaviour, and consequently propose additional measures aiming at reducing negative effects on road safety (for example, installing new safety barriers, reducing the slopes of cuts/fills, reducing the grade of concrete culverts along the road, and in exceptional cases, propose traffic calming measures, etc.).

The audit carried out at this design stage is the last possibility for modifying the design before the road construction starts. At this stage, the expropriation process may have already been completed. That is why road safety auditors should be careful when suggesting proposals which would contain significant changes in road alignment or cross-section elements and require subsequent expropriation of land.

3.2.3 Construction design (Stage 3)

Scope – It is necessary to re-check the issues analyzed at Stage 2 of the audit, as well as to see if design modifications have been made, according to the recommendations from Stage 2 of the audit. At this stage, the drawings incurred from a detailed elaboration of design solutions for Construction permit design, necessary for the execution of construction works, have been added to the design. Additions also include textual documentation of the design containing technical descriptions with additional data in relation to those already defined by the construction permit design, which, *inter alia,* relate to technical specifications (technical conditions for performance of works) of construction materials and equipment intended for fitting. At this design stage, design solutions related to safe circulation of traffic during construction works have been particularly defined.

The purpose of the audit at Stage 3:

- To assess the safety of those road elements that were not visible or mentioned at the previous design stage,
- To assess, from the point of view of road safety, if the needs of all road users have been met to a sufficient degree,
- To check if the material and equipment foreseen by the design are in line with road safety requirements,
- To check if an adequate temporary delineation (road signs and road markings) has been designed,
- To check, by putting the auditors in road user's shoes, how these road users will understand the new road, and
- To check if all deficiencies identified at previous stages have been eliminated.

The audit of the Construction design is carried out immediately before the beginning of construction works and is the last opportunity to identify and remove possible deficiencies that are likely to affect road safety.

3.2.4 As-built design (Stage 4)

Scope – Project implementation (road construction or reconstruction) has been completed and the road is ready for operation. At this stage of the audit, it is necessary to check if the construction of infrastructure facility has been carried out in line with the design and if, while performing the works, there have occurred any deficiencies that may affect road safety. Special attention should be paid to possible modifications and deviations from design which occurred during the construction works.

At the same time, after 6 months at the latest of the usage of the new or reconstructed road, an assessment is made to check if the road is used in accordance with the planned conditions and if any modifications/supplements are needed, given the real behavior of road users in traffic, and having regard to available data on road crashes that may have probably occurred after the road became open to traffic.

The purpose of the audit at Stage 4 – prior to opening the road to traffic:

- To assess safety of those road elements that have not been visible or mentioned in the construction design,
- To assess, from the point of view of road safety, if the needs of all road users have been met to a sufficient degree,
- To check if all temporary delineation (road signs and road markings) and remnants from construction that may cause danger, from the point of view of all road users, have been removed,
- To check, by putting the auditors in road user's shoes, how these road users will understand the new road, and
- To check if all deficiencies identified at previous stages have been eliminated

The purpose of the audit at Stage 4 – up to 6 months following road opening:

- To assess all road features, design elements and local conditions (dazzling glare of an approaching car, night visibility, occurrences on the nearby land, etc.) that may increase the risk of road crashes and severity of their consequences,
- To check how different road users understand the delineation and other road elements and whether they behave according to expectations,
- To check the mutual influence of various design elements and mutual influence among those elements and the existing road network,
- To check the influence of additional measures that have been built at the stage of preliminary operation (for example, as-built noise barriers) on road safety of all road users on the newly built road infrastructure and on existing roads,
- To observe how road users behave on the new road, and in particular, the changes in their behaviour that are the result of improved road safety features,
- To assess if the demands of all road users in terms of road safety have been satisfied, and
- To explore the trends of influence of the new road and possible safety related problems on that road.

The audit of the as-built road immediately before the opening of that road to traffic is the last possibility to identify and eliminate possible deficiencies that might affect road safety.

During the audit procedure, immediately before the road opening, the professional audit team has the possibility to make a detailed check of the road and of roads connecting with the existing road network. The check is carried out by driving on the new section and walking along more important portions of that road, during which the professional audit team becomes directly acquainted with the whole road.

It is important to make the check in conditions of daytime visibility and at nighttime. Nighttime check is of particular importance, since the road arrangement at night has a different layout. During the nighttime check, it is possible to identify the problems such as inadequate public lighting, irregular delineation of curves, intersections and intersecting roads, poor retro-reflexion and poor perception of road signs and road markings and other hidden dangers on the road.

Given that the road has been completely finished, there may be suggested some physical modifications of the cross-section, changes in road alignment or arrangement. Proposals should be primarily focused on modifying the public lighting, road signs, road markings, pavement markings, removing dangerous physical obstacles along the road or smaller structural changes (for example, building dropped kerbs in pedestrian crossing zones, etc.). However, such small modifications on the road can, at minimum costs, also reduce considerably the risk of road crashes and improve road safety.

Due to the proactive nature of that check, Stage 4 (after road opening) must not be interpreted wrongfully as the analysis of road crashes or black spot management and must not depend on the retrospective analysis of road crash data!

In fact, black spot management and in-depth analysis of road crashes are based on data on road crashes with the aim to find out which traffic and road safety related problems occur on a particular road location. These activities are before all based on studying road traffic conflicts and road crashes, since they analyze road safety problems after the occurrence of a road crashes or they examine causes of road crashes. As a rule, such analyses are the consequence of road crashes concentrated on a particular road section or location on the road (for example, at an intersection or in a curve), or they are the result of road crashes with the most serious consequences occurred on a particular location.

Contrary to this, the audit at Stage 4 is primarily based on field review of a road, review of final design solutions (updated in the as-built design) and other design data (for example, previous reports) in order to be able to identify possible locations of potentially dangerous sites, where road crashes might occur. Thus the auditor gets a precise insight into a road safety situation on that road. That is why the road safety audit is a proactive action, as it helps determine possible locations of road crashes and assess severity of their consequences, before the first road crash has occurred on that road.

Road crash data, if available, should be used only as an addition to all fact found as a result of field review and review of technical documentation. It is recommendable for the auditor to check the data on road crashes only after he/she has conducted the field review and review of technical documentation, so that road crash data could not affect his/her professional assessment.

When carrying out the audit on the built road, the auditor has a better possibility to understand potential road safety problems than he/she has it when making the audit at pre-construction and construction stages. The auditor not only checks various road features here, but also observes road traffic to understand how road users behave on a certain location. The auditor can identify critical elements having adverse effects on road safety by observing driver's behaviour, for example, from which he/she can conclude that basically something has been done incorrectly or incompletely when arranging the road. Particular attention should be paid to vulnerable road users (for example, elderly drivers or pedestrians, visually impaired pedestrians, children, etc.) who may experience special problems while walking the surveyed location or when using the road facility. Motorcyclists must be also observed as they might make traffic offences (speeding, passing at the red light, not giving the right of way to pedestrians, etc.) and to that end, solutions for improvement must be suggested, too.

Another advantage of carrying out a road safety audit on a built road (compared to the audit made at pre-construction and construction stages) is in the fact that the auditor can analyze the consequences of possible road crashes, conflicts and other occurrences, such as:

- Damaged curbs, safety barriers, trees, poles, delineators and road signs,
- Traces of vehicle impacts with curbs or roadside barriers,
- Traces of tyres of a skidding vehicle, broken glass, oil stains, etc.

Such evidences facilitate the recognition of potential locations with an increased risk of occurrence of road crashes. On locations where road equipment or facilities have been damaged (for example, damaged fence) it is important to stop, record the damage occurred, analyze their impact on road safety in a professional manner, and register and enter that evidence into the report as a significant problem in terms of road maintenance.

When carrying out the audit of the newly built road, it is necessary to have in mind that the road itself, road facilities, road equipment, but also immediate roadside area are subject of the audit, just like it was when carrying out the audits at pre-construction stages.

Another characteristic of the road safety audit procedure applicable to newly built roads is that the auditor checks first if the analyzed road section has the same function and purpose as it was foreseen by the design and construction stages. Significant changes in the volume and/or structure of road traffic, increased share of vulnerable road users or modifications in the land use may cause the change in assumptions from the road design stage.

Provisions of the regulations, other by-laws and norms are the basis and framework used by designers during the road design and construction stages. However, the auditors can propose the application of advanced solutions intended for road safety improvement, even when these solutions have not been prescribed, but nevertheless have a positive impact on road safety. When proposing such solutions, the audit team should elaborate additionally and in detail the reasons and importance of their application.

If no audit has been carried out in any of the previous design stages, a combined audit intended for the current and previous design stage will be carried out, in accordance with Article 4 of the Regulation on conditions and method of carrying out road safety audits and road safety inspections.

If there have occurred significant modifications in the design, in relation to previous technical documentation, subject to completed audit, or if several minor changes may endanger road safety, following Article 5 of the Regulation on conditions and method of carrying out road safety audits and road safety inspections, the audit at design stage will have to be repeated completely.

3.3 Implementation steps of an RSA procedure

Figure 3.1 shows the algorithm of implementation of a road safety audit procedure, whereas Table 3.2 contain detailed processes and activities undertaken within the audit procedure.

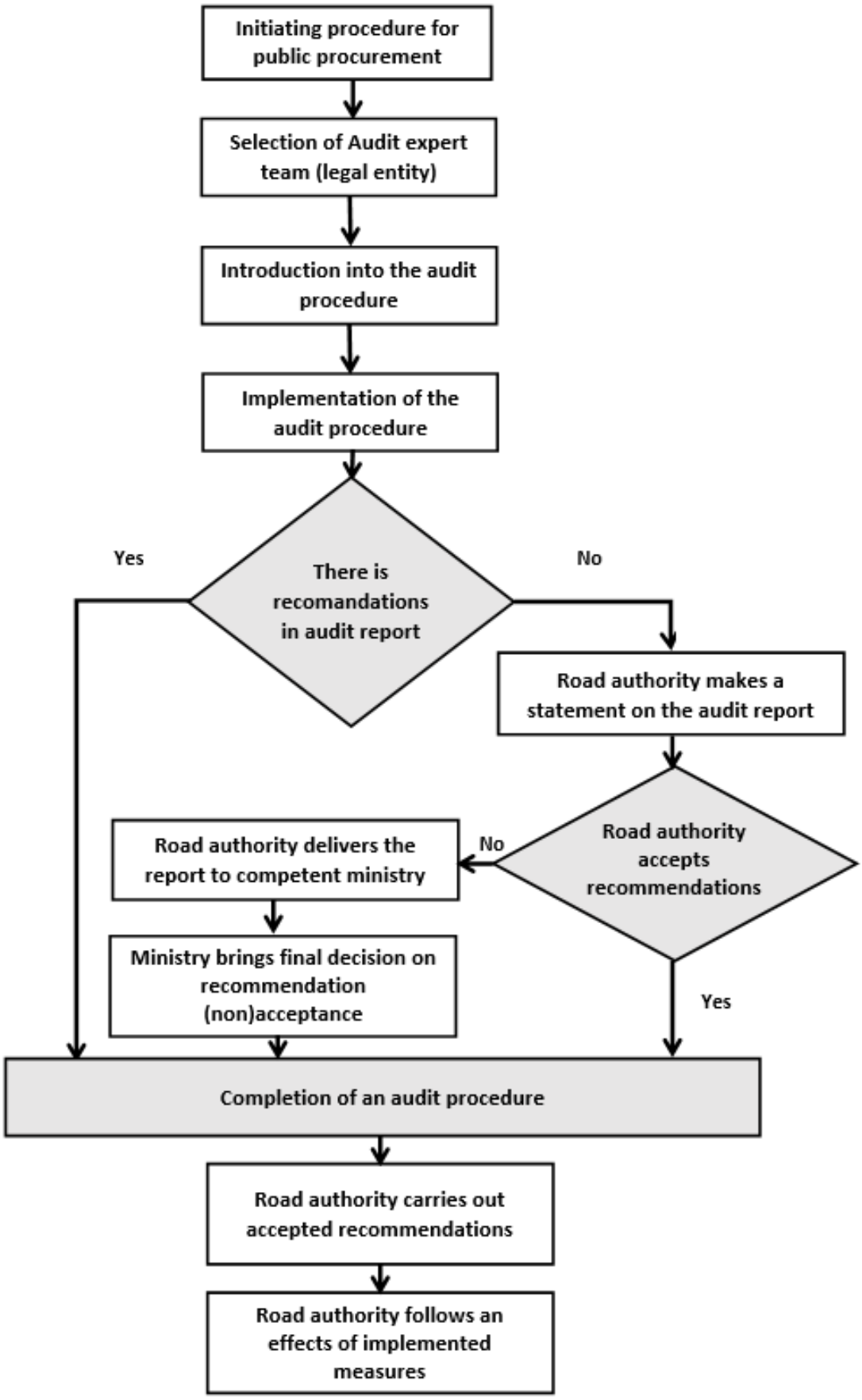

Figure 3.1 Algorithm of audit procedure implementation

Table 3.3 Processes and activities undertaken within audit implementation

Process	Activities undertaken within audit implementation
Initiating procedure for audit implementation	The contracting authority of the audit[1] prepares the ''Terms of reference for audit implementation'' and documentation for procurement of the audit, for a specific project.
	Interested legal entities submit their offers with the list and references of leaders and members of the professional audit team. The leader and the members of that professional audit team enclose the statements on independence in which they state that they have not been included in previous road designs procedures or road maintenance process that is subject of the making of report.
	The contracting authority of the audit chooses the legal entity that will undertake activities related to the audit, and also the professional audit team.
	After the completion of procurement procedure, the contracting authority of the audit concludes an agreement with the legal entity through which the auditors – members of the audit team will be conducting the audit.
Introduction into the audit procedure	The contracting authority of the audit organizes a kick-off meeting with the chosen professional audit team at which clarification is offered for the subject of the audit, expected contents of the report and dynamics of implementation. If the road authority is not the contracting authority of the audit, then the contracting authority of the audit invites the representative of the road authority to attend this meeting. The contracting authority of the audit hands over all technical documentation to the audit team leader, including the reports on the audits at earlier stages (if any) and other documents of significance for the audit.
Audit implementation	Professional audit team carries out the audit and draws up a report which will be delivered to the contracting authority of the audit.
Statement of the contracting authority of the audit on the report	The contracting authority of the audit reviews the audit report and gives a statement on the recommendations concerned. If needed, the contracting authority of the audit delivers the audit report to the designer for statement (if it concerns design audit – stages 1, 2 and 3). Based on designer's statement, the contracting authority of the audit writes the final statement and delivers it to the audit team.
Statement of the audit team	The audit team analyzes the statement of the contracting authority of the audit and of designer and enters its position on acceptance or non-acceptance of the clarification made by the contracting authority of the audit and of designer.
Implementation of recommendations made by the audit team	The contracting authority of the audit requires from the designer to modify the design with regard to implementation of auditor's recommendations agreed by the contracting authority of the audit.

[1]If the contracting authority of the audit is the road authority, then it initiates the public procurement in line with the Law.

Final opinion of the authority in charge of traffic matters	In the case of non-acceptance of recommendations of the audit team or impossibility to act following the recommendations from the report, the contracting authority of the audit will be obligated, within 30 days from the day of receiving the report, to clarify to the authority in charge of transport matters its possible failure to act (according to Article 89 of the Law on Public Roads). Competent authority for traffic matters offers the final opinion for the clarification made by the contracting authority of the audit. The contracting authority of the audit is obligated to act in accordance with the final opinion of the competent authority for transport matters (according to Article 89 of the Law on Public Roads).

3.3.1 initiating audit procedure

The procedure is initiated by the road authority, or other contracting authority of the audit (investor of the facility connecting with the road, concessionaire, etc.).

In Serbia, the selection of a professional audit team is made through public procurement of an audit, for a certain project or group of projects. Legal entities meeting general and specific conditions, employing or recruiting the audit team leader and its members are eligible for the public call. Selection of a legal entity that is going to implement audit activities is made on the basis of number of points obtained from references of the audit team leader and licenced audit team members (at least 50% of points), the prices, timelines and other criteria of importance for the quality and efficient audit implementation.

Professional audit team is chosen according to Article 92 of the Law on Public Roads, and Article 18 of the Regulation on conditions and method of carrying out road safety audits and road safety inspections.

In addition to licenced auditors, the audit team may have, as team members, professionals from the transport and civil engineering profession who are not licenced for audit activities. If specific projects or facilities are concerned, road authority can require including professionals of other profiles, as team members, into the audit team (electrical energy specialists, drainage specialists, railroad transport specialists, horticulture specialists, etc.).

As a rule, the same professional audit team is appointed for the audits before and after opening the road to traffic.

When submitting the application to the public call, legal entities – potential audit contractors, enclose to the road authority their statements on independence. With these statements, the audit team leader and the members state that they have not been included in previous road design or road construction procedures or road maintenance process associated with the road that is subject to audit.

After the selection has been made, the contracting authority of the audit concludes an agreement with the road authority on undertaking the audit in question. If the road authority estimates that it is more practical, it can draw individual agreements with the audit team

leader and each member of the professional audit team, holder of a road safety auditor's licence.

3.3.2 Introduction into the audit procedure

Prior to the audit, the road authority organizes a kick-off (initial) meeting with the chosen professional audit team.

The subject matter of the audit, expected structure and contents of the report, as well as dynamic plan of audit implementation, are presented in detail at that meeting.

Road authority hand over all technical documentation to the audit team leader, including the reports on earlier stages of the audit (if any) and all other documents of significance for a concrete audit, if any.

3.3.3 Tasks and assignments of the professional audit team during the audit implementation

The audit procedure itself commences after the professional audit team has been appointed, and after the professional audit team has received all necessary technical documentation, all other documents of importance for the audit concerned (if any) and all other guidelines and information relative to audit implementation.

The tasks and assignments of the professional audit team differ depending on the audit stage.

The following methodology is used for **Stages 1, 2 and 3** of the audit:

- The audit team of experts reviews all previous inspection reports and audit reports (if any), including potential reports on recommendations that have not been taken into consideration at certain design stages,
- The audit team of experts jointly reviews the technical documentation and get acquainted with the design concept,
- The audit team of experts makes field review of the location of the planned construction, makes photo documentation and notes,
- Members of the audit experts team, independently and separately, and in a systematic manner, review technical documentation, notes and photos taken in the field, together with all other data enclosed by the road authority,
- The Leader of the audit experts team collects the remarks of all team members, remarks related to solutions which auditors find likely to cause the occurrence of road crashes, if the design remains unchanged,
- The Leader of the audit experts team puts together all the remarks made by the members into a single document,
- The Leader of the audit experts team organizes a meeting of all team members where team members together have a discussion on all identified deficiencies,
- Following their opinion, members of the audit experts team decide on which solutions of concern are related to road safety and discuss the possible measures for improving design solutions.

- It is desirable to take the minutes or notes at the meeting. It is necessary to note all the remarks that have been discussed, but are not entered into the final report, and to also include the justification as to why that remark has not been entered into report;
- One of the team members (rapporteur), appointed by the team leader, prepares the concept of the audit report,
- The Leader of the audit team reviews and corrects the concept of the audit report and submit it to all team members,
- Members of the team of experts confirm the final version of the report, sign it and send one or more copies to the contracting authority of the audit.

The following methodology is used for **Stage 4** of the audit - before road opening:

During the audit implementation, immediately before road opening, it is recommendable to go to in the field together with the representatives of traffic police (head of traffic department or officer in charge of monitoring road crashes) and the representatives of the company in charge of maintenance of that particular road section, as well as supervisory representatives, local community representatives (local road safety council). They participate only as expert advisors and are not a part of team of experts for audit implementation.

- The audit experts team studies the sight distance situation of spatial engagement/ general drawing/environmental impact assessment in order to determine the scope or size of the project,
- The audit experts team studies the as-built design,
- The audit experts team studies and reviews all previous audit reports and reports on recommendations that have not been taken into consideration so that all doubts and open questions at the stage of preparing technical documentation could be analyzed again in the field itself, or on the as-built road,
- Experts team leader invites representatives of traffic police, road maintenance enterprises, enterprises for supervision and local communities, makes them familiar with the subject of audit and harmonizes possibilities for their contribution to the quality of audit (meetings, joint field visits, enclosing previously prepared analyses and letters, etc.),
- The audit experts team and advisors review the analyzed section in daytime conditions. It is necessary to visit a bit wider area than the area occupied by the project, in order to have a better insight into traffic environment,
- Team leader manages field review,
- One of the team members registers all potential dangerous locations and sources of possible hazards that are likely to contribute to the occurrence of road crashes or could increase the severity of those crashes. During the meetings and field review, opinions of all advisors that may be of importance for drawing up the reports are also registered,
- One of the team members takes the photos of all identified potentially hazardous

road elements,

- Members of the audit experts team, together with the attending specialists, representatives of various stakeholders, discuss all important topics and questions, prior to leaving the field. Thus the notes from field review contain all problematic locations and opinions of various stakeholders,
- Professional audit team reviews the analyzed section at night, and if possible, in various weather conditions (rain, sunny weather, etc.);
- One of the team members (rapporteur), appointed by the team leader, prepares the draft concept of the audit report and submits it to the team leader, other team members and all specialists attending the meetings and carrying out field review,
- Based on the comments by all participants in a field review, a team member appointed by team leader, writes a concept of the audit report and submits it to the team leader,
- Team leader examines the concept of the audit report and submits it to all audit team members who enclose to team leader their comments and proposals for improvement,
- Team leader organizes a meeting with team members where all identified deficiencies, possible measures for improvement are analyzed and recommendations harmonized,
- Professional audit team leader makes the final audit report, signed by all team members, and delivers it afterwards to the contracting authority of the audit, i.e. road authority.

The following methodology is used for **Stage 4** of the audit – up to 6 months after road opening:

- Professional audit team studies technical documentation in order to have an insight into the scope or size of the project,
- Professional audit team reviews and compares all previously drawn audit reports and all unimplemented recommendations so that all open questions could be analyzed again in the field,
- Professional audit team carries out field review, observes and analyzes road user's behaviour. An analysis of traffic conflicts (conflict technique includes drawing and analysis of charts of traffic conflicts) can be made at critical locations.
- One of the team members, appointed by the team leader, prepares the concept of the audit report and submits it to the team leader and other team members. The concept of the report may contain data on road crashes before and after construction, or reconstruction of infrastructure facility,
- Team leader and team members give their comments and proposals for improving the concept of the report,
- Team leader organizes a meeting with team members where they analyze all identified deficiencies and harmonize the recommendations,
- The leader of the professional audit team makes the final audit report, signed by all

team members, and delivers it to the contracting authority of the audit, i.e. road authority.

3.3.4 Field review

Already at early design stages, a field review helps assess the impact the project of new or reconstructed road and its environment (for example, shaping of the previous road section, road environment, etc.) has on the area where a new or reconstructed road will be built.

Field review, or visit conducted within audit stages 1, 2 and 3 , is of importance since technical documentation (primarily of the construction site) and field review serve to identify where road alignment will be situated in terms of spatial arrangement, which interventions will be applied in that space and to which extent, what the relationship will be between the new road and existing road, where (on which locations) and in which way the new, or reconstructed road will tie into the existing road network, etc.

Field review, or visit conducted within audit stage 4 (before road opening, or up to 6 months after road opening) must include the review of alignment of the newly built or reconstructed road that is subject of the audit, as well as of all other roads in the area of impact engagement, or spatial interventions. It is necessary to ensure the review of all roads affected by the new project. Particular attention should be paid to locations where new or reconstructed road ties into the existing road network.

Within that field review, it is necessary to record the locations (video recordings and photos) that are likely to be the sites where road crashes may occur. Critical road elements on these locations that may contribute to the occurrence of road crashes or increase their consequences are analyzed, described and recorded in detail.

Based on their own estimates, the professional audit team may decide at what time of the day the field review should be carried out on certain road sections (for example, when pupils arrive at school, in early morning hours when the sun dazzles the drivers, etc.).

The most important questions to which members of the professional audit team must persistently and continually look for answers, when conducting field reviews at stage 4 (before road opening, or up to 6 months after road opening) are the following ones:

Can any road element contribute to the occurrence of a road crash on this location?

What would be the consequences of a possible road crash? and

Can any of road elements be additionally improved and consequently reduce the risk and consequences of road crashes?

Experiences from road safety are the basis for assessing those road features that might increase the risk of occurrence of road crashes and road casualties. There are two methods that can help recognize possible high-risk locations and road hazards:

- the use of check-lists, and
- putting the auditors in the shoes of each road user.

Experiences of many states acquired in the years following the implementation of Directive within EU, support the statement that check-lists have not achieved its purpose. Check-lists can only be a direction of action (reminder) providing that, within the audit procedure, all road elements are analyzed, as are all road users and all possible questions of importance for road safety. However, check-lists must not limit the auditors, or reduce the audit procedure only to a simple filling in of check-lists, without any thinking and searching for the substance of the problem concerned, or without an innovative and researchful approach. Many states have revoked the check-lists or minimized their use and reduced them to simple reminders, while relying on professionalism, commitment and great experience of road safety auditors.

Regardless of the abovementioned, the last section of the present guidelines offers some typical road deficiencies that should be given special attention when conducting an audit.

3.4 Report on conducted road safety audit

The result of the conducted audit is the official audit report defining the identified failures and deficiencies from the point of view of road safety and offering recommendations for elimination of those observed failures and deficiencies or recommendations for reducing their adverse effects on road safety.

The report contains only those identified failures and deficiencies that may have adverse effects on road safety!

The audit report can be organized in various ways. However, the report should contain at least the following main parts - chapters:

- Front page
- Basic data on the project and the road/fact sheet
- Identified road safety problems and recommendations
- Recommendation summary and classification
- Statements of audit team members
- Feedback form
- Appendices of the report

A detailed contents of individual elements is given in the text below.

It should be stated that the audit report of some specific projects can contain other specific parts.

3.4.1 Front page

The front page must at least contain data on the project, contracting authority and professional audit team (and external professional associates), audit stage, unique document number, status of the report (draft/final version), data on designer or contractor, and date of audit implementation.

3.4.2 Basic project and road data/fact sheet

At the beginning of the report, it is necessary to present a brief information with data on project audit: who the contracting authority of the audit is, service procurement method, audit team of experts, dates (procurement initiation, submission of technical documentation for auditing, handover of audit report).

All the documentation handed over by the contracting authority of the audit to the audit team leader is also mentioned (all technical documentation, including the reports on earlier stages (if any) and other documents of importance for the audit).

Documents that the audit team of experts has not obtained from the contracting authority (but must have obtained them) are also mentioned in this part of the report.

The following road data are presented in the next part: road type, length of the audited road section, road function, cross-section elements, road alignment, intersections (at-grade and grade-separated), public and private road facilities, vulnerable road users, delineation, public lighting, road equipment and passive safety elements.

If there are bridges, viaducts, under- and over-passes, etc. on the audited road section, it is necessary to mention, for each of them, the name of the facility, start and end chainage, cross-section elements of the road at that facility and their dimensions.

If there are intersections (at-grade and grade-separated), petrol stations, etc. on the audited road section, it is necessary to mention for each of them the name of the facility and the chainage of the middle part of that facility.

If there are tunnels longer than 500 m on the audited road section, it is necessary to mention for each of them the name of the tunnel, start and end chainage, and cross-section elements of the road in the tunnel and their dimensions.

Regardless of the fact that tunnels are subject of analysis of another directive and that safety checks of tunnel features are carried out by other professionals, the road safety auditor must check the road alignment in the tunnel, cross-section elements in the tunnel and their widths, cross-section elements in front and behind the tunnel and their widths, road signs in front, inside and behind the tunnel, road markings, etc.

Data on field review are given at the end of report: data on persons attending the field review, date and time of review, time spent in the field, conditions during the field review (weather conditions, traffic conditions, etc.).

3.4.3 Identified road safety problems and recommendations

Methodology used for carrying out the audit procedure is mentioned first in this part of report. The present Guidelines are used for implementation of audit procedure in the Republic of Serbia.

Regardless of the abovementioned, in special cases (specific facilities, or projects), guidelines of other states may be used, too, provided they do not contravene the guidelines applicable

in the Republic of Serbia.

General remarks come next, followed by a detailed list of identified failures and deficiencies from the point of view of road safety and of recommendations for eliminating those identified failures and deficiencies or recommendations for reducing their adverse effects on road safety.

Specific road safety problems should include the smallest problems relating to the following elements: road function, road alignment and cross-section, intersecting roads, intersections (at-grade and grade-separated), vulnerable road users, public lighting, road signs and road markings, traffic lights, facilities, safety zones in roadside areas and lane keeping systems, road surface, bridges and tunnels, other elements (parking, participation of heavy goods vehicles, dazzling glare, work zones, land use, ITS equipment, plants and animals in road environment, school zones, etc.).

General remarks refer to the project as a whole (''*the design does not show ...'', ''cross-section is missing drawn elements ... '', ''the design does not have sight-distance analyses for intersections ...'', ''inadequate types of safety barriers have been planned ...'', ''the public lighting design is missing in the submitted technical documentation ...'',* etc.).

Each design solution that is unacceptable from the point of view of road safety requires a description of „deficiencies“ and „recommendations“. A location for such a solution must be precisely defined for an easier communication between the audit team, on one side, and the contracting authority and designer (or contractor), on the other side.

The report is intended for the road authority, or other contracting authority of the audit that will decide which failures and deficiencies identified will be eliminated and in which way it will be done. That is why the report must be precise, argumentative and convincing!

Each identified problem within road safety audit must be mentioned under a specific point in the report. Observed problems must be described using the chainage data, description of the problem in terms of road safety, description of a road crash or incident that may be the consequence of the identified deficiency of technical documentation (use a pictogram to show road crash types). Along with the location description, it is desirable to add a graphic display of a situation, at stages 1, 2 and 3, and some photos at stage 4 (before road opening, or up to 6 months after road opening).

When making a decision on whether to include the observed problem in the audit report, the professional audit team must consider possible road users involved in a road crash or incident concerned and how it can occur.

If the audit team of experts cannot determine the type of road crash or incident that may occur, then that problem should not be included in the audit report.

Each of the problems observed must have a suitable proposal for eliminating identified deficiencies or reducing the risk.

The audit experts team primarily proposes measures that are implemented at design stage. Proposed measures must be adequate, feasible and justified. Proposals of measures that contain the clause "to consider" should be avoided. Proposals containing the clause "monitoring" can be applied only within the audit that is carried out after road opening. Characteristic measures that cannot be implemented within the existing design stage, measures requiring modifications of planning documentation and measures that do not fall under the jurisdiction of the contracting authority of the audit, will be presented by the audit team, in a special chapter in the report.

Descriptions of errors and deficiencies, as well as recommendations for eliminating them, must be as short and comprehensive as possible. Risk assessment for road users must be mentioned clearly and concisely. It is followed by a detailed description of possible dangerous situations (traffic conflicts) and reasons for their occurrence. A recommendation concerning the modification of design solutions enabling or providing better road safety on a specific location and expected effect of that recommendation are mentioned thereafter.

There are three ways in which to systematize the content of an audit report:

- Findings and recommendations can be systematized according to the type of problem, in the way that general problems relating to the overall road section are analyzed first, after which individual problems relating to road function, road alignment, intersections, vulnerable road users, delineation (road signs and road markings), public lighting, road environment, etc. are also analyzed, or
- Problems incurring along the road alignment (for example, per increasing chainage) are analyzed in the report by analyzing all the problems at the beginning of the road alignment, through analysis of each location along the road alignment, including all the deficiencies of that particular location and recommendations for eliminating them, and finally, completing the analysis at the end of road alignment, or
- Road authority can request a combined procedure that would understand using both ways for writing a report.

Though all three methods are acceptable, the procedure from the second method has proven to be the most suitable one in terms of practical use, especially from the point of view of road authority. The audit according to the second method describes possible problems road users may experience in the arrangement according to chainage, without „jumping“ between some locations with certain common characteristics. That is why a larger number of EU states has foreseen that method, i.e. the second method of reporting.

However, it is desirable to use the introductory part (general remarks) for an analysis of deficiencies occurring on many locations on the road alignment (for example, intersection elements are not determined according to road crash data).

All deficiencies (and related recommendations thereto) must be listed and explained separately, or individually. The auditors must avoid associating, or connecting various deficiencies and recommendations related to them as this may cause lack of clarity to designer or contracting authority (as some of them take into consideration only one recommendation, and neglect all others).

An audit report must highlight and describe unacceptable, or incorrect design solutions from previous audit stages, that have not been eliminated. Such open questions should be analyzed again, if deemed necessary (if design solutions have not been modified). The content of the reports created at previous audit stages can easily change the sense due to the level of processing technical documentation and limitations, or due to different level of design details. This particularly applies in cases in which the auditors have issued warnings about the deficiencies at previous stages of the audit, where the recommendations have been accepted by the contracting authorities, but not implemented.

The auditors must support the implementation of recommendation and elimination of all identified unacceptable design solutions. In rare cases, when elimination of such solutions is not feasible, deficiencies however need to be listed in the report, but without recommendations for settling them.

The statements mentioned in the report must reflect the activities of the road safety auditor as an experienced advisor in the design procedure. When preparing the recommendations, it is needed to propose the solutions that are actually feasible, from the point of view of possible implementation. It means that they should not represent an insurmountable obstacle for the designer and the contracting authority during their implementation and that they are at the same time acceptable cost-wise.

Exceptionally, in cases when the audit team does not possess sufficient information and cannot propose a measure for improvement, they will use in their report the expressions such as „it is necessary to re-check“, „there should be additional research into ...“, etc. However, in these cases, the road authority should treat expressions like these as recommendations or part of recommendations. Nevertheless, it is not desirable for the audit team to use these expressions very often, as this would indicate professional inexperience or uncertainty of the auditor, and the road authority would not eventually take into account such remarks.

3.4.4 Recommendation summary and classification

A summary is a short review of the most important parts of the report, and of observed deficiencies and recommendations in particular. It needs not be an iteration of the text already written in previous points of the audit report.

The summary of an audit report contains a short list of identified deficiencies, or potential road safety problems classified according to the stage of the audit.

There is no need to repeat detailed descriptions and explain possible consequences of non-acceptance of recommendations.

If Stages 1 and 2 of the audit are concerned, as a rule, recommendations refer to problems that may be eliminated during the stage of making a preliminary design, construction permit design and construction design.

If the Stage 3 of the audit is concerned, as a rule, recommendations relate to problems that may be eliminated during construction.

If the Stage 4a of the audit is concerned (before road opening), as a rule, recommendations relate to problems that may be eliminated before road opening.

If the Stage 4b of the audit is concerned (up to 6 months after road opening), as a rule,

recommendations relate to problems that may be eliminated without delay, or in the shortest possible delay.

3.4.5 Auditor's statement

An audit report must contain the statement of the professional team members who have carried out the audit procedure, confirming thereby that the audit has been carried out in accordance with the knowledge and professional experience of auditors and regulations and guidelines in force that are the basis for implementation of the audit procedure.

All other external associates who participated in certain parts of the audit (police, representative of the maintenance service, representative of the local community, etc.) should be mentioned in the statement, even if they do not sign that statement.

3.4.6 Audit feedback form

An audit feedback form is the constituent part of the Audit report. The leader of the audit team sends the audit report officially to the contracting authority of the audit. Once they get the audit report, the road authority is obligated to act on the basis of that report, and in particular to do the following:

- Professional unit of the road authority (organizational unit in charge of road safety and/or organizational unit managing the road design process) analyzes the road safety audit report,
- They consider in particular described deficiencies mentioned by the auditors in their RSA report,
- They analyze recommendations presented by the auditor which aim at eliminating deficiencies or reducing adverse consequences of the mentioned deficiencies,
- They have to make the designer, or the contractor of construction or reconstruction works (depending on the stage of the audit) familiar with the audit report, or with deficiencies identified and recommendations by the audit team, asking the designer/contractor to submit an observation statement on deficiencies and recommendations,
- Based on the submitted observation statement by designer/contractor, they must provide a written statement on whether they accept the recommendations and which of these recommendations they will accept, or which recommendations they do not accept (and why),
- They have to submit again the audit feedback form to the RSA team for their observation statement,
- They have to submit the report to the ministry in charge (ministry in charge of transport matters), with all observation statements and clarifications, for final decision on accepting or not accepting recommendations the road authority have not accepted, and
- They have to take final decisions on (not) accepting the recommendations and enter them into the audit feedback form, and thus complete the audit process.

According to possibilities, policies, development plans intended for road networks, terms of reference and the contract with the designer/contractor, the road authority submits the observation statement for each recommendation individually. It is optimum to have a special

table with the list of recommendations into which road authority can enter its positions on accepting recommendations and clarifications.

Road authority can:

- Accept the fact that the design (or the newly built or reconstructed road) has deficiencies identified, accept the recommendation and appoint responsible entity for implementation (organization or an individual) and set deadlines,
- Cannot accept that the design (or the newly built or reconstructed road) has deficiencies identified, and reject the recommendation and elaborate its own position,
- Accept that there is a problem – deficiency, but reject the recommendation and elaborate its own position,
- Accept that there is a deficiency in the design (or on the newly built or reconstructed road), but reject the recommendation and propose another, alternative measure (not offered by the RSA team),
- Accept that there is a deficiency on the road and accept one of the proposed alternative measures, elaborate its own position and appoint responsible entities for implementation and set deadlines.

A written reply (observation statement) by the road authority is the constituent part of the Audit report and is archived.

3.4.7 Appendices of the report

The following can be an appendice to the report, for example:

- Correspondence (letters) between the audit team leader and road authority (exceptionally between the audit team leader and designer/contractor) at the time of carrying out the audit,
- Additional explanations and calculations (for example, calculation of the need for introducing traffic lanes for slow vehicles, a plotted sight distance triangle in an intersection situation, plotted curves of trajectories of heavy goods vehicles at parking of service facilities, etc.) that have been submitted by the designer/contractor to the audit team leader, upon the request by the audit team leader,
- Sight distance situation with marked locations that have been analyzed in certain parts of the report and that have been highlighted as problematic,
- Written opinions by police, local community, schools, owners of adjacent facilities, etc. concerning a part of the project.

3.5 Conclusion of the audit

3.5.1 Final meeting

Guidelines applicable in many countries with high-level of road safety and longstanding practice of implementing road safety audits, recommend organizing the final meeting. Many European projects relying on road safety audits find those final meetings very beneficial. Although they have not been prescribed by by-laws and are not binding, such guidelines determine when the final meeting is desirable, and when it is obligatory.

The final meeting is organized by the road authority. This meeting is attended by the representatives of the following entities: road authority, designers, contractors, and professional audit team. The final meeting is desirable in the case of simple projects (for example, a single intersection, a single railroad intersection, a short road section, etc.), and is mandatory in the case of complex projects (a long road section, multiple intersections at one and/or many levels on a road section, bridges, tunnels, viaducts, underpasses, overpasses, service facilities on the road, petrol stations, etc.).

The final meeting enables achieving a broader consensus on remarks mentioned in the professional audit team report. The final meeting should serve the road authority to facilitate the process of taking correct decisions on accepting or not accepting recommendations by the audit team. Also, a designer has an opportunity to explain the reasons for design solutions offered, and the auditor can clarify in more detail identified safety problems and risks of certain design deficiencies. In addition, some new solutions for specific road safety problems may be found by that joint effort at the final meeting.

In exceptional cases, if the road authority has not taken a decision on the final meeting, the audit team leader may initiate that meeting, if he/she deems it necessary. However, the road authority has the final word in that case, i.e. it decides on and also organizes the final meeting.

As a rule, the final meeting is organized in the offices of the road authority, but it can be also held in the field (Stage 4 of the audit).

3.5.2 Final decision

It is not possible to avoid some disagreements, or different opinions by the road authority, designer and auditor during the audit implementation procedure, incurring from their specific roles and responsibilities in the project (road management, road design and road safety audit). One should bear in mind different impacts of certain measures:

- Road lighting generally improves road safety, but also increases the costs of construction and contributes to the light pollution of the environment;
- The level of road safety at multi-lane roundabouts, compared to the single-lane roundabouts, is lower, but the multi-lane roundabout solution increases the capacity and reduces traffic congestion;
- A correctly built pedestrian underpass or »passarela« offers maximum road safety to pedestrians, but also increase the costs of construction and maintenance;
- Introducing safety barriers on a road section generally improves road safety, but increases construction costs and causes higher speeds of motorcycle riders;
- Introducing one-way traffic on two traffic lanes increases road capacity, but causes higher vehicle speeds, etc.

In such cases and in cases when road authority cannot accept the recommendations from the audit report, the Law on Public Roads stipulates in Article 89 that road authority must inform accordingly the competent authority for transport matters, which takes the final decision.

The road authority must act according to the final opinion of the competent authority in charge of transport matters.

4. AUDIT COST ASSESSMENT CRITERIA[2]

The framework recommendations concerning fees for carrying out road safety audits are given below.

The costs of an audit include the review of previous audit and inspection reports, review of technical documentation, field review in daytime and nighttime conditions, writing an audit report, writing minutes from the meetings held during the audit, submitting all materials generated during the audit, clarification of recommendations and compliance with other participants in the process.

The costs of an audit also include preparatory work in the office, field review, writing inspection and audit reports, writing minutes from the meetings held during the inspection and audit, clarification of recommendations and compliance with other participants in the process. The cost must include all elements necessary for audit or inspection implementation, and cannot be increased subsequently.

The cost is calculated per kilometer of road for which the audit and inspection are carried out.

The cost is calculated using the following formula:

$C=N \times O_c \times F_{kp} \times F_{dp} \times F_{fp} \times F_{br} \times F_{tr} \times F_{dd} \times F_{ds} \times \ldots$

Where

- N – road length in kilometers,
- O_c – basic cost per linear road kilometer,
- F_{kp} – road category factor,
- F_{dp} – road (road section) length factor,
- F_{fp} – design stage factor,
- F_{br} – intersection number factor,
- F_{tr} – intersection type factor,
- F_{dd} – additional documentation factor (studies, analyses, etc.),
- F_{ds} – additional roadside facilities factor.

Road length (km)	0-5	5-10	10-20	20-50	>50
F_{dp}	1,00	0,95	0,9	0,85	0,8

Road category	IA	IB	IIA	IIB
F_{kp}	1,2	1,05	1,1	1,1

Note: IA column – calculation is made for both carriageways.

Design stage	Preliminary design	Construction permit design	Combined audit of preliminary design and construction permit design	Construction design	As-built design
F_{fp}	0,9	1,0	1,5	0,8	0,7

[2] The authors of the proposal believe that the prices of the implementation of the audit should not be an integral part of these guidelines, but can be adopted as a separate document, in the form of recommendation, and each specific case requires a professional analysis of the scope, type and audit tasks specificities.

Number intersection factor	0 - 5	6 - 10	11 - 30	over 30
F_{br}	1,0	1,2	1,4	1,5 - 3,0

Level of intersection	At grade intersections			Grade-separated intersection
Intersection type	three-leg	four-leg	roundabout	
F_{tr}	1,1	1,2	1,5	1,5 – 3,0

Basic cost is for an audit is 350 points/km.

The costs of an audit differ for individual facilities and individual intersecting roads when the audit is carried out for them individually.

The cost of the audit of an individual junction is calculated as a triple basic cost of a road kilometer.

The cost of a road facility audit is calculated as a triple basic cost for facilities between 15 and 49m, a five-time basic cost for facilities between 50 and 149m, and seven-time basic cost for facilities between 150 and 499m.

The cost of an at-grade intersection built as an individual facility is calculated as a double basic cost of a road kilometer if the number of legs is less than or equals 4, or if the number of legs is over 4, the cost is calculated as a triple basic cost of a road kilometer.

The cost of an audit of a roundabout is calculated as a five-time basic cost of a road kilometer.

The cost of a grade-separated intersection is calculated as a five-time basic cost of a road kilometer.

In each specific case depending on the complexity of the work, the contracting authority will define a price that may deviate from the above recommendations.

5. THE AUDIT IN PRACTICE

It is possible to obtain a large number of significant data on the basis of results from research into circumstances in which road crashes occur on various road types and on the basis of research into effects of implemented measures. Over the last decades, a huge number of scientific road safety research studies have been conducted world-wide, and the results of those numerous research studies have been published in the most significant scientific journals and other publications. There are manuals with systematic review of various research results of road safety measures and their effects. Those results are used for a continual improvement of sustainable safe road design standards, but also for improvement of the audit process. Scientific research studies can be a source of information on some existing solutions with a negative effect on road safety. Such solutions are modified or removed from road design regulations, standards and practical usage. On the other hand, research studies offer scientific and professional arguments according to which some new solutions are good, though such solutions have not been introduced yet into official regulations, standards and technical specifications. This is how further development of road design and construction regulations, standards and practice is being directed.

Some road crash contributing factors related directly to design solutions or associable with road deficiencies are only mentioned in a separate appendix of these guidelines. In fact, each example needs to be treated separately, taking into account all road conditions and environment. It is not possible to propose some established ''recipes'' for solving all those similar problems. The present separate appendix of these guidelines show only basic attributes of road crashes that are characteristic of a certain road type. Some important deficiencies that may have a significant influence on the number and consequences of road crashes are also mentioned.

The following are the most important, general inputs that road safety auditors must keep in mind at all times:

PEOPLE HAVE PHYSICAL AND OTHER LIMITATIONS!
A road must be so designed and built that it considers human limitations in the best possible way.

TO ERR IS HUMAN!
A road should be so designed and built that it is able to reduce the consequences of human errors! A designer has an obligation to so design the road that nobody gets killed due to the error that may have been predicted and expected.

VARIOUS ROAD USER TYPES HAVE VARIOUS NEEDS AND INTERESTS!
A road must take into account the needs of all road users, but primarily the needs of vulnerable road users.

The audit procedure has to be conducted from the point of view of all predicted road user types. The audit at the first three stages is carried out by „virtual use“ of infrastructure facilities.

Road users and their behaviour are the most significant road safety factor that is contributing

to the occurrence of a huge number of road crashes. Road safety designers and auditors must constantly have in mind that road infrastructure should be such that all road users have a ''clear picture'' of all road elements: road type, road alignment, delineation and road equipment, speed limit, interdictions, right of way, etc. (the so-called orientation sight distance). It means that the so-called „human factor“, with its natural limitations, must be the starting point of a road design and road safety audit procedures.

Therefore, due to the aforementioned, the following situations must be avoided:

- Frequent and drastic modifications of design speed, or the maximum speed posted on the road,
- Too high maximum permissible speeds,
- Big differences in solutions intended for guiding and regulating traffic on a particular road,
- Application of road elements that are not suitable for the road type,
- Frequent and abrupt changes in road alignment,
- Frequent and abrupt changes in driving conditions,
- Simultaneous dissemination of a large quantity of information to road users,
- Other unpredictable situations.

With the aim to respect the human factor, it is necessary to warn the drivers, in a suitable and timely manner, of unusual situations, changes in driving conditions on the road, of dangerous locations and hazardous road sections, etc. It is also important that all road users are guided, clearly and unambiguously, through such portions of roads.

A design solution must follow expectations of road users (instinctive reactions), and not go against what an average road user expects from that solution. One of the main tasks of a road safety auditor is to recognize every sudden and potentially dangerous situation on the road and to require their elimination, or mitigation of consequences of a potential road crash. The auditor should recommend modifications in the design or on the road with the aim to provide a uniform relationship towards road users and nearly equal ''logic of solutions'', wherever possible.

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