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Road Safety Audit (RSA) Guidelines of Selected Nations – a Comparative Review

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Abstract

One of the proactive preventive strategies for the global issue of road crashes is the Road Safety Audit (RSA). There are many advantages to using RSA, however, country-specific regulations often apply when it comes to conducting RSAs. The goal of this study was to compare the content of regulations in a sample of seven countries. Crucial indicators were examined and compared. The term 'RSA' was defined differently in each set of guidelines. Different project phases in various nations required the RSA methodology. The contents and coverage of the accompanying checklists or forms also varied. The documents unevenly stressed the team's needs or the auditors' qualifications. The legal liability issues received no attention from three of the seven guideline publications. The documents of two countries lacked any examples of RSA reports or case studies. The documents of some countries placed a strong focus on certain criteria but fell short in other areas. There was no RSA guideline document which may be referred to as best practice that accounted for the local circumstances and requirements. Improvements to guideline documents are suggested. This study, updated as of October 2023, will assist the road safety community, including transport officials, world banks, highway practitioners, road safety auditors, policymakers, urban planners and research scholars.

Key Findings

- RSA guidelines must include and clarify the audit approach for all stages and all types of roadways.
- RSA guidelines should cover legal liability issues.
- Flowcharts for all activities give a comprehensive understanding of the audit process.
- Checklists for different audit stages must be included in all guidelines.
- Specimen case studies should be provided, preferably as appendices.

Introduction

Road safety is a worldwide socioeconomic concern, particularly in developing nations where crashes and fatalities are rising alarmingly quickly. Road crash injuries are projected to cost the economies of low-income nations one percent (1.0%) of their gross national product (GNP), middle-income nations one and a half percent (1.5%), and high-income nations two percent (2.0%) (G. Jacobs et al., 2000). Road trauma will rise from the eighth place in 2018 to the fifth position among all primary causes of death in 2030, according to the World Health Organization (2018; WHO, 2004). The estimated rate of road traffic fatalities per 100,000 population is shown in Figure 1. According to the Highway Safety Manual 1st Edition (American Association of State Highway and Transportation Officials [AASHTO], 2010), roadway factors account for a third (34%) of all crashes, either directly or indirectly. Proactive and reactive techniques are two internationally acknowledged engineering strategies for addressing the issue of road safety. The reactive approach involves making safety-improvement modifications after numerous incidents have already happened. Because many nations lacked the requisite standard criteria, a reactive approach has not led to significant progress (Roads and Highways Department, 2005).

The proactive approach includes taking corrective action before an incident occurs and collision prevention. The Road Safety Audit (RSA) is one of the proactive strategies (Hoque et al., 2006) and is a relatively new concept in developing countries. RSA is a technique that can contribute to preventing collisions. Despite being challenging to quan-

Table 1. List of RSA guideline documents reviewed

Country	Name/Year of Publication/Agency (Latest Revision)
Bangladesh	Guidelines for Road Safety Audit, Roads and Highways Department, May 2005 (Roads and Highways Department, 2005)
India	Manual on Road Safety Audit (First Revision), Indian Roads Congress, August 2019 (Indian Roads Congress, 2019)
Nepal	Road Safety Audit Manual (First Revision), Department of Roads, Ministry of Physical Infrastructure and Transport, February 2022
Malaysia	Road Safety Audit: Guidelines for the Safety Audit of Roads and Road Project in Malaysia, Public Works Department, 1997 (Mansor et al., 2019)
Ireland	Transport Infrastructure Ireland (First Revision), Dublin, December 2017 (Transport Infrastructure Ireland, 2017)
UK	GG 119 Road Safety Audit (Second Revision), Highways England, January 2020 (Highways England, 2020)
USA	Federal Highway Administration Road Safety Audit Guidelines, U.S. Department of Transportation, 2006 (Federal Highway Administration, 2006)

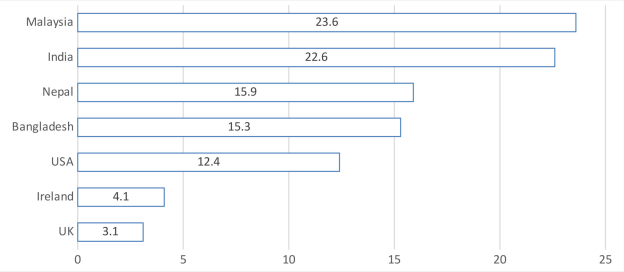

Figure 1. Estimated rate of road traffic fatalities per 100,000 population (World Health Organisation, 2018)

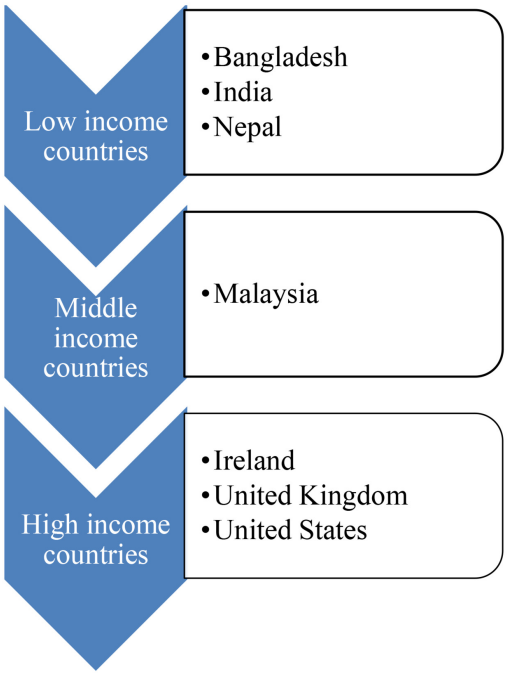

Figure 2. List of countries compared in this study by income level

tify, RSA has many advantages. Studies attempting to measure the benefits of audits have produced impressive findings. The benefit-cost ratio of an RSA has been calculated to be 15:1 in the United Kingdom (UK) and 20:1 in New Zealand. The estimated first-year return on investments for safety-audited projects in Denmark was 146 percent (Federal Highway Administration, 2004). The first RSAs were carried out in the UK in the 1980s, followed by Australia and New Zealand in the early 1990s and later in other developed nations, including the United States of America (USA) in 1996 (Lipinski & Wilson, 2004). RSAs were spread throughout the 1990s to several other nations, including South Africa, Denmark, Sweden, Canada, Germany, Switzerland, and the Netherlands. In recent years, developing nations including Bangladesh, India, Malaysia, Mozambique, Singapore and the United Arab Emirates (UAE) have actively implemented RSAs (G. D. Jacobs & Baguley, 1998; Tiwari et al., 2022). The World Bank and the European Transport Safety Council (Federal Highway Administration, 2006) are aggressively pushing RSAs as component of national road safety programmes.

The objective of this study was to examine the contents of the guidelines in a group of nations representing low-, middle-, and high-income economies. Based on the availability of RSA documentation, a total of seven nations were chosen. The review took into account the following RSA guidelines parameters:

1. definition of Road Safety Audit in the respective guidelines
2. stages of a Road Safety Audit
3. checklists/forms attached to the RSA guidelines
4. different crucial aspects of a guideline, including:
   - composition of an audit team
   - qualification of an audit team
   - consideration of legal liability issues in RSA
   - audit work flowcharts
   - specimen reports and/or case studies on the whole process and/or different stages of RSA

Data Collection and Methodology

The guidelines for RSA were downloaded from the websites of the individual countries' highway agencies or obtained as physical copies from those organisations. Table 1 is a list of the country guidelines that were evaluated. Figure 2 is a list

Table 2. Road Safety Audits reviewed: guidelines and definitions

Country	Year of Publication (latest revision)	Definitions
Bangladesh	2005	A road safety audit is "a systematic method of checking the safety aspects of new roads in order to detect potential safety hazards before the road is open to traffic." (p.1)
India	2019	A road safety audit is "a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report of the potential safety concerns in the project." (p.7)
Nepal	2022	A road safety audit is "a formal and detailed examination of a road project by an independent and qualified team of auditors that leads to a report that lists any potential safety concerns in the project." (p.9)
Malaysia	2020	A road safety audit may be defined as "the systematic process of examining the planning, design, and construction of road project, and of the feature and operation of an existing road by independent and qualified auditors to determine any potential hazard of road feature or operational arrangement that may adversely affect the safety of any road user." (https://ipm.my/an-introduction-to-road-safety-audit)
Ireland	2017	A road safety audit is "the evaluation of a road scheme during design, construction and early operation, to identify potential safety hazards which may affect any type of road user, and to suggest measures to eliminate or mitigate those problems." (p.1)
UK	2020	A road safety audit is "the review of highway schemes at the completion of preliminary design, completion of detailed design, the completion of construction and as a post opening monitoring exercise." (p.9)
USA	2006	A road safety audit is "a formal safety performance examination of an existing or future road or intersection by an independent audit team. The RSA team considers the safety of all road users, qualitatively estimates and reports on road safety issues and opportunities for safety improvement." (p.5)

Figure 3. Findings in reviewed guideline publications on the definition of RSA

of countries which were compared in this study grouped by their income economy. Three nations have comparatively poor economic conditions: Bangladesh, India, and Nepal. One nation, Malaysia, served as an example of the middle-income scenario. The remaining three nations represented high-income economies: Ireland, the UK, and the USA.

In this study, comparisons were made between selected guideline documents regarding a few parameters or features considered important for an RSA. The elements that were assessed were chosen in light of the knowledge of the principles of an RSA in general garnered from the literature analysis. Each RSA document was carefully examined to understand both the textual content and the document's general scope. The parameters were examined side by side on an equal basis so that any guideline document's shortcomings or strengths could be clearly highlighted. This approach made it possible to pinpoint any guidelines' shortcomings as well as any prospective changes this study might suggest.

Results

Definition of Road Safety Audit (RSA) in the guideline documents

The first factor analysed was the 'definition' of Road Safety Audit (RSA) in the guideline documents under evaluation. Three terms were found to be crucial and vital in the definition. These are associated with defining an RSA as:

- A formalised assessment/process which distinguished it from generic safety surveys
- Performed by impartial, experienced specialists
- Performed before, throughout, and after the completion of a project

Table 2 shows the year in which the latest (revised) guidelines of the selected countries were published and the definitions of RSA as mentioned in these guidelines.

The evaluation approach highlighted the adequacies and inadequacies of the definitions of each reviewed guideline in relation to the above three terms (Ahmed et al., 2013). The next step was to thoroughly examine the text of the RSA definition from each relevant guideline in light of the aforementioned terms. Figure 3 summarises the comparison's major findings in terms of the three parameters. Table 3 displays the key findings from the comparison.

Project Stages – When, according to the guidelines, is an RSA required?

The RSA guidelines explain when an RSA should be performed within a project. This could begin at the commence-

Table 3. Findings in reviewed guideline publications on the definition of RSA

Country	Included	Limited/missing
Bangladesh	• 'systematic method' is mentioned, however, an informal method might also be systematic	• 'independent and qualified examiner' is missing • 'detecting potential safety hazards before the road is open to traffic' is specified, detailed information is lacking
India	• formal procedure • independent and qualified examiner	• type of 'project' not clearly stated
Nepal	• formal and detailed examination • positive process • structured process • independent and qualified team of auditors	• type of 'project' not clearly stated
Malaysia	• systematic process • Independent and qualified examiners • planning, design and construction of a road project • characteristics and operation of an existing road	• formal process
Ireland	• road schemes during design, construction and early operation	• formal process • independent and qualified examiner
UK	• review of highway schemes • completion of preliminary design, completion of detailed design • the completion of construction • post opening	• formal process • independent and qualified examiner, not specified
USA.	• formal safety performance examination • independent audit team • qualitative estimate	• Although "independent audit team" is stated, the term "qualified" is not specified

Table 4. Project stages – when is an RSA required, according to the guidelines?

	After construction/ operational	Pre-opening	During construction	Detailed design	Draft/ preliminary design	Feasibility/ planning
Bangladesh		√		√	√	√
India	√	√	√	√	√	
Nepal	√	√	√	√	√	√
Malaysia	√	√	√	√	√	√
Ireland	√	√		√	√	√
UK	√	√		√	√	
USA	√	√	√	√	√	√

ment of the project however, RSAs are uncommon during the Concept Stage or Pre-feasibility Stage. However, the review procedure began with the premise that an RSA is needed from the project's Feasibility Study stage. RSAs are frequently performed on pre-existing roadways.

Three major categories were considered: pre-project, construction, and post-completion stage. RSAs were conducted more frequently and with greater coverage in developed countries due to greater consciousness of the benefit, well-established systems and fewer resource constraints. In general, less developed nations were more focused on infrastructure development than RSAs. Table 4 displays the stages at which RSA is performed in the seven countries.

Checklists Included in the guidelines

Comprehensive field surveys are typically necessary for an RSA process. Critical factors are the aspects that the surveys and items included. Suitable checklists will allow standard recommendations to be expanded and/or amended as appropriate. Checklists included in the guidelines are listed in Table 5. Table 6 provides an overview of the national laws related to safety in the chosen seven countries.

Table 5. Checklists included in the guidelines

Country	Number of checklists	Stages for checklists
Bangladesh	8-10	• Applicable to the majority of highway projects including: ◦ planning, alignment, cross-section, roadside facilities, junction (including signal-controlled junctions and roundabouts), roadside hazards, lighting, road markings, traffic signs, special road users
India	10-14	• Checklists for all five stages of RSA including: ◦ planning, detailed design, construction, pre-opening and existing roads stages ◦ items included in checklists: drainage, emergency service vehicle access, horizontal and vertical alignment, intersection and interchanges, landscaping, lighting and night time issues, parking, road design standards, roadside hazards, traffic signs, pavement markings and delineation, visibility and sight distance, vulnerable road users, cross sections etc • Also, detailed design stage RSA of roads in rural areas
Nepal	8-15	• Applicable to all road projects • Checklists for: ◦ feasibility/planning, draft design, detailed design, construction, pre-opening stages and for existing roads.
Malaysia	7	• Individual stages have their own RSA checklists for: ◦ feasibility and planning, preliminary design, detailed design, traffic management plan/ during construction/ pre-opening stage, after construction/ operational stages
Ireland	8	• Checklists for: ◦ route selection checklist, preliminary design, detailed design, pre-opening stages • No checklist for post-opening monitoring
UK	8-15	• Checklists for: ◦ preliminary design, detailed design, pre-opening stages • No checklist for post-opening monitoring
USA	2-11	• Checklists for: ◦ planning, preliminary design, detailed design, work zone traffic control, pre-opening, existing roads (post-construction), development project for land use stages

Further parameters examined and comparative findings assessed

Four more crucial factors were identified as part of the evaluation process, and the guideline documents were compared. Additional criteria reviewed were:

1. Auditor's qualifications and team size
2. Legal liability issues in Road Safety Audits
3. Flowcharts for the audit activities
4. Case studies/sample RSA reports

The agencies involved in the audit process were taken into account while choosing the above parameters, as well as their importance and practicality. Table 7 provides an overview of the parameters for each of the additional criteria.

Auditor's qualifications and team size

A certified practitioner with expertise in traffic safety engineering, road design and other related fields is requisite for an auditor in nations where RSA is a recognised practice (Taneerananon et al., 2003). A group of experts with a variety of abilities and experience, or one adequately skilled individual, may perform an RSA. One person who is proficient in every aspect of the audit process is uncommon so often audit teams are formed. However, this raises a series of important questions. What should the team's balance of skills be for each stage? How many people should be assigned to an RSA? What level of ability should be required of people given the variety of project types and sizes? A crucial factor to consider is whether the guideline specifies any requirements for RSA process training or accreditation. These inquiries are crucial to a guideline's users. The study examined and analysed information extracted from the guidelines to determine whether the minimal requirements for an auditor and the configuration of the teams for the various audit stages are addressed and described in the guidelines.

Table 6. Overview of national laws related to safer road users

Parameters	Bangladesh	India	Nepal	Malaysia	Ireland	UK	USA
National speed limit law	√	√	√	√	√	√	√
National drink-driving law	√	√	√	√	√	√	√
National motorcycle helmet law	√	√	√	√	√	√	√
National seat belt law		√	√	√	√	√	√
National child restraint law					√	√	√
National law on mobile phone use while driving		√		√	√	√	√
National drug-driving law	√	√	√		√	√	√

(Source: World Health Organisation, 2018)

Legal liability issues in Road Safety Audits

The concept of public authority accountability for wilful misconduct is quite new and developing, particularly in emerging and middle-income nations. Understanding a road agency's obligation under an RSA is a crucial consideration. However, this problem is frequently disregarded in many nations, particularly in developing nations.

Flowcharts for the audit activities

An RSA is a methodical and formal process that includes sequential and linked steps. A flowchart or sets of flowcharts can be used to visually depict the process. The report can be one for the overall work process or one for the various sorts of audits. Flow charts make any systemic and/or connected tasks easier to present. The study compared the various ways in which the auditing processes are described in each document.

Case studies/sample RSA reports

When samples of previously completed activity reports are accessible, any action or procedure is simplified. This facilitates keeping uniformity in the report styles and formats and aids in making the processes clearer for prospective teams of auditors. Understanding how and when to undertake an audit activity can be aided by case study analysis. The writing of any report can benefit from using report templates. The checklists were developed in the UK, Australia and New Zealand by their road traffic organisations, the countries where RSA was first implemented (Hirasawa et al., 2005). They play a significant part in RSA and are utilised at various stages during the implementation process.

However, there is still confusion and legal ambiguity in some countries regarding the veracity of any previously produced reports antecedent to attachment to a standard guideline. The report styles and formats also change in developing nations when RSAs are carried out in conjunction with new foreign aid projects. As a result, it becomes very difficult to choose the best RSA report to reflect the audit at a particular stage of the project.

Conclusions and recommendations

The following conclusions and recommendations are provided based on results of the comparative review of seven selected countries RSA guideline documents:

1. The process's fundamental element, the 'definition' of RSA, varies from document to document. RSA is a 'formal' procedure that distinguishes it from other safety surveys. The fact that an RSA must be carried out by impartial and experienced professionals is one of its fundamental qualities. Four out of seven country guidelines that were evaluated (Bangladesh, Malaysia, Ireland, and the UK) did not include a definition nor define this 'formal' concept in their standards for RSA. Setting up the process of a comprehensive program of work among nations requires consistency in concepts. Therefore, it is advised that the definitions contain all significant and crucial terms. All the terms required to define scope and coverage should be included in the guideline papers that are missing the crucial term from the RSA definition.
2. The RSAs must be completed at each phase of a project, from the feasibility study to the post-construction stage, as well as for existing roadways. Due to resource limitations, the RSA guideline document for Bangladesh suggests an audit only for more significant minor roads and for larger projects up to the pre-opening stage. It also explains and justifies this suggestion. Only the audit up to the pre-opening stage is covered by the guideline documents for Bangladesh. Feasibility and planning stage RSA is not mentioned in the guideline document for the UK. It is strangely combined with the preliminary design stage in Indian guidelines. RSA during the construction stage is not mentioned in the guidelines for Bangladesh, Ireland, and the UK. These documents, however, make no mention of why they missed RSA for the construction stage. Based on the findings of this study, the RSA guidelines must include and clarify the audit approach for roadways during construction, which must include a traffic management plan like in Malaysia.
3. The documents of developing nations (such as Bangladesh, India and Nepal) do not mention anything about the RSA's legal validity. The documents

Table 7. Comparative findings about four other parameters

Parameter Details	Bangladesh	India	Nepal	Malaysia	Ireland	U.K.	U.S.A.
Auditor's qualifications and team size?	-	++	+	++	++	+	+
Legal liability issues in RSAs – have they been discussed?	-	-	-	+	+	+	+
Flowcharts for the audit activities – are they included?	-	SWI	-	-	OAI	-	OAI
Case studies/specimen RSA reports – are they enclosed?	-	+	++	++	+	+	++

- Not mentioned or discussed, + Some mention or discussion, ++ Well mentioned, good detail; SWI Stage Wise included, OAI Overall activity included only

analysed from the other four nations provide some insights into the legal intricacies. Based on the study, RSA guidelines should cover legal liability issues and include document references for further in-depth information.

4. Important components of an RSA guideline include the minimum credentials and areas of expertise of the auditors as well as the structure of the audit team. The Bangladesh document, however, makes no recommendations in this regard, while documents from the USA and the UK only cover a portion of the subject. It is advised that the documents include more precise standards for the auditors' qualifications.
5. A thorough list of forms, checklists, and prompt lists is provided in some of the country guideline documents for various audit stages, as well as for several features (such as alignment, roadside hazards, cross-section etc.) and specific sites (such as bridges and culverts). A few examples of thorough checklists are found in the documents from Bangladesh, India, Nepal, and the USA. Although there are comprehensive checklists for each audit step in the Malaysian document, there is no distinct form for each unique design element or unique complex location. There is no form for the audit of existing roads in the documents from Ireland, Nepal, and the UK. It is recommended that each agency incorporate checklists/forms for different audit stages, particular design characteristics, and custom forms for audits in particular conditions in their guidelines.
6. The study revealed that there are no or very vague and limited examples of RSA reports or case studies in the documents from Bangladesh, India, Ireland, and the UK. This could be due to legal issues as well as concerns and uncertainties regarding the accuracy and precision of a previously conducted RSA. To help with the explanation of the guideline document's key texts, it is suggested to list specimen reports and/or RSA case studies in the appendices section.
7. The documents from Malaysia, Nepal and Bangladesh do not include a flowchart outlining the steps that should be taken during an RSA process. A good example of flowcharts for each level of audits with risk and priority is included in the guidelines from India. The documents from Ireland, the UK, and the USA include flowcharts outlining the fundamental processes in the auditing procedure. According to the study, a general or stage-by-stage flowchart of the audit activities should be added to the guidelines to give readers a comprehensive understanding of the processes that should be followed during the audit process.

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Author contributions

Both authors contributed to the study's conception. Data collection and analysis were performed by Ashish. The first draft of the manuscript was written by Ashish. Dr. Sumedh Mhaske critically revised the manuscript and improved the overall readability of tables and graphs. Both authors have read and agreed to the published version of the manuscript.

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Human Research Ethics Review

This article does not contain any studies with human participants or animals performed by any of the authors.

Data Availability Statement

The data were obtained by downloading PDFs of various required documents, as indicated in the references. The original hard copy of IRC:SP:88-2019 was provided by Sumanil Designers and Consultants Pvt. Ltd., Ghaziabad. The draft guideline document for Nepal was received via email. The information about Malaysian guidelines was gathered from the official website of IPM Professional Services. All the other standard codes are available online on the official websites of the respective departments.

Conflicts of interest

The authors declare that there is no conflict of interest.

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