Road Infrastructure Safety Management

Review of National Design Guidelines and Procedures

Varhelyi, Andras; Farah, Haneen; Sam , Enoch Frederick; Rimoy , Siya; Mawele , Susan

2023

Document Version:
Publisher's PDF, also known as Version of record

Project No. 101069500—AfroSAFE

AfroSAFE: Safe System for radical improvement of road safety in low- and middle-income African countries

HORIZON EUROPE—European Union's funding programme for research and innovation

Deliverable 3.1

Road Infrastructure Safety Management
Review of National Design Guidelines and Procedures

Deliverable due date: 31.08.2023

Project start: 01.09.2022
Duration: 42 months

Lead contractor for this deliverable:
Lund University, Sweden

Version 4.0 (2023.09.23)

Dissemination Level

PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Document information

Authors: András Várhelyi (Lund University, Sweden)
Haneen Farah, (Technical University of Delft, the Netherlands)
Enoch Frederick Sam (University of Education, Winneba, Ghana)
Siya Rimoy (University of Dar Es Salaam, Tanzania)
Susan Mawele (Zambia Road Safety Trust, Zambia)

Quality check: Carmelo D'Agostino (Lund University, Sweden)

Project Coordinator

Aliaksei Laureshyn
Department of Technology and Society
Faculty of Engineering, LTH
Lund University

Box 118
221 00 Lund, Sweden

Phone: +46 46 222 91 31
Email: aliaksei.laureshyn@tft.lth.se

www: www.afrosafe-eu.africa

Coordinator of WP3

András Várhelyi
Department of Technology and Society
Faculty of Engineering, LTH
Lund University

Box 118
221 00 Lund, Sweden

Phone: +46 46 2224824
Email: Andras.varhelyi@tft.lth.se

Project funding

Horizon Europe
Grant Agreement 101069500

Revision and History Chart

Version	Date	Comment
1	2023-02-12	First draft
2	2023-05-05	Updated with input from local partners
3	2023-07-07	Final version for internal review
4	2023-09-23	Final version

This project has received funding from the Horizon Europe, the European Union's funding programme for research and innovation under grant agreement No 101069500.

The present document is a draft; the approval from the EU Commission is pending.

Definitions

Black Spot Management

Identification and treatment of hazardous road locations (black spots) in the road infrastructure with a higher number of accidents than other similar locations.

Network Safety Management

Identification and treatment of road sections with high accident concentration, considering at least the number of fatal accidents that have occurred in previous years per unit of road length in relation to the volume of traffic and, in the case of intersections, the number of such accidents per site.

Road Assessment Programme (IRAP)

Assessing the safety level of roads. It involves the collection of data on road characteristics with the aim of determining the level of protection the road environment provides for the road user if a crash occurs. Usually, Road Assessment Programme is carried out by non-governmental organisations to "keep a thumb in the eye" of the Road Authority.

Road Safety Impact Assessment

Evaluation of the safety effects of road improvements or building new roads to be carried out at the initial planning stage before the infrastructure project is approved to indicate the road safety considerations which contribute to the choice of the proposed solution.

Road Safety Audit

A formal safety performance examination of planned roads by an independent audit team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

Road Safety Inspection

A systematic review of existing roads with the intention to identify any potential hazards, faults, or deficiencies that may lead to serious accidents.

Executive Summary

As part of the HORIZON EUROPE project AfroSAFE: Safe System for radical improvement of road safety in low- and middle-income African countries, a review of national regulations, guidelines, and procedures for Road Infrastructure Safety Management (RISM), as well as road design guidelines was carried out in Ghana, Tanzania, and Zambia. Information was collected from relevant authorities and the review had special attention to the safety of vulnerable road users (pedestrians, cyclists, and motorcyclists). It was examined whether any of the following RISM tools are being used in these countries:

- Black Spot Management (identification and treatment of hazardous road locations in the road infrastructure)
- Network Safety Management (identification and treatment of road sections with high accident concentration)
- Road Safety Impact Assessment (assessment of the safety effects of building new roads)
- Road Assessment Programme (assessing the safety level of existing roads)
- Road Safety Audit (a formal safety performance examination of planned roads by an audit team)
- Road Safety Inspection (a formal, systematic review of existing roads with the intention of identifying potential hazards).

The findings reveal that design guidelines do not take the needs of motorcyclists, the elderly, children, and disabled people into consideration in sufficient details. More specific considerations of designing infrastructure facilities in locations with high concentrations of elderly, children, and disabled people are necessary. Furthermore, the guidelines do not address sufficiently the physical separation of vulnerable road users, such as cyclists and pedestrians, from motorized traffic driving at speeds higher than 30 km/h. The principles of the safe system should be operationalized in detail in all parts of the road design manual.

In all three countries, Road Safety Audit and Road Safety Inspection are practiced nationwide. In Ghana, Black Spot Management and Network Safety Management are practiced occasionally, and Road Assessment Programme is practiced locally. In Tanzania, Road Assessment Programme is practiced to some degree. In Zambia, Black Spot Management is practiced occasionally.

National legislation does not explicitly say anything about Road Infrastructure Safety Management (RISM). The mandatory utilisation of all RISM tools should be stipulated by national legislation. Also, national legislation should point out the supervisory authority with responsibility to supervise the process of carrying out these RISM activities, issue authorisation for certified experts who can carry out these RISM activities and keep an open database of certified experts. Legislation should also prescribe that the accident database owner regularly provides the road authority with accident data necessary for carrying out RISM activities.

A national regulatory framework should be established regarding procedures and responsibilities for initiating, carrying out, supervising, administrating and documenting RISM activities.

The procedures for carrying out the various RISM activities should be described in detail, pointing out the involved stakeholders, with their responsibilities, such as the project owner (road agency) with the responsibility to initiate the activity, procurement, the designer/planner organisation with the responsibility to provide all necessary information, and the expert team carrying out the RISM activity and reporting their findings to the project owner.

For carrying out Road Safety Audit, Road Safety Inspection, and Road Assessment Programme, appropriate international guidelines are available. However, it is recommended that national Manuals/Guidelines are developed for:

- Black Spot Management in Tanzania and Zambia, and
- Network Safety Management and Road Safety Impact Assessment in all three countries.

A training centre with staff and curricula for training road safety professionals to carry out the various Road Infrastructure Safety Management activities should be established. The trainers might be brought in from outside when needed, but the permanent secretary of the training centre should continuously monitor the need for training and advertise training courses. After the training centre has issued a certificate for a completed course, the supervisory authority should authorise certified experts in various RISM methods.

Table of Contents

1 Introduction

1.1 Background

As part of the HORIZON EUROPE project AfroSAFE: Safe System for radical improvement of road safety in low- and middle-income African countries, activities on improving road infrastructure safety are being carried out. The objectives of these activities are:

- Review national regulations, guidelines, and procedures for Road Infrastructure Safety Management (RISM)
- Develop guidelines for the introduction of the tools comprising RISM
- Build capacity for applying RISM tools
- Run pilot projects demonstrating the application of RISM tools.

1.2 Aim

The aim of the work this report describes was to review national regulations, procedures, and guidelines for Road Infrastructure Safety Management (RISM), as well as national road infrastructure design guidelines with special attention to the safety of vulnerable road users (pedestrians, cyclists, and motorcyclists) in Ghana, Tanzania, and Zambia.

1.3 Method

Information on national regulations, procedures, and Manuals/Guidelines for RISM, as well as on road infrastructure design guidelines was collected from Ghana Highways Authority in Ghana, the Ministry of Works and Transport of the United Republic of Tanzania, and the Road Development Agency in Zambia. The review was made with special attention to the safety of vulnerable road users (pedestrians, cyclists, and motorcyclists). It was examined whether any of the following RISM tools are being used in the three countries:

- Black Spot Management of hazardous locations (identification and treatment of hazardous locations in the road network)
- Network Safety Management (identification, selection, and treatment of road sections with high accident concentration)
- Road Assessment Programme (assessing the safety level of existing roads)
- Road Safety Impact Assessment (assessment of the safety effects of building new roads)
- Road Safety Audit (a formal safety performance examination of planned roads by an audit team)
- Road Safety Inspection (a formal, systematic review of existing roads to identify potential hazards).

2 Findings

2.1 Ghana

2.1.1 Road geometric design guidelines

As road geometric design guidelines, the Road Authorities of Ghana use the Ghana Road Design Guide issued in 1991. Chapter 3.6 in this guide is dedicated to bicycle tracks and sidewalks, as part of the composition of the cross section. It is indicated that bicycle tracks are currently not popular in the country, but since it is a sustainable mode of transport it is recommended. The guide provides a flowchart to determine when the bicycle track needs to be separated from pedestrians and car traffic. This depends on the type of road and the intensity of car traffic, bicycle traffic and pedestrians' intensity. A sidewalk width can range between 1.5 and 3.0m, a mixed sidewalk and bicycle track width can range between 1.75 and 3.50m, and a sole bicycle track width is 2.0m. The sidewalk is elevated with a kerb from the carriageway, and when the sidewalk and bicycle track are mixed an additional planting zone of 1.50 - 2.0m is added to separate them from the carriageway and provide extra protection to the vulnerable road users. When the bicycle track and sidewalk are separate from each other, then the bicycle track is separated from the carriageway with a planting zone, and the sidewalk would be placed next to the bicycle track away from the carriageway.

Chapter 5.6 details the design of a stop line and pedestrian crossing. A pedestrian crossing should be placed at locations to conform with the existing pedestrian movements as much as possible and as close as possible to the centre of the intersection to minimize the intersection area and be set at right angle to the carriageway to provide the shortest crossing distance. When the crossing distance exceeds 15m, it is recommended to provide a refuge island in the middle to allow pedestrians cross in two stages. The width of a pedestrian crossing is 4.0m on major roads, and 2.0m is acceptable on minor roads.

In addition to 'Ghana Road Design Guide', the 'Traffic Calming Design Guideline' has been published in 2008 by the Road Safety and Environment Division of the Ghana Highway Authority, the Ministry of Transportation. This guide tackles those roads that cross towns and settlements changing their function from through road to access road. In this design guideline several traffic calming measures are discussed, and their design is detailed. These measures target the reduction of speeds which is beneficial to vulnerable road users (VRUs).

The report 'Pedestrian Road Safety Action Plan for the Accra Metropolitan Assembly 2018 – 2022', published in 2017 embraces the 'safe system' principles and strategy. It is aligned with and supports the Ghana National Road Safety Strategy III, and its current Action Plan, which has a stated focus on pedestrian safety improvement. However, the target area for this Action Plan is the Accra Metropolitan Area, and not yet the whole country. The plan details the specific actions to improve the safety of pedestrians that were planned to be implemented between 2018-2022. For each specific action, a responsible stakeholder is identified, as well as the year of implementation. The report also includes a section on iRAP star ratings for pedestrians. According to the report, of the 110km of roads evaluated, 65% are only rated one (1) or two (2) stars, 26% are rated three (3) stars, less than 10% are four stars, and none are five (5) stars.

The National Road Safety Strategy IV (NRSS IV) (Ablin Consult Engineers, 2022) has recognized that road infrastructure in Ghana is inadequate to cater for the needs of and safety of VRUs. It puts forward an Action Plan for VRUs, including pedestrians and motorcyclists. It proposes various road geometric design-related recommendations for the national level in all the sixteen regions of Ghana. To improve the safety of VRUs, activity one outlines conducting a gap analysis of the existing road infrastructure from the perspective of VRUs safety and

activity two deals with the provision of dedicated infrastructure facilities for VRUs. However, the main focus of NRSS IV is to improve road safety for VRUs through educational and training programmes, focus on change in road design is minimal. Most of the suggested measures are passive road safety measures and the proposed measures do not indicate the incorporation of the safe system approach in the road design at large.

2.1.2 Regulatory and management issues of Road Infrastructure Safety Management

The Ghana Highway Authority Act of 1997 (ACT 540) established the Ghana Highways Authority and appointed it as responsible for the administration, maintenance, and operation of all trunk roads in Ghana. The ACT also contains information about road signs and what a road user should know to ensure safety on the road. The ACT, under Section 3 'Functions of the Authority' states the following:

- (a) plan, develop, maintain, protect and administer trunk roads and related road works
- (b) control vehicle usage on trunk roads with the aim of providing safe and adequate infrastructure for road transportation commensurate with the economic development of the country
- (c) classify and lay down design standards on the different classes of trunk roads
- (d) undertake research or collaborate with any research organisation with a view to facilitating the Authority's planning, development, and maintenance activities
- (e) maintain and preserve such records relating to its functions as it considers expedient
- (g) carry out, on a permanent basis, such necessary engineering, traffic and economic studies as it may consider necessary for the maintenance and improvement of the trunk road network
- (h) implement a maintenance management system for planning, organising, directing and controlling routine and periodic maintenance activities performed by employees of the Authority or through independent contractors
- (i) carry out either by its employees or through contractors with qualified consultants, location and design studies (including right-of-way and borrow pit requirements) necessary or programmed trunk road improvement or rehabilitation projects and prepare corresponding construction plans, specifications, cost estimates and other documents required for proper tendering of the programmed works.

The ACT does not explicitly state anything about Road Infrastructure Safety Management or its tools.

The National Road Safety Authority Act of 2019 (ACT 993) established the National Road Safety Authority to develop and promote road safety in Ghana, to coordinate and regulate activities, procedures and standards related to road safety and to provide for related matters. The ACT, under Section 3 'Functions of the Authority' states (among others) to "establish the procedure and standards for road safety audit with the road authorities and collaborate with the road agencies to ensure implementation of findings of road safety audits in accordance with existing design, construction and maintenance procedures and standards for the provision of road infrastructure". It also prescribes that the President shall, in accordance with the article 195 of the Constitution, appoint road safety inspectors. The ACT also specifies their responsibilities, tasks, and qualifications. However, the ACT (beside road safety audit) does not mention any other Road Infrastructure Safety Management tools.

2.1.3 Road Infrastructure Safety Management tools

The review revealed that some of the Road Infrastructure Safety Management (RISM) tools, such as Road Safety Audit and Inspection are used in Ghana, and there are written Manuals/Guidelines for three of these. However, there are no Manuals/Guidelines for Network Safety Management, Road Assessment Programme, and Road Safety Impact Assessment. For an overview, see Table 1.

Table 1. RISM tools applied in Ghana.

RISM tools	Practiced	There is a written Manual/guidelines
Black Spot Management	Locally, in some municipalities/cities	Yes
Network Safety Management	Yes	No
Road Assessment Programme	Locally	No
Road Safety Impact Assessment	Locally	No
Road Safety Audit	Yes	Yes
Road Safety Inspection	Yes	Yes

Black Spot Management

Black Spot Management - identification and treatment of hazardous road locations (black spots) in the road infrastructure with a higher number of accidents than other similar locations - is practiced locally in some municipalities/cities. A manual on identifying and treating accident sites, titled 'Identifying and Treating Accident Sites', was issued in January 2002 by the Ministry of Roads and Highways. The manual is of a good international standard.

The National Road Safety Authority (NRSA) also identifies and publishes the top 20 blackspots in each of Ghana's 16 administrative/geographical regions. Additionally, its Research Directorate conducts observational studies of these blackspots to identify and assess the actual and potential hazards and thereafter make recommendations to the appropriate authorities/agencies for redress.

Network Safety Management

Network Safety Management (identification and treatment of road sections with a high accident concentration) is practiced by various road agencies in Ghana; the road network is periodically assessed for the identification of road sections with high accident concentration. Thereafter necessary countermeasures are implemented to address the identified safety issues.

A current example is the treatment of the railway crossing at Anyinam in the Eastern Region of Ghana where lots of rear-end collisions were recorded. Additionally, the Nsawam–Apedwa section of the N6 road has been "dualized" to minimise the numerous head-on collisions that were being recorded along that section.

However, there are no written national guidelines or manuals.

Road Assessment Programme

Road Assessment Programme, i.e., assessing the safety level of a road by collecting data on road characteristics to determine the level of protection the road environment provides for the road user when a crash occurs - is practiced sporadically, locally in Ghana. The Ghana Highway Authority and the Department of Feeder Roads, with the support of the World Bank, assessed roads in the Northern and Upper West Regions using iRAP Methodology in 2022 (see report by University of Zagreb, 2022). A handful of individuals are accredited to do iRAP. However, there are no national manuals or guidelines, hence foreign manuals are used.

Road Safety Impact Assessment

Road Safety Impact Assessment (evaluating the safety effects of road improvements or building new roads to be carried out at the initial planning stage before the infrastructure project is approved) is practiced locally in isolated cases and needs to be institutionalised in Ghana. It is undertaken as part of the permitting requirements for new filling stations and other new installations/industries, which get access to the road network and attract and generate substantial traffic. For example, Road Safety Impact Assessments were conducted before the Awoshie–Pokuasi Road and the Pokuasi Interchange and local roads were constructed. However, there are no written national guidelines or manuals, hence foreign manuals are used.

Road Safety Audit

Road Safety Audit (a formal safety performance examination of planned roads by an independent audit team) is practiced in Ghana. The manual, titled 'Road safety audit', issued by Ghana Highway Authority (GHA) in January 2002, is used. There are Road Safety Auditors in the country, however, most of them are not certified. The Auditors rely on knowledge and experiences from field practice, and internal and external training courses to perform their work. The GHA had a certification programme for Auditors in 2016 but it has become redundant. The Authority is currently working to secure international accreditation for its Auditors.

Road Safety Inspection

Road Safety Inspection (a systematic review of existing roads to identify any potential hazards, faults or deficiencies that may lead to serious accidents) is practiced in Ghana. It is one of the steps in the process of Road Safety Audit concerning newly built or existing road infrastructure. The manual, titled 'Road safety audit', issued by Ghana Highway Authority (GHA) in January 2002, is used. Officials of the GHA perform road safety inspections annually to back recommendations for improvements of certain roads.

Training activities

There is a Training Division in GHA mandated to organise training to build the GHA officials' capacity. However, these pieces of training are not forthcoming due to budgetary constraints. Nevertheless, there are monthly meetings on a project basis for officials engaged in specific projects, e.g., Japan International Cooperation Agency (JICA) projects.

GHA officials also rely on external training workshops/short courses like those organised by TU Delft etc., to acquire the necessary skills and expertise to perform their work.

Since there is no organised training of Road Safety Auditors in Ghana, the Auditors attend external short courses to acquire the needed knowledge and develop capacity. For instance, a few of them attended the Road Safety Course organised by TU Delft in 2019. A similar course was organised by the Ghana Institute of Engineers in 2020.

2.1.4 Recommendations

Road geometric design guidelines

Since the guidelines do not take the need of motorcyclists, elderly, children, and disabled people into due consideration, the Ghana Road Design Guide should be amended accordingly.

The Guide provides some general guidelines regarding the placement, width and separation of sidewalks and bicycle tracks from each other and from the car traffic on road sections depending on the traffic intensities of these modes, and the design of pedestrian crossings at intersections. However, the design for cyclists at intersections and roundabouts is not addressed. The Guide should be updated considering this issue too.

It is recommended that the traffic calming measures presented in the Traffic Calming Design Guideline of 2008 to be integrated into the Ghana Road Design Guide.

According to the Ghana Highway Authority there is currently a new road design guide being prepared, in which the concerns expressed in this report should be duly taken into consideration.

Widening and implementing the 'Pedestrian Road Safety Action Plan' from only focusing on the Accra Metropolitan area to other areas in Ghana is recommended.

Legislative/regulatory issues concerning Road Infrastructure Safety Management

The mandatory utilisation of all Road Infrastructure Safety Management (RISM) tools should be prescribed by legislation, e.g., included in the Highway Authority Act, or in any other relevant legislative act. That means that besides Road Safety Audit, also tools, such as Road Safety Inspection, Management of hazardous road locations, Network Safety Management, and Road Safety Impact Assessment should be prescribed by a relevant legislative act. Also, the legislation should point out the supervisory authority with responsibility to supervise the process of carrying out these RISM activities, issue authorisation for certified experts who can carry out these RISM activities and keep an open database of certified experts.

Legislation should also prescribe that the accident database owner regularly provides the Ghana Highways Authority with accident data necessary for carrying out RISM activities.

Responsibility

A national regulatory framework should be established regarding procedures and responsibilities for initiating, carrying out, supervising, administrating and documenting RISM activities.

Procedures

The procedures for carrying out the various RISM activities should be described in detail, pointing out the involved stakeholders, with their responsibilities, such as the project owner (road agency) with the responsibility to initiate the activity and procurement, the designer/planner organisation with responsibility to provide all necessary information, and the expert team carrying out the RISM activity and reporting their findings to the project owner.

Manuals/Guidelines

There are existing national manuals for Identifying and Treating Accident Sites, as well as for Road Safety Audit and Inspection. Such national manuals should also be developed for Network Safety Management, and Road Safety Impact Assessment.

Training/Certification

A training centre with staff and curricula for training road safety professionals to be able to carry out the various RISM activities should be established. The trainers might be brought in from outside when needed, but the permanent secretary of the training centre should continuously monitor the need for training and advertise for training courses.

After the training centre has issued a certificate for a completed course, the supervisory authority should authorise certified experts in various RISM methods.

2.2 Tanzania

2.2.1 Road geometric design guidelines

The Tanzanian Road Authorities use the Tanzania Road Geometric Design Manual of 2011 as road geometric design guidelines. Chapter 4.5 'Performance of Pedestrians and other Road Users' starts by explaining the main characteristics of pedestrians. This includes, for example, the impact of age on walking speed. The sub-section regarding cyclists is relatively thin and does not discuss the characteristics of cyclists, instead mentions some points regarding the surface of the cycle path, but with insufficient details. Sub-section 5.13 as part of Chapter 5 'Cross Section Elements' specifies the design requirements for footways and cycleways. The starting point of this sub-section is that "the conventional practice is to assume that pedestrians and cyclists can use the shoulders, but it is much safer for them to be on a separate footway, or combined footway/cycleway". When footways and cycleways are combined the width is 3.0m (with 2.0m as absolute minimum). Outside urban areas, the footway/cycleways should be separated from the carriageway by a grass strip or similar, at least 2.0m wide, while on embankments the footway/cycleway can be benched into the fore slope. In urban areas, raised and kerbed footways should be provided and cycleways, where necessary, should be constructed beyond the footway. Another cheaper alternative is to have the footway at the same level as the traffic lane but separated by a barrier kerb or low wall. In this case the footway and cycleway can be combined. In the separator, gaps are left to allow drainage and access to roadside premises.

Regarding road users with disabilities, it is indicated that at the intersections and pedestrian crossings, ramps must be provided where the change in elevation is more than 200 mm to cater for the disadvantaged.

In sub-section 7.7.10 'Pedestrian and Cycle Crossings', the placement of pedestrian crossing at roundabouts is discussed briefly. In this situation, the crossing serves both pedestrians and cyclists with no separation.

In Chapter 9, 'Road Furniture and other Facilities', and specifically in sub-section 9.3 'Pedestrian Facilities', the relationship between the risk of dying for pedestrians depending on the impact speed is shown. Next, in sub-section 9.3.1, further details regarding the design of shoulders and footways are discussed. Criteria for providing footways on one side or both sides are given and depend on the average daily vehicle traffic, pedestrian flow per day, and speed limit. A grade-separated crossing is advised for design speeds of 60 km/h and 80 km/h.

The design guidelines do not address motorcyclists, elderly, or children. Although it is pointed out that at pedestrian crossings, a ramp should be designed for persons using wheelchairs, no attention is given to other measures needed along the footways or measures needed for other disabilities, like design for blind people.

2.2.2 Regulatory and management issues of Road Infrastructure Safety Management

The Roads Act No.13 of 2007 specifies under 'Road Management' the responsibilities of the Ministry of Works and Transport (MoWT), appoints the Tanzania National Road Authority (TANROADS), describes its functions, and entails the Road Authority to Ensure Safety of the Roads under its jurisdiction, but it does not include any statements on Road Infrastructure Safety Management. MoWT has traditionally been a custodian of the national procedures, manuals and guidelines related to road infrastructures.

The Road Traffic Act of 1973 Establishes a National Road Safety Council (NRSC) whose responsibilities include - among others - "to identify local accident hazards, devise and suggest

remedies and advise authorities concerned to promote action". The recently proposed amendment to the Road Traffic Act proposes that the NRSC shall be the lead agency of all road safety matters in Mainland Tanzania and in collaboration with relevant sector ministries shall - among others:

- Identify projects and programmes or types of projects and programmes, for which Road Safety Audit or Road Safety Monitoring may be conducted,
- Carry on Road Safety Audit and Inspection.

The National Road Safety Policy of 2009 requires TANROADS to carryout Road Safety Audit on their roads. However, the utilisation of any of the other RISM tools is not prescribed.

2.2.3 Road Infrastructure Safety Management tools

The review revealed that some of the Road Infrastructure Safety Management (RISM) tools, such as Road Safety Audit and Inspection, as well as Road Assessment Programme (to some degree) are used by the Tanzania Roads Agency (TANROADS). For an overview see Table 2.

Table 2. RISM tools applied in Tanzania.

RISM tools	Practiced	There is a written Manual/guidelines
Black Spot Management	No	No
Network Safety Management	No	No
Road Assessment Programme	Yes	The International Road Assessment Program iRAP Manual is used
Road Safety Impact Assessment	No	No
Road Safety Audit	Yes	Yes
Road Safety Inspection	Yes	Yes

Black Spot Management

Black Spot Management is not practiced systematically. There are no written national guidelines or manuals. The prerequisites for applying this RISM tool are missing, since TANROADS does not systematically receives accident data with positioning from the accident database owner.

Network Safety Management

Network Safety Management is not practiced by TANROADS and there are no written national guidelines or manuals. The prerequisites for applying this RISM tool are missing, since TANROADS does not systematically receive accident data with positioning from the accident database owner.

Road Assessment Programme (IRAP)

The Tanzanian Road Assessment Programme, TanRAP was launched in September 2022. (https://irap.org/2022/09/tanrap-launched-to-eliminate-high-risk-roads-in-tanzania/).
The Road Agencies (TANROADS and TARURA) are supposed to administrate the Road Assessment Programme. The International Road Assessment Program - iRAP is used for road assessment.

Road Safety Impact Assessment

Road Safety Impact Assessment is not practiced by TANROADS, and there are no written national guidelines or manuals. The prerequisites for applying this RISM tool are missing, since TANROADS does not systematically receive accident data with positioning from the accident database owner.

Road Safety Audit

RSA is practiced in Tanzania. The recently proposed amendment to the Road Traffic Act appoints the National Road Safety Council to - among others - identify projects and programmes or types of projects and programmes, for which road safety audit or road safety monitoring may be conducted.

The Road Safety Policy of 2009 requires the Road Agency to carry out Road Safety Audit on its roads. The supervising body for RSA to be carried out is the Ministry of Works and Transport through its institutions TANROADS and the President's Office Ministry of Regional Administration and Local Government through its institutions Tanzania Rural and Urban Roads Agency (TARURA).

There are written national guidelines 'A Guide to Road Safety Auditing', produced by Ministry of Infrastructure Development in 2009. The guidelines are of good international quality. However, there is no written procedure for how to initiate, run, administrate, and file Road Safety Audits.

There are trained Road Safety Auditors in Tanzania but there is no Board/Institution to certify them though they completed Road Safety Audit training.

Road Safety Inspection

Road Safety Inspection is practiced in Tanzania. The supervising body for RSI to be carried out is the Ministry of Works and Transport through its institutions, the Tanzania National Roads Agency (TANROADS) and the President's Office Ministry of Regional Administration and Local Government through its institutions Tanzania Rural and Urban Roads Agency (TARURA).

There are written national guidelines 'A Guide to Road Safety Auditing', produced by Ministry of Infrastructure Development Safety and Environment Unit of Tanzania in 2009. The guidelines are of good international quality. However, there is no written procedure for how to initiate, run, administrate, and file Road Safety Inspections.

There are trained Road Safety Auditors to carry out Inspections in Tanzania but there is no Board/Institution to certify them though they completed Road Safety Audit trainings.

Training activities

There have been sporadic and periodical training activities in RISM in Tanzania. The National Institute of Transport, which is under the Ministry of Works and Transport hosts a Regional Centre of Excellence in Road Safety (https://nit.ac.tz/index.php/center-of-excellence-and-road-safety/) offers some training. Training in Road Safety Audit is conducted by various Institutions, such as Tanzania Technology Transfer Centre and Tanzania Roads Association.

2.2.4 Recommendations

Road geometric design guidelines

The design guidelines provide some details regarding the design for pedestrians and cyclists, but not with enough emphasis on separating them from motorized traffic and separating them from each other. Because of the differences in speed and mass, further separation is recommended. Since the design guidelines do not address the needs of motorcyclists, elderly, or children, amendments should be made accordingly. Although the guidelines require a ramp at pedestrian crossings for persons using wheelchairs, no attention is given to other measures needed along the footways or measures needed for people with other disabilities, like design for blind people. Further attention and amendments in the design guidelines for these areas are needed.

Legislative/regulatory issues concerning Road Infrastructure Safety Management

The mandatory utilisation of all Road Infrastructure Safety Management (RISM) tools should be prescribed by legislation, e.g., included in the National Road Safety Policy, or any other relevant legislative act. That means that - beside the already prescribed Road Safety Audit and Road Safety Inspection tools – also the tools Management of hazardous road locations (identification and treatment of hazardous road locations in the road infrastructure), Network Safety Management (identification and treatment of road sections with high accident concentration), and Road Safety Impact Assessment (assessment of the safety effects of building new roads) should be prescribed by a relevant legislative act. Also, the legislation should point out the supervisory authority with responsibility to supervise the process of carrying out these RISM activities, issue authorisation for certified experts who can carry out these RISM activities and keep an open database of certified experts.

Legislation should also prescribe that the accident database owner regularly provides TANROADS and TARURA with accident data necessary for carrying out RISM activities.

Responsibility

A national regulatory framework should be established regarding procedures and responsibilities for initiating, carrying out, supervising, administrating and documenting Road Infrastructure Safety Management activities.

Procedures

The procedures for carrying out the various RISM activities should be described in detail, pointing out the involved stakeholders, with their responsibilities, such as the project owner (road agency) with the responsibility to initiate the activity and procurement, the designer/planner organisation with responsibility to provide all necessary information, and the expert team carrying out the RISM activity and reporting their findings to the project owner.

Manuals/Guidelines

There are existing national manuals for Road Safety Audit and Road Safety Inspection. Such national manuals should also be developed for Management of hazardous road locations (identification and treatment of hazardous road locations in the road infrastructure), Network Safety Management (identification and treatment of road sections with high accident concentration), and Road Safety Impact Assessment (assessment of the safety effects of building new roads).

Training/Certification

A training centre with staff and curricula for training road safety professionals to be able to carry out the various RISM activities should be established. The trainers might be brought in from outside when needed, but the permanent secretary of the training centre should continuously monitor the need for training and advertise for training courses.

After the training centre has issued a certificate for a completed course, the supervisory authority should authorise certified experts in various RISM methods.

2.3 Zambia

2.3.1 Road geometric design guidelines

As road design guidelines, the Road Development Agency (RDA) has adopted the usage of the Southern Africa Transport and Communications Commission (SATCC) Design Guidelines and Specifications, the Low-volume Roads Manuals, as well as the '*National Guidelines on Road Traffic Signing- 2016', 'SADC Road Traffic Signs Manual- Vol 1-4' and other Zambian Guidelines.*

SATCC Design Guidelines and Specifications

The Code of Practice for the Geometric Design of Trunk Roads 1998 (SATCC) is largely derived from the American and English practices; however, over the years the lack of uniformity in the sets of standards applied for rural roads has increased among different local authorities. It gives a special emphasis on paved two-lane rural roads and directed mainly towards the Southern Africa Development Community (SADC) trunk road system. Chapter 11 in the SATCC refers to pedestrians and cyclists. This chapter begins by highlighting that there is a concentration of accidents involving pedestrians and pedal cyclists on rural roads, especially close to the proximity of towns, in densely populated rural areas (e.g., at schools, bus stops, shops and housing next to the roadway), at mines and mining compounds, industrial plants, agricultural depots, irrigation schemes, etc. Furthermore, in most cases, there are no dedicated road facilities (e.g., pedestrian sidewalks) for these vulnerable road users. The code of practice follows by detailing the conditions in which a footpath for pedestrians would be required. This is dependent on the average daily traffic, pedestrian flow per day, and the design speed (60-80 km/h or 80-120 km/h). The minimum width is 1-1.5 meters, situated at least 3 meters from the travelled way, and has all-weather surface. On roads in rolling or mountainous landscape, the footpath is provided adjacent to the travelled way only separated by a premix kerb or guardrails. In some situations, when footways are not warranted, the shoulder width is recommended to be used as a footway.

The SATCC also gives some attention to the design of bus stops and bus bay layout (deceleration lane, holding area, and merging area). These bus bays are placed adjacent to the paved or gravel shoulder. However, there should be a proper deceleration lane and acceleration lane getting the bus stop separated from the travelled way and giving the bus enough distance to decelerate and accelerate. Also, proper solutions should be advised for crossing pedestrians.

Grade-separated crossings over motorways by means of bridges or subways are advised in certain conditions when there is a concentration of pedestrian crossings at one point, and at the same time there is a concentration of accidents.

Regarding cycling lanes, only one short paragraph on their design is provided. It indicates that a cycle lane should be provided on a paved shoulder. A minimum width of 1.2 m is recommended, assuming a gravel shoulder is available next to the cycle lane.

Low-volume Roads (LVRs) Manual (2019)

The Low-volume Roads Manual has a section on safety with various considerations during the design, maintenance, and construction of various roads. Volume 2 focuses on the geometric design and road safety. This guideline applies to District and Tertiary Roads in rural areas and lower-order road and street networks in urban environments.

LVRs often need to cater to high proportions of non-motorized traffic including pedestrians, bicycles, and animal-drawn carts as well as motorcycle traffic. Motorcycle traffic often constitute the main means of public transport. A context-sensitive design approach is adopted which provides flexibility to encourage independent designs tailored to situations, i.e., the design can deviate, when necessary, from accepted design criteria provided acceptable

standards of safety are achieved at reduced costs. On LVRs with speed range 40-80 km/h, pedestrians and cyclists share the road with motorized traffic, mostly using the sides of the roads.

In Part B 'Geometric Design of Urban Roads', sub-section 6.5.3 indicates that a cycle lane can be added outside the lanes intended for motorised vehicles and that such lanes should be 1.5 m wide and clearly demarcated for cycle use only. The use of wider cycle lanes should not be considered as motorists will tend to use them as an additional traffic lane. Some cross sections in other sub-sections of the design guideline present a cycle lane that is located in between a traffic lane and a parking lane, which puts the cyclist at risk of being hit either by the parking car, or the moving car in the traffic lane. Further, it is also indicated that cycle lanes should be contiguous with the travelled way with no distinction in surfacing, for ease of construction and to prevent difficulties with maintenance, drainage, and scour. However, physical separation should be mentioned.

Sub-section 6.7 details the design guidelines for verges and sidewalks. Pedestrians are protected against traffic and traffic from running into the drain, by the kerb-like protrusions, but there is no protection for pedestrians against falling into the drain. With stormwater from the road flowing unimpeded across the sidewalk, the sidewalk will be difficult to negotiate during rainy weather and virtually loses its function. Sub-section 6.7.2 'Sidewalks' discusses the need to separate the sidewalk from the travelled way by a kerb, and when a bus stop is provided the sidewalk should continue behind the bus station. Although preferable, sidewalks need not be paved but should be purpose-made, weatherproof and free of all obstructions. As a cost-saving measure, sidewalks are often only paved on one side of the street. Cobblestones are not suitable as paving for sidewalks, being uncomfortable, especially for wheelchair users and other disabled persons. No further additional measures for disabled people are mentioned.

Part C of the manual refers to Road Safety and introduces very briefly the sustainable road safety and the safe system approach and then continues with examples of different speed reducing measures.

Although the reviewed documents mention the principles of safe system and show some examples and illustrations in a section of its own – however, not in detail - these principles are not integrated in the design chapters.

2.3.2 Regulatory and management issues of Road Infrastructure Safety Management

The Public Roads Act No. 12 of 2002 is a comprehensive legislative document. It appoints the Roads Development Agency as responsible to provide for the care, maintenance, and construction of public roads in Zambia. The Road Traffic Act No.11 of 2002 and the Road Traffic (Amendment) No. 8 of 2022 established the Road Transport and Safety Agency and defined its functions; among others to provide for a system of road safety and traffic management and to provide for the promotion of road safety. However, none of the acts say explicitly anything about the use of any of the Road Infrastructure Safety Management tools.

2.3.3 Road Infrastructure Safety Management Tools

The review of the use of various RISM tools in Zambia revealed that only Road Safety Audit and Road Safety Inspection are applied. However, there are no national guidelines/manuals but PIARC's guidelines are used. For an overview see Table 3.

Table 3. RISM tools applied in Zambia.

RISM tools	Practiced	There is a written Manual/guidelines
Black Spot Management	Road Safety Inspections are done occasionally at known black spots	No
Network Safety Management	No	No
Road Assessment Programme	No	No
Road Safety Impact Assessment	No	No
Road Safety Audit	Yes	PIARC's guidelines are used
Road Safety Inspection	Yes	PIARC's guidelines are used

Black Spot Management

Black Spot Management is not practiced systematically. The Road Development Agency (RDA) conducts Road Safety Inspections at known blackspots and implement recommendations to improve road safety. There is no written national manual or guidelines for Black Spot Management.

Network Safety Management

The Road Development Agency (RDA) undertakes works to improve safety of the road network using various maintenance initiatives such as Routine, Periodic and Emergency works. These interventions are aimed at improving the overall safety profile of the roads as well. However, Network Safety Management is not practiced systematically and there is no written national manual or guidelines.

Road Assessment Programme

Road Assessment Programme is not practiced and there is no written national manual or guidelines for this method.

Road Safety Impact Assessment

Road Safety Impact Assessment is not practiced and there is no written national manual or guidelines for this method.

Road Safety Audit

Road Safety Audit is practiced nationwide. The Road Transport Safety Agency supervises that Road Safety Audit and Road Safety Inspection are carried out. The Road Development Agency submits various designs of roads to the Road Safety Engineering Committee secretariate of the Road Transport and Safety Agency (RTSA) who convene Road Safety Audits and give the RDA their recommendations. Currently, there are no written national guidelines, the RTSA is however, in the process of developing these. The Road Safety Guidelines of PIARC are used, which are of good international standard.

There are no certified Road Safety Auditors in the country and there is no training of Road Safety Auditors in Zambia.

Road Safety Inspection

Road Safety Inspection is practiced nationwide. The Road Transport Safety Agency (RTSA) supervises that Road Safety Inspection are carried out. The Road Safety Engineering Committee undertakes Road Safety Inspections when need arises on a quarterly basis. There are no written national/regional procedures for carrying out and administration of Road Safety Inspections. There are no written national guidelines, the RTSA is however in the process of developing these. The Road Safety Guidelines of PIARC are used, which are of good international standard.

There are no certified Road Safety Auditors in the country.

Training activities

No training activities in applying any of the RISM tools have been carried out in Zambia.

2.3.4 Recommendations

Road geometric design guidelines

Since in the current Road Geometric Design Guidelines there is very limited to no consideration of the needs of cyclists, motorcyclists, pedestrians, elderly, children, and disabled people, amendments in these respects are necessary. There should be much more focus on separating vulnerable road users (pedestrians and pedal cyclists) physically from motorized traffic when speeds are higher than 30 km/h.

Regarding the design of bus stops and bus bay layouts (deceleration lane, holding area, and a merging area), there should be proper deceleration lane and acceleration lane getting the bus stop separated from the travelled way and giving the bus enough distance to decelerate and accelerate. Proper solutions should be advised for crossing pedestrians.

Even if the design manual for low-volume roads introduced the ‘safe system’ approach and speed reducing measures, these are not directly integrated into the design recommendations. The principles of ‘safe system’ should be operationalized in detail in all parts of the road design manual.

Legislative/regulatory issues concerning Road Infrastructure Safety Management

The mandatory utilisation of all Road Infrastructure Safety Management (RISM) tools should be prescribed by legislation, e.g., included in the National Road Safety Policy, or in any other relevant legislative act. That means, that all the RISM tools, i.e., Road Safety Audit, Road Safety Inspection, Management of hazardous road locations, Network Safety Management, and Road Safety Impact Assessment should be prescribed by a relevant legislative act. Also, the legislation should point out the supervisory authority with responsibility to supervise the process of carrying out these RISM activities, issue authorisation for certified experts who can carry out these RISM activities and keep an open database of certified experts.

Responsibility

A national regulatory framework should be established regarding procedures and responsibilities for initiating, carrying out, supervising, administrating and documenting Road Infrastructure Safety Management activities.

Procedures

The procedures for carrying out the various RISM activities should be described in detail, pointing out the involved stakeholders, with their responsibilities, such as the project owner (road agency) with the responsibility to initiate the activity, procurement, the designer/planner

organisation with responsibility to provide all necessary information, and the expert team carrying out the RISM activity and reporting their findings to the project owner.

Manuals/Guidelines

National manuals for all the RISM tools should be developed.

Training/Certification

A training centre with permanent staff and curricula for training road safety professionals to be able to carry out the various RISM activities should be established. The trainers might be brought in from outside when needed, but the permanent secretary of the training centre should continuously monitor the need for training and advertise for training courses.

After the training centre has issued a certificate for a completed course, the supervisory authority should authorise certified experts in various RISM methods.

3 Conclusions

The design guidelines do not take the needs of motorcyclists, elderly, children, and disabled people into consideration in sufficient detail. More specific considerations of designing infrastructure facilities in locations with a high concentration of elderly, children, and disabled people are necessary. Furthermore, the guidelines do not address sufficiently the physical separation of vulnerable road users, such as cyclists and pedestrians, from motorized traffic driving at speeds higher than 30 km/h. The principles of Safe System should be operationalized in detail in all parts of the road design manual.

In all three countries, Road Safety Audit and Road Safety Inspection are practiced nationwide. In Ghana, Black Spot Management and Network Safety Management are practiced occasionally, and Road Assessment Programme is practiced locally. In Tanzania, Road Assessment Programme is practiced to some degree. In Zambia Black Spot Management is practiced occasionally.

For carrying out Road Safety Audit, Road Safety Inspection, and Road Assessment Programme, appropriate international guidelines are available. However, it is recommended that national Manuals/Guidelines are developed for:

- Black Spot Management in Tanzania and Zambia, and
- Network Safety Management and Road Safety Impact Assessment in all three countries.

National legislation concerning Road Infrastructure Safety Management does not explicitly say anything about Road Infrastructure Safety Management (RISM). The mandatory utilisation of all RISM tools should be stipulated by national legislation. Also, national legislation should point out the supervisory authority with responsibility to supervise the process of carrying out these RISM activities, issue authorisation for certified experts who can carry out these RISM activities and keep an open database of certified experts. Legislation should also prescribe that the accident database owner regularly provides the road authority with accident data necessary for carrying out RISM activities.

A national regulatory framework should be established regarding procedures and responsibilities for initiating, carrying out, supervising, administrating and documenting RISM activities.

The procedures for carrying out the various RISM activities should be described in detail, pointing out the involved stakeholders, with their responsibilities, such as the project owner (road agency) with the responsibility to initiate the activity, procurement, the designer/planner organisation with the responsibility to provide all necessary information, and the expert team carrying out the RISM activity and reporting their findings to the project owner.

A training centre with permanent staff and curricula for training road safety professionals to carry out the various Road Infrastructure Safety Management activities should be established. The trainers might be brought in from outside when needed, but the permanent secretary of the training centre should continuously monitor the need for training and advertise training courses. After the training centre has issued a certificate for a completed course, the supervisory authority should authorise certified experts in various RISM methods.

References

Ghana

- Ablin Consult Engineers & Planners LTD (2022) Development of NRSS IV And 2022-24 Action Plans. Ghana.
- Accra Metropolitan Assembly (2017) Pedestrian Road Safety Action Plan for the Accra Metropolitan Assembly 2018 – 2022.
- Ghana Highway Authority (1991) Road design guide. Ministry of Roads and Highways. GHA, Accra.
- Ghana Highway Authority (2002) Identifying and Treating Accident Sites.
- Ghana Highway Authority (2002) Manual of Road safety audit.
- Ghana Highway Authority (2008) Traffic Calming Design Guideline. Ministry of Roads and Highways. GHA, Accra.
- Republic of Ghana (1997) Ghana Highway Authority Act (ACT 540).
- Republic of Ghana (2019) National Road Safety Authority Act (ACT 993).
- University of Zagreb (2022) Road Safety Infrastructure Studies in Ghana Contract No. 7201271 iRAP Star Rating Sr4d Analysis – Final Report- Trunk Road and Upper West Feeder Roads.

Tanzania

- Ministry of Infrastructure Development (2009) National Road Safety Policy, Tanzania.
- Ministry of Infrastructure Development (2009) A Guide to Road Safety Auditing, Tanzania.
- Ministry of Works (2011) Road Geometric Design Manual - 2011 Edition, Tanzania.
- The United Republic of Tanzania (2007) The Roads Act No.13, Tanzania.
- The United Republic of Tanzania (1973) The Road Traffic Act, Tanzania.

Zambia

- Division of Roads and Transport Technology, CSIR (1998). Code of Practice for the Geometric Design of Trunk Roads (SATCC).
- Government of Zambia (2002) The Public Roads Act No. 12, 2002.
- Government of Zambia (2002) Road Traffic Act No.11 of 2002
- Government of Zambia (2022) Road Traffic (Amendment) No. 8 of 2022.
- Ministry of Housing and Infrastructure Development, Republic of Zambia (2019). Low-volume Roads Manual, Volume 2, Geometric Design and Road Safety.